ASIAN ACADEMY *of* MANAGEMENT JOURNAL *of* ACCOUNTING *and* FINANCE

AAMJAF Vol. 21, No. 1, 181–200, 2025

THE NONMONOTONIC INVESTMENT–CASH FLOW SENSITIVITY AND BUSINESS LIFE CYCLE: EVIDENCE FROM AN EMERGING MARKET

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ABSTRACT

This article aims to investigate the non-linear correlation between investment and cash flow. Drawing on a sample of 669 Vietnamese publicly listed firms from 2010 to 2021, the study tests two hypotheses concerning the investment–cash flow relationship, employing a two-step system-GMM approach. The sensitivity of investment to cash flow is examined across different financial scenarios and business stages. The results demonstrate a U-shaped investment-cash flow relationship, which consistently holds across various firms' financial positions and ownership structures. Interestingly, this pattern is absent under the influence of the COVID-19 pandemic. When considering the business life cycle, the results indicate that while companies in the introduction and expansion phases exhibit the inverted U-shaped sensitivity, those in the maturity and decline stages display a U-pattern. These outcomes enrich the existing corporate literature and offer significant practical insights for investors, firm managers, and policy-setting parties, particularly within the emerging market context.

Keywords: Investment, Cash flow, Financial constraints, Life cycle, COVID-19, Vietnam

Received: 27 May 2024; Accepted: 26 December 2024; Published: 18 June 2025

To cite this article: Thai, T. H. A., & Ha, L. H. N. (2025). The nonmonotonic investment–cash flow sensitivity and business life cycle: Evidence from an emerging market. *Asian Academy of Management Journal of Accounting and Finance, 21*(1), 181–200. https://doi.org/10.21315/aamjaf2025.21.1.7

To link to this article: https://doi.org/10.21315/aamjaf2025.21.1.7

INTRODUCTION

The existing body of research has dedicated significant focus on how firms make investment decisions, particularly exploring how firm investment responsiveness is affected by firm-specific factors, such as internal funds (see Fazzari et al., 1988; Cleary, 1999; Cleary et al., 2007; Hovakimian, 2009). The widely recognised impact of cash flow on a firm's investment expenditure primarily stems from the acknowledgement of imperfections in financial markets (Gilchrist & Himmelberg, 1995). Due to these market imperfections, corporate investments are not only affected by the availability of investment opportunities but also by the firm's ability to finance these opportunities, specifically through internally generated funds. This understanding is supported by thorough investigations starting with the study of Fazzari et al. (1988), which establishes a positive investment–cash flow sensitivity. The rationale for this is based on the pecking-order theory of Myers (1984) and Myers and Majluf (1984) and the free cash flow (FCF) theory raised by Jensen (1986). According to the pecking order hypothesis, managers determine their firms' level of capital expenditure based on internal cash flow, as this source presents minimal challenges related to information asymmetry and adverse selection. FCF theory supposes that firms with high free cash flow tend to waste their money on unproductive investment projects.

However, debates persist concerning the direction of the investment-cash flow relationship (Fazzari et al., 1988; Hoshi et al., 1991; Kaplan & Zingales, 1997; Stein, 2003; Cleary et al., 2007; Hovakimian, 2009). Cleary et al. (2007) is the first study that reveals a non-linear association between internal funds and investment. This correlation takes on a U-shaped form, and investment reaches its lowest point when cash flow or net liquid assets hover near zero. The investment level then increases as cash flow becomes more positive or more negative. Similarly, Guariglia (2008), Borri et al. (2022) and Lawrenz and Oberndorfer (2023) also demonstrate a U-shaped investment–cash flow sensitivity in their findings. Chen and Chen (2012) argue that investment–cash flow sensitivity vanishes, even though financial constraints remain a primary concern for firms. Investment and cash flow sensitivity, therefore may not reliably serve as an indicator of financial constraints. Hovakimian (2009) identifies a nonmonotonic connection between investment and cash flow and interestingly, his study reveals that this relationship is driven by the corporate life cycle.

The drive to investigate the investment-cash flow relationship in Vietnamese listed firms stems from some key reasons. First, while the Vietnam market provides a unique economic context for studying corporate investment behaviour, the understanding of this topic within this particular emerging market remains incomplete. This country has seen rapid economic growth after

