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Testing the Granger Causality between Capital Structure and Profitability of Listed Egyptian Companies

اختبار العلاقة السببية بين هيكل رأس المال وربحية الشركات المدرجة في البورصة المصرية

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Abstract: The paper investigates the causal relationship between capital structure and profitability using a sample of 69 non-financial firms from the most active 100 firms listed in the Egyptian Stock Exchange for the period (2011-2023). A Panel Vector Auto Regression (PVAR) model under a Generalized Method of Moments (GMM) framework is estimated to test the Granger causality between the two variables. The results reported a unidirectional causality running from capital structure to profitability meaning that past values of capital structure can be used to predict future values of profitability for the sample. The estimated system GMM model identified a significant positive impact of capital structure on profitability which is consistent with the Trade-off and the Agency theories. Therefore, this paper contributes to existing literature by using an alternative way of testing the possible interactions between capital structure and profitability of Egyptian listed non-financial firms using a PVAR estimation under a system GMM framework. Which helps in the overall understanding of the inconclusive results regarding the interactions between the two variables in previous studies. Moreover, the results contribute with some practical implications regarding the use of capital structure decisions to improve future firm profitability and increase firm value in the Egyptian context.

Keywords : Profitability, Capital Structure, Granger Causality, Egyptian Listed Firms

الملخص: الهدف الأساسي من البحث الحالي هو ايجاد العلاقة السببية بين هيكل رأس المال والربحية باستخدام عينة من 69 شركة غير مالية من أنشط 100 شركة مدرجة في البورصة المصرية من 2011 إلى 2023. يتم ذلك باستخدام نموذج (PVAR) في إطار طريقة (GMM) لاختبار سببية جرانجر بين المتغيرين. اثبتت النتائج وجود سببية أحادية الاتجاه تمتد من هيكل رأس المال إلى الربحية مما يعني أنه يمكن استخدام القيم السابقة لهيكل رأس المال للتنبؤ بالقيم المستقبلية للربحية لعينة الشركات المستخدمة. النتائج النهائية لتحليل GMM اسفرت عن تأثير إيجابي لهيكل رأس المال على الربحية وهو ما يتوافق مع نظريات المفاضلة والوكالة. لذلك، تساهم هذه الورقة في اثراء نتائج الدراسات السابقة الموجودة باستخدام طريقة بديلة لاختبار العلاقات والتأثيرات المتبادلة بين هيكل رأس المال وربحية الشركات غير المالية المدرجة في البورصة المصرية باستخدام نموذج PVAR مقدر في إطار نظام GMM. مما يساعد في الفهم العام للنتائج غير الحاسمة فيما يتعلق بالعلاقات المختلفة بين المتغيرين في الدراسات السابقة. علاوة على ذلك، تساهم النتائج ببعض المساهمات العملية فيما يتعلق باستخدام قرارات هيكل رأس المال لتحسين ربحية الشركة المستقبلية وزيادة قيمة الشركة في سياق السوق المصري.

الكلمات الدالة: الربحية، هيكل رأس المال، العلاقة السببية، الشركات المصرية المدرجة.

1. Introduction:

An interesting model was proposed by (Modigliani & Miller, 1958), called in the Capital Structure Irrelevance model, in which they argued that financial leverage has no effect on firm performance. It can also be found that a number of alternative theories discussed the association between capital structure and firm profitability; however, some contradictions exist in this theoretical background. By reviewing different theories, it can be concluded that one of the most important variables affecting profitability of any business organisation is the capital structure which can be measured using debt financing as a ratio of the company's total assets. In the same line, (Rose & Hudgins, 2008) argued that different sources of funds are essential for business institutions. While business firms tend to rely primarily on internally generated funds or retained earnings for financing, which means that debt financing comes next as a more costly option to firms, but with more risk. Despite the risk associated with debt financing, it poses more potential for utilizing growth opportunities that would not have been made possible by relying on internal financing solely. Previous literature studied the relationship between these two important variables: capital structure or financial leverage and firm profitability for business organisations with intensive discussions in different contexts regarding the effect of capital structure on profitability. However, the reverse effect of profitability on capital structure hasn't been paid the same attention in previous studies. In a research conducted by (Xie, 2024), it was mentioned that 60 out of the Fortune 500, that are consistently included in the list, increased their leverage more than 40 times from 0.5% to 20.4% over the past 70 years. This study used a large panel dataset with 3,536 observations to investigate factors affecting the dynamic choice of leverage for firms, with the main research questions of what internal and external factors affect the use of debt. Another recent study by (Ima, et al., 2024) explained that financial leverage refers to the use of liabilities by firms to fund their assets. When firms can utilize the resulting increase in assets efficiently, they can generate more revenues or gains than the expenses resulting from incurring more debt. Therefore, firms are in continuous search for the optimum capital structure that enables the firm to grow while maintaining a useful balance between their funding resources to increase the firm value and increase shareholders' wealth. Therefore, it can be argued that firms relying on debts strive to find the balance between the benefits associated with debt financing and the extra risks borne by the firm because of possible financial distress that arises due to the use of debt. Therefore, one of the main objectives of business organisations is to try achieving an optimal capital structure.

The Optimal capital structure is the specific mix of debt and equity that ensures that the marginal benefit achieved from the use of debt exceeds the marginal cost of debt, while at the same time minimizing the firm's Weighted Average Cost of Capital (WACC) while achieving the maximum value of the firm (Ross, et al., 2008)

Due to the importance of capital structure and the great effect it imposes on firm performance, literature has paid excessive attention to studying capital structure measures, as well as its relationship with firm profitability. However, examining the effect of capital structure on firm profitability produced varying results as some studies reported a significant impact of capital structure on firm profitability that agrees with the Trade-off theory and some arguments of the Agency theory. While other studies verified the results of the Pecking Order theory and reported a negative impact of capital structure on profitability in many cases. Other studies examined the reverse effect of profitability on capital structure, which also resulted in some significant findings that varied between positive and negative effect of profitability on capital structure. These significant findings that resulted from studying the effect of each of the variables on the other paved the way for examining the causal relationship between both variables. However, inconclusive results can be found in the few studies that tested the causal relationship between the two variables. Some studies reported a unidirectional relationship between both variables, while others reported a bidirectional relationship, indicating that both variables influence each other.

This ambiguity in the direction of the relationship between capital structure and profitability calls for further research in different contexts. Therefore, this paper attempts to test the causal relationship between capital structure and profitability in 69 non-financial listed firms in the Egyptian Stock Exchange in the period 2011-2023. Having that said, the current paper employs a PVAR model to investigate the causal relationship between capital structure or financial leverage and firm profitability. The PVAR model introduced by (Holtz-Eakin, et al., 1988) and extended by (Love & Zicchino, 2006) under a GMM framework is used to test for the Granger causality between the two variables, based on the pioneer concept of (Granger, 1969). The statistical analyses employed in this paper use the same statistical codes provided by (Love & Zicchino, 2006), which integrates the traditional vector autoregression model that treats all variables as endogenous with panel data techniques under a system GMM estimation, developed by (Arellano & Bover, 1995) and (Blundell & Bond, 1998).

The system GMM estimation accounts for different problems associated with endogeneity and unobservable heterogeneity associated with the estimated models. The estimated models facilitate utilizing missing variables as instruments and uses a system of equations to overcome the problem of weak instruments that exists when using the difference GMM, developed by (Arellano & Bond, 1991).

Therefore, the main contribution of this paper is achieved through the use of a different way of testing for the interaction between financial leverage and firm profitability. This is mainly done through statistical techniques similar to that proposed by (Love & Zicchino, 2006) in which the use of a system GMM estimation improves the efficiency of models and helps in accounting for the possible bias resulting from the correlation between possible omitted variables and the error terms of the estimated models. In addition to accounting for other endogeneity and unobservable heterogeneity issues associated with the estimation. Also, the estimated PVAR model under a system GMM framework is used to test for the Granger causality between the two variables of interest. The outcome of the current paper is expected to contribute both on a theoretical and practical bases. This can be done through providing more insights that should help in understanding the inconclusive results reported by previous studies and provide better policy implications relevant to the Egyptian context that do not exist in previous empirical studies in the Egyptian context.

