DETERMINANTS OF DEBT-TO-EQUITY AND ITS IMPACT ON THE PERFORMANCE OF INDUSTRIAL COMPANIES LISTED ON AMMAN STOCK EXCHANGE

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Abstract

This paper focuses on investigating the determinants of the debt-to-equity ratio, and its impact on the performance of 20 industrial companies listed on the Amman Stock Exchange (ASE). It uses a numerical research model comprised of two operations: data envelopment analysis (DEA) followed by regression analysis, that is to identify the key determinants of the said ratio and examine the effects of it and its determinants on companies' performances. Furthermore, the paper detects that firm risk has a substantially positive impact on debt-to-equity and firm size; whereas tangibility and liquidity have a substantially negative impact on debt-to-equity. Finally, the study finds that debt-to-equity and firm size both have a substantially negative impact on performance; contrastingly, liquidity and tangibility and possess a substantially positive impact on the industrial companies' performances. The importance of exploring the research problem lies in its potential to further benefit and help the industry leaders in the ASE, and stakeholders of these industries, in developing an action plan that determines the debt-to-equity ratio for financing they will need in order to optimize the company's sustainability and profit generation (Drobetz & Fix, 2005).

Keywords: Debt-to-Equity, Data Envelopment Analysis, Regression Analysis, Capital Structure, Amman Stock Exchange, Industrial Jordanian Firms, Strategic Management

Authors' individual contribution: Conceptualization — K.A.; Methodology — A.B.-H.; Software — A.B.-H.; Validation — K.A.; Formal Analysis — A.B.-H.; Investigation — A.B.-H.; Resources — A.B.-H.; Data Curation — A.B.-H.; Writing — Original Draft — A.B.-H.; Writing — Review & Editing — K.A.; Visualization— K.A.; Supervision — K.A.; Project Administration — K.A.; Funding Acquisition — K.A.

Declaration of conflicting interests: The Authors declare that there is no conflict of interest.

1. INTRODUCTION

When a firm demands capital, it normally acquires it through either of the two methods: bond market-borrowing or equity utilization. Debt-to-equity is very essential for the trade-off between risk and return, making the settlement of such financing decisions a challenge for the firm; as it ought to select the composition of financing that best optimizes its worth and the shareholders' wealth. All of which are identifying the optimal debt-to-equity ratio as one of the most crucial goals to achieve in strategic management, one whose cruciality is underestimated; as indicated by little research on it in regards to the industrial companies listed in the Amman Stock Exchange (ASE).

In the financial markets, debt-to-equity is a great contributing factor to the valuation of the listed economic enterprises. Furthermore, the markets' dynamic nature forces companies' ranking to depend largely on their debt-to-equity ratios, that is to choose the resources capable of reaching "shareholders' wealth maximization" (Drobetz & Fix, 2005). Therefore, financial executives are advised to pay heed to maximize shareholders' wealth by determining the greatest amalgamation of financial resources for the organization.

Capital structure varies between one firm and another (Ahmadpour & Yahyazadefar, 2010). Furthermore, firms can resource finances from either "internal financial resources" or "external financial resources". In the former, those funds are found in the form of accumulated earning; which executives can utilize to fund the firm's return-efficient operations in lieu of splitting profit amongst shareholders. As for the latter, those funds can be gathered from issuing stock and issuing debt (Grinblatt & Titman, 1998).

In spite of the fact that the theories found to interpret capital structure are numerous, researchers in finance are yet to find a model to determine the optimal debt-to-equity ratio. Since the connection between the said ratio and a firm's performance has been a subject of great interest in corporate finance literature ever since Modigliani and Miller (1958) stated that a firm's value is independent of the capital structure if the capital market assumption is ideal; as in one that involves a market that is free of arbitrage activities. And taxation is avoidable through debt-taking. In turn, the premiere capital structure that an enterprise can take in is one whose debt percentage is 100%. Adding to that, it is worthy to consider that a firm's value is uninfluenced by its structure of finances.

Modigliani and Miller's (1958) theory, just like any other theory, was susceptible to criticism. In response to that, they amended their theory to include tax benefits as a debt-to-equity determinant. This is due to the cruciality of one of the taxation's properties that recognizes interest as a tax-deductible expenditure. And according to Modigliani and Miller (1958), a firm that closely fulfills its tax commitments benefits from partially offsetting interest, viz. the tax shield, in the shape of paying lower taxes. This way, Modigliani and Miller (1958) denote that firms can shoot up their value by utilizing more debt due to tax shield benefits associated with the utilization of debt. As a result, firms gain from taking on more leverage.

Concludingly, Modigliani and Miller (1958) demonstrate that firm value and performance are expanding functions of leverage due to the tax-deductibility of the interest payments at the corporate level.

Market inefficiency, in actuality, is attributable to a number of facets; including but not limited to: taxes, transaction costs, information asymmetry, bankruptcy costs, and agency conflicts. By taking these elements into consideration, Modigliani and Miller's (1958) theory leans to fail to retain the bulk of its explanatory power. Nevertheless, what this theory has managed to retain is its celebration of being the one to lay the foundation stone for countless of the theories that followed.

The trade-off theory argues that, in spite of the existence of market imperfections (i.e., agency costs, bankruptcy costs, and taxes), firms trade off the benefits and costs of debt and equity financing and manage to reach an optimal debt-to-equity. Successful firms are even capable of extended borrowing. But, to a certain limit. As if that limit is exceeded, the profitability and the value of the firm will decline as a result of the interaction of bankruptcy and agency costs (Myers, 2001).