replacing the old centrally-planned system with an effectively market-oriented model. According to the Asia Business Outlook (https://www.asiahouse.org/files/documents/Asia-House-Annual-Outlook-2025.pdf), Vietnam is experiencing a significant upward path of development, marked by a growing economy, a stable political landscape, and a youthful workforce. This combination renders the country an appealing prospect for businesses seeking to broaden their operation in Asia, and a prime destination for foreign investors eyeing opportunities in Southeast Asia. This enables Vietnamese businesses to gain substantial opportunities within a positive economic environment. Despite these encouraging prospects, a notable challenge for many Vietnamese businesses is the risk of capital depletion. This shortage results in a disruption of cash flow, impeding both production and the procurement of raw materials for the upcoming production cycles (Hue, 2023). The critical scarcity of capital arises from a simultaneous bottleneck in all three pillars of the capital market—bonds, credits and securities. The corporate bond market in Vietnam is not fully developed, and while the equity market is expanding, it is still insufficient to meet the capital requirements of firms. Bank lending mainly satisfies short-term needs, mostly for working capital or consumer credit, rather than long-term investments (https://www.undp.org/vietnam/publications/developing-domestic-capital-markets-boost-viet-nams-sustainable-development). Consequently, firms experience varying degrees of financial constraints depending on their size, sector and ownership structure. Thus, they are forced to depend more on their internal funds to sustain investment activities. Given that Vietnamese firms are characterised by financial constraints (Tran & Le, 2017), state ownership domination (Vo, 2016), and inefficient investment problem (Ha & Thai, 2023); it is necessary to explore the nature of the relationship between investment and cash flow of these firms, in different development scenarios and across different stages of business life-cycle. This understanding would assist policymakers and financial institutions in designing interventions that improve funding access, reduce constraints and support sustainable economic growth. Second, Vietnamese firms are distributed across various stages of the business life cycle, from introduction to maturity. Thus, studying how investment–cash flow sensitivity varies across these stages reveals important investment patterns. This knowledge would assist managers in tailoring their investment strategies to align with each phase of the firm's life cycle to achieve consistent and sustainable financial performance.

Third, the year 2020 is remembered for the outbreak of the COVID-19 pandemic. This health crisis, causing adverse shocks both in demand and supply, creates an ideal opportunity for investigating corporate investment behaviour. While numerous papers have examined the short-term effects of COVID-19 on the values of the global stock market and aggregated abnormal returns, revealing

challenges for firms in raising capital from the market, the impact of COVID-19 on corporate investment–cash flow sensitivity has been largely neglected, particularly in emerging markets (Jiang et al., 2021, Thai et al., 2023). Thus, examining the impact of the COVID-19 economic shock on investment–cash flow sensitivity within the context of emerging markets is essential for offering valuable insights to managers and policymakers. Last but not least, there is a limited body of research on the investment–cash flow correlation in the Vietnamese economy, and empirical findings associated with the relationship remain controversial. While Nguyen (2013) reveals a significant and positive statistical correlation between investment and cash flow, Thoa and Uyen (2017) and Tran and Le (2017) demonstrate the existence of a U-shaped relationship.

By examining a sample of Vietnamese publicly listed firms, we document a U-shaped pattern in investment–cash flow sensitivity. The results consistently hold across a range of firms' financial positions and ownership structures. Our primary model surpasses existing studies by incorporating not only the key determinants like firm size, leverage, Tobin Q and cash holdings, but also by adding the ownership structure[1] (i.e., state and foreign ownership), making it more comprehensive. Interestingly, the study finds that the presence of this U-pattern is absent under the influence of the COVID-19 pandemic. Additionally, to analyse variations in cash flow-investment sensitivity across four stages of the business life cycle—introduction, growth, maturity and decline—we use the method of corporate cash flow pattern developed by Dickinson (2011). Before our study, Hovakimian (2009) examines the investment–cash flow relationship concerning business stages measured by firm age. Compared to firm age and other measurements like sales or revenue, the cash flow pattern is a more reliable approach (see Dickinson, 2011; Castro et al., 2016; Tian et al., 2015). Considering the role of the business life cycle, the results indicate that while companies in the inception and expansion phases exhibit the inverted U-shaped sensitivity, those in the maturity and decline stages display a U-pattern.

Our study, therefore, provides some significant contributions. First, we add to the emerging literature on corporate finance by documenting a U-shaped investment-cash flow relationship. Second, the findings confirm the influence of the business life cycle on corporate investment decisions. Third, the study broadens the growing body of literature on COVID-19 by presenting evidence regarding the disappearance of investment–cash flow sensitivity during the crisis.

LITERATURE REVIEW

The subject of corporate investment attracts significant interest in financial research due to its crucial impact on shareholders' wealth (Tran et al., 2023). Modigliani and Miller (1958) contend that firms' investment choices are solely motivated by profitable opportunities. However, real-world conditions introduce various frictions that can influence investment decision-making. Indeed, investment decisions are often limited by the accessibility of funds because of various factors such as information differences between insiders and external parties, conflicts of interest between managers and shareholders, as well as between majority and minority shareholders, transaction expenses, and moral hazard associated with risk-taking over investment. Given such issues, firms cannot always align their investment choices perfectly with the net present value (NPV) principle (Guariglia & Yang, 2016).

Substantial empirical studies, for example, Fazzari et al. (1988), Hubbard (1998), Stein (2003), Bloom et al. (2007), Nguyen (2013), etc. demonstrate a notably positive correlation between cash flow and investment spending. Alternatively, others, including Cleary et al. (2007), Guariglia (2008), Hovakimian (2009) and Lyandres (2007) provide empirical and theoretical proof of non-linearities in investment-cash flow correlation. Cleary et al. (2007) discovered a U-shaped correlation between cash flow and investment level. This pattern is explained by an economic mechanism referred to as the trade-off between the cost and revenue impacts of investment (Lawrenz & Oberndorfer, 2023). They indicate that investment is at its lowest when cash flow or net liquid assets are near zero, and investment levels increase when cash flow levels become more positive or negative. That is, on the right side of the U-shape, there is a positive relationship between cash flow and investment, with the domination of cost effect. In the presence of the cost effect, a firm may have high internal funds but insufficient funds to finance its entire investment opportunities. Consