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Financial Constraints, Investment, and Firm Value: Evidence from Vietnamese Firms

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Abstract

In an imperfect capital market, firms face financial constraints due to information asymmetry. These constraints have a significant impact on the effectiveness of investment decisions. When either an underinvestment or overinvestment process occurs, it directly affects the firm's value. This study aims to examine the quadratic relationship between investment and firm value, specifically within the context of financial constraints. Our analysis is based on a dataset comprising 269 Vietnamese non-financial firms listed on the Ho Chi Minh City Stock Exchange (HOSE) from 2013 to 2022, resulting in a total of 2,690 firm-year observations. After checking the stationarity of panel data, three estimation methods are OLS, REM, and FEM, tested in turn, and finally, the GLS method is applied to deal with the heteroskedasticity problem. The results indicate a quadratic relationship between investment and firm value, suggesting the presence of an optimal investment level. Notably, the optimal level varies depending on the firm's degree of financial constraints. Firms with fewer financial constraints tend to have a higher optimal investment level compared to those with greater financial constraints.

Keywords: Financial Constraints, Firm Investment, Firm Value, Optimal Investment
JEL Classifications: G31, G32, G35

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1. Introduction

For a firm to achieve its stated goals and ensure uninterrupted business operations, capital investments are essential for acquiring, renovating, and upgrading fixed assets. Thus, investment decisions play a crucial role in determining the firm's operational efficiency. Modern financial theory recognizes investment decisions as critically important, as they create value and shape the firm's development (Ross et al., 2008). Theoretically, both operational efficiency and firm value are maximized at the optimal investment level[1] (Hubbard, 1997). In a perfect and tax-free capital market, as described by Modigliani & Miller (1958), investment decisions are independent of financing decisions since there are no cost differences between internal and external capital. During this scenario, firms have unlimited access to funding sources, and their investment demand is solely based on available investment opportunities. Consequently, firms can maximize their value by achieving the optimal investment level.

Numerous empirical studies have provided evidence supporting the existence of imperfect financial markets (Myers & Majluf, 1984; Stiglitz & Weiss, 1981). In situations where firms and potential investors possess asymmetric information about a firm's prospects, certain sources of external financing may carry higher costs or may even be entirely unavailable to certain types of firms. According to Fazzari et al. (1987) and Kaplan & Zingales (1997), a distinction exists between internal and external funds, and firms are considered financially constrained when they encounter difficulties accessing external capital due to their elevated costs. Financially constrained firms primarily rely on internal funds to finance new projects, which often leads to the unfortunate consequence of having to forego projects with positive net present value (NPV) due to a lack of internal resources. Consequently, financially constrained firms tend to invest below the optimal level, resulting in underinvestment. Conversely, when a firm possesses substantial cash reserves and experiences significant free cash flow, the agency problem becomes more pronounced (Jensen, 1986). In such cases, managers may invest in projects with negative NPV, leading to excessive investments that surpass the optimal level, known as overinvestment. These observations highlight the impact of financial constraints and agency problems on firms' investment decisions. Financially constrained firms face limitations in accessing external capital, leading to underinvestment, while firms with excessive internal funds may succumb to overinvestment due to agency issues. Understanding these dynamics is crucial for assessing the optimal level of investment and its implications for firm value.

Underinvestment and overinvestment are both considered suboptimal investment states. Research by Morgado & Pindado (2003) demonstrates that the relationship between firm value and investment follows a quadratic pattern, indicating the presence of an optimal investment threshold. Initially, firms pursue investment projects with positive net present value (NPV), leading to an increase in firm value. However, as these valuable projects become exhausted, further investments may involve projects with negative NPV, resulting in a decline in firm value. In the given context, investment degrees below the optimum support the hypothesis of underinvestment, suggesting that firms are not investing enough to maximize their value. On the other hand, investment levels above the optimum support the overinvestment hypothesis, indicating that firms are investing excessively, leading to a decrease in their market value.

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[1] The marginal benefit of investment is equal to the marginal cost of capital.

Additional studies have further contributed to our understanding of the relationship between investment and firm value. For example, Titman et al. (2004) found a negative association between abnormal investment spending and firm profits. This relationship was particularly pronounced for firms with higher cash flows and lower debt ratios, as highlighted by Liu et al. (2021). Both underinvestment and overinvestment have negative implications for operating performance or firm value, although the impact of underinvestment is generally considered to be more significant. This finding has been supported by studies conducted by Farooq et al. (2015) and Liu & Bredin (2010), which emphasize the greater influence of underinvestment on firm value.

Indeed, the association between investment and firm value is not a straightforward linear relationship, as highlighted by Morgado & Pindado (2003). Underinvestment and overinvestment states can have adverse effects on firm value, indicating that the relationship is more complex. In imperfect financial market conditions, investment decisions are closely intertwined with financial decisions, and financial constraints play a significant role in influencing investment efficiency. Numerous empirical studies support the notion that underinvestment occurs as a result of financial constraints faced by firms (Farooq et al., 2015;; Morgado & Pindado, 2003). Guariglia & Yang (2016) further explain that firms lacking internal finance are more likely to abandon potential investment projects. In other words, when firms encounter financial constraints, negative cash flow shocks can trigger an underinvestment process.

In our study, we aim to explore the connection between investment and firm value, particularly in the context of financial constraints faced by Vietnamese firms. This investigation is motivated by two key reasons. First, the Vietnamese financial market is characterized by significant information asymmetry between companies and investors. Unlike stock markets in developed countries, the level of transparency and information availability for listed companies in Vietnam is often lower. As a result, many firms experience challenges in accessing external capital, which comes at a high cost, while their internal funds are insufficient to support investment opportunities. The 2022 PCI (Provincial Competitiveness Index) study conducted by the Vietnam Chamber of Commerce and Industry (VCCI) revealed that 47% of the surveyed firms faced challenges in securing funding, particularly for medium- and long-term loans. A significant factor contributing to this issue is the stringent collateral requirements imposed by banks. This need for collateral stems from the information asymmetry that exists between firms and financial institutions. Consequently, financial constraints lead to suboptimal investment decisions, forcing firms to invest below their ideal levels. Second, to our knowledge, there is a lack of empirical research in Vietnam examining the impact of investment on firm value, especially within the framework of an imperfect financial market where investment choices are influenced by financial constraints. Much of the existing literature has primarily focused on how financial constraints affect investment, rather than the reverse. Our findings contribute valuable empirical evidence regarding the quadratic nonlinear relationship between investment and firm value, highlighting the existence of an optimal investment threshold for Vietnamese firms. This also underscores the potential for underinvestment when firms encounter financial constraints. Furthermore, our research reveals that the optimal investment threshold is influenced by the degree of financial constraints; firms facing higher levels of such constraints tend to be less efficient in their investments, often having to forgo more viable investment projects.

The structure of the paper is organized as follows. Section 2 presents a comprehensive literature review to provide a theoretical foundation for our analysis. Section 3 outlines the research methods. In Section 4, we present the main findings and discuss the implications derived from our analysis, and Section 5 concludes.

2. Literature Review

2.1 Investment and Firm Value

Since the seminal work of Modigliani & Miller in 1958, which proposed the independence of investment and finance decisions, a substantial body of literature has emerged examining the relationship between these decisions in the presence of capital market imperfections. McConnell & Muscarella (1985) played a significant role in initiating studies on the investment-firm value relationship. Their findings indicated that investment announcements by industrial firms led to an increase in the market value of the firm. Researchers have taken different approaches to studying the market response to investment announcements, considering factors such as the strategic orientation of the announcement. Woolridge (1988) and Burton et al. (1999) found that the market reaction to investment announcements was generally positive, although the abnormal returns varied depending on the stock market's response. Chen & Ho (1997) focused on the role of investment opportunities and free cash flow in explaining the market response to investment announcements. They discovered that firms with good investment opportunities received a highly favorable market response to their investment announcements, whereas firms with poor investment opportunities experienced either an inverse or a non-significant reaction. In contrast, Del Brio et al. (2003) employed a methodology that complemented event studies to analyze the relationship between investment and firm value. Their results demonstrated a direct but inversely proportional relationship between the two variables.

Indeed, imperfections in capital markets, such as information imbalances and agency costs, can give rise to both underinvestment and overinvestment phenomena. Consequently, not all projects with positive NPV will be pursued, and some projects with negative NPV will not be denied. A study conducted by Morgado & Pindado (2003) concludes that there exists a quadratic relationship between firm value and investment, indicating the presence of an optimal investment degree. Investment levels that fall below this optimum indicate underinvestment, whereas levels that surpass it indicate overinvestment. This finding suggests that firms investing below the optimal level are constrained financially, as they are unable to undertake all projects with positive NPV. Additionally, the findings of Fu (2010) demonstrate a similar inverted U-shaped relationship between investment and changes in a firm's operating performance. This relationship is positive in firms experiencing underinvestment, as increased investment leads to higher operating performance. Conversely, this relationship is negative in firms experiencing overinvestment.

From another perspective, Titman et al. (2004) and Liu et al. (2021) explored the connection between investment and firm value by examining the relationship between investment and the firm's stock returns. In theory, increased investment spending can convey both positive and negative information. There are several reasons to consider the positive aspects. Firstly, higher investment costs might indicate greater investment opportunities. Secondly, investment growth signifies that investors in the capital market have increased confidence in the firm and its management. Consequently, greater investment spending can lead to higher stock profits for the firm. However, there is also a potential negative aspect to consider. Managers may engage in empire-building strategies to pursue individual benefits, particularly when the firm has high levels of free cash flow. If investors become aware of such behavior, stock returns following increased investment spending are likely to be negative. Titman et al. (2004) found a negative relationship between abnormal investment and stock returns, and this relationship is stronger for firms with higher cash flows and lower debt ratios. In a similar vein, Liu et al. (2021) argued that the negative relationship between abnormal investment and future stock returns is primarily driven by underinvestment rather than overinvestment.

In summary, most empirical studies confirm the existence of a negative relationship between abnormal investment and firm value. Deviating from the optimal investment level, whether it is too low or too high, has detrimental effects on firms. Asymmetric information creates financial constraints for companies operating in imperfect capital markets, making it challenging to accurately determine the optimal investment level using investment models. Consequently, the quadratic relationship between investment and firm value serves as an indicator that firms may be either underinvesting or overinvesting in imperfect capital markets, as highlighted by Morgado & Pindado (2003) and Fu (2010).

The empirical evidence discussed earlier has led to a broad consensus regarding the distortions arising from informational asymmetries in investment decision-making. This consensus challenges the hypothesis of perfect capital markets originally proposed by Modigliani and Miller in 1958. It underscores the impact of informational asymmetries, which can result in both underinvestment and overinvestment scenarios, ultimately impacting a firm's value. In the context of Vietnam's financial market, which is relatively smaller compared to other countries in the region, its development has not kept pace with its potential. Consequently, firms in Vietnam continue to face financial constraints, particularly small firms that struggle to access external capital. Therefore, the first hypothesis in our paper posits a quadratic relationship between firm value and investment.

H1. The relationship between investment and firm value is quadratic.