As for Myers and Majluf (1984), they introduced the Pecking order which put forward that to reduce information asymmetry between the parties, firms must adhere to a financing hierarchy (internal funds, debt, and new equity). Since, when managers, who are normally more knowledgeable about the true conditions of the firm than the investors issue new equity, investors seem to conjecture that those managers believe the firm to be overvalued; thus, taking advantage of this over-valuation. Hence, investors will place a lower value on the new equity issuance. Theory predicts that more profitable firms, ones that generate high cash flows, are expected to use less debt capital than those that generate lower cash flows.

In 1976, Jensen and Meckling developed the agency cost theory. This theory proposes that the optimal debt-to-equity ratio will be determined by minimizing the costs that result from disagreements between managers and shareholders. The possible reason as to why such disagreements may arise in the first place is that managers hold less than 100% of the residual claim (Harris & Raviv, 1991). And when ownership and control do not go hand in hand, operational inefficiencies can begin to dominate a firm's business. Since, in such a case, managers may devote less time and effort in managing the firm's resources; thus, decreasing the firm's value.

The free cash flow theory follows the agency cost theory in the way that: "Free cash flow is cash flow in excess of that required to fund all projects that have positive net present values when discounted at the relevant cost of capital" (Jensen, 1986, p. 323). Significant free cash flows controlled by firm managers can be used in increasing dividends or repurchasing stocks, followed by the payout of current cash. In contrast, managers will invest in low-return projects. Furthermore, debt is used to control managers' behavior by reducing the free cash flows, as this will decrease the possibility of excessive investment or infeasible-project investment by placing them under the commitment of paying fixed-interest payments.

Table 1. Summary of capital structure theories

Theory	Relationship
Modigliani and Miller's (1963)	A positive relationship between firm value (performance) and debt-to-equity.
Trade-off	A positive relationship between firm value (performance) and debt to a certain level, then a negative relationship due to bankruptcy cost.
Pecking order	A negative relationship between firm value (performance) and debt-to-equity.
Agency cost	A negative relationship between firm value (performance) and debt-to-equity.
Free cash flow	A positive relationship between firm value (performance) and debt-to-equity.

Source: Prepared by the researchers.

The lack of consensus among the theories summarized in Table 1 gives rise to different empirical studies in debt-to-equity. These studies are aiming to reach a conclusion about the effect of debt-to-equity on a firm's performance. Nevertheless, they are yet to devise a specific result that can be used to generalize about the extent of the relationship between debt-to-equity and firm performance. This, however, stipulates that the door for carrying out more research on the said relationship is still open; all for the sake of attempting to reach a proper understanding of an interchange as significant as debt-to-equity and firm performance.

The particular aim of this research is to investigate the determinants of debt-to-equity and its impact on the performance of industrial firms listed in the ASE, by examining the relationship between debt-to-equity and firms' performance.

The remainder of the paper is structured as follows. Section 2 explores the paper's topic in the scope of previous literature that is of importance. Section 3 examines the methodology that is utilized to perform the appropriate statistical analysis on. Section 4 presents the results of the said method performed. Section 5 provides the readers with the conclusions made.

2. LITERATURE REVIEW

The roots of debt-to-equity theory stem more than five decades ago from the work of Modigliani and Miller (1958). Years of work, which give rise to what is now known as the "irrelevance proposition theorem". One proposes that the value of the levered firm equals the value of the unlevered firm. Then, in 1963, Modigliani and Miller put forward new proof which indicated that the cost of capital has an effect on debt-to-equity, and therefore has an effect on the value of the firm.

The trade-off theory is then introduced in response to a debate over the Modigliani and Miller's (1963) theory. When the corporate tax was added to the initial irrelevance proposition of Modigliani and Miller's, a benefit for debt was noted that functions to shield earnings from taxes. In regards to that, the trade-off theory states that the optimal debt-to-equity is the trade-off between the benefits of debt and the costs of debt (Brigham & Houston, 2020).

Counter to the trade-off theory, the Pecking order theory proposes that firms favor internal funding over external funding. As in the case that they require external funding, they are more likely to resort to the debt over equity, and equity is generated as the last resort. Moreover, the theory predicts that exceedingly profitable firms that make high cash flows are anticipated to use less debt capital than those that generate lower cash flows.

The following literature review will cover the more recent research done on debt-to-equity, beginning with Mugun, Odhiambo, and Momanyi (2019), who are researchers that investigated the impact of debt-to-equity ratio on the financial performance of Monetary Financial Institution (MFIs) in Kenya. In their investigation, they prepared panel data for 12 MFIs covering the period from 2009 to 2013. Further, they used the random effect model and accordingly proved that the debt-to-equity ratio has an insignificantly negative relationship with assets return, portfolio to assets ratio had a significantly positive relationship with financial performance, and operating expense ratio had a significantly negative relationship with the return to assets ratio. The researchers then recommended Association of Monetary Financial Institutions (AMFI) conduct an audit for the purpose of ensuring that all of them sustain an appropriate balance between debt and equity.

Nukala and Prasada Rao (2021) prepared a case study to assess the return on assets for two corporations, in addition to the tradeoff of the return and risk from the projects that are based on capital. For that purpose, the researchers use the standard capital asset pricing method. This is to elaborate on the effect of the discount rate on the present values of future cash flows when the debt-to-equity capital structure ratio is changed between 0 and 2.5 debt-to-equity. The study concludes that, first, when the debt-to-equity ratio is high, it provides a flatter net present value with an increase in gross margins. And, second, when the average cost of capital crosses a certain threshold, the impact on the net present value is negative. They also conducted a covariance analysis on two stocks traded in BSE SENSEX and S&P 500 to identify the individual returns using the beta values. This analysis shows that returns are changes that depend on the possible earning levels, firm growth rate, prices of the stock, and dividend payout ratios.

Hendrani and Septyanto (2021) conducted a study to identify the effect of return on asset (ROA), debt-to-equity ratio (DER), and company size on company value as proxied by PBV (price-to-book value). They focus on food and beverage sub-sector corporations listed on the Indonesian Stock Exchange (IDX) for the period 2014–2018. Further, the study covers eight corporations, and shows that return on asset has a significantly positive effect on company value and that the debt-to-equity ratio variable does not. The researchers also show that the company size variable does not have a significant effect.

Dinh and Pham (2020) analyzed the effect of capital structure on the financial performance of pharmaceutical enterprises listed on Vietnam's stock market. The researchers conducted a regression using ROE as a dependent variable and long-term asset, self-financing, debt to assets ratios, and financial leverage as independent variables. Further, the researchers also use firm size, growth, and fixed asset rate as control variables. The data coverage period is from 2015 to 2019 for 30 pharmaceutical corporations listed on Vietnam's stock market.

Further, they use least square regression (OLS) to test the impact of capital structure on the firms' financial performance. As a result, the researchers find a positive relationship between financial leverage ratio (LR), debt-to-assets ratio (DR), and long-term asset ratio (LAR) and corporate performance, but a negative relationship between self-financing (E/C) and return on equity (ROE).

The last of the recent literature that discussed debt-to-equity is by Toukan (2021), who studied the verdict to go public under the issuance of both debt and equity financing. The models of his research are based on the main idea that owners, managers, and shareholders spend a considerable effort to increase their profit from the public firm; where the output of this effort and the listing decision are affected by the cost of debt. Moreover, the researcher focuses on the interaction between shareholders, managers, and debtholders. The research results show that raising funds through the take-on of debt is favored over equity, while in industries demonstrating growing returns to scale, a positive relationship acquires between the interest rate and the issuance of equity.

Kashefi-Pour (2011) investigates the debt-to-equity determinants regarding firms' sizes based on the trade-off and Pecking order theories. The study presents empirical results on the debt-to-equity of the United Kingdom listed firms of the small, medium, and large sizes based on a large panel data set during 1990–2006. The findings of the study show that both theories help in explaining the debt-to-equity of the said firm sizes. Although, larger emphasis should be placed on the trade-off theory. Moreover, among the small firms, there is a variation from large companies in the level of growth opportunities, the structure of assets, probability of bankruptcy, and agency costs. This explains the variations in firms' characteristics that are important to affect debt-to-equity determinants and thus, these determinants are prone to be size-dependent. These results support the existing differences between small and large firms considering the agency costs and the bankruptcy costs.

Vătavu (2015) aims to investigate the determinants of capital structure in manufacturing companies listed on the Bucharest Stock Exchange. The sample consists of 196 companies, with data available over a span of years stretching from 2003 to 2010. Furthermore, six financial indicators were estimated as the independent variables (tangibility, size, investment opportunity, tax shield, risk, inflation). Whereas, the dependent variables are the capital structure ratios (long-term debt, short-term debt, and total debt). In terms of results, first, the paper reveals size as the main financial indicator of significant effect on the capital structure of companies operating in the manufacturing industry. Second, it reveals a significantly-positive relationship between size and debt; a negative relationship between tangibility and short-term debt; a positive relationship between risk and short-term debt and total debt; and a positive relationship between inflation and long-term debt.

Cortez and Susanto (2012) aimed to discover the relations between firm-specific experience and debt-level in Japanese firms; specifically, in manufacturing companies as they comprise a sector that is vital to the Japanese economy. They intended

to add to the existing literature by investigating the determinants of debt-to-equity in Japan. For that purpose, they used panel data and multiple regression to study the relationships between the dependent variable, viz. leverage, and the independent variables which are tangibility, profitability, non-debt tax shield, size, growth in fixed assets, and growth in total assets. The study results that size, growth in fixed assets, and growth in total assets are not significant. Nevertheless, it reveals that the variables tangibility, profitability, non-debt tax shield are statistically significant. It also results that tangibility has a positive relation with debt level, while profitability and non-debt tax shield have negative relations with debt level. These relationships are projected in either the Pecking order theory or static trade-off theory; however, neither of those theories demonstrate an increasingly prepotent projective capacity over the other. It is then that researchers proposed the trade-off adjusted order theory, which merges the components of the two said theories, as a probable clarification for this behavior.

Nasimi (2016) investigates the determinants of capital structure, which are of premiere importance, of 15 firms listed on the New York Stock Exchange (S&P 500 index) using panel data from over 5 years (from 2010 to 2014). In the investigation, the researcher uses multiple regression analysis in order to examine the effect of six independent variables (profitability, size, growth, tangibility, cost of financial distress, and tax shield effects) on the three following dependent variables: short-term debt ratio, long-term debt ratio, and total debt ratio. The outcomes of the researcher's investigation revealed that between all of the six independent variables, the tangibility variable was the one to have a noteworthy effect on the dependent variables. Hence, profitability, size, growth, tangibility, cost of financial distress, and non-debt tax shield effects are the decided determinants of capital structure for the information technology firms in America. Finally, the investigation draws the conclusion that debt is favored in the debt-to-equity of the American information technology firms.

Through inspecting them empirically, Titman and Wessels (1988) worked to study the theoretical determinants of capital structure. To further detail, asset structure, on-debt tax shields, growth, uniqueness, industry classification, firm size, earnings volatility, and profitability were tested to monitor the way that they impact a firm's debt-to-equity ratio selection. For that purpose, four financial measures are used (long-term, short-term, and convertible debt divided by market and by book values equity). Furthermore, the study is conducted on 469 large firms in the United States and its data is gathered between 1974 and 1982. The results showed consistencies with theory in terms of the elements impacting firms' choices in capital structure. At last, the study presents the following compelling deductions. The negative levels of debt to the uniqueness of a firm's line of business, the negative relation between short-term debt ratio and firm size, and the influentially-negative relationship between debt ratios and past profitability.

Huang and Song (2006) employ a new database, which holds the market and accounting data of

greater than 1000 Chinese listed companies from 1994 to 2000, to present the features of these firms with regards to capital structure. Subsequently, the researchers found that there exists a positive correlation between leverage in Chinese companies and firm size, non-debt tax shields, and fixed assets; whereas a negative correlation exists between that same leverage and profitably. Furthermore, leverage in Chinese companies surges with volatility, and companies are inclined to have reduced long-term debt. The trade-off theory is considered to be the most accurate in clarifying the characteristics of capital structure in companies in China.

Cheng, Liu, and Chien (2010) explore the possibility of existing an optimal leverage point for the optimization of a firm's value. In this exploration, the researchers use an advanced panel threshold regression model to investigate the panel threshold effect of leverage on firm value among 650 A-shares of firms listed in China between 2001 and 2006. ROE is used as a surrogate for firm value and debt-to-asset ratio as the threshold variable. The findings prove that a triple-threshold effect is indeed found and show an inverted-U correlation between leverage and firm value. Finally, the exploration puts grounds to the possibility of detecting the certain degree past which, an additional expansion in debt financing, is incapable of boosting proportional firm value.

Goyal's (2013) objective is to present empirical evidence on the basis of the influence of debt-to-equity on the profitability of public sector banks in India. Specifically, the banks listed on the National Stock Exchange from the period between 2008 and 2012. For the sake of achieving this objective, the author used the regression analysis method to determine the relationship between return on equity, return on assets, and EPS with debt-to-equity. The study resulted in the exhibition of first, a positive relation between short-term debt with profitability. Second, a negative relation between long-term debt capital and return on assets, return on equity, and earnings per share. Third, a positive relation between firm size and the variables ROA and EPS, and a negative one with ROE. And fourth, a positive relation between assets growth and return on asset, equity, and earnings per share. The authors concluded that there exists a positive relationship between short-term debt and the profitability of banks in India.

3. METHODOLOGY

Statistical analysis is not used only as a method of data analysis in order to reach conclusions; it is also used to predict the outcome for the situations with uncertainty. In this paper, we used the appropriate statistical analysis method in accordance with the research data used. Furthermore, it is worth noting that selecting the best statistical analysis type is not an easy process, so the researchers will use the most appropriate analysis depending on the literature review and theories.

3.1. Model and variables definitions

The study methodology consists of a research model that is modeled over two operations: data envelopment analysis (DEA) and regression analysis. This is to identify the key determinants of debt-to-equity and examine the effect of it and its determinants on the firms' efficiency (performance) of industrial firms listed on the ASE. In the DEA program, the corporate structure will be used as an input while the corporate efficiency indicators will be used as the outputs. Further, the corporate structure consists of the capital structure, also known as "the value of debt divided by total equity and debt" (Lehmann, Warning, & Weigand, 2004). Two control variables were added: capital intensity and firm size. The capital intensity, known as "the value of total assets divided by the number of employees", is added as an input in the DEA in order to control possible variations in capital contribution per employee across firms. And finally, the firm size represents the log of total assets which is used to control possible variations in firm size (Lehmann et al., 2004).

The corporate efficiency indicators consist of three dimensions:

1. *Investment:* according to Lehmann et al. (2004), represents the value of dividing the fixed assets expenditure on total assets.

2. *Growth:* according to Ezzamel and Watson (1993), is equal to the change in the book value of total assets.

3. *Profitability:* is clarified as the return on assets (ROA) (Lehmann et al., 2004) that is calculated by dividing the net income by total assets.

Figure 1. DEA variables
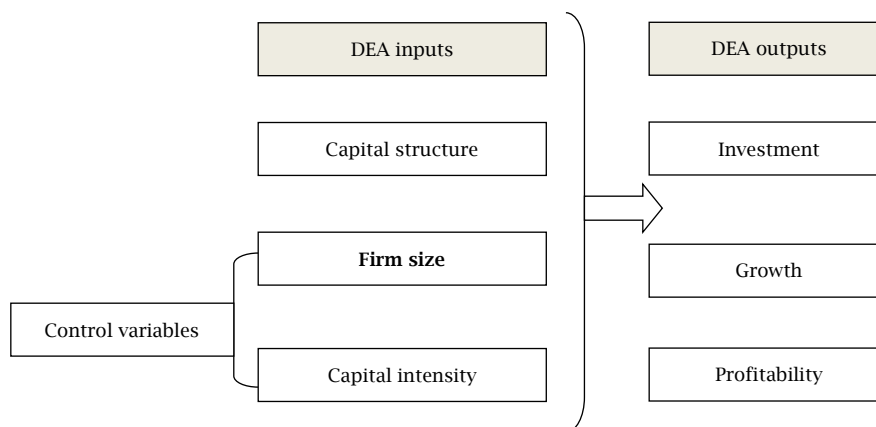
In the first regression analysis, the dependent variable is debt-to-equity, and the independent variables are firm size, risk, tangibility, and liquidity.

Secondly, the study will examine five independent variables: debt-to-equity, firm size, risk, tangibility, and liquidity and their impact on firm efficiency (performance) as a dependent variable.

3.2. Models

Model 1

$$DTE = \beta_0 + \beta_1 SIZE_{it} + \beta_2 RISK_{it} + \beta_3 TANG_{it} + \beta_4 LQ_{it} + e_{it} \quad (1)$$

Model 2

$$Efficiency = \beta_0 + \beta_1 DTE_{it} + \beta_2 SIZE_{it} + \beta_3 RISK_{it} + \beta_4 TANG_{it} + \beta_5 LQ_{it} + e_{it} \quad (2)$$

where:
β_0 = constant coefficient;
β_1–β_5 = regression coefficients;
DTE = debt-to-equity;
SIZE = firm size;
RISK = firm risk;
TANG = tangibility of fixed asset;
LQ = liquidity of the firm;
e = error component showing unobserved factor;
i = firm;
t = time.

Debt-to-equity: is found by the ratio of total liabilities over total assets. Total liabilities encompass long-term debts, short-term debts, and outstanding interest expenses on those debts. Long-term debts denote the firm's outstanding debt that is repayable over the span of one year, and short-term debts are outstanding debt repayable within one year.

Efficiency (performance): the DEA will measure the efficiency of the firms. Whereas the firms' size, capital structure, and capital intensity will be used as inputs and the corporate efficiency indicators will be used as outputs: investment, growth, and profitability.

Firm size: in past literature, firm size is expressed by the natural logarithm of total assets. Whereas the total assets are outlined as the sum of net fixed assets, total intangibles, total investments, net current assets, and other assets (Titman & Wessels, 1988) indicate the existence of a high relationship between the total assets' logarithm and sales logarithm; therefore, choosing any of them is a substitute to the other.

Firm risk: it is measured by standard deviation, as it dictates the firm's capacity to fulfill its interest payments (Brailsford, Oliver, & Pua, 2002; Ferri & Jones, 1979). Further, it can be calculated by the standard deviation of operating income before interest and taxes divided by the sum of assets.

Tangible assets: it is found by dividing the sum of fixed assets by the sum of assets (Weill, 2008) and (Margaritis & Psillaki, 2010). Tangibility assets are regarded as a form of security and guaranteed form of capital for creditors when the company requires external financing.

Liquidity: it is described as the company's capacity to fulfill its commitments (debt) at the time they are due (Laitinen, 2002). Moreover, it is fundamental for the company's survival that it possesses liquid resources to fulfill its commitments. The ratio that was found to be most fit for representing a company's liquidity is the current ratio: current assets/current liabilities.

3.3. Sample, data, and period of study

The population of this study consists of companies all listed on the ASE. The selected sample contains 20 industrial companies that meet the following conditions:

• Industrial firms' shares have been traded in the ASE during the period 2005–2015.

• Trading has not been interrupted in those firms' shares, where they have not been merged or liquidated throughout the period of study.

• All data concerning the companies' financial structure has been available throughout the period of study.

The number of the selected companies was affected by the number of the listed companies in the ASE; as this was one of the major limitations to selecting a larger number of companies or extending the study for a longer period. The researchers covered as many companies as possible.

3.4. Data envelopment analysis (DEA)

Industrial firms' efficiency scores represent the output of the DEA, and Zheka (2005) mentions that there are three main benefits of using DEA in corporate researches. First, the DEA is a nonparametric method and does not force any hypothesis of functional forms in production. Second, DEA concentrates on each observation individually rather than on population average. Third, DEA uses the best practice frontier, and not the central tendency frontier, to compare firm efficiency data.

The DEA model is often utilized in determining the efficiency of varying firms through a number of inputs and outputs. The study depends on the reality that firms function by the means of employing numerous inputs to produce certain outputs. In turn, depending on how intelligently firms employ their inputs to produce outputs, the efficiency of their capital structure is determined.

Upon the gathering of raw data, a comprehensive evaluation process is conducted on them and, accordingly, are arranged for analysis using an Excel spreadsheet. Subsequently, the author carries out preliminary analysis based on the research assessment, i.e., mean and standard deviation calculations as part of descriptive statistics. It was then time to run the DEA program, using the data envelopment analysis program (DEAP) developed by notable economist Timothy James Coelli (1996), to get industrial corporate efficiency scores. Those scores, of all of the firms in the research sample, are found using descriptive statistics methods, such as central tendency and variability.

Table 2. Descriptive statistics for industrial firms' DEA variables

Variable	Mean	Median	Max.	Min.	S. D.	Skewness
Capital structure	0.360	0.327	2.275	0.004	0.258	2.823
Firm size	7.418	7.277	9.088	6.078	0.676	0.822
Capital intensity	161,858	119,187	2,941,863	16,966	277,536	8.74
Investment	0.548	0.526	0.999	0.205	0.183	0.549
Growth	0.037	0.018	1.109	-0.537	0.201	1.654
Profitability	0.021	0.025	0.449	-0.637	0.132	-0.928

Notes: Capital structure equals the value of debt divided by (total equity and debt); Firm size represents the log of total assets; Capital intensity equals the value of total assets divided by the number of employees; Investment equals the value of fixed assets divided by total assets; Growth represents the change of the book value of total assets; Profitability equals the value of net income divided by total assets.

The mean of the capital structure indicates that on average 0.360 of Jordanian industrial firms are depending on the debt. Also, the percentage of equity on capital structure is less than the debt which is a positive indicator for the industrial sector. The median value is 0.327 which is similar to the average, and this indicates that capital structure data is normally distributed. The max. value for capital structure is 2.275, indicating that some of the Jordanian industrial firms are highly dependent on debt. In addition, the large number which exceeded 100% is explained by the negative total equity values of some firms in some years due to the losses. The min. value of the capital structure is 0.004, showing that some of the companies are highly dependent on equity without the need for any debt. The standard deviation value is 0.258, which suggests a small variability of capital structure values in the industrial sector.

Firm sizes for Jordanian industrial firms vary between 9.088 (max.) to 6.078 (min.) with an average of 7.418. That is a positive measure of Jordanian industrial firms' sizes being generally moderate. The standard deviation of firm size is 0.676, and the variability is explained by the different sectors covered by the study; as it includes multiple sectors with different firm sizes.

As for capital intensity, it has a mean value of 161,858 and a standard deviation value of 277,536; thus, indicating that there is high variability in capital intensity in the Jordanian industrial sector. Since the total assets differ in the number of employees percentage across firms. Some of the firms with large assets tend to have fewer employees relative to other firms with small assets, and this result can be interpreted as the large firms have more experience and they manage the resources more efficiently than small firms. This is also due to the differences in the sectors, as some sectors need fewer employees than others. When comparing to the total assets, skewness is 8.74, median 119,187, max. value 2,941,863, and min. value 16,966. All of which represent a high range of capital intensity values, which is also considered to be an indicator for the high variability of capital intensity in the Jordanian industrial sector.

Investment has a mean value of 0.548 and a standard deviation of 0.183. The low standard deviation indicates that most of the Jordanian industrial firms have the same level of fixed assets compared to total assets. Since the industrial sector requires more fixed assets than other sectors; the values of skewness (0.549), median (0.526), max. (0.999), and min. (0.205) represent a high range of investment values interpreted by the existence of anomaly values; as low standard deviation shows that the investment values are consistent.

Growth has a mean value of 0.037 and a standard deviation value of 0.201. The low value of standard deviation can be interpreted by the small differences in the Jordanian industrial sector size and total assets changes across the timeframe of the study. Skewness being 1.654, median (0.018), max. value (1.109), and min. value (-0.537) are other indicators of the variability of firm growth amongst Jordanian industrial firms during the period of the study.

Profitability has a mean value of 0.021 and the standard deviation value of 0.132. This indicates that the Jordanian industrial firms' net income relative to total assets is almost the same. Skewness is -0.928, median 0.025, max. value 0.449, and min. value is -0.637; all of which stipulate that some firms have losses.

The DEA results show that the efficiency for the observations varies from 0.158 to 1.00. This reflects the firms' efficiency in managing the inputs in order to generate the intended outputs. Table 3 shows a descriptive summary of the DEA results.

3.5. Descriptive statistics for regression models variables

Table 3 shows the results of the descriptive statistics for the dependent and independent variables (debt-to-equity, efficiency, liquidity, tangibility, risk, and firm size). Liquidity has a mean value of 2.265, and a standard deviation of 1.809; which demonstrates that most of the Jordanian industrial firms can meet their short-term commitments. The median value is 1.740, skewness is 1.513, max. value 8.773, and min. value 0.031 are other indicators for the high variability in liquidity in the Jordanian industrial sector.

Tangibility has a mean value of 0.548, and a standard deviation value of 0.183, which indicates a small variability in tangibility values. The median value is 0.526, skewness 0.549, max. value 0.999, and min. value 0.205 are indicators for the high variability of tangibility in the Jordanian industrial sector.

Risk has a mean value of 0.100 and standard deviation value of 0.061 which indicates a small variability of the risk. The values being 0.087 for mean, 0.907 for skewness, 0.238 as max., and 0.021 as min. are indicators for the high variability of risk in the Jordanian industrial sector.

Firm Size has a mean value of 7.42 which shows that Jordanian industrial firms' sizes are generally moderate, and the standard deviation of Firm Size is 0.68. Further, Jordanian industrial firms contain different types of firms which explains the variability of the firm sizes. Finally, skewness being 0.82, median value 7.28, max. value 9.09, and min. value 6.08 imply that Jordanian industrial firms differ in their sizes.

Table 4. Descriptive statistics for regression models variables

	Debt-to-equity	Efficiency	Liquidity	Tangibility	Risk	Firm size
Mean	0.832	0.591	2.265	0.548	0.100	7.42
Median	0.486	0.550	1.740	0.526	0.087	7.28
Max.	13.641	1.000	8.773	0.999	0.238	9.09
Min.	0.004	0.158	0.031	0.205	0.021	6.08
S. D.	1.429	0.258	1.809	0.183	0.061	0.68
Skewness	6.686	0.255	1.513	0.549	0.907	0.82

Correlation matrix

The correlation coefficient matrix is one of the descriptive measures that demonstrate the degree of the relationship between every two variables in the model. It is regarded to be the best method for estimating the relationships amongst all the model variables (between all possible pairs of variables), as shown in the below table.

The matrix shows the variables (debt-to-equity, DEA efficiency, firm size, tangibility, liquidity, and risk) in rows and columns to present the values for each variable alongside all other variables.

Table 5 shows a significant negative correlation between DEA efficiency and the firm size (-0.58), which points that as DEA efficiency decreases, the independent variable, firm size, will increase. Another significant correlation, a negative one, is found between liquidity and tangibility, which equals -0.404. On the other hand, it is observed that there is a significant positive correlation between risk and liquidity, which equals 0.333. Meaning, when one of the two variables increases, the second variable will also increase. At last, the insignificant correlation between risk and firm size equals -0.560.

Table 5. Correlation matrix for the model variables

	Debt-to-equity	Firm size	DEA efficiency	Tangibility	Liquidity	Risk
Debt-to-equity	1.000					
Firm size	-0.145*	1.000				
DEA efficiency	-0.173*	-0.58*	1.000			
Tangibility	-0.002	0.13*	0.148*	1.000		
Liquidity	-0.52*	-0.180	0.16*	-0.404*	1.000	
Risk	0.167*	-0.560	0.021	-0.278*	0.333*	1.000

*Note: * Correlation coefficient is significant at the level 0.05 (two-tailed).*

According to the correlation matrix result, and to guarantee that there is no multicollinearity or autocorrelation between the independent variables, multicollinearity and autocorrelation tests are conducted. All of which were capable of demonstrating that there is no strong (significant) multicollinearity or autocorrelation between the independent variables.

4. RESULTS

The main purpose of the regression analysis is to show the relationship between the dependent variable and independent variables. Since it represents how the dependent variable will change in case of any independent variables changes; whilst keeping all the other variables equal. This means that the regression analysis can show the relationship between the dependent variable and any of the independent variables separately. In general, it provides a good expectation for the value of the dependent variable in accordance with the independent variables.

The researchers conducted OLS regression. The below tables show the output of the regression analysis.

Table 6. Multiple regression analysis outputs (Debt-to-equity)

Variables	Debt-to-equity
Constant	0.905
	5.95*
	0.000
Firm size	-0.044
	-2.25*
	0.026
Firm risk	1.468
	6.36*
	0.000
Firm tangibility	-0.2491
	-3.11*
	0.002
Firm liquidity	-0.10131
	-12.35*
	0.000
R-squared	44.43%
Adj. R-squared	43.40%

*Note: * T-value, significant at the 5% level.*

4.1. Hypotheses testing: Model 1

In order to test the formulated hypotheses, reject or accept the null hypotheses, the researcher uses multiple regression and t-test, as shown in the above table. Accordingly, the research hypotheses are:

$H1_0$ (null hypothesis): There is no relationship between debt-to-equity and firm size.

The t-value of the firm size variable equals -2.25 and the p-value equals 0.026. To reject the null hypothesis ($H1_0$), the t-calculated absolute value should be greater than the t-tabulated, and the p-value should be less than the significance level, which is 0.05. For firm size, the two conditions exist and the coefficient of firm size is equal to -0.044. Therefore, we reject the $H1_0$ to accept the alternative hypothesis ($H1$), which indicates that there is a negative significant relationship between debt-to-equity and firm size. This result is consistent with Alipour, Mohammadi, and Derakhshan (2015) and inconsistent with Deesomsak, Paudyal, and Pescetto (2004) and Kashefi-Pour (2011).

$H2_0$ (null hypothesis): There is no relationship between debt-to-equity and firm risk.

The t-value of the firm risk variable equals 6.36 and the p-value equals 0.000. The two conditions exist and the coefficient of firm risk is equal to 1.468. In turn, we reject the null hypothesis ($H2_0$) and accept the alternative hypothesis ($H2$), which indicates that there is a significant relationship between debt-to-equity and firm risk. There is a positive relationship between debt-to-equity and firm risk, and the result is consistent with both Vătavu (2015) and Tamulyte (2012).

$H3_0$ (null hypothesis): There is no relationship between debt-to-equity and firm tangibility.

The t-value of the firm tangibility variable equals -3.11, and the p-value equals 0.002. The two conditions exist and the coefficient of firm tangibility is equal to -0.2491. Thus, we reject the null hypothesis ($H3_0$) and accept the alternative hypothesis ($H3$), which indicates that there is a significant relationship between debt-to-equity and firm tangibility. Further, there is a negative relationship between debt-to-equity and firm tangibility. This is consistent with Serghiescu and Văidean (2014), Masoud (2014), Alzomaia (2014), Tamulyte (2012), and inconsistent with Cortez and Susanto (2012) and Nasimi (2016).

$H4_0$ (null hypothesis): There is no relationship between debt-to-equity and firm liquidity.

The t-value of the firm liquidity variable equals -12.35 and the p-value equals 0.000. The two conditions exist and the coefficient of firm liquidity is equal to -0.10131. Consequently, we reject the null hypothesis ($H4_0$) and accept the alternative hypothesis ($H4$), which indicates that there is a significant relationship between debt-to-equity and firm liquidity. Furthermore, there is a negative relationship between debt-to-equity and firm liquidity. This result is consistent with Serghiescu and Văidean (2014), Deesomsak et al. (2004), Masoud (2014), Alipour et al. (2015), Tamulyte (2012).

The model seems to fit the data very well: R-squared is 44%, which means that 44% of the variation in the debt-to-equity is explained by these explanatory variables.

Table 7. Multiple regression analysis output (Efficiency)

Variables	Efficiency (Performance)
Constant	2.166
	13.60*
	0.000
Debt-to-equity	-0.1924
	-2.91*
	0.004
Firm size	-0.2448
	-12.72*
	0.000
Firm risk	0.214
	0.88
	0.382
Firm tangibility	0.434
	5.47*
	0.000
Firm liquidity	0.0223
	2.14*
	0.034
R-squared	47.73%
Adj. R-squared	46.50%

*Note: * Significant at the 5% level.*

4.2. Hypotheses testing: Model 2

$H5_0$ (null hypothesis): There is no relationship between performance and debt-to-equity.

