

A meta-analysis: capital structure and firm performance

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Capital
structure and
firm
performance

111

Abstract

Purpose – The paper aims at providing insights on the relationship between capital structure and performance of the firm by employing meta-analytical approach to obtain a synthesized result out of controversial studies as well as the sources for such inconsistency.

Design/methodology/approach – Using secondary data, the analysis is divided into two main parts with concerns to the overall strength of the relationship, the effect size and the potential paper-specific characteristics influencing the magnitude of impacts between leverage and firm performance (moderators of the relationship). Overall, a total number of 32 journals, reviews and school presses were selected besides online libraries and publishing platforms. There were 50 papers with 340 studies chosen from 2004 to 2019, of which data range from 1998 to 2017.

Findings – Using Hedges *et al.* (1985,1988), descriptive and quantitative analysis have been conducted to confirm that corporate performance is negatively related to capital decisions, which inclines toward trade-off model with agency costs and pecking order theory. The estimation induces rather small effect size that implies sufficiently large sample size to be effectively investigated. In terms of moderator analysis, random-effects meta-regression models of three different techniques are used to increase the robustness in research findings, showing statistically significant elements as publication status, factor of industry and proxy of firm performance.

Originality/value – This paper is one of the first papers presenting meta-analysis in capital structure and performance for two languages, Vietnamese and English, providing a consistent result with previous worldwide papers.

Keywords Capital structure, Firm performance, Meta-analysis, Moderators

Paper type Research paper

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1. Introduction

Capital structure of the firm, as defined by Baker and Martin (2011), is the mixture of debt and equity that the firm employs to finance its productive assets, operations and future growth. It is a direct determinant of the overall costs of capital and contributes to the firm's total level of risks. The choice of different proportions of debt among mixed financing resources can impose major influences on the firm value, and thus on the wealth of the shareholders (Baker and Martin, 2011). Since capital decision is one of the most important elements in corporate finance, it has attracted considerable concern of both academics and practitioners over the past few decades.

At the beginning of its theory development, capital structure was convinced to be irrelevant to the performance of corporations, as suggested by Modigliani and Miller (1958, 1963).

However, given the existence of an imperfect market's conditions and behaviors, the concept of optimal capital structure emerges with the proposal of trade-off theory that integrates the effect of corporate taxes, financial distress and agency problems. On the other hand, the recognition of information asymmetry also leads to the appearance of signaling hypothesis and the pecking order theory, which neglect the term of an optimal leverage. Each theory, despite



concerning the same relation of capital structure and firm performance, suggests quite a divergent collection of outcomes toward the sign of impacts between the two subjects of interest.

Myriad empirical studies have been conducted to confirm if the market is more inclined to the most suitable theories, but none of them has come close to a consensus. It is due to the fact that practices observed from the real marketplace are rather sophisticated and influenced by many relevant factors. Since the final outcomes of each study remain fractional and inconsistent, the need for a generalized conclusion comes into consideration as one of the most fundamental issues. Moreover, conventional research tends to focus on answering whether a significant relation between two variables exists, rather than reporting how much influence they have on one another, which underestimates the true value that a research is expected to contribute.

Originally used in medical study, meta-analysis has become more widespread in the field of finance and economics. However, these papers mostly work on the determinants of capital structure or firm performance separately and have rarely been investigated under the view of a relationship. Besides, in addition to the mutual relation between capital structure and firm performance, other accountable factors such as industry, business strategy of the firm or even paper-specific characteristics of each study can also be potential sources of controversial results, yet they have not been evaluated with appropriate level of emphasis. In fact, these third elements, besides providing insights on how the relationship of interest changes under different contexts, also offer solutions for the improvement in research design and sampling technique if they are properly scrutinized.

In general, the study is expected (1) to determine the strength of relationship between leverage and performance of the firm, both in terms of direction and quantified intensity, and (2) to explore possible factors that influence the magnitude of relationship between capital structure and firm performance.

The paper is divided into seven major sections. The first part of *introduction* will provide background knowledge and general idea of how the analysis manages to address the problem of controversial results in a coherent and logical way. Next, in *literature review*, five major theories of capital structure will be discussed to demonstrate the possible influence of leverage on the firm value. Around 15 empirical researches will be summarized, based on which hypotheses of this paper will be developed for future testing, including one on the relationship of interest and seven others concerning the moderating effect of potential third factors. The *methodology* is then explained with the basis of meta-analytical approaches as well as data collection and processing methods. After that, *descriptive analysis* will classify different groups of paper-specific features and exhibit descriptive statistics of the regression outcomes from the selected studies. In the fifth section of *quantitative analysis*, the strength of relationship between capital structure and firm performance, or the overall effect size, will be measured and combined according to the standardized framework proposed by Hedges and his colleagues. Then, *moderator analysis* will investigate the potential sources of heterogeneity among individual studies by performing different meta-regression techniques. It helps to explore possible moderating elements that impose certain influence on the magnitude of effect from leverage to the firm value; thus, the second purpose of this research will be fulfilled by this section. Besides, further test for small-study effect will also be conducted as a complementary analysis to examine if the quality of data implies any probability of the bias problem. Finally, significant remarks on the empirical findings will be summarized in the *conclusion* along with several limitations of the study and future opportunities of research.

2. Literature review

2.1 Theoretical framework

Modigliani and Miller first proposition (1958). This research is among the pioneers attempting to unravel the relationship between capital structure and firm value. Their

proposition, usually referred to as *MM theorem*, was first introduced in 1958, and it brought up the most intriguing question about the relevance of funding decisions toward corporate performance. In particular, they argue that any changes in the current proportions of debt and equity cannot affect the value of the firm, which means no capital structure is better or worse, and firm values remain irrelevant to different levels of leverage (Modigliani and Miller, 1958).

Modigliani and Miller alternative propositions (1963). Using tax-deductible expenditure, the appearance of interest promotes lower tax payments and thus improves the firm's general cash flows (Miller and Modigliani, 1963). Indeed, the two economists also discovered that the firm value is now positively related to financial leverage, which implies that corporations are fully capable of maximizing their values by raising their debt levels.

Trade-off Theory. states that the capital decision of one firm involves a trade-off between the tax benefit of debts and the costs of financial distress (Kraus and Litzenberger, 1973).

When adopting the trade-off theory, each firm tends to set its own targeted debt-to-equity ratio and strives to achieve the expected optimum which varies with the characteristics of different firms (Myers, 1984)

Agency Theory. proposed by Jensen and Meckling (1976) and Myers (1977) investigates the influence of capital structure under a new perspective of corporate governance. Since the theory is developed on the basis of previous models, it shows consistent results with the trade-off theory. In general, agency problems involve the participation of three parties including managers, shareholders and creditors.

Agency problems between shareholders and managers. The first type of conflict is rooted when the managers own less than 100% of the share of the firm's assets, which induces less motivation behind their acts to maximize the firm value for shareholder's best interest (Jensen and Meckling, 1976) With a low level of debt, managers will own more freedom to spend the firm's free cash flows, and hence they easily take on low-return projects and acquire unnecessary physical assets to enlarge the firm size, which is believed to reflect their own reputation. For such reasons, managers increase the *agency costs of equity*, which is detrimental to the firm performance. On the contrary, if the firm is funded by higher amount of leverage, the commitment to fulfill interest payments leaves managers with less freedom to distribute the cash flows; therefore, they are required to be more efficient in choosing investments and generally improve the firm performance.

Agency problems between shareholders and creditors. The second conflict arises when two groups of investors prefer different levels of risk-taking behaviors. In particular, shareholders may have the incentive to either take considerably risky projects or move toward underinvestment (Ross *et al.*, 2013; Westerfield and Jaffe, 2013). Regarding the former motive in which shareholders take part in high-risk investments, they shall receive extra return if the projects succeed and share losses with their counterpart in any case of failure (Jensen and Meckling, 1976). Concerning the second incentive, if a firm owns excessive amount of leverage, the significant probability of bankruptcy would discourage shareholders to take on new investments despite positive NPVs; hence, the firm becomes underinvested (Myers, 1977).

Pecking Order Theory. is an alternative to the trade-off model that declares a negative relationship between firm's performance and its decision of financing. There are two rules as proposed by the pecking order (Myers, 1984): (1) use internal financing and (2) issue safer securities first. In other words, the preference of financial instruments shall be prioritized as follows: internally generated funds, debt and equity. The driving force behind this arrangement generally stems from the problems of information asymmetry. According to Ross *et al.* (2013), in some cases where the managers wish to embark on a risky project but the lenders, due to discrepancy of information, stay rather optimistic about the venture, the issuance of debt would be much likely to be overpriced just as the equity issuance. It leads to a

major problem in which investors eventually recognize the pattern of issuing decisions for both equity and debt whenever they are overvalued under the managers' perspective. As a result, any public offering can then become less than a success since this phenomenon creates a never-ending cycle of skepticism between investors and managers of the firm.

Signaling Theory. is proposed by Ross (1977) in which the choice of debt-to-equity ratio is independent of the optimum concept and rather represented by the willingness of a firm in sending certain messages to the investors. Profitable firms sometimes attempt to push up the stock price by excessively increasing debt over its optimal level and mislead the market to believe in its inflated growth opportunity in the future. Indeed, they believe that the extra cost of issuing debts shall prevent less profitable firms from taking advantages of higher leverage as compared to those with better performance, despite the managers' attempt to fool the public (Ross *et al.*, 2013). Additionally, Myers and Majluf (1984) propose the tendency in which managers are rather reluctant to issue equity when it is believed to be undervalued; consequently, investors tend to perceive issuance of stocks as a bad signal, assuming that managers offer equity to the public only if it is fairly priced or overpriced. In short, the relationship between leverage and firm performance is found positive under the signaling theory.

Among the five theories, only MM and Signaling support the positive relationship between leverage and firm performance, while the other three theories – Agency, Trade-off and Pecking order – support the negative relationship.

2.2 Empirical research

As a majority of theoretical frameworks provide equivalently credible arguments, it requires remarkable effort and profound knowledge to convince that one of them should be more competent and appropriate than the others, not to mention the influence of an inefficient market and different aspects of behavioral finance. For such reasons, myriad of empirical researches have been conducted to obtain statistical conclusions by representative observations in the market. Since the number of studies is clearly substantial, Table 1 in Appendix only includes several recently published articles to examine their main ideas and empirical results. In our knowledge, the paper of Hang *et al.* (2018) is the first publication on meta-analysis of factors influencing the capital structure, and a bit different from ours is the relationship between firm leverage and performance.

2.3 Hypothesis development

As presented in Table 1 in Appendix, the empirical results are quite diverse when the positive, negative and insignificant influences are all recorded, with only 15 selected research papers published recently. Similar to different theories, the divergence in empirical evidences also causes controversy related to the direction of the relationship. However, it is apparent that negative outcomes dominate, with prevailing explanations supported by agency problems, trade-off model and pecking order theory. Thus, with the aim to answer the first research question about the systematic impact of leverage on a firm's performance, the first hypothesis is proposed as follow:

H1. There is a negative relationship between capital structure and firm performance.

Regarding the second purpose of this meta-analysis, in general, the variation in each study can be traced to different qualitative features involving research designs, sampling methods or analytical techniques. As can be seen from Table 2, many outcomes are reported with specific notes on the three elements that potentially influence the final conclusion on the relationship, such as the choice of indicators for firm performance, the condition of sample firms being listed or the relevance of business strategies and industrial factors accounted in

Moderators on the relationship		Hypothesis	Description
Capital structure – Firm performance	H1	There is a negative relationship between capital structure and firm performance	
Publication status	H2	A significant effect of publication status as a moderator on the relationship between capital structure and firm performance	
Country development	H3	A significant effect of country development on the relationship between capital structure and firm performance	
Listed status	H4	A significant effect of listed status on the relationship between capital structure and firm performance	
Industry	H5	A significant effect of industry on the relationship between capital structure and firm performance	
Business strategy	H6	A significant effect of business strategy on the relationship between capital structure and firm performance	
Proxy of firm performance	H7	A significant effect of proxy of firm performance on the relationship between capital structure and firm performance	
Econometric method	H8	A significant effect of econometric method on the relationship between capital structure and firm performance	

Table 1. Hypothesis testing on the relationship between leverage and firm performance

Publication status	Number of studies	%
Yes	174	71.0
No	71	29.0

Table 2. Number of studies categorized by publication status

each study. Indeed, [Sánchez-Ballesta and García-Meca \(2007\)](#) suggest that the contextual characteristics of analysis, proxies for firm value, econometric methods and types of firm can contribute further insights to explain the inconsistency in the prevailing impact of capital structure on the firm performance. Since the paper is expected to explore potential sources of heterogeneity that lead to divergent results, based on the empirical evidence discussed above, seven categorical characteristics of each paper are chosen to be scrutinized as potential moderators on the relation between firm value and leverage, namely: (1) *publication status*, (2) *country development*, (3) *company's listed status*, (4) *industry factor*, (5) *business strategy*, (6) *proxy for firm performance* and (7) *econometric method for analyzing*. In short, all the hypotheses included in this paper are summarized in [Table 1](#).

3. Research methodology

3.1 Research design

3.1.1 Meta-analysis. *Meta-analysis*, as explained by [Borenstein et al. \(2011\)](#), refers to the statistically synthesized results from a series of studies collected through a methodological procedure. According to [Glass \(1976\)](#), meta-analysis can be considered as “the analysis of analyses” where individual researches are gathered with the aim to integrate their knowledge and findings. In particular, meta-analysis allows separate empirical outcomes of different papers to be aggregated and compared after being transformed into one common metric called the *effect size*.

3.1.2 Meta-regression. Besides the purpose of obtaining a generalized empirical evidence on the relation of two variables, meta-analysis can also be advanced into *meta-regression*, or

meta-regression analysis, which performs closer scrutiny on the third elements that potentially influence the strength of relationship.

According to Higgins and Green (2011), meta-regression is quite similar in essence to simple regressions where a dependent variable is forecasted by one or more explanatory variables. However, meta-regression should be distinguished from simple regressions by two means. Firstly, the weight of each study is assigned based entirely on the precision of its effect estimates, in which larger studies tend to have stronger influence as compared to the smaller ones. Secondly, the existence of residual heterogeneity that cannot be explained by independent variables should be recognized and allowed in the analysis, giving rise to the term “random-effects meta-regression” (Thompson and Sharp, 1999).

3.1.3 Generalized models and assumptions. According to Field and Gillet (2010), meta-analysis can be conceptualized using two models of fixed and random effects. The fixed-effect model assumes that selected studies are sampled from only one population of which the average effect is fixed and implies homogeneity among individual effect sizes. Alternatively, random-effect model proposes the existence of heterogeneity by which the true effect size varies from study to study. Let us assume that a study of a total n studies produces an estimate, y_i , for the effect of interest and a standard error, σ_i . The basis of meta-analysis as well as meta-regression is presented below, with a simplified mathematical demonstration (Harbord and Higgins, 2008).

- (1) *Fixed-effects meta-regression* is the extension of fixed-effect meta-analysis where the mean effect, θ , is developed into a linear predictor, βx_i , such that.

$$y_i = \beta x_i + \epsilon_i, \text{ where } \epsilon_i \sim N(0, \sigma_i^2), \beta \text{ is a } (k \times 1) \text{ vector of coefficients and } x_i \text{ is a } (1 \times k) \text{ vector of } k \text{ covariates in study } i.$$

- (2) *Random-effects meta-regression*, similarly, is extended from the random-effects meta-analysis with consideration of the covariates.

$$y_i = \beta x_i + u_i + \epsilon_i, \text{ where } u_i \sim N(0, \tau^2) \text{ and } \epsilon_i \sim N(0, \sigma_i^2).$$

3.2 Data selection method

3.2.1 Data collection. The process of collecting and evaluating data for a meta-analysis is of critical importance since it is one of the most significant factors that can contribute to the analytical success. Overall, a total number of 32 journals, reviews and school presses were selected [1] besides online libraries and publishing platforms, namely, Elsevier, JSTOR, ResearchGate, Wiley, SSRN and Springer. There were 50 papers with 340 studies chosen from 2004 to 2019, of which data ranged from 1998 to 2017.

3.2.2 Data evaluation and final sample size. After the first stage of massive data collection, four additional standards were established as predetermined requirements for the following screening procedure.

First of all, the general search for papers on relationship between capital structure and firm performance leads to two ways of defining main dependent variables where a minority of 7.4% choose leverage ratios and the other 92.6% choose firm value indicators. While there is no threshold on the number of studies needed for a meta-analysis (Pigott and Terri, 2012), it remains more preferable to keep the data collected at its potential maximum.

Secondly, proxy for firm value can be divided into two main groups: accounting-based measures including return on asset (ROA), return on equity (ROE) and market-based ratio such as Tobin's Q.

Thirdly, further steps of data processing require the provision of at least two following figures: (1) beta coefficients of regression, and (2) t -statistics or p -value, which means studies without these numbers are also excluded.

Lastly, statistically significant outcomes tend to be utilized repeatedly in multiple works of the same authors under different forms such as dissertations, working papers and journal articles. At the end of the screening process, the final data officially consist of 34 papers which propose 245 studies served as observations for this meta-analysis. The time period also changed, as it now covers researches during 2012–2019, with a data set dated from 2000 to 2017.

4. Descriptive analysis

4.1 Descriptive analysis of paper-specifics

Since the purpose of meta-analysis is to examine the effect sizes as well as the potential impact of other qualitative characteristics on the intervention effects, it is essential to take a look at the descriptive summary of these paper-specific data.

As stated in [Table 2](#), the data collection takes into account all papers with no regard to publication status. Consequently, 71% of studies were published as review and journal articles, while 29% were not, since they are either graduate dissertations or master thesis (See [Table 3](#)).

Out of 245 studies, 17.1% analyze the relationship between capital structure and firm performance by classifying each group of firms by the industry that they are operating in. For the remaining researches, external environments such as industrial factors are neglected during analysis (See [Table 4](#)).

In terms of firm value indicators, number of studies employing accounting measures (ROA, ROE) amount up to 73.1% compared with 26.9% using market ratio (Tobin's Q). The prevalence of accounting-based indices is nearly three times higher than its counterpart, which means ROA and ROE are generally more favorable as representatives for firm performance than Tobin's Q (See [Table 5](#)).

Regarding statistical approaches, pooled OLS is a dominant method with the use of nearly 41% of the selected papers. Next, fixed-effects model ranks second in popularity with 30.2%, closely followed by its counterpart. Meanwhile, a modest 3% of the studies use GMM as their preferable method.

Factor of industry	Number of studies	%
Yes	42	17.1
No	203	82.9

Table 3.
Number of studies considering influence of industry

Proxy	Number of studies	%
Accounting-based measures (ROA, ROE)	179	73.1
Market-based measure (Tobin's Q)	66	26.9

Table 4.
Number of studies categorized by proxies of firm performance

	Pooled OLS	FEM	REM	GMM
Number of studies	100	74	64	7
%	40.8	30.2	26.1	2.9

Table 5.
Number of studies categorized by statistical methods

4.2 Descriptive analysis of study results

The development of meta-analysis is to provide a comparison and synthesis on the findings of individual researches; hence, it is no surprise to see inconsistent results collected from 245 separate studies. Table 6 shows a summary of conclusions according to their statistical outcomes at 5% level of significance.

As illustrated in Table 6, negative relationship between capital structure and firm performance seems to be a prevalent result, accounting for nearly 50% of the consequences, whereas the proportions of positive and insignificant outcomes similarly vary around 26%.

Overall, Table 7 has clearly shown the dominance of negative relation between leverage and firm performance. The values of both mean and median are lower than 0, and its 95% confidence interval within the range of [-1.01, -0.287] only confirms the prevailing frequency of an adverse relationship.

Conclusion 1. Descriptive analysis of study results supports H1: There is a negative relationship between capital structure and firm performance.

5. Quantitative analysis: overall effect size

Quantitative analysis is a crucial part of meta-analysis which generally concerns the determination of effect sizes. With regard to the rapid increase in the total number of studies and the evolution of statistics means, Gene Glass, an American statistician and researcher who originated the term “meta-analysis,” believed that “statistical significance is the least interesting thing about the results” as they should be able to answer not just the question of whether or not a relationship between two variable exists, but rather how strong the relation can be.

In general, the following section of quantitative analysis will cover two main parts, described below.

5.1 Hedges et al.’s method (1985,1988)

Based on the framework of Hedges *et al.*, effect sizes are represented by the Pearson “r” correlation coefficient of individual studies, which is appropriate and widely used for comparing results of two continuous variables.

The procedure from analyzing to interpreting the overall effect size is demonstrated in Figure 1.

In general, each study is expected to produce one Pearson “r” correlation which will be transformed into its z-scale statistic by Fisher’s method. Then, the combined effect size represented by z-score is obtained and converted back to receive the overall correlation for further interpretation (Borenstein and Hedges, 2011; Higgins and Green, 2011).

Table 6.
Study results on the relationship between leverage and firm performance

	Positive effect	Negative effect	Insignificant effect
Number of studies	63	117	65
%	25.7	47.8	26.5

Table 7.
Descriptive statistics of beta coefficients for the effect of capital structure

Mean	-0.649
Min	-17.004
Standard deviation	2.872
Confidence interval	[-1.01, -0.287]

5.1.1 *Standardized effect sizes.* It is noted that the values of “ r ” obtained from separate papers remain dependent on different research designs and not yet synthesized; thus, they are not directly interpretable. It explains why Pearson “ r ” should be transformed into a standardized measure of *Fisher score* “ Zr ” before combining the average true effect. According to Hedges and Olkin (1985), Rosenthal (1991) and Hedges and Vevea (1998), the transformation of “ r ” into “ Zr ” is proved to be capable of correcting skewness problems in the distribution of Pearson correlation coefficient. This statement is also supported by prior research of Silver and Dunlap (1987) who also observed a less distorted distribution in “ r ” with the complement of Fisher standardization.

One noticeable problem detected during data collection is that not all studies in management and finance provide Pearson “ r ” correlation in their analysis (Rocca, 2010). Fortunately, Cooper and Hedges (1994) suggested a way of retrieving “ r ” using the t -Students as illustrated by Eqn 1.

$$r_i = \sqrt{\frac{t_i^2}{t_i^2 + df_i}} \tag{1}$$

where r_i is the correlation coefficient of study i ; t_i is the t -statistic of beta coefficients of study i ; df_i is the degree of freedom that equals to $n - (k' + 1)$; n is the sample size and k' is the number of independent variables of study i .

Next step is to convert r_i into Fisher Z -score by Eqn 2 (Field and Gillett, 2010).

$$Zr_i = \frac{1}{2} \ln\left(\frac{1 + r_i}{1 - r_i}\right) \tag{2}$$

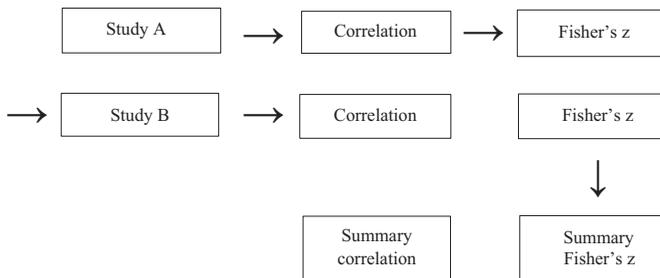
where Zr_i is the standardized Z -score of the corresponding r_i in study i ; r_i is the correlation coefficient of study i .

5.1.2 *Weights under fixed-effects model.* The first approach is based on a model which states that if the sample size is large enough, residual errors will converge toward 0 (Hedges and Olkin, 1985), thus indicating an increase in the level of accuracy as more subjects are added to the sample of interest:

$$w_i = n_i - 3 \tag{3}$$

where w_i is the weight of study i among a total of k studies; n_i is the sample size of study i .

In the second approach, it is recalled that fixed-effects model assumes one true effect size θ for every study, and its only source of error is reflected in the within-study variances, σ_i^2 . In particular, with a smaller standard error, the estimation of effect size is appraised as



Source(s): Hedges et al. (1985, 1998)

Figure 1. Procedure to analyze overall effect size on correlation.

more rigorous. Consequently, it leads to Eqn 4, which simply shows the reverse relation between within-study variances and weights allocated to selected studies (Hedges and Vevea, 1998).

$$w_i = \frac{1}{\sigma_i^2} = \frac{1}{SE_i^2} \tag{4}$$

where w_i is the weight of study i among a total of k studies; SE_i is the standard error of the estimate in study i .

5.1.3 *Weights under random-effects model.* While fixed-effects model allows no heterogeneity, random-effects model does the exact opposite, which results in the appearance of second variance component, τ^2 , during the computation of weights. Accordingly, the value of between-study variance must be incorporated as illustrated in Eqn 5 (Hedges and Olkin, 1985, Hedges and Vevea, 1998).

$$w_i = \frac{1}{\sigma_i^2 + \tau^2} \tag{5}$$

The estimation of between-study variance, τ^2 , proposed by Hedges and Olkin (1985), is provided below.

$$\tau_{HO}^2 = \max \left\{ 0, \frac{1}{k-1} \sum (y_i - \bar{y})^2 - \frac{1}{k} \sum \sigma_i^2 \right\} \tag{6}$$

where k is the total number of studies; y_i is the effect size in study i ; \bar{y} is the average effect size of k studies; σ_i^2 is the within-study variance in study i .

However, this method only works when τ^2 is non-negative. In practice, several researches have shown the possibility of negative value of τ^2 . It is then set back to 0 according to the rule stated above and seemingly denies the existence of heterogeneity. To promote a more effective measure, Chung *et al.* (2013) suggested the use of DerSimonian and Laird's (1986) estimate that employs method of moment estimator as follows:

$$\tau_{DL}^2 = \frac{\sum_i s_i^{-2} (y_i - \hat{\mu})^2 - (n-1)}{\sum_i s_i^{-2} - \sum_i \frac{s_i^{-4}}{s_i^{-2}}} \tag{7}$$

where s_i is the standard error of the estimate [2] in study i ;

y_i is the effect size in study i ;

n is the total number of studies; $\sum y_i/s_i^2$

$\hat{\mu}$ is defined by the formula $\hat{\mu} = \frac{\sum y_i/s_i^2}{\sum 1/s_i^2}$

5.1.4 *Overall effect size.* Eqn 8 provides the calculation of “ Zr ” as suggested by Hedges and Olkin (1985) and Hedges and Vevea (1998), which takes into account the distribution of the weights:

$$\bar{Zr} = \frac{\sum_{i=1}^k w_i Zr_i}{\sum_{i=1}^k w_i} \tag{8}$$

where \bar{Zr} is the weighted mean of effect sizes from k studies;

Zr_i is the standardized effect size of study i ;
 w_i is the corresponding weight of study i among a total of k studies.
 The standard error for weighted average “ Zr ” is calculated as below.

$$SE(\bar{Z}r) = \sqrt{\frac{1}{\sum_{i=1}^k w_i}} \tag{9}$$

where $SE(\bar{Z}r)$ is the standard error of the weighted mean of effect sizes from k studies;
 w_i is the corresponding weight of study i among a total of k studies.

After achieving the mean value of “ Zr ,” it must be converted into its correlation form for final conclusions on the strength of relationship between capital structure and firm performance. [Borenstein et al. \(2011\)](#) introduced the conversion formula for “ r ” in the following equation.

$$r_{\text{overall}} = \frac{e^{(2 \times \bar{Z}r)} - 1}{e^{(2 \times \bar{Z}r)} + 1} \tag{10}$$

where r_{overall} is the overall effect size as measured by correlations;

$\bar{Z}r$ is the weighted mean of effect sizes from k studies.

For the interpretation of results, [Cohen \(1977\)](#) proposed the “rules of thumb” as [Table 8](#).

5.2 Discussion of findings

Given all essential elements, the calculation of overall effect size (ES) between capital structure and firm value was performed on MS Excel spreadsheets in several different ways with the aim to provide diverse perspectives on the same subject. The main statistics are summarized in [Table 9](#).

$ r $	Magnitude of effect	Sample size needed
$ r \cong 0.1$	Small	452
$ r \cong 0.3$	Medium	72
$ r \cong 0.5$	Large	28

Source(s): [Cohen \(1977\)](#)

Table 8.
 Benchmarks for the magnitude of effect and suggested sample size

Approach	Standardized overall ES	Standard error	Confidence interval (95%)	Q-test	Number of studies
(1) Mean pearson “ r ”	-0.0903	0.5030	[-0.0270, -0.1536]		245
(2) Unweighted Zr	-0.0904	0.7142	[-0.0005, -0.1802]		245
(3) Unweighted Zr (statistically significant studies)	-0.1027	0.8224	[-0.2237, 0.0183]		180
(4) Weighted Zr (FEM – inverse variance weighted)	-0.0326	0.00005	[-0.0326, -0.00007]	0.0000	245
(5) Weighted Zr (FEM – sample size weighted)	-0.0105	0.0006	[-0.0105, -0.00008]	0.0000	245
(6) Weighted Zr (REM)	-0.0326	0.00005	[-0.0326, -0.00007]	0.0000	245

Table 9.
 Descriptive statistics of standardized overall effect sizes

It is evident that the combined effect sizes under z-scale, despite standardized or unstandardized measurements, are all negative. Five out of six 95% confidence intervals stay below zero, except for case (3) where the upper limit of confidence surpasses this value. However, the third method only accounts for unweighted outcomes from statistically significant studies.

Interestingly, the confidence interval under random-effects model is closely similar to that of fixed-effects model weighted by the within-study variances, while it is generally expected to be larger. However, as compared to method (5) where “Zr” is weighted based on adjusted sample size, the random-effects approach indeed provides a wider interval, hence showing a more conservative result (See Table 10).

Since the absolute values of all effect sizes are under 0.1, the influence of capital structure on firm performance does exist but is relatively small according to Cohen’s “rules of thumb” (1977).

Conclusion 2. Quantitative analysis of overall effect size confirms H1: There is a negative relationship between capital structure and firm performance.

6. Moderator analysis

While the main interest of a simple meta-analysis is the combination of an overall effect size, moderator analysis is rather an extension which performs meta-regression to investigate relevant factors that may be influential to the relationship of interest (Rocca, 2010). In particular, the magnitude of impact measured between two variables is expected to diverse from study to study, partially due to the differences in paper-specific characteristics, such as clinical diversity and methodological diversity (Harbord, 2010). By the use of meta-regression, the amount of statistical heterogeneity among empirical results can be examined to further understand how much of the variation stems from one or more elements of paper-specifics (Thompson and Higgins, 2002).

6.1 Specification of variables and methods

6.1.1 *Moderating variables.* In moderator analysis, the standardized effect size of leverage on firm performance, “Zr”, becomes the dependent variable since it represents the magnitude of impacts and is sensitive to different strength across studies (Rocca, 2010). Meanwhile, other paper-specific features that potentially induce controversial results should be chosen as the explanatory variables (Wolf, 1986; Rosenthal, 1991). In particular, the examination of heterogeneity utilizes dichotomous covariates and subgroups of observations according to various categorical characteristics. Since dummy variables are employed in the regression, the coefficients would emphasize on the differences of effect sizes between subgroups in comparison with another nominated subgroup of which all dummy variables are assigned to 0 (Higgins and Green, 2011). We use the moderator variables as dummy variable. For example, D-publication = 1 if the study is published, and = 0 otherwise. Theses moderating variables are based on hypotheses H2-H8.

Approach	Mean effect size	Magnitude of effect
(1) Unweighted Zr	-0.0902	Small
(2) Unweighted Zr (statistically significant studies)	-0.1023	Small
(3) Weighted Zr (FEM – inverse variance weighted)	-0.0326	Small
(4) Weighted Zr (FEM – sample size weighted)	-0.0105	Small
(5) Weighted Zr (REM)	-0.0326	Small

Table 10.
Overall effect sizes by correlation

6.1.2 *Econometric method.* Many researchers suggest the use of *random-effects model* as the proper method for meta-regression, such as [Hedges and Olkin \(1985\)](#), [Cooper and Hedges \(1994\)](#) and [Hedges and Vevea \(1998\)](#). This method considers both within-study variance, σ_i^2 , and between-study variance, τ^2 , which means two sources of errors due to two levels of sampling are addressed simultaneously. Furthermore, in contrast to fixed-effect model that assumes homogeneity across studies, random-effects model accepts “residual heterogeneity,” which is the between-study variance component that cannot be explained by the covariates. In conclusion, for the reasons above, *random-effects meta-regression* is selected as the appropriate method for moderator investigation.

In fact, the default estimation method for τ^2 by “metareg” is the restricted maximum likelihood (REML) since this model takes into account the problem of autocorrelation and works well with unbalanced or correlated data ([Rocca, 2010](#)). Hence, it is suggested by both [Thompson and Sharp \(1999\)](#) and [Viechtbauer \(2005\)](#), who also perform comparison among methods and conclude that REML is generally the preferable approach in meta-regression. Therefore, based on the aforementioned opinions, REML is decided to be the benchmark model for this moderator analysis. However, two other options of moment-estimator and empirical Bayes will also be included to increase the robustness of investigation.

6.2 Regression models

6.2.1 *Initial regression models.* After performing “metareg” command in Stata 14, the initial regression model uses eight independent variables such as D_publication, D_development, D_listed, D_industry, D_strategy, D_proxy, D_ols, D_fem and D_rem. In general, the moderating effect on the relationship between capital structure and firm performance is the joint contribution of *publication status*, *factor of industry* and *proxy of firm performance*. Hence, three hypotheses with respect to these moderators, including H2, H5 and H7, are statistically supported, while the remaining statements are rejected.

6.2.2 *Final regression models.* The final models are conducted with the participation of three significant variables discovered in previous section, including D_publication, D_industry and D_proxy.

In comparison with [Table 11](#), all values of the *adjusted R²* generally increase, especially in the case of moments method where it turns from an abnormal negative figure to a positive number despite remaining extremely low (0.32%), confirmed together with the *F*-statistics, which implies a considerable rise in overall significance of each model.

On the other hand, *VIF test* shows remarkable reduction in value for all regressors, and hence produces smaller mean VIF at only 2.02, much below 10, confirming the absence of multicollinearity in the regression.

Variable	REML	Empirical Bayes	Method of moments	VIF
D_publication	-0.2703 (0.002)**	-0.2707 (0.001)***	-0.2748 (0.002)***	2.06
D_industry	0.2743 (0.009)***	0.2744 (0.006)***	0.2928 (0.005)***	1.39
D_proxy	-1.2284 (0.000)***	-1.2295 (0.000)***	-1.2705 (0.000)***	2.6
Constant	0.9474 (0.000)***	0.9483 (0.000)***	0.9742 (0.000)***	
Observations	245	245	245	
Adj. R-squared	53.61%	53.86%	0.32%	
F-statistics	84.21	93.44	101.02	
F-test (p-value)	0.000	0.000	0.000	
I ² _{res}	99.99%	99.99%	99.99%	

Source(s): Author’s calculation (2019)

Table 11.
Random-effects meta-regression final results

Meanwhile, no change is observed in the index of variability, I^2 . It is understandable since the proportion of variation due to between-study variance is independent of the moderators taken into account.

7. Conclusion

As indicated in the Introduction, the paper is expected to answer the following research questions: What is the overall effect size between capital structure and firm performance?

In particular, two analyses are included to address the first inquiry: a descriptive analysis to predict the sign that should be expected from the relationship of interest, and a standard meta-analysis, or quantitative analysis, to standardize individual outcomes and estimate the overall effect size that leverage imposes on the firm performance. These two approaches are employed to test Hypothesis 1 which states that there is a negative relationship between the two variables of concern.

At first, the descriptive analysis of study results has clearly shown the number of studies proposing negative outcomes dominate those with positive and insignificant conclusions. Hence, $H1$ is initially supported. Consequently, based on Hedges and his colleagues' framework, the quantitative analysis of the overall effect size is conducted, which produces confidence intervals with the upper limits generally below 0. Thus, as a matter of fact, values of the mean effect size are negative despite the use of standardized or unstandardized methods, fixed-effects or random-effects models. The consistent results statistically confirm $H1$, and possibly imply the prevailing relevance of trade-off theory with agency costs as well as the theory of pecking order in financial practices. In addition, Cohen's "rule of thumbs" (1977) suggests that the combined effect between capital structure and firm performance is relatively small, which does not mean it is insignificant in the real market, but rather recommends future research concerning this subject affords a sufficiently large sample size of 452 participants to investigate the underlying impacts in the most effective way. In this part, Q -test for homogeneity is also performed, and the result indicates the existence of heterogeneity across studies, which emphasizes the need of meta-regression for the next question to obtain appropriate answers.

7.1 Moderator analysis confirms the following hypotheses:

- $H2$. There is a negatively statistically significant effect of publication status as a moderator on the relationship between capital structure and firm performance.
- $H5$. There is a positively statistically significant effect of industry as a moderator on the relationship between capital structure and firm performance.
- $H7$. There is a negatively statistically significant effect of proxy of firm performance as a moderator on the relationship between capital structure and firm performance.

The analysis of the paper still encounters some limitations. Firstly, besides small-study effects, the concept of publication bias in meta-analysis also refers to many other problems as well, including bias during the process of data collection. In fact, all the studies collected are either in English or in Vietnamese, indicating a language-bias issue. Furthermore, they are completely free of charge due to financial capability, which implies the possibility of selection bias in which the collection of data is dependent on free academic resources.