2.2 Financial Constraints and Investment

When firms and potential investors possess unequal access to information about a firm's prospects, certain sources of external finance may become more costly or even completely unavailable for certain types of firms. Consequently, a firm's investment decisions become reliant on internal funds. In credit markets, the presence of asymmetric information can result in credit rationing, as discussed by Stiglitz & Weiss (1981) and other scholars. High lending rates create two effects that diminish lenders' expected profits, particularly for banks: (i) The first effect is adverse selection. If the required investment for all projects with positive NPV exceeds the firm's internal funds, the firm might choose to forego these investment opportunities instead of resorting to issuing high-risk debt; (ii) The second effect is moral hazard. Shareholders, with their limited liability, may be inclined to finance riskier investment projects beyond what was initially agreed upon in the loan terms. To mitigate moral hazard, lenders may increase interest rates, impose credit rationing, or impose restrictions on investment and financing terms. These measures restrict shareholders' ability to pursue their investment projects, resulting in underinvestment. When issuing new shares, prospective shareholders will demand a higher rate of return from "good companies" to compensate for potential losses incurred from unknowingly financing "bad companies" due to informational asymmetries. Prospective shareholders lack awareness of the true value of the firm. With this higher return rate, existing shareholders may incur greater losses if investment projects are pursued compared to if they are abandoned (Myers & Majluf, 1984). Myers & Majluf (1984) demonstrated that firms may forego positive NPV projects due to the presence of pre-contract asymmetric information regarding both the investment projects and the firm's existing assets.

Financial constraints and investment issues have been examined from various perspectives. Empirical studies have focused on the underinvestment hypothesis caused by financial constraints stemming from information asymmetry. Notably, Fazzari et al. (1987) and subsequent studies have explored the relationship between cash flow (representing internal capital) and investment. They have concluded that when firms face financial constraints, investment becomes dependent on cash flow, implying that a lack of internal funds leads to underinvestment. Another perspective, presented by Vogt (1994), delves into the causes of the well-established link between cash flows and investment spending. One of the hypotheses explaining this relationship is the pecking order hypothesis, which suggests that managers underinvest due to financial constraints arising from asymmetric information. In the case of firms with valuable investment opportunities, a positive correlation between cash flows and investment spending indicates an underinvestment problem. This perspective argues that financially constrained firms rely on internal funds for investment. Consequently, a lack of internal funds causes firms to forgo certain investment projects, even if they have positive NPV, ultimately resulting in underinvestment. Guariglia & Yang (2016) have provided empirical evidence supporting the notion that the sensitivity of cash flow shortages to underinvestment is more pronounced in firms with negative cash flow. In underinvested firms, the sensitivity of investment to free cash flow increases as the level of financial constraints intensifies. More recently, research conducted by Altaf & Shah (2018) and Guizani & Ajmi (2021) has verified that the positive and stronger sensitivity of investment to cash flow exists in financially constrained firms. These findings further reinforce the idea that financial constraints are a significant driver of the underinvestment process.

In summary, financial constraints in an imperfect financial market are perceived as a hindrance to a firm's investment activities and are also responsible for ineffective investment decisions, such as underinvestment. If the aforementioned hypothesis is confirmed, it suggests that the relationship between investment and firm value varies based on the level of financial constraints. Specifically, the more pronounced the financial constraints a firm faces, the less effective its investment decisions become. Consequently, the relationship between the above two factors weakens in such circumstances.

H2. The relationship between investment and firm value varies among firms with different levels of financial constraints.

3. Methodology

3.1. Identifying Firm Financial Status

Rather than relying on individual indicators like size, age, or debt ratio to measure financial constraints, we utilize two combined indicators for a more comprehensive understanding of a business's financial aspects. This approach includes the Kaplan and Zingales (KZ) index and the Z-score index, which serve as a basis for classifying financial constraints (Cleary, 1999; Kaplan & Zingales, 1997).

KZ Index

In their study, Kaplan & Zingales (1997) conducted a classification of a sample of US firms into five groups based on the level of their financial constraints. This classification was carried out by considering both qualitative information extracted from the firms' annual reports and quantitative information derived from management's statements regarding liquidity. Motivated by the work of Kaplan & Zingales (1997), Lamont et al. (2001) conducted an ordered Logit estimation to further investigate the categories of financial constraints. They focused on five specific financial ratios using the original KZ sample: cash flow, dividends, cash and cash equivalents (deflated by beginning-of-year fixed capital), Tobin's Q, and debt to total assets. A higher KZ index value indicates a greater degree of financial constraints for a firm. The interpretation of the KZ index is as follows: (1) Large internal funds, high dividends, and substantial cash holdings contribute to a low KZ index value. This suggests that the firm has ample internal resources and is less financially constrained; (2) For firms with high debt ratios, a large Tobin's Q implies that the cost of external capital is expected to be high. This, in turn, leads to a higher KZ index value, indicating greater financial constraints. We use the estimated coefficients that they reach to construct the Kaplan and Zingales (KZ) index of financial constraints in the following Lamont et al. (2001).

$$KZ = -1.002 \times \frac{CF}{NFA} - 39.368 \times \frac{DIV}{NFA} - 1.315 \times \frac{CH}{NFA} + 0.283 \times Q + 3.139 \times \frac{D}{TA} \quad (1)$$

Where CF is net cash flow, NFA is the net value of fixed assets, Q is Tobin's q coefficient, DIV is dividends paid to shareholders, CH is the amount of cash held, D is total debt, and TA is total assets.