The t-value of the debt-to-equity variable equals -2.91 and the p-value equals 0.004. The two conditions exist and the coefficient of debt-to-equity is equal to -0.1924. On that account, we reject the null hypothesis ($H5_0$) and accept the alternative hypothesis ($H5$), which indicates that there is a significant relationship between performance and debt-to-equity. Further, there is a negative relationship between performance and debt-to-equity. The result is consistent with Al-Taani (2013), Titman and Wessels (1988), and Huang and Song (2006) and inconsistent with Dehnavi and Hosseinzade (2013).

$H6_0$ (null hypothesis): There is no relationship between performance and firm size.

The t-value of the firm size variable equals -12.72 and the p-value equals 0.000. The two conditions exist and the coefficient of firm size is equal to -0.2448. Henceforth, we reject the null hypothesis ($H6_0$) and accept the alternative hypothesis ($H6$),

which indicates that there is a significant relationship between performance and firm size. Further, there is a negative relationship between performance and firm size. This result is consistent with Cheng et al. (2010) and Goyal (2013) and inconsistent with Huang and Song (2006).

$H7_0$ (null hypothesis): There is no relationship between performance and firm risk.

The t-value of the firm risk variable equals 0.88 and the p-value equals 0.382. The two conditions are not met; so, we accept the null hypothesis ($H6_0$), which indicates that there is no significant relationship between performance and firm risk. It must be noted that the coefficient of firm risk is equal to 0.214.

$H8_0$ (null hypothesis): There is no relationship between performance and firm tangibility.

The t-value of the firm tangibility variable equals 5.47 and the p-value equals 0.000. The two conditions exist and the coefficient of firm tangibility is equal to 0.434. Henceforth, we reject the null hypothesis ($H8_0$) and accept the alternative hypothesis ($H8$), which indicates that there is a significant relationship between performance and firm tangibility. There is a positive relationship between performance and firm tangibility.

$H9_0$ (null hypothesis): There is no relationship between performance and firm liquidity.

The t-value of the firm liquidity variable equals 2.14 and the p-value equals 0.034. The two conditions exist and the coefficient of firm liquidity is equal to 0.0223. Accordingly, we reject the null hypothesis ($H9_0$) and accept the alternative hypothesis ($H9$), which indicates that there is a significant relationship between Performance and firm liquidity. Moreover, there is a positive relationship between performance and firm liquidity. Finally, the model seems to fit the data very well: R-squared is 48%, which means that 48% of the variation in the debt-to-equity is explained by these explanatory variables.

4.3. Discussions

The results show that firm size, firm risk, firm tangibility, and firm liquidity have a significant effect on the debt-to-equity ratio. This result is consistent with the literature. Since higher firm size encourages the companies to higher the leverage, and the larger tangible assets also require a larger capital to cover those assets. Usually, companies tend to cover those assets by taking loans which will increase the debt-to-equity ratio, and those companies that tend to take more risk always tend to have larger leverage.

It is also important to mention that the debt-to-equity ratio, firm size, firm tangibility, and firm liquidity have a significant effect on DEA efficiency. This is also consistent with the literature, and the only variable that is insignificant to the DEA efficiency is the firm risk. The sample shows that most of the companies with larger size, leverage, liquidity, and more tangible assets tend to be more efficient in managing their resources.

5. CONCLUSION

This study empirically investigated the determinants of debt-to-equity and its impact on the performance of 20 industrial companies listed on the ASE from 2005 to 2015. All industrial companies that the investigation covered have traded in the ASE during the aforementioned years and trading has not been interrupted, merged, or liquidated throughout the period.

A two-step numerical research model was used — DEA and regression analysis. The results of regression analysis used debt-to-equity as the dependent variable and firm size, firm risk, tangibility, liquidity as independent variables. The finding of the study supports the Pecking order theory, trade-off theory, and agency cost theory. Since, the results indicate that, first, there is a significant negative relationship between firm size and debt-to-equity; indicating that firms of greater size use less debt percentage than other small firms. Second, there exists a significant positive relationship between firm risk and debt-to-equity; as an indicator that firms that accept higher risk acquire more debt. Third, there also exists a significant negative relationship between tangibility and debt-to-equity; which is consistent with the Pecking order theory that proposes a negative relationship between short-term debt and asset structure. This is generally owing to the reality that a firm with a rising level of tangible assets could have already adopted a secure source of income; one that supplies it with increasingly internally-generated financial resources. That is in addition to the increased possibility of being able to stay away from utilizing external financing.

There is a significant negative relationship between liquidity and debt-to-equity, which suggests that firms with higher liquidity tend to avoid raising external loan capital. Further, negative relations could possibly set forth that firms that function in these markets finance their operations in accordance with the financing order of the Pecking order theory. Finally, the result indicates that there is a significant negative relationship between debt-to-equity and performance; a significant negative relationship between firm size and performance; an insignificant relationship between firm risk and performance; a significant positive relationship between tangibility and performance, and a significant positive relationship between liquidity and performance.

It is imperative for researchers to analyze the debt-to-equity structure, identify the factors that affect the debt-to-equity structure of companies, and understand the effect of such percentage on companies' performance. In addition, it is required to understand the impact of structure on the companies' efficiency by understanding the best debt-to-equity ratio that is recommended per sector.

We faced some challenges in finding a large set of companies that have available data as per the selection criteria, and we recommend other researchers cover more sectors and periods. All in order to provide more insights on the best capital structure and the impact of other factors on this structure and firms' efficiency.

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