Secondly, the estimation of effect sizes in quantitative analysis requires the presence of t -statistics. However, after the evaluation of data, 30 studies were excluded due to zero p -values, which make it impossible to infer the corresponding t -statistics by all means. In other words, 30 studies with statistically significant results were omitted from the analysis.

Notes

1. Please refer to [Table A1](#) for the list of journals, reviews and university presses originally collected.
2. Note that $s_i^{-2} = 1/s_i^2$ and $s_i^{-4} = 1/s_i^4$.

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Appendix 1



Paper	Period	Scope	Relationship	Explanation
Mehmood <i>et al.</i> (2019)	2004–2017	520 manufacturing firms from 4 countries in South Asia (Pakistan, India, Sri Lanka, Bangladesh)	(1) Mixed results, mostly negative with respective to different countries and 3 performance indicators (ROA, ROE, Tobin's Q)	Agency theory
Tran <i>et al.</i> (2017)	2010–2014	130 joint stock companies in Hue, Vietnam	(1) Negative results between leverage and 3 measures of firm performance (ROA, ROE, EPS)	Trade-off theory and agency theory
Nguyen and Đàng (2017)	2007–2014	All listed companies on Ha Noi and Ho Chi Minh City stock exchange markets, Vietnam	(1) Negative result between leverage and ROA	Information asymmetry
Afza and Ahmed (2017)	2006–2013	333 non-financial firms from Pakistan	Despite different business strategies: (1) Negative results between leverage and ROA, ROE (2) Positive results between leverage and Tobin's Q	Information asymmetry
Olajide <i>et al.</i> (2017)	1996–2014	60 listed firms from Nigeria	(1) Negative results between leverage and different performance measures (ROA, ROE, PE, Tobin's Q, performance index)	Agency theory
Vuong (2017)	2009–2015	142 industrial commodity and service firms listed on Ha Noi and Ho Chi Minh City stock exchange markets, Vietnam	(1) Negative results between 3 debt ratios (total debts, long-term and short-term debts) and ROE	Pecking order theory
Vijayakumaran (2017)	2003–2010	853 listed industrial firm in China	(1) Positive results between leverage and ROA, ROE	Agency theory

Table A1.
Empirical results on the relationship between leverage and firm performance
(continued)

Paper	Period	Scope	Relationship	Explanation
Vuong <i>et al.</i> (2017)	2006–2015	739 very large and large listed firm in UK	(1) Negative results between long-term debts and ROA, ROE (2) Insignificant results between short-term debts and ROA, ROE (3) All positive results between 2 debt ratios (long-term and short-term debts) and Tobin's Q (4) Impact of leverage on ROA, ROE is stronger than other indicators	Agency theory
Phan (2016)	2007–2013	95 manufacturing firms listed on Vietnam stock exchange markets	(1) Negative results between leverage and ROA, ROE despite different regression models	Trade-off theory and agency theory
Vo (2016)	2008–2014	272 listed non-financial companies on Ha Noi stock exchange market	(1) Negative results between 3 debt ratios (total debts, long-term debts, short-term debts) and ROA, EPS	
Avci (2016)	2003–2015	110 manufacturing firms in Turkey	(1) Negative results between both long-term, short-term debt and ROA, ROE	
Chadha and Sharma (2016)	2003–2013	422 listed manufacturing firms in India	(1) Insignificant results between leverage and ROA, Tobin's Q (2) Negative results between leverage and ROE	
Hoang (2015)	2008–2012	150 listed manufacturing firms in Vietnam	(1) Positive results between total debt, short-term debt and Tobin's Q (2) Insignificant between long-term debt and Tobin's Q	Agency theory
Jiahui (2015)	Before 2013	367 listed SMEs in China	(1) Negative results between leverage and ROE	Pecking order theory
Fosu (2013)	1998–2009	257 firms in South Africa	(1) All positive results between three different debt ratios and ROA	

Table A1. Source(s): Author's summary (2019)

Appendix 2

List of journals for data collection

- (1) Indian Journal of Finance.
- (2) Review of European Studies.

- (3) Review of Finance.
- (4) The Singapore Economic Review.
- (5) Journal of Marine Science and Technology.
- (6) External Economics Review.
- (7) Journal of Science.
- (8) Science of Management and Economics Review.
- (9) Review of Finance.
- (10) Economics and Business Review.
- (11) University of Twente Press Journal.
- (12) Journal of Economics and Finance.
- (13) Accounting and Taxation Review.
- (14) Applied Economics and Finance.
- (15) Proceedings of the Academy of Finance.
- (16) International Journal of Business and Commerce.
- (17) Journal of Competitiveness.
- (18) Journal of Risk and Financial Management.
- (19) Journal of Natural and Social Science.
- (20) Journal of Business Perspective.
- (21) Global Journal of Management and Business Research.
- (22) Science Review of Ho Chi Minh Open University.
- (23) The Quarterly Review of Economics and Finance.
- (24) International Journal of Academic Research in Economics and Management Sciences.
- (25) Journal of Emerging Trends in Economics and Management.
- (26) Eurasian Journal of Business and Management.
- (27) Turkish Journal of Economics and Administrative Sciences.
- (28) Global Illuminators Publishing.
- (29) International Journal of Accounting and Financial Reporting.
- (30) International Journal of Environment, Agriculture and Biotechnology.
- (31) Management Science and Engineering.
- (32) Journal of Finance and Economics Research.

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