Z-score Index

Indeed, financial distress is often considered a state of financial constraint, as mentioned in Bhagat et al.(2005). To assess the level of financial constraints, some studies utilize Altman's Z-score index, which provides a measure of a firm's financial health and the likelihood of bankruptcy. The Z-score index is computed using multiple financial ratios, and a Z-score below one is generally interpreted as an indication of financial distress or potential bankruptcy. In this case, the firm is considered to be more financially constrained due to its weakened financial position. Conversely, firms with a Z-score index greater than one are regarded as being less financially constrained. A detailed measurement of the Z-score index is as follows:

$$Z\_score = 0.012\frac{NWC}{TA} + 0.014\frac{RI}{TA} + 0.033\frac{EBIT}{TA} + 0.006\frac{ME}{D} + 0.999\frac{S}{TA} \quad (2)$$

Where NWC is net working capital value, TA is total assets, RI is retained earnings, EBIT is profit before taxes and interest, ME is market value of equity, D is total debt, and S is the revenue.

3.2 Models and Variables

To examine the hypotheses stated in the preceding section, we construct a model inspired by Morgado & Pindado's (2003) approach, which relates firm value to its investment decision:

$$\frac{M_{i,t}}{C_{i,t-1}} = \beta_0 + \beta_1\frac{I_{i,t}}{C_{i,t-1}} + \beta_2\left(\frac{I_{i,t}}{C_{i,t-1}}\right)^2 + \beta_3\frac{Deb_{i,t}}{C_{i,t-1}} + \beta_4\frac{Div_{i,t}}{C_{i,t-1}} + \beta_5 Size_{i,t} + \beta_6 Age_{i,t} + \beta_k\sum_{j=1}^{8} Industry + \varepsilon_{i,t} \quad (3)$$

Where $M_{i,t}$ represents the market value shares of the firm *i* at the end of period *t*, $I_{i,t}$ denotes the increase in investment made by firm i during period t, $Deb_{i,t}$ signifies the incremental value of debt issued during period t, $Div_{i,t}$ represents the dividends paid out during period t, $Size_{i,t}$ represents the scale of operations of firm i in period t, $Age_{i,t}$

represents the number of operating years of firm i in period t, and $C_{i,t-1}$ denotes the value of investment capital at the end of the preceding period t-1[2].

After estimating Model (3) and considering the quadratic relationship between investment and firm value, it implies the presence of an optimal degree of investment. In this context, if the firm is experiencing underinvestment, a marginal increase in investment would have a positive impact on firm value. Conversely, if the issue is overinvestment, the effect of a marginal increase in investment would be negative. To further analyze this relationship, we proceed by taking the derivative of the firm value variable concerning the investment variable, leading to the following expression:

$$\frac{\partial(M_{i,t}/C_{i,t-1})}{\partial(I_{i,t}/C_{i,t-1})} = \beta_1 + 2\beta_2\left(I_{i,t}/C_{i,t-1}\right) \tag{4}$$

By setting the first derivative of the firm value variable concerning the investment variable equal to zero, we can solve for the optimal investment level. This can be expressed as follows:

$$\frac{I_{i,t}}{C_{i,t-1}} = -\frac{\beta_1}{2\beta_2} \tag{5}$$

To test the first hypothesis, it is expected that β_2, the coefficient associated with the quadratic term in Equation (5), is negative, and β_1, the coefficient associated with the linear term, is positive. For the optimal level of investment determined in Equation (5) to be positive, the signs of these coefficients must remain consistent when estimating Model (3). Therefore, if the signs of these coefficients hold during the estimation of Model (3), our first hypothesis will be supported.

To examine the validity of the second hypothesis, we propose an expanded model that includes a financial constraints variable (FC) interacting with the linear and quadratic terms of the investment variable. The financial constraints variable is measured by two indexes, namely KZ and Z-score, as indicated earlier. The new model can be represented as follows:

$$\frac{M_{i,t}}{C_{i,t-1}} = \beta_0 + \left(\beta_1 + \delta_1 FC_{i,t}\right)\left(\frac{I_{i,t}}{C_{i,t-1}}\right) + \left(\beta_2 + \delta_2 FC_{i,t}\right)\left(\frac{I_{i,t}}{C_{i,t-1}}\right)^2 + \beta_3\frac{Deb_{i,t}}{C_{i,t-1}} + \beta_4\frac{Div_{i,t}}{C_{i,t-1}} + \beta_5 Size_{i,t} + \beta_6 Age_{i,t} + \beta_k\sum_{j=1}^{8} Industry + \varepsilon_{i,t} \tag{6}$$

In the case of the degree of financial constraints measured by the KZ index, where a higher value indicates a more financially constrained (MFC) firm, the optimal level of investment may differ from less financially constrained (LFC) firms. In Model (6), the coefficients β_1 and β_2 define the optimum of investment for LFC firms using Equation (5). However, for MFC firms, the optimum can be reached through an equivalent equation, as follows:

$$\left(\frac{I_{i,t}}{C_{i,t-1}}\right) = -\frac{\beta_1+\delta_1}{2(\beta_2+\delta_2)} \tag{7}$$

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[2] For a more intricate elucidation of the variables, please refer to the Appendix.

In the case of the Z-score index, a firm with a value less than 1 is generally considered to be more financially constrained. In Model (6), the coefficients β_1 and β_2 define the optimal degree of investment for MFC firms, whereas the optimum for LFC firms can be obtained using Equation (7).

Under imperfect capital market conditions, finance decisions and dividend policies can indeed impact firm value. The inclusion of debt and dividend variables as control variables in Models (3) and (6) allows for the examination of their effects on firm value. Capital structure theories, such as the theory of Modigliani & Miller (1963) and the trade-off theory, suggest that new debt can enhance firm value by providing tax benefits through new tax shields. Empirical evidence from studies like Farooq & Masood (2016) and Ater (2017) supports the positive impact of debt on firm value. Thus, it is expected that there is a positive relationship between an increase in debt and firm value, as long as the probability of bankruptcy remains low. This positive relationship stems from the potential tax advantages associated with obtaining new debt. Dividend policy is another important financial decision that can affect firm value. According to Ben Naceur et al. (2006), firms that pay dividends often demonstrate high and stable profits and possess the ability to manage large cash flows effectively. Additionally, firms that pay dividends may attract investors and are often characterized by rapid growth and operational efficiency. Therefore, a positive relationship is expected between dividend policy and firm value. Furthermore, the study included the factors of scale of operation and time of operation in Models (3) and (6) to better understand firms' investment decisions and their influence on firm value. Scale is often seen as an initial indicator for investors assessing a company; larger firms typically enjoy a competitive edge in the market due to economies of scale. Consequently, many companies strive to expand their operations to leverage these advantages. Therefore, a positive relationship is expected between operating scale and firm value. According to Nagy et al. (2009), the duration of a company's operation significantly impacts its value. Generally, companies with long-standing experience in their industry tend to accumulate valuable insights and resources, allowing them to generate revenue, manage costs, and achieve profitability more effectively than newer entrants. Thus, we anticipate that uptime will positively influence firm value.

3.3 Data

For our empirical analysis, we collected data from the Fiinpro system, which is managed by FiinGroup Company. We focused on balanced panel data consisting of 269 non-financial firms based in Vietnam that are listed on the Ho Chi Minh City Stock Exchange (HOSE). The data spanned from 2013 to 2022, providing us with a total of 2,690 firm-year observations. Our dataset encompassed various financial statements as well as the market value of each company's shares.

Table 1 presents the structure of the panel, detailing the allocation of the sample's companies across nine sectors based on their respective products.

Table 1: Sample Distribution by Industry Classification of Vietnamese Firms

Sectors	Number of firms	% of firms
Materials	47	17.47
Consumer goods	51	18.96
Industries	76	28.25
Property	39	14.50
Pharmaceutical and Medical	11	4.09
Public Utilities	23	8.55

Sectors	Number of firms	% of firms
Consumer Services	14	5.20
Information Technology	7	2.60
Oil and Gas	1	0.37

Source: Outputs of data processing

Moving on to Table 2, it provides summary statistics for the variables utilized in our estimation. The statistics include the mean, standard deviation, minimum, maximum, and the number of observations for each variable.

Table 2: Summary Statistics of 269 Vietnamese Firms

Variables	Mean	St. dev.	Min	Max	Obs.
$(M_{it}/C_{i,t-1})$	6.2325	42.587	0.0326	1,752.9	2,690
$(I_{it}/C_{i,t-1})$	0.5281	4.3962	-21.123	172.20	2,690
$(I_{it}/C_{i,t-1})^2$	19.598	596.22	0	29,655	2,690
$(Deb_{it}/C_{i,t-1})$	1.1127	31.277	-48.433	1,594.9	2,690
$(Div_{it}/C_{i,t-1})$	0.1740	0.6849	0	24.508	2,690
Size	6,454	24,927	82.98	577,407	2,690
Age	25	13	3	66	2,690
KZ	-17.210	148.95	-6,285	272.49	2,690
Z-score	1.0515	1.0433	-0.1098	12.833	2,690

Notes: Size is measured in billion VND, Age is measured by the number of years of operation.
Source: Outputs of data processing

The descriptive statistics presented in Table 2 reveal notable variations in the firm's value variable and investment variables across different firms. This is evident from the relatively large standard deviation in comparison to the mean values. The wide range of values suggests that some firms engage in significant disinvestment activities, while others make substantial investments relative to their capital stock. This discrepancy contributes to the high standard deviation observed. Furthermore, the data indicates that certain firms are increasing their financial leverage, while others are decreasing their reliance on loans compared to the previous period. Despite the average dividend-to-investment capital ratio being 17.40%, it is worth noting that there are numerous companies with a ratio of 0, indicating that they do not distribute dividends relative to their investment capital.

3.4 Estimation Methods

To ensure the reliability of the regression results, we conducted a Panel Unit Root Test to assess the stationarity of the panel data. This step is crucial to prevent any potential manipulation of the results. Given that our panel data is strongly balanced and the cross-section units are cross-sectionally independent, we employed the Levin-Lin-Chu test (Levin et al., 2002) and the Breitung test (Breitung, 2001) in our study. If the data meets the stationarity requirement (I(0)), we proceed to the second step, where we consider suitable estimation methods for panel data. There are three common estimation procedures: pooled Ordinary Least Squares (pooled OLS) estimation, random effects (RE) estimation, and fixed effects (FE) estimation (Plasmans, 2006). However, using OLS models alone can yield biased and inconsistent results if there is unobserved heterogeneity, such as unobserved individual-specific effects among firms. To mitigate this bias, FE or RE estimators are typically employed (Perotti & Vesnaver, 2004; Schaller, 1993). The appropriate method is determined using the Hausman test. We also examine the presence of multicollinearity in the regression by assessing the Variance Inflation Factor (VIF). Additionally, we conduct tests related to the reliability of the regression model in the final step. If the model exhibits heteroskedasticity, we employ generalized least squares estimation (GLS) to obtain the final regression results.

4. Results

4.1 Testing for Stationarity

Table 3: Results of Testing the Stationarity of the Variables at I(0)

Variables	Levin - Lin - Chu		Breitung		Results
	t-statistic	P_value	lambda-statistic	P_value	
$(M_{it}/C_{i,t-1})$	-8.5e+02	0.0000	-7.2288	0.0000	I(0)
$(I_{it}/C_{i,t-1})$	-1.0e+02	0.0000	-15.6304	0.0000	I(0)
$(I_{it}/C_{i,t-1})^2$	-5.5e+03	0.0000	-15.4311	0.0000	I(0)
$(Deb_{it}/C_{i,t-1})$	-2.8e+02	0.0000	-17.4602	0.0000	I(0)
$(Div_{it}/C_{i,t-1})$	-62.6056	0.0000	-9.7711	0.0000	I(0)
$Size_{it}$	-27.6477	0.0000	-12.0525	0.0000	I(0)
Age_{it}	-81.8018	0.0000	-31.9462	0.0000	I(0)
KZ	-17.3593	0.0000	-7.9222	0.0000	I(0)
Z_score	-26.8607	0.0000	-4.7843	0.0000	I(0)

Source: Outputs of data processing

The test results indicate that all data series for each variable are stationary without a trend and statistically significant at the one percent level. This finding allows us to proceed with selecting the appropriate estimation method based on the data characteristics. The results of the chosen estimation method will be presented in the next section.

4.2 Findings and Discussions

The estimation results of Models (3) and (6) are presented in Table 4. Before discussing the results, it is important to note a few key points. Firstly, the correlation coefficient between pairs of independent variables is below 0.8, indicating that the possibility of multicollinearity in the models is limited, except for the pair of variables $(I_{i,t}/C_{i,t-1})$ and $(I_{i,t}/C_{i,t-1})^2$. While correlation coefficients provide initial insights into the potential presence of multicollinearity, they are not sufficient to conclusively determine whether multicollinearity exists. To further investigate multicollinearity, we examine the Variance Inflation Factor (VIF) values. As the VIF values for all variables are less than 10, it can be concluded that there is no significant evidence of multicollinearity in the research model (Gujarati, 2008). Secondly, the Hausman test indicates that fixed effect (FE) estimation is more suitable for both Models (3) and (6). This suggests that there are individual-specific effects among firms that should be accounted for in the estimation. Thirdly, the Wald statistics for the heteroskedasticity diagnostic test are highly statistically significant at the one percent level. This indicates the presence of significant heteroskedasticity across firms. However, the Wooldridge test shows that the model is not affected by serial correlation. To address heteroskedasticity, we employ the generalized least squares (GLS) regression and base our final results on this estimation method.

Table 4: Estimation Results

Variables	**(I) Model 3**	**(II) Model 6**	
		KZ	**Z_score**
$(I_{it}/C_{i,t-1})$	0.8922^{***}	0.8666^{***}	0.5434^{***}
	(0.0903)	(0.0890)	(0.0808)
$(I_{it}/C_{i,t-1})^2$	-0.0052^{***}	-0.0043^{***}	-0.0042^{***}
	(0.0007)	(0.0007)	(0.0006)
$(Deb_{it}/C_{i,t-1})$	0.3145^{***}	0.3169^{***}	0.3338^{***}
	(0.0490)	(0.0488)	(0.0422)
$(Div_{it}/C_{i,t-1})$	6.4997^{***}	6.3459^{***}	6.5277^{***}
	(0.3029)	(0.3015)	(0.2773)
$Size_{it}$	-0.0559	-0.0419	-0.0894
	(0.0345)	(0.0362)	(0.0325)
Age_{it}	0.2144^{***}	0.2122^{***}	0.2172^{***}
	(0.0526)	(0.0538)	(0.0557)
$(I_{it}/C_{i,t-1})$xFC		-0.0059^{***}	-0.0828
		(0.0006)	(0.0732)
$(I_{it}/C_{i,t-1})^2$xFC		-0.0003^{***}	0.0188^{***}
		(0.0000)	(0.0062)
Materials	-0.6435^{***}	-0.6033^{***}	-0.9037^{***}
	(0.1666)	(0.1686)	(0.1528)
Industries	-0.9646^{***}	-0.9220^{***}	-0.8322^{***}
	(0.1392)	(0.1423)	(0.1412)
Property	1.9091^{***}	1.7159^{***}	1.7144^{***}
	(0.5126)	(0.4649)	(0.5271)
Pharmaceutical and Medical	1.1092^{***}	1.1471^{***}	0.9592^{**}
	(0.3780)	(0.3796)	(0.3854)
Public Utilities	-0.9412^{***}	-0.9315^{***}	-0.9713^{***}
	(0.1382)	(0.1402)	(0.1399)
Consumer services	0.0832	0.1262	0.0048
	(0.5556)	(0.5599)	(0.5927)
Information technology	-0.2370	-0.2109	-0.4469
	(0.3316)	(0.3229)	(0.2793)
Oil and Gas	-1.1435^{***}	-1.1637^{***}	-1.1374^{***}
	(0.2461)	(0.2499)	(0.2004)
Constant	2.7980^{***}	2.3957^{**}	3.8428^{***}
	(1.0366)	(1.0764)	(0.9754)
Obs.	2,690	2,690	2,690
Wald chi2	942.65^{***}	$1,059.74^{***}$	$1,042.35^{***}$

*Notes: The table reports the estimated results of Models (3) and (6) for the whole sample period (2013-2022) by GLS regression estimates. In the table, the dependent variable is $M_{i,t}/C_{i,t-1}$ which denotes the value of the firm. The independent variables are firm investment ($I_{i,t}/C_{i,t-1}$) and its square, Debt ($Deb_{i,t}/C_{i,t-1}$), Dividend paid ($Div_{i,t}/C_{i,t-1}$), Scale of operation ($Size_{i,t}$), Years of operation ($Age_{i,t}$), and financial constraints (FC) measured by KZ index (in Equation (1)) and Z_score index (in Equation (2)). The value of standard errors after correcting for heteroskedasticity is shown in parentheses. *** and ** indicate significance at the 1% and 5% levels, respectively.*

Source: Outputs of data processing

The results obtained from Model (3) confirm our first hypothesis (H1). As presented in Table 4, column I, the coefficient β_1 is positive and the coefficient β_2 is negative, both of which are statistically significant at the one percent level. These findings indicate that the relationship between investment and firm value follows a quadratic pattern rather than a linear one. Notably, we calculate the optimal investment threshold to be 85.79. This result aligns with empirical studies conducted by Morgado & Pindado (2003) and Fu (2010). In general terms, these findings suggest that firms continue investing in projects with positive NPV until they reach the optimal investment threshold. During this period, the value of their shares continued to increase. However, once this optimum is surpassed, firms start undertaking projects with negative NPV, leading to a decrease in the value of their shares.

Indeed, the optimal investment threshold implies that Vietnamese firms should prioritize investing in fixed capital, particularly in machinery, equipment, and financial assets. By investing in these long-term assets, firms can modernize their infrastructure, improve labor productivity, enhance competitiveness in the market, and ultimately enhance operational efficiency. These factors serve as the foundation for increasing the firm's stock price in the market. However, it is important to note that exceeding the optimal investment threshold can lead to inefficiency. At this point, the benefits gained from investment may not be sufficient to compensate for the firm's losses, resulting in a decrease in firm value. Therefore, the research results offer a broader understanding of the relationship between investment and firm value. While investment contributes to the growth of firm value, there exists an optimal threshold beyond which excessive investment can lead to diminishing returns and a decrease in firm value.

This finding offers limited support for the notion that, in the presence of imperfect capital markets, a firm's investment efficiency is influenced by financial constraints. The existence of unequal information between the company and its sources of capital (such as bondholders and potential investors) leads to higher costs associated with external capital compared to internal capital. Consequently, financially constrained firms may experience a shortfall in their investment activities, resulting in underinvestment.

The findings obtained from Model (6) provide support for our second hypothesis (H2), which explores the relationship between investment and firm value within the context of financial constraints. The results, presented in column II of Table 4, shed light on this relationship. It's worth noting that in the case of LFC firms, the coefficients β_1 and β_2 represent the impact of investment and square investment variables, respectively. Whereas for MFC firms, the coefficients for these variables are $(\beta_1 + \delta_1)$ and $(\beta_2 + \delta_2)$ respectively. Specifically, when financial constraints are measured using the KZ index, the coefficient β_1 is positive, and β_2 is negative. This confirms that the relationship between investment and firm value follows a quadratic pattern, particularly for LFC firms. The estimated coefficients of the interaction variable between financial constraints (FC) and investment, as well as its square, are both statistically significant at the one percent level. This further supports the quadratic relationship for MFC firms. By substituting the values of β_1 and β_2 into Equation (5), we calculate that the optimal degree of investment for LFC firms is 100.77. Similarly, by substituting $(\beta_1 + \delta_1)$ and $(\beta_2 + \delta_2)$ into Equation (7), we determine that the optimum for MFC firms is 93.55. These results indicate that as the level of financial constraints increases (as indicated by a higher value of the KZ index), the influence of investment on firm value decreases. This suggests that firms with greater financial constraints experience a reduced impact of investment on their overall value. Furthermore, these findings support the relationship between investment and firm value proposed in the Model (3), where the optimal investment degree for the entire sample of firms is determined to be 85.79. In the case where financial constraints are measured using the Z-score index, the study confirms a nonlinear relationship between investment and firm value for MFC firms. A Z-score index below 1 indicates higher financial constraints. The optimal investment level for firms with greater financial constraints is determined to be 64.69. However, there is insufficient evidence to determine the optimum for LFC firms in this scenario.

Based on our expectations, it has been observed that both the debt variable, dividend policy, and operating year have a significant positive impact on firm value, with a statistical significance level of one percent. When firms increase their debt capital, they can benefit from new tax shields, thereby enhancing their overall value. This finding aligns with the theories of free cash flow and signaling, as it suggests that firms tend to pay dividends when they generate profits and effectively manage their cash flow. Furthermore, implementing an attractive dividend policy can contribute to maintaining a positive perception of the firm among various stakeholders in the market. From the perspective of the firm, a well-designed dividend policy helps to instill trust among existing shareholders and attracts potential shareholders, ultimately ensuring that firms have sufficient financial resources to invest in profitable projects. In terms of operating time, it is evident that long-established firms have carved out a position in the market, developed a brand, and cultivated a steady customer base. As a result, their competitive advantage tends to be more stable compared to that of newly established or recently operating firms.

Furthermore, we analyzed to determine if there were variations in firm value across different business sectors when examining the non-linear relationship between investment and firm value. To establish a benchmark, we selected the consumer goods industry and compared it with eight other industry groups. The findings revealed that firms operating in the property industry and pharmaceutical and medical industry exhibited higher firm value compared to those in the consumer goods industry. Conversely, the firm value of the remaining industry groups was lower than that of the consumer goods industry.

4.3 Robustness tests

To test the robustness of our results, we estimate Equation (6) using single indicators to measure the degree of financial constraint, specifically focusing on size and years of operation. According to Hovakimian & Titman (2003), smaller firms are typically viewed as more financially constrained because they receive less coverage from analysts, which limits their access to external funding due to adverse selection issues. As a result, external financing tends to be more expensive for these firms. Similarly, in terms of age, years of operation can indicate the disparity between the costs of external and internal funds (Devereux & Schiantarelli, 1990). Younger and growing firms are more susceptible to financial constraints.

The results presented in Table 5 align with our earlier findings, revealing a significant nonlinear quadratic relationship between investment and firm value. This confirms the presence of an optimal investment threshold, particularly influenced by the extent of financial constraints faced by the firm. Firms with greater financial constraints (MFC) exhibit a lower optimal investment threshold compared to those with fewer constraints (LFC). This suggests that financially constrained firms cannot increase their investments to the desired level, leading them to forgo lucrative opportunities and increasing the likelihood of underinvestment. This further reinforces the robustness of our prior results.