Next section is intended to discuss different theories that are of relevance to the interaction between capital structure and firm profitability, including Capital Structure Irrelevance principle, the Trade-off theory, the Agency theory, and the Pecking order theory. Then, a section for literature review is provided with detailed discussion of previous studies on the association between the two variables. The literature review section compares the results of previous studies along with a discussion of the proxies used to measure each variable, in addition to discussing validation of relevant theories in empirical studies. The literature review section ends with an identification of the literature gap and a discussion of hypotheses development. Then a methodology section is presented with discussion of the model specifications, population and sampling, and description of the specific measures used in the study is also provided in this section. Followed by the results section that presents the detailed results of the estimated statistical models along with a discussion of these results in the light of the discussed theoretical background and the results of relevant previous studies.

In addition to a discussion of the tested hypotheses to answer the main research question regarding the existence of a causal relationship between the two variables to highlight the paper's main contribution and implications. Limitations of the study are then discussed in a separate section along with recommendations for future studies in the light of the identified limitations. Finally, a summary of the main conclusions and implications of the study is presented by the end of the paper along with the list of references.

2.Theoretical Background

When studying firms' capital structures and its relationship to firm Profitability, many theories are of great importance in explaining how firms decide on their capital structure including the Principle of Capital Structure Irrelevance, the Trade-Off Theory of Capital Structure, the Agency theory, and the Pecking Order Theory. (Modigliani & Miller, 1958) developed the Capital Structure Irrelevance principle, stating that the firm value is not affected by its debt level. This means that regardless of the level of leverage for the firm the firm value is affected by different other factors that directly affect firm performance. However, (Modigliani, et al., 1963) reviewed their original model to add the impact of tax shield with a deductible interest expense for tax purposes that makes debt financing less costly. While (Miller, 1977) added an argument on the existence of bankruptcy costs with more leverage in the firm, but its effect is lower compared to the tax benefits or tax shield. The tax shield effect suggests that leverage results in an expense that is deductible from net income used as the base for tax calculations. Therefore, supporters of this theory argue that the tax shield effect allows firms with high leverage to save part of the income which helps in increasing the firm value (Yildiz, 2024).

According to (Kraus & Litzenberger, 1973), (Baxter, 1976), and (Scott, 1976) the trade-off theory refers to the optimum capital structure level that is achieved when the cost and benefit of leverage are in equilibrium. After a certain level, the cost of bankruptcy increases and the firm value decreases as a result of increased leverage. Therefore, The Trade-Off theory states that firms decide on the level of corporate leverage by balancing the tax-savings benefit of debt against the risk of possible financial distress. The optimal mix of a company's debt and equity should be the one that minimizes its WACC while at the same time achieving the maximum value of the firm. Moreover, (Jensen & Meckling, 1976) discussed the agency theory and how the conflict of interest between managers, investors, and different credit providers affect capital structure decisions.

Different interests of managers and shareholders can be aligned through more financial leverage that imposes the need for more cash flow to make principal and interest payments which ensures that management decisions will be directed to more efficient decisions to increase returns and generate better cash flows to face the debt obligations and saves management interests as well. In addition to the effect of enhanced monitoring and control on performance to deal with the risky source of funding in the form of increased debt. Therefore, companies should take into considerations the agency cost while deciding on the optimum level of capital. Also, (Fama & French, 2002) stated that there is a positive association between leverage and profitability. Finally, (Ross, 1977) stated that firms show good image through increased leverage, which is referred to as the signalling hypothesis. Indicating that large firms with more profitability signal their success through increased leverage.

Furthermore, (Donaldson, 1961), (Myers, 1984), and (Myers & Majluf, 1984) developed the Pecking Order theory or the Pecking Order Model, stating that there is no optimum level of leverage. Instead, companies prioritize their funding sources and use their internal funds, followed by debt and equity, in which the priority of lower cost of funds is maintained in capital structure decisions. In other words, firms would usually rely first on internal financing or retained earnings, as their primary source of finance, followed by debts then equity. Due to asymmetric information and the fact that external parties like creditors and investors possess less information about the company and its potential risks and prospects than internal ones, external parties tend to demand higher returns which makes debts and equity more expensive financing options compared to retained earnings. Asymmetric information leads to the assumption by investors that companies demanding more equity are overvalued. Therefore, managers tend to use internally generated funds first, followed by debt, and finally demanding more equity funding. As result, it can be found that firms with higher profitability tend to have less need for more leverage and new equity funding. Therefore, it can be implied that different capital structure theories discuss different relationships in terms of strength, direction, and reasoning between capital structure and profitability.

3. Literature Review

3.1. Capital Structure

Capital Structure is the mix of debt and equity financing used by firms, which affects their WACC. Conventionally, the cost of debt is lower compared to equity funding cost, this is because interest expense is deducted for the purpose of tax calculations. Therefore, one important decision by firms is how much debt to use in its capital structure in order to maximize the firm value (Kurniasih & Rustam, 2022). In other words, capital structure decisions involve a critical choice of the optimum combination of debt and equity that a firm relies on to finance its investment decisions (Timipere & Eze, 2020). Capital structure has been addressed in many articles, studying its effect on company performance, with special attention given to its effect on firm profitability. Capital structure has been measured differently across literature. (Ima, et al., 2024) used different proxies for capital structure in their study. They used debt to assets, current liabilities to assets, debt to equity, and current liabilities to equity as measures for financial leverage or capital structure. They stated that the ideal level of financial leverage in business organisations is still not determined, and it depends to a certain extent on management discretion. In their study, different results have been concluded regarding the effect of leverage on profitability, depending on the measure being used in each case. Providing for no conclusion about the final effect of leverage on profitability.

Moreover, (Zhou, et al., 2021) discussed the trade-off in capital structure decisions between risk and return. As the firm value to shareholders is maximized with more leverage in case of well-performing firms; however, more risk is incurred with more leverage since repayments of interest and principal involve uncertainty and can be affected by future changing conditions. Therefore, many measures of financial leverage have been used in the financial literature trying to capture the effect of capital structure decisions. Different measures have been used by (Abor, 2005), who used short-term debt to total assets, long-term debts to total assets, and total debt to total assets as measures of capital structure when studying the relationship between capital structure and profitability of listed firms in Ghana. Moreover, (Singh & Singh, 2016) have also used short-term debt to total assets and long-term debts to total assets among other measures to capture the effect of capital structure on profitability of listed firms in India.

(Hussein, 2020) has also used short term debt to assets and long-term debt to assets ratios in measuring the effect of capital structure on firm profitability of non-financial listed companies in the Egyptian stock exchange. (Chang, et al., 2019) investigated the relationship between capital structure and profitability for listed firms in Taiwan, Korea, Singapore, and Hong Kong. In their study, total debt to assets was used as a proxy for capital structure. Some other previous studies measured capital structure using total debt to equity ratio and its variations. (Timipere & Eze, 2020) have used total debt to equity ratio, together with Short-term debt to equity ratio, and Long-term debt to equity ratio to measure capital structure when testing its effect on firm profitability. (Arifin, 2017) has also relied on Long-term debt to equity ratio as a proxy for capital structure when studying the Granger Causality between capital structure and profitability. Finally, (Herciu & Ogrean, 2017) have also used the ratio of total debt to equity to test the effect of Capital structure on return on assets (ROA) and return on equity (ROE) of the top ranked 59 non-financial companies in Fortune Global 500.

3.2.Profitability

Profitability is a measure of a firm's financial performance, which refers to a firm's ability to earn profits (Titman & Wessels, 1988). Profitability is also defined in terms of the ability to generate income relative to expenses and costs. Previous studies have mainly used ROA and/or ROE as measures for a firm's profitability. It can be found that many studies have addressed the relationship between capital structure and profitability in different countries, sectors, and company sizes. (Yildiz, 2024) stated that ROA is more important in measuring profitability of capital-intensive companies, this is because it incorporates total resources of the firm in measurement, and it provides for assessment of the firm's efficiency in utilizing its assets to generate profits. While (Ima, et al., 2024) used different proxies to measure profitability including earnings per share, ROA, ROE, and basic earnings power as measured by the ratio of earnings before interest and taxes, or the operating income, to total assets. In their study, they reported mixed results of the impact of leverage on profitability. The results differ according to the proxy used to measure each of the dependent and independent variables while controlling for the effect of firm age and firm size.

Similarly, (Prasad, et al., 2024) conducted a study on the top twenty listed pharmaceutical firms in Indian National Stock Exchange between 2018-2022 to investigate the impact of firm profitability on capital structure. In their study they measured profitability using four proxies: ROA, ROE,

earnings per share, and Tobin's Q measure of market value. While capital structure was measured using financial leverage ratios: long term debt to total assets, short term debt to total assets, and total debt to total assets. The study used three accounting measures of company performance in addition to the Tobin's Q which is considered market-based measure of company financial performance. The results of the study highlighted negative effect of leverage on the accounting measures of financial performance and no significant effect of leverage on Tobin's Q, this implies that capital structure decisions have no or minimal impact on the firm's market value in this study. Similarly, (Imad & Benraïss, 2024) used ROA and ROE to measure profitability of Moroccan firms in their study of 30 agricultural small and medium-sized enterprises. They used ROA as a measure of firm's efficiency in using its assets, and the ROE as a measure of management decision making to fulfil shareholders' goals.

Some studies reported a positive relationship between capital structure and profitability, while others reported a negative relationship between both variables. A positive relationship between capital structure and firm profitability indicates that companies who rely more on debts in financing its operations benefit from a larger tax-shield, leaving the firms with more profits, as higher interest payments tend to reduce the firm's tax burden, which is supported by the Trade-off and the Agency theories. Another explanation to the positive relationship between capital structure and firm profitability can be attributed to disciplinary effects that arise when the managers of a high leveraged firm make more efficient decisions to meet the firm's debt obligations, which drives profitability in return. A negative relationship between capital structure and firm profitability might arise due to high interest expense borne by firms who rely heavily on debts in financing their operations, which implies that higher interest expense drives lower profits to the firm. The negative association between leverage and profitability is supported by the Pecking-Order theory. The negative relationship between capital structure and profitability might also be affected by economic downturns, managers' fear of new risky investment opportunities, and increased costs associated with financial distress (Abor, 2005; Gill, et al., 2011; Derayat, 2012; Arifin, 2017; Hussein, 2020; Timipere & Eze, 2020).

3.3. The Relationship between Capital Structure and Profitability

Manny studies including (Yildiz, 2024) stated that there is no conclusion regarding the relationship between profitability and financial leverage in literature, although several previous studies investigated the association between both variables. Likewise, (Ima, et al., 2024) stated that there is no conclusion about the relationship between financial leverage and firm performance in previous literature. In their study on a number of firms listed in Dhaka Stock Exchange for the period (2000-2021); they found conflicting effects of capital structure on profitability depending on the measure of capital structure. They reported a significant negative effect of debt to assets and current liabilities to assets ratios on profitability as measured by the ROA. On the other hand, debt to equity and current liabilities to equity ratios as measures of financial leverage affect profitability positively. (Yildiz, 2024) studied the effect of different factors on capital structure decision making in 29 American shipping companies between 2010-2021. Their results showed a positive impact of size and profitability on leverage, and a positive impact of tangibility on financial leverage. While (Karim, et al., 2023) concluded results that were similar to the results of (Yang, et al., 2022). Both studies found a negative significant impact of profitability on financial leverage of the firm. They argued that the results support the Pecking Order model in which companies prioritize their sources of funding and use their internally generated funds or retained earnings prior to using the external funding resources. This explains the negative impact of profitability on leverage, since more profitable companies have more internally generated funds that decrease their reliance on leverage to improve their performance.

In their study; (Ima, et al., 2024) found that a negative impact of financial leverage as measured by total debt or debt to assets ratio on profitability as measured by earnings per share ratio. When profitability is measured by ROA, it has been found that leverage has a negative impact on profitability when measured by both current liabilities to assets ratio and total liabilities to assets ratio. The effect is reversed to be positive when leverage is measured by debt to equity or current liabilities to equity ratio, while measuring profitability through the ROE ratio. Two control variables were used in this study which are firm age and size. Also, the results illustrate a negative impact of age and a positive impact of size on firm profitability as measured by earnings per share and by ROE. This study found mixed results regarding the impact of leverage on profitability which implies inconclusive results that need further investigation to test the relevant theories and provide more explanation for each of the mixed results in previous literature. Similarly,

(Das, et al., 2021) reported a highly negative impact of leverage on profitability in firms with high profitability levels than in firms with low profitability levels. Also, (Kalash, 2023) found a negative effect of leverage on profitability of firms, especially on firms with greater financial distress risk. (Imad & Benraïss, 2024) discussed the moderating effect of governmental subsidies on the relationship between financial leverage and profitability of a sample of 30 Moroccan agricultural small and medium-sized enterprises (SMEs). The study reported no significant effect of government subsidies on firm profitability, while government subsidies variable affected the interaction between Profitability as measured using ROA and ROE and leverage measured using long-term debt. The study concluded a negative impact of leverage on profitability as measured by ROA and ROE. In case of using subsidies as a moderating variable, the effect persists to be negative, especially in case of measuring leverage using short-term debt.

On the other hand, (Puri, 2023) combined multiple univariate and multivariate techniques to test the effect of leverage on profitability to find that leverage has a significant positive impact on smaller businesses than larger ones. Similarly, (Abor, 2005) reported that a significant positive relationship exists between short-term debt ratio and ROE, and a negative relationship between long-term debt ratio and ROE for listed companies in Ghana. A positive relationship was also found between the ratio of total debt to assets and ROE. (Gill, et al., 2011) found a positive relationship between capital structure and profitability when they used ROE as a profitability measure, and a negative relationship when they used ROA. (Derayat, 2012) studied the effect of capital structure on profitability in 150 Macedonian firms and found that ROE was positively correlated with short-term debt and inversely correlated with long-term debt. Moreover, (Herciu & Ogrean, 2017) have also tested the effect of Capital structure as measured using debt to equity ratio on ROA and ROE of the top ranked 59 non-financial companies in Fortune Global 500. Findings revealed that capital structure influences company profitability as measured using ROE positively. (Timipere & Eze, 2020) examined the effect of financial structure on firm profitability (ROA) and whether these effects are sensitive to macroeconomic conditions. Results show that debt to equity ratio, long-term debt ratio, and short-term debt ratio have a significant effect on profitability of firms.

However, (Prasad, et al., 2024) found that there are inconsistent results regarding the association between capital structure and profitability of firms in previous literature applied on Indian companies and in different international contexts in the pharmaceutical sector.

They also concluded that the interaction between the two variables vary from industry to industry in different markets. The main findings of this study showed negative impact of leverage ratios as measured by total debt, as well as long term debt on one hand, and short-term debt on the other hand. However, the effect is insignificant when performance is measured by the market value measure, the Tobin's Q. Alternatively, the effect turned to be negative and significant when financial performance is measured by the accounting measures ROA, ROE, and earnings per share. Similarly, (Hussein, 2020) measured the effect of capital structure on firm profitability of non-financial listed companies in the Egyptian Stock Exchange. Results indicate that short-term debt ratio has a significant negative effect on ROA, ROE, and Earnings Per Share, and a significant positive effect on Tobin's Q. Results also showed a significant negative relationship between long-term debt ratio and ROA, and a significant positive relationship between long-term debt ratio and ROE. (Prasad, et al., 2024) concluded that using more leverage has the effect of improving company's efficiency in using its resources, which improves the ability to generate more profits and increase the firm value. Therefore, managers will always be trying to find the optimum level of financial leverage that will help them fulfilling their managerial objectives.

Other previous studies have tested the causal relationship between capital structure and profitability. (Arifin, 2017) examined the relationship between capital structure and profitability of all listed non-financial Indonesian companies using Granger causality tests in order to determine the direction of the relationship between both variables. Reported results of the causality tests showed that the relationship between both variables is unidirectional, running from profitability to capital structure. (Abdullah & Tursoy, 2021) also examined the causal relationship between financial structure and profitability in 102 non-financial listed firms in Germany over the years 1993-2016, using GMM estimation and panel causality tests. Findings of their study revealed that financial leverage positively affects profitability. It also reveals a bidirectional relationship between capital structure and profitability, which indicates that both variables influence each other. (Supyan & Kuswanto, 2023) examined the relationship between capital structure, profitability, and firm value in order to understand how capital structure and profitability affect each other and how they impact firm value. The study used Granger causality tests in order to test these relationships in Indonesian state-owned construction companies in the period 2016-2020. A bidirectional relationship between capital structure and profitability has been reported, and both variables were found to have a significant impact on firm value.

3.4. Literature Gap and Hypotheses Development

Different capital structure theories have been discussed throughout the last 80 years, in addition to many empirical studies that tried to investigate and apply the implications of these theories. Different theoretical background discussed the association between capital structure and profitability starting with the Capital Structure Irrelevance principle, then the Trade-off Theory, The Pecking order theory, the Agency theory, and the Signalling hypothesis. In addition to many empirical studies that tried to validate these theories. However, conclusive results were very hard to prove, as different studies found different results ranging from no association between financial leverage and firm performance or profitability to significant positive or negative association and evidence of different causal linkages. Some studies found that the effect depends on the proxies used to measure both variables. (Ima, et al., 2024) stated that the inconclusive results regarding the relationship between capital structure and firm profitability can be found in different previous studies that used data from both developed as well as developing countries. They added that there is inadequate number of those studies in developing countries which implicates the need for more studies in developing countries to find better conclusions about these important relationships.

Moreover, the causal relationship using the Granger causality concept between both variables hasn't been investigated in developing countries like Egypt yet. Having that said, the current study will try to fill in this gap in literature by trying to investigate the causal relationship between capital structure and firm profitability using Granger causality and the statistical code developed by Inessa Love in her paper (Love & Zicchino, 2006) that has more than 2300 citation on Google Scholar and have been widely used in many empirical studies to test the causal relationship between two variables. Love's article was published in the 46th volume of the "The Quarterly Review of Economics and Finance" Journal which is one of the top-level journals in social sciences, published by Elsevier and indexed in the first quartile of Scopus economics and econometrics category according to the CiteScore ranking of 2023. In doing so, the statistical analysis used in the current study will be testing the following hypotheses, as illustrated in Table (1).

Table (1) : Research Hypotheses

H1: There is a unidirectional causal relationship running from Capital structure to profitability, as measured, by ROA for the most active non-financial firms listed in the Egyptian Stock Exchange.
H2: There is a unidirectional causal relationship running from Capital structure to profitability, as measured by ROE, for of the most active non-financial firms listed in the Egyptian Stock Exchange.
H3: There is a unidirectional causal relationship running from profitability, as measured by ROA, to Capital structure of the most active non-financial firms listed in the Egyptian Stock Exchange.
H4: There is a unidirectional causal relationship running from profitability, as measured by ROE, to Capital structure of the most active non-financial firms listed in the Egyptian Stock Exchange.
H5: There is a bidirectional causal relationship between profitability, as measured by ROA, and Capital structure of the most active non-financial firms listed in the Egyptian Stock Exchange.
H6: There is a bidirectional causal relationship between profitability, as measured by ROE, and Capital structure of the most active non-financial firms listed in the Egyptian Stock Exchange.

4.Methodology

4.1.Model Specifications

Treating all variable as endogenous variables using Vector Auto Regression (VAR) modelling in time-series was done in the famous "Macroeconomics and Reality" research by (Sims, 1980). Where the first introduction of the VAR modelling in panel settings was done in the research of (Holtz-Eakin, et al., 1988). PVAR models are used extensively in the finance and economics literature as an alternative to the multivariate structure equation modelling. The current research uses a PVAR modelling that runs a multivariate panel regression between a dependent variable and its lags and lags of other independent variables under a GMM estimation, following the concept of Granger causality. This combines the causal analysis of the relationship between two variables developed by (Granger, 1969) using the traditional VAR representation in a panel setting under a GMM estimation. The use of GMM in panel data modelling helps to control for unobservable heterogeneity; in addition to other problems related to endogeneity and the inclusion of lagged dependent variable in the analysis.

Estimating a PVAR model under a GMM estimation requires the variables used to be stationary which can be tested in panel modelling using tests developed by (Maddala & Wu, 1999); (Choi, 2001); (Hadri, 2000); (Levin, et al., 2002); and (Im, et al., 2003). The Fisher-type tests are the most popular in the literature based on the idea developed by (Fisher, 1932). Therefore, the current research uses a Fisher-type test based on Phillips-Perron tests to test for stationarity of variables with the null hypothesis of a unit root in each cross section, and an alternative one of at least one stationary cross-section. Therefore, rejecting the null hypothesis implicates stationarity of data. It is worth mentioning here that (Sarbapriya, 2012) stated that Phillips-Perron tests are favoured over other Fisher-type tests as it tries to satisfy the stationarity condition for all variables. The stationarity condition is necessary to validate the tested models to produce unbiased, consistent, and efficient estimates. Moreover, stationary data reduces possibility of spurious regression that produces misleading results with high R-squared indicating strong relationships that might exist due to trends or random walks.

The statistical codes used in the analysis is the one developed by Inessa Love and applied in her famous paper (Love & Zicchino, 2006). The full estimation and inference procedures are conducted in the proposed package, where removing fixed effects is done using the forward orthogonal deviation or Helmert transformation proposed by (Arellano & Bover, 1995). Helmert transformation maintains the orthogonality among lagged regressors and transformed variables; therefore, lagged regressors can be used as instruments under a system GMM estimation of the coefficients. Moreover, the predicted PVAR model is based on a consistent moment and model selection criteria (MMSC) for GMM estimations as proposed by (Andrews & Lu, 2001). (Rezazadeh, et al., 2023) used the same Three-Model-Selection criteria for selecting lag length or the order of the PVAR model under GMM estimations. They described it as a consistent MMSC that is based on Hansen's J-statistics of overidentifying restrictions. These selection criteria are analogue to the commonly used criteria such as Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), and Hannan-Quinn Information Criteria (HQIC). Hansen's test for over-identifying restrictions that was developed by (Hansen, 1982) has the null hypothesis that all instruments are valid and uncorrelated with the error term, and therefore, the model is correctly specified; therefore, a model with valid instruments requires an insignificant J-statistic.

According to Granger (1969); the concept of Granger causality is based on the idea that one variable Granger causes another variable if the prediction of the first variable given its lagged values can be enhanced using the past values of the second variable, and there is unidirectional causal relationship between the two variables in this case. Whereas a bidirectional Granger causality occurs when the opposite holds true. A time-stationary VAR model specification for two variables adapted to a panel setting can be represented by the following equations.

$$Y_{it} = \alpha_0 + \sum_{j=1}^{J} \alpha_j Y_{it-j} + \sum_{j=1}^{J} \delta_j X_{it-j} + f_{yi} + u_{it}$$

$$X_{it} = \beta_0 + \sum_{j=1}^{J} \beta_j Y_{it-j} + \sum_{j=1}^{J} \gamma_j X_{it-j} + f_{xi} + v_{it}$$

In the previously mentioned equations, the symbols used represent the 69 companies that will be used in the analysis section, time periods, the number of lags, error terms, and the individual fixed effects of companies. Where; i is the number of cross-sectional panel members (companies), t is the number of periods, , are to the intercepts, j is the number of lags considered, , are the error terms, and fxi, fyi refer to the individual fixed effects for the panel member i. Moreover, after estimating the model under a GMM framework, that allows for dealing with different endogeneity problems arising from estimating the VAR model using panel data, a Granger causality Wald test is used. The Wald test is intended to test for the joint hypotheses of the existence of a Granger causality from X to Y and from Y to X in the previously specified equations. That is; if all X-coefficients in the Y equation are not equal to zero then X Granger causes Y, and if all Y-coefficients in the X equation are not equal to zero, then Y Granger causes X.

It is worth mentioning here that when examining the causal relationships between variables, the concept of cointegration is relevant. This is because cointegration is about finding stable long-run relationship between two variables with individual time series of each cross-sectional unit that is non-stationary, but might have a combination of stationary series. However, testing such relationship require non-stationary variables, because stationary variables are already mean reverting, therefore the concept of cointegration doesn't apply and there is no need to check for any long-term relationship.

Many tests are used in this context to test cointegration in panel data, but they are used to test non-stationary panel data (Pedroni, 1999). In this context, a recent study by (Al-Majali, et al., 2024) was conducted with the main objective of testing the Granger causality among two variables: Composite Digital Financial Literacy Index and the Financial Development Index. They tested for cointegration in their panel datasets using Johansen-Fisher test to test for cointegrations among non-stationary variables. The study tested for any stable linear combinations of the variables of interest that exhibit stationarity on the long run which helps in understanding the long-run equilibrium relationships among variables.

Similarly, another recent study by (Rezazadeh, et al., 2023) tested the causal relationship between financial inclusion and financial stability on one hand, and between financial stability and financial cycle on the other hand. The study measured the causal interaction between each pair of the three variables: financial inclusion, financial cycle, and financial stability using the same statistical codes and techniques introduced by (Love & Zicchino, 2006). (Rezazadeh, et al., 2023) stated that the theory and the knowledge of the researcher is used to determine the variables tested in the model in case there is no accurate information regarding the determinants of pattern variables. It can be concluded that when the research has the main objective of testing whether one variable Granger-causes another one across different entities in a panel setting, it is sufficient to use only two variables and keep the model as simple as possible, in some cases it is more efficient to keep it simple with only two variables in the model estimation. This is helpful in the current research to help in isolating the direct causal effect between the variables of interest, and to help in avoiding the complications that come with adding more variables, like the complications discussed in previous studies.

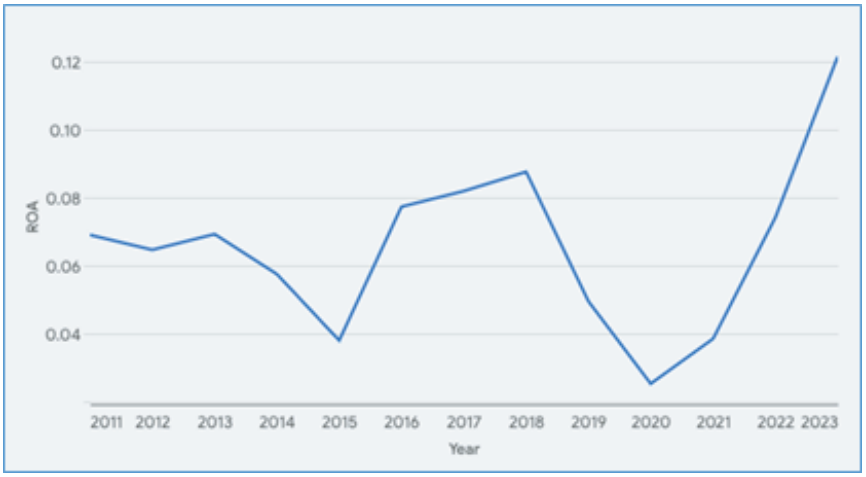
Therefore, the current paper follows the suggested model specifications of (Love & Zicchino, 2006) who developed their own Stata statistical code to run the analysis. They took several steps to ensure the validity of the model and decrease the omitted variable bias, which cannot be fully eliminated in any single model. The specified model included internal instrumental variables generated from the system of equations used in the form of lagged values of the dependent and independent variables in the system.

The PVAR model is estimated under a GMM framework using these instrumental variables to be able to account for the endogeneity problems associated with the omitted variable bias resulting from possible correlation with the error term. Moreover, the statistical code used in this paper used the system GMM estimation developed by (Arellano & Bover, 1995) and (Blundell & Bond, 1998) that is preferred over Difference GMM, especially in small T large N data settings. The Difference GMM uses lagged levels of the explanatory variables as instruments, while differencing the explanatory variables to account for the fixed effects. System GMM improves the problem of weak instruments in Difference GMM by adding additional moment conditions through using lagged differences of explanatory variables as additional instruments for equations in levels. The additional moment conditions and validity of instruments is then tested using the Hansen's test for overidentifying restrictions.

4.2.Population and Sampling

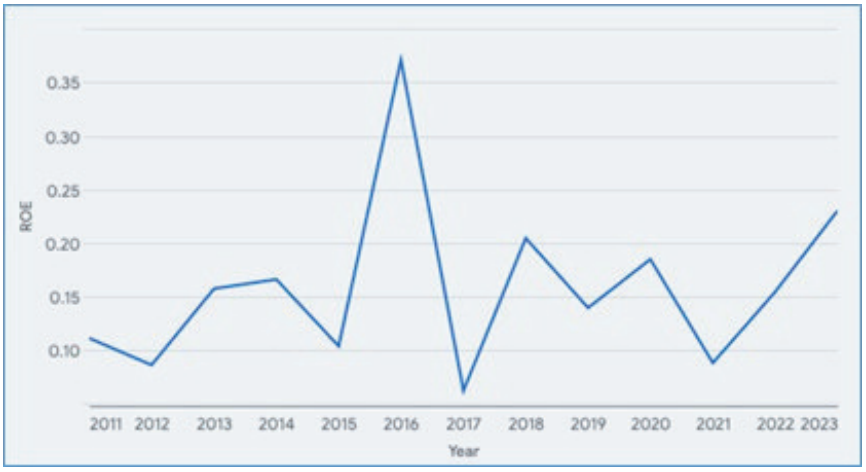
The sample of the study includes the top 69 most active non-financial companies listed in the Egyptian Stock Exchange (EGX 100), that is extracted from Refinitiv Database over the sample period 2011-2023. Initial examination of the dataset shows that average profitability reported sharp decreases in 2015, 2017, and 2020 following the effects of Egyptian revolutions, the Egyptian pound devaluation, and the Pandemic in 2019-2020, respectively. A slight improvement in profitability occurred during the 2017-2018 years indicating a period of relative stability. Better representation of sample data during the sample period can be done by plotting the variables of interest on line charts to visualize its trend and have better understanding of the dataset. The following figures show that the Egyptian listed companies experienced volatility in its profitability throughout the sample period. While, the financial leverage figures of the sample companies show a steady increase throughout the sample period, with a declining trend that started in 2021 until 2023. These figures can be used as indictor that Egyptian companies had a general tendency during the sample period to use more debt financing versus equity financing in to amplify their financial performance throughout the sample period. The following figures present the trend for each of the variables used in the study, which show that changes in the capital structure variable can be visually linked more to changes in the ROA variable than ROE. However, this cannot be used as a prediction of the results of the Granger causality between the variables of interest.

Figure (1): Average ROA over the Sample Period



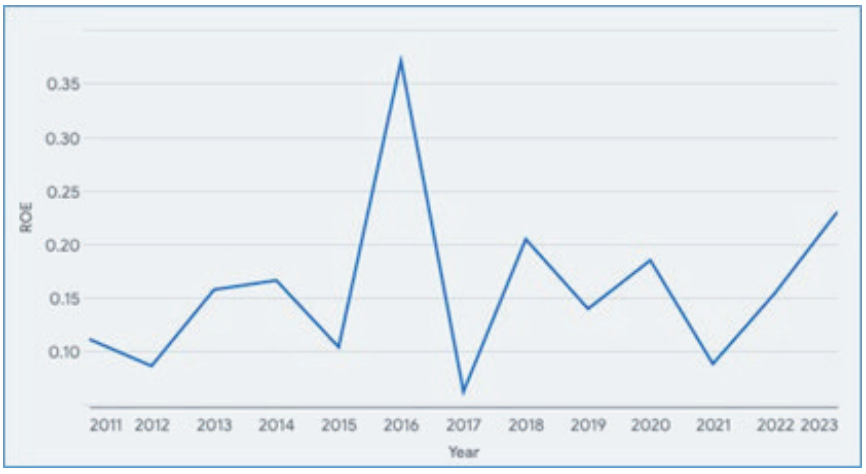
Source: Research Data from Refinitiv Database

Figure (2): Average ROE over the Sample Period



Source: Research Data from Refinitiv Database

Figure (3): Average Capital Structure over the Sample Period



Source: Research Data from Refinitiv Database

4.3. Description of Variables

Capital structure as a measure of the firm's mix of debt and equity financing is measured in previous studies using the ratio of total debt to total assets of the firm. The current research employed this measure following (Abor, 2005), (Chang, et al., 2019), and (Ima, et al., 2024) among others. All of the previous studies employed this proxy of total debt to total assets or other proxies that are considered variations of this measure such as total debt to total equity ratio, total equity to assets ratio, long-term debt to assets ratio, and short-term debt to assets ratio. All these measures calculate the proportion of debt in the company's financing sources relative to the use of equity financing; while measures that use long-term debt and short-term debt focus on measuring the magnitude of risk borne by the firm in terms of liquidity and solvency. Total debt to total assets ratio as well as other measures used in the current research are calculated using financial statements information extracted from Refinitiv database for the sample period, as mentioned earlier. One important consideration here is that different companies can take different risk in terms of debt according to the nature of their operations and the industry norms.

On the other hand; profitability is usually measured by ROA and ROE in previous studies such as (Abor, 2005), (Arifin, 2017), (Gill, et al., 2011), (Derayat, 2012), (Hussein, 2020), (Timipere & Eze, 2020), (Yildiz, 2024), (Ima, et al., 2024), (Prasad, et al., 2024), (Imad & Benraïss, 2024). As discussed in the literature section, previous studies used ROA as a measure of how a firm can utilize its assets to generate sales, and when the firm can control its expenses, more sales with lower expenses will result in higher profits and higher ROA. Therefore, firms with high ROA have better ability to use its assets to operate and generate sales, that will in turn generate higher profits due to the firm's operational efficiency. While better ROE figures are considered the bottom line for shareholders who can view the ability of the firm to generate higher profits relative to their capital contributions. Higher ROE figures can be directly related to higher leverage, this is because more leverage means more financial resources, which should result in higher profits for companies in case of having high operational efficiency. More leverage means less equity financing, which improves the ROE figures from mathematical perspective. This implies a direct effect of leverage on profitability as measured by ROE, as discussed in the DuPont analysis. However, the causal relationship between profitability and capital structure still needs more investigation due to the inconclusive results in previous studies. The following table presents a summary of the selected variables, their measures, and data sources.

Table (2): Variable Description and Data Sources

Variable	Abbreviation	Measure	Source
Return on Assets	ROA	Net Income Before Tax/Total Assets	Financial Statement of Egyptian Non-financial Listed Firms reported in Refinitiv Database (2011-2023)
Return on Equity	ROE	Net Income Before Tax/Total Equity	Financial Statement of Egyptian Non-financial Listed Firms reported in Refinitiv Database (2011-2023)
Capital Structure	CAPS	Total Debt/Total Assets	Financial Statement of Egyptian Non-financial Listed Firms reported in Refinitiv Database (2011-2023)

5.Results and Discussion

5.1.Analysis Results

This section is intended to present the results of all the tests discussed previously in the methodology section, then it will be followed by an extended discussion of the results and their theoretical and practical implications. The paper employed Fisher-type unit-root test to test for stationarity of variables used in analysis, this is because the Fisher-type tests are the most used panel unit root tests in previous literature. Moreover, the Fisher-type unit root test based on Phillips-Perron tests is favoured over other Fisher-type tests because it tries to satisfy stationarity condition for all variables. The test is for the null hypothesis that all panels have unit roots, with an alternative hypothesis that at least one panel is stationary. Therefore, rejecting the null hypothesis implicates the stationarity of the variable being tested. The analysis results, as reported in the following table showed that all variables that are used in the study are stationary at level, which is illustrated by the P-values of all the resulted test statistics (P, Z, L, and Pm), that are all less than (0.01). Therefore, the null hypothesis can be rejected at the 1% level of statistical significance, and all variables are stationary. Other panel unit-root tests can be used to test for data stationarity; however, the Fisher-type tests are

the most used and they are reported to have accurate results in previous studies (Sarbapriya, 2012). Testing for data stationarity is an important step in estimating PVAR models to ensure accuracy of the model estimation and reliability of results. This is because non-stationary data can result in spurious regression with high reliability that is not real with no significant relationships between variables. In this case the misleading results can be the result of trends or random walks. The next step after panel unit-root testing would be the selection of appropriate lag level that is needed to estimate the PVAR model.

Table (3): Fisher-type unit-root tests based on Phillips-Perron tests

Ho: All panels contain unit roots		
Ha: At least one panel is stationary		
ROA		
	Statistic	p-value
Inverse chi-squared (134) P	242.6048	0.0000
Inverse normal Z	-5.2003	0.0000
Inverse logit t (329) L	-5.2003	0.0000
Modified inv. chi-squared Pm	6.4639	0.0000
ROE		
	Statistic	p-value
Inverse chi-squared (134) P	289.4485	0.0000
Inverse normal Z	-5.7811	0.0000
Inverse logit t (324) L	-6.7651	0.0000
Modified inv. chi-squared Pm	9.3042	0.0000
Capital Structure		
	Statistic	p-value
Inverse chi-squared (134) P	170.1707	0.0000
Inverse normal Z	-0.4879	0.0000
Inverse logit t (324) L	-0.5239	0.0000
Modified inv. chi-squared Pm	2.0719	0.0000
P statistic requires number of panels to be finite.		
Other statistics are suitable for finite or infinite number of panels.		

Authors' Analysis Using Stata

Selecting the appropriate lag length is done using the Three-Model-Selection criteria developed by (Andrews & Lu, 2001). This model is commonly used in previous studies that were estimating PVAR models under GMM estimation following (Love & Zicchino, 2006) methodology and using their statistical codes, as previously discussed in the methodology section. According to the Three-Model-Selection criteria; the appropriate lag length is the one with the smallest values of Modified Akaike Information Criteria (MAIC), Modified Bayesian Information Criteria (MBIC), and Modified Hannan-Quinn Information Criteria (MHQIC). These criteria are analogue to the common selection criteria used; (AIC), (BIC), and (HQIC). The following results indicate that the first order PVAR model is the preferred model based on the Three-Model-Selection criteria, since it has the smallest values for each of the (MAIC), (MBIC), and (MHQIC). The Stata results for the PVAR lag selection test is reported in the following table. Then, the next step is to estimate the first-order PVAR model under a system GMM, as it produces more robust results than the traditional difference GMM. The estimated models will use multiple equations to test for the causal relationship between the variables of interest using the Granger causality concept and the Granger causality Wald tests.

Table (4): PVAR Lag Order Selection, The Three-Model-Selection Criteria

First Model (Using ROA)						
Lags	CD	J	J p-value	MBIC	MAIC	MQIC
1	0.9719861	9.541399	0.9757462	-106.7412	-30.4586	-60.87025
2	0.95809	7.578165	0.9604445	-85.44792	-24.42184	-48.75116
3	0.9648593	3.993776	0.9835484	-65.77579	-20.00622	-38.25321
4	0.9457684	2.28279	0.9710918	-44.23025	-13.71721	-25.88187
5	0.9145439	1.196304	0.8787068	-22.06022	-6.803696	-12.88603
Second Model (Using ROE)						
Lags	CD	J	J p-value	MBIC	MAIC	MQIC
1	0.9666517	9.475273	0.9767202	-106.8073	-30.52473	-60.93638
2	0.9504068	7.170069	0.969842	-85.85602	-24.82993	-49.15925
3	0.9373258	4.56109	0.9710586	-65.20848	-19.43891	-37.6859
4	0.9705243	4.260991	0.8328416	-42.25205	-11.73901	-23.90367
5	0.8993152	1.546451	0.8183826	-21.71007	-6.453549	-12.53588

Source: Authors' Analysis Using Stata

Testing the causal relationship between the variables of interest is presented in the following table of results based on selecting the first-order PVAR model. Table (5) shows the results of the estimated first-order PVAR under GMM framework, as well as instrumental variables validation test which is the Hansen's test for overidentifying restrictions, in addition to the Granger causality Wald tests. The reported results showed a significant positive impact of capital structure as measured by the total debt to assets ratio on profitability as measured by the ROA in the first model, and the same results are reported when measuring profitability by the ROE in the second model. Consequently, both models showed the significant positive effect of capital structure on profitability, whether measured through ROA or ROE. It is worth mentioning here that all models were estimated in Stata using the Stata code developed by Inessa Love and used for the first time in (Love & Zicchino, 2006). The statistical codes, as presented in (Love & Zicchino, 2006) are developed to run automatically throughout the analysis steps. The analysis results of the four estimated equations report strong significant effect of all lagged dependent variables used as explanatory variables, together with a strong significant and positive relationship between lagged variables of capital structure when used as independent variables and profitability variables measured by ROA and ROE, when used as dependent variables. The validity of the estimated models is shown in the table through the Hansen's test used to check the validity of the used instruments with the null hypothesis that instrumental variables are not correlated with the error term and that the specified model is valid. The p-value of the Hansen's test for the first model is (0.889) which indicates that the test doesn't reject the null hypothesis implying the validity of the used instruments and the specified model. Similarly, the p-value of the Hansen's test for the second model is (0.919) which proves the same results as that of the first model, meaning that the used instruments and the estimated model are valid.

Finally, the Wald test is used to test for the causality between the equation variable and the excluded variable for the models of interest in the system. The test for the first model rejected the null hypothesis that the excluded variable doesn't Granger-cause the equation variable in the ROA equation with a p-value of (0.045). However, the test didn't reject the null hypothesis that the excluded variable doesn't granger-cause the equation variable in the case of the capital structure equation with p-values equal to (0.276). Accordingly,

the first model shows that there is a unidirectional causality running from capital structure as measured by total debt to assets ratio and profitability as measured by ROA, and the effect is positive as indicated by the positive sign of the coefficient in the system GMM estimation in Table (5). The second model reported a Wald test of the ROE equation that also rejects the null hypothesis that the excluded variable doesn't granger-cause the equation variable, at 1% significance level, with a p-value of (0.000). However, the test didn't reject the null hypothesis in case of the capital structure equation. This concludes that the tested models reported a similar unidirectional relationship running from capital structure to ROE as a measure of business profitability, and the effect is positive as illustrated by the positive sign of the coefficient in the system GMM estimation.

Table (5): PVAR Granger Causality Results

First Model								
Variables	ROA				CAPS			
	Coefficient	Standard Error	z	P>|z|	Coefficient	Standard Error	z	P>|z|
ROA (t-1)	0.5298636	0.1345754	3.94	0.000	0.1436733	0.1317868	1.09	0.276
CAPS (t-1)	0.5531778	0.2760977	2	0.045	0.579322	0.1587698	3.65	0.000
Wald Test (p-value)	0.045				0.276			
Hansen's Test (p-value)	0.889							
Second Model								
Variables	ROE				CAPS			
	Coefficient	Standard Error	z	P>|z|	Coefficient	Standard Error	z	P>|z|
ROE (t-1)	0.013979	0.025866	0.54	0.5890	0.0056155	0.0068013	0.83	0.409
CAPS (t-1)	2.824177	0.7224702	3.91	0.000	0.4975443	0.1493002	3.33	0.001
Wald Test (p-value)	0.000				0.409			
Hansen's Test (p-value)	0.919							

Note: The table presents the first order PVAR model estimated using system GMM to test the Granger causality between profitability as measured by ROA in the first model and by ROE in the second model on one hand, and capital structure as measured by total debt to assets ratio on the other hand. The number of lags was specified using the Three-Model-Selection criteria proposed by (Andrews and Lu, 2001). ROA stands for return on assets as measured by the ratio of net income to total assets, ROA (t-1) is the first lag of ROA. ROE stands for return on equity as measured by the ratio of net income to total equity, ROE (t-1) is the first lag of ROE. CAPS stands for capital structure as measured by the ratio of total debt-to-assets; CAPS (t-1) is the first lag of CAPS. Also, note that; panel VAR-Granger causality Wald test has the following null and alternative hypotheses

Ho: Excluded variable does not Granger-cause equation variable

Ha: Excluded variable Granger-causes equation variable

Source: Authors' Analysis Using Stata

5.2.Hypotheses Testing

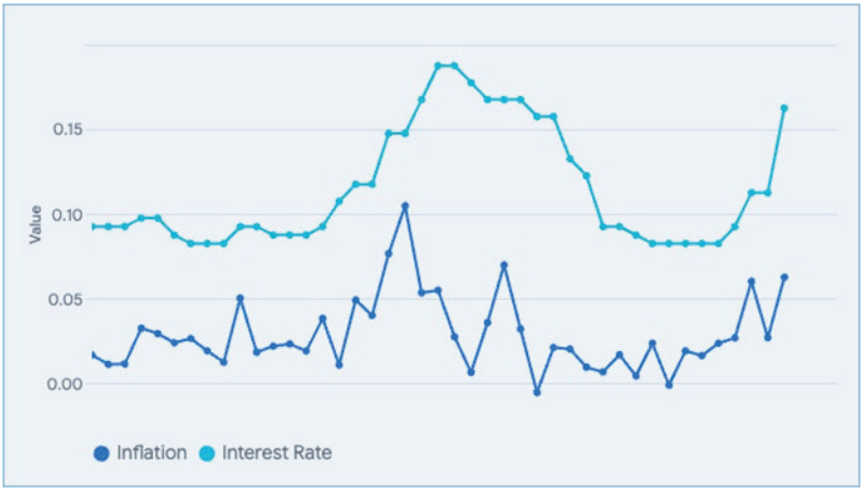
The previously presented results can be used to test the research hypotheses, presented in Table (1), and discuss the results of hypotheses testing in the light of relevant theoretical background and the results of previous empirical studies. It can be noted that only two hypotheses are not rejected. The first hypothesis "H1: There is a unidirectional causal relationship running from Capital structure to profitability, as measured, by ROA for the most active non-financial firms listed in the Egyptian Stock Exchange" is not rejected. Similarly, the second hypothesis "H2: There is a unidirectional causal relationship running from Capital structure to profitability, as measured by ROE, for of the most active non-financial firms listed in the Egyptian Stock Exchange" is not rejected. This verifies a unidirectional causal relationship from capital structure as measured by the total debt to assets ratio and profitability as measured by either the ROA or the ROE ratio. The implied unidirectional causal relationship running from capital structure to profitability as measured by both ROA and ROE indicates that past values of capital structure as measured by the total debt to assets ratio for the sample firms during the 2011-2023 period can be used to predict future values of profitability as measured by both ROA and ROE. The results imply that firms' capital structure decisions or their decisions of how much debt they are using, have a predictive power of their future profitability. The estimated significant positive impact is consistent with the Trade-off theory discussed previously and can be explained also through the perspective of the Agency theory. This means that increased leverage of Egyptian firms can be used as a sign of increased future profitability through the utilization of the tax-shield by Egyptian firms, as implied by the Trade-off theory. In addition to the motivating factors that exist in case of increased leverage to improve profitability and provide sufficient cash flows to face principal and interest payments to fulfil shareholders goals as discussed in the Agency perspective. Moreover, the Agency theory referred to the increased monitoring and control for firms with higher leverage that helps in enhancing operational efficiency and improving profitability.

Similarly, the positive impact of capital structure on profitability is discussed in previous studies based on relevant theoretical framework. The tax shield logic is used in studies that concluded a positive impact of financial leverage on profitability.

Previous studies stated that the tax shield created by high leverage is due to more interest payments that are tax-deductible, which usually has a positive impact on profitability through decreasing the relative proportion of its tax payments. One more justification used in different studies is the logical disciplinary effect from management perspective, as well as the increased monitoring by different stakeholders, in a trial to improve efficiency to meet debt obligations which eventually improves profitability. The previously mentioned reasoning for the positive association between profitability and capital structure based on the Trade-off theory and the Agency theory was intensively discussed in many research papers including; (Fama & French, 2002), (Abor, 2005), (Gill, et al., 2011), (Derayat, 2012), (Herciu & Ogrean, 2017), (Arifin, 2017), (Hussein, 2020) , (Zhou, et al., 2021), (Abdullah & Tursoy, 2021), (Puri, 2023), and (Ima, et al., 2024).

The unidirectional relationship running from capital structure to profitability can also have more practical implications for decision makers such as investors and financial managers who can consider capital structure decision as a determining factor in forecasting future firm profitability, which can help in financial analysis and budgeting. It can be said that financial modelling used to plan company's future financial performance can make use of the predictive power of capital structure variable to improve future profitability using trend analysis. Moreover, the Egyptian market witnessed major changes and volatility in interest rates and inflation rates during the sample period as shown in the following figure. Increasing average inflation rates throughout the sample period was accompanied by tightening monetary policy and increases in interest rates to control inflation. Such economic challenges can have a dramatic effect on association between different financial variables. However, according to (Modigliani & Cohn, 1979) firms with high pricing power can pass on price increases to final consumers and have a positive impact of inflation on profitability. This is a close case to the Egyptian market with high pricing power of Egyptian firms that might have passed the inflationary effects to final consumers which help boosting their revenues with amounts that more than offset increases in their expenses. In this case, firms can utilize this opportunity and leverage their performance with more debt to cease this opportunity and improve their profitability. This can be used as another explanation for the positive effect of past values of increased debt on future firm profitability for the sample of Egyptian companies during the sample period. It is expected that future research will avoid the limitations that will be discussed in more details in following section to try to investigate such effects in more details.

Figure (4): Inflation Rate and Interest Rate over the Sample Period



Source: Research Data from Egyptian Ministry of Planning and International Financial Statistics Data Bases

It can be noted that the reported results couldn't prove the existence of a bidirectional causality between profitability and capital structure that was reported in some previous studies such as; (Abdullah & Tursoy, 2021), and (Supyan & Kuswanto, 2023). The results of the current research add to the never-ending argument regarding the association between capital structure and profitability. However, it might serve as a crucial component that contributes to the overall understanding of the issue. This implies the need to further investigate the inconclusive results about the relationship between the two variables in future research. A large set of theoretical background can be found regarding the interrelated effects between capital structure and firm profitability. However, no single conclusion can be stated on such relationships until the moment, which is also evident through the results of the current study, as well as the results of all previous studies and theories discussed earlier. This means that the interaction between leverage and profitability will remain a valid point of research that is worth further investigation by future research studies, taking into consideration different limitations that will be discussed hereafter.

6. Limitations and Future Studies

It can be seen from reviewing different studies and theories, and from comparing the results of the current study to all the previous discussions, that there is no consensus on the relationship between financial leverage and profitability.

This implies the need for more future studies to investigate such relationships to into consideration the limitations of the current study while trying to conclude different relationships between leverage and profitability. The economic conditions represent an important limitation of the current study, as Egypt witnessed major economic changes during the sample period. This can have an influence on the risk factor of having higher leverage and it might have influenced firm's capital structure decisions implying potential bias in the reported results. The current study found it statistically not possible to measure the effect of the economic challenges that faced Egypt during the sample period. Those challenges can represent major structural breaks that might improve the efficiency of the tested results when taken into consideration. The sample size is not large enough to run comparative analysis between different sample periods to test how different economic and political challenges could have influenced the results of the study. Therefore, future studies should try to have a larger sample size to be able to test for possible impact on the relationship between the two variables of interest.

Furthermore, different industries have different levels of capital structure, and the sample include companies from different industries. Some industries, such as real-estate development industry, can afford higher levels of leverage, while others cannot. It's worth mentioning here that the real-estate sector witnessed major growth in Egypt during the sample period compared to other industries due to the strategic orientation of the Egyptian economy towards building new cities and the improvement of the country's infrastructure. This means that the real-estate sector in Egypt is an important sector and have a remarkable contribution to the country's economy. Therefore, a separate investigation for each sector might provide more insights for researchers and policy makers. Moreover, investigating the effect of different firm-specific and macroeconomic variables on the tested relationships might help identifying different justifications of the causal relationship between the two variables. The role of other variables in controlling the relationship between the two variables might need a special focus. This is because variables such as age, size, operational efficiency, inflation, interest rate, and other internal and external factors might influence the tested relationships. This can be tested in different model specifications and larger datasets that give more flexibility to include different excluded effects.

The statistical techniques used in the current study control for the effect of those variables to ensure efficiency of the estimated models and reliability of results. The current research is only focusing on testing the direct causal relationships between the variables of interest in a panel setting to exclude the complications that might arise from adding more considerations to the estimation process that are found in different previous studies. However, measuring the effects of those variables can help in solving the never-ending argument of the tested relationships

7.Conclusion and Implications

Firm capital structure is an important variable that affect different financial decision-making processes, so one of the main objectives of any firm's financial management is achieving the optimum capital structure that increases firm value and maximizes shareholders' wealth. Different economic theories discuss the interaction between capital structure on one hand, and firm profitability as an indicator of firm's ability to operate efficiently and increase firm value on the other hand. However, reviewing various relevant theories such as the Trade-off Theory, the Agency theory, and the Pecking Order theory will lead to different implications for the interactions between the variables of interest. Also, there is no consensus in previous studies regarding the direction and justification of such relationships in previous recent studies as discussed earlier. Also, there is still an ambiguity regarding the Granger causality between capital structure and profitability, as few studies tested the existence of such causal relationships such as (Arifin, 2017) and (Supyan & Kuswanto, 2023), with no conclusive results on the interaction between the two variables. This might be due to different complications and multiple interactions surrounding relationships between these variables and other internal and external factors of any business organizations.

Therefore, the current paper tries to fill in this gap in literature regarding the inconclusive results on the interaction between capital structure and firm profitability through using the statistical methods suggested by (Love & Zicchino, 2006). This is done by estimating a PVAR model of the variables of interest under a GMM framework using system GMM estimation and by employing the Wald test of Granger causality that is based on the pioneer concept developed by (Granger, 1969). The causal relationship between capital structure and profitability of Egyptian companies is tested using data of the 69 most active non-financial companies listed in the Egyptian Stock Exchange for the period 2011-2023.

Capital structure variable was measured using the ratio of total debt to assets, while profitability was measured using the two main accounting-based proxies of profitability: ROA and ROE. The use of the system GMM estimation in the tested model is needed to account for potential bias resulting from problems associated with panel modelling such as endogeneity and unobservable heterogeneity problems. Following (Love & Zicchino, 2006), the lag order was selected using the Three-Model-Selection criteria and the first order PVAR model was estimated. This was done after testing the variables of interest for stationarity using Fisher-type test based on Phillipe-Perron tests. Additionally, Hansen's test for overidentifying restrictions of the estimated models was used and it verified the used instruments and validated the estimated PVAR model.

The results reported a Granger causality Wald test that failed to reject the null hypothesis of no Granger causality in the capital structure equations. This means that there is no Granger causality running from profitability to capital structure. While, the Wald test of the profitability equations rejected the null hypothesis resulting in a conclusion of a unidirectional relationship running from capital structure to profitability. The reported results imply the predictive power of capital structure to improve future profitability of Egyptian firms during the sample period. The estimated system GMM model reported a positive significant impact of capital structure on profitability in both the ROA and ROE estimations. The results are consistent with many of the previous studies that investigated this relationship between the two variables using different models and in different contexts. Moreover, the results agree with the Trade-off theory and the Agency theory that discussed the important effect of the tax-shield in improving highly leveraged firm's profitability through the increased tax-deductible interest expense. While, the effect of the increased bankruptcy costs associated with more debt is more than offset with the tax-shield advantage. Moreover, the disciplinary effect plays its role, according to the Agency theory, management will be more committed to improving firm profitability in case of using more debt to be able to provide the cash flow needed for principal and installment payments. In addition to the increased monitoring and control of shareholders to ensure the targeted level of managerial efficiency needed to deal with the increased level of risk associated with more leverage.

Practical implications of these results might help decision makers in their analysis and planning by using past values of capital structure to predict future profitability. This can be relatively important in the Egyptian context due to the persistent uncertainty and the great amount of risk that surrounded the business environment in Egypt during the past decade and continue to do so. Therefore, investors, managers, creditors, and policy makers can use indicators of the levels of leverage in Egyptian firms as a determinant of the forecasted firm profitability. Moreover, on the level of the listed firms, these interesting results can affect the investment decisions in listed companies with the implied predictive power of financial leverage indicators in measuring future profitability. Further policy implications can be discussed with respect to the effect of increased levels of interest which represent the price of debt, as well as the inflationary effects during the sample period. It can be argued that increased prices during the sample period could have helped firms with more leverage that managed to increase their profitability through utilizing their pricing power and passing on the effects of increased prices to the final customer, in a way that results in increased in revenues that more than offset the increase in expenses, which resulted in improving profitability. Future studies are expected to work according to the recommendations of the current research and avoid its limitations to test for the possible interactions that can affect the causal relationship between capital structure and profitability.

8.Bibliography

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