Table 5. Estimation results: further tests

Variables	**Model 6**	
	Size	**Age**
$(I_{it}/C_{i,t-1})$	0.3232***	0.7014***
	(0.0547)	(0.1728)
$(I_{it}/C_{i,t-1})^2$	-0.0017***	-0.0110***
	(0.0017)	(0.0101)
$(Deb_{it}/C_{i,t-1})$	0.3972***	0.3365***
	(0.0501)	(0.0441)
$(Div_{it}/C_{i,t-1})$	6.3874***	6.6348***
	(0.3380)	(0.2993)
$Size_{it}$	0.0346	-0.0659*
	(0.0442)	(0.0377)
Age_{it}	0.0531	0.3685***
	(0.0462)	(0.0902)
$(I_{it}/C_{i,t-1})$xFC	0.8752***	-0.0378**
	(0.2411)	(0.0147)
$(I_{it}/C_{i,t-1})^2$xFC	-0.0052**	-0.0007**
	(0.0023)	(0.0006)
Materials	-0.5059***	-0.8549***
	(0.1661)	(0.1797)
Industries	-1.0188***	-0.7039***
	(0.1322)	(0.1751)
Property	2.1578***	1.6224***
	(0.4674)	(0.5028)
Pharmaceutical and Medical	1.7982***	0.9680**
	(0.4655)	(0.3765)
Public Utilities	-0.7254***	-0.9815***
	(0.1468)	(0.1830)
Consumer services	0.3245	-0.0190
	(0.5842)	(0.5913)
Information technology	-0.1511	-0.2701
	(0.2839)	(0.3305)
Oil and Gas	-1.0551***	-1.2462***
	(0.2109)	(0.2274)
Constant	0.3826	2.8521**
	(1.3039)	(1.1290)
Obs.	2,690	2,690
Wald chi2	843,06***	846.77***

*Notes: Financial constraints (FC) are assessed based on the scale of operations and the duration of operations. Larger firms (longer operational histories) are viewed as having fewer financial constraints (LFC), while those categorized as more financially constrained (MFC) are smaller firms (shorter operational histories). The value of standard errors after correcting for heteroskedasticity is shown in parentheses. *** and ** indicate significance at the 1% and 5% levels, respectively.*

Source: Outputs of data processing

5. Conclusion

This study aims to test two primary hypotheses. Firstly, it examines the relationship between investment and firm value, hypothesizing that this relationship is quadratic, indicating the existence of an optimal investment level. Secondly, it explores whether there are variations in the relationship between investment and firm value based on the degree of financial constraints faced by the firms.

Based on the obtained results, we can conclude that the aforementioned hypotheses have been supported. The findings demonstrate the presence of an optimal level of investment, which represents the point at which all positive NPV projects have been undertaken. Consequently, firms that surpass this optimal level experience an overinvestment scenario. On the other hand, firms that fall short of reaching the optimal level encounter an underinvestment situation. The underinvestment arises because asymmetric information raises the cost of external funds, leading firms to forego profitable NPV projects. In this context, the inefficiency in the investment process stems from the conflicting interests between shareholders and capital suppliers, such as bondholders, bankers, and prospective shareholders. In simpler terms, financial constraints serve as the underlying cause for inefficient investment decision-making.

Additionally, our study reveals that there is a distinction in the optimal investment level among firms with varying degrees of financial constraints. Specifically, firms facing higher levels of financial constraints tend to engage in smaller investments until they reach their optimal level. In contrast, firms with lower levels of financial constraints exhibit an optimal investment level that surpasses that of the more financially constrained firms. This observation confirms the notion that financially constrained firms exhaust their available funds at a lower optimal level compared to their counterparts with fewer financial constraints.

Research Limitations

There are two potential limitations to consider in this study. Firstly, the study relies on only two indicators to assess the level of financial constraints within a firm. Consequently, the findings may not capture the full extent of this aspect, thus limiting the comprehensiveness of the results. Secondly, the inclusion of interaction variables may introduce a higher risk of multicollinearity. This could potentially impact the signs and significance levels of the variables in the models, thereby influencing the overall findings.

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Appendix: Variables

Within this appendix, we provide the definitions and calculations, as required, for all the variables utilized in our study. The book values for all firms listed on HOSE are sourced from a comprehensive database comprising the Financial Reports. These reports are published by the Fiinpro system of FiinGroup Company.

Firm value

Consistent with customary practices in financial literature, we define firm value as the market value of equity. In this study, the market value of equity ($M_{i,t}$) is obtained from the Fiinpro system of FiinGroup Company.

Investment

The calculation of investment follows the approach proposed by Morgado & Pindado (2003) and is expressed as follows:

$I_{i,t} = NF_{i,t} – NF_{i,t-1} + BD_{i,t}$

Where $NF_{i,t}$ represents the net fixed assets for period t, which is calculated by subtracting the accumulated book depreciation for period t from the gross book value of fixed assets. $BD_{i,t}$ refers to the book depreciation expense corresponding to period t.

Debt

$Deb_{i,t} = BDA_{i,t} – BDA_{i,t-1}$

Where $BDA_{i,t}$ represents the book value of the total debt, which includes both short-term debt and long-term debt.

Dividends

$Div_{i,t}$ represents the total amount of dividends, which is determined based on the current year's net income.

Size

$Size_{i,t}$ represents natural logarithm of total assets.

Age

$Age_{i,t}$ is number of years since founding.

Investment capital

$C_{i,t}$ is the value of investment capital, normalized by the book value of net fixed assets.

Financial constraints

As mentioned in the research design section, we use two indexes Kaplan and Zingales (KZ) and Z_score to measure the degree of financial constraints of the firm.

The definition and calculations of the KZ index are presented in Equation (1).

The definition and calculations of the Z_score index are presented in Equation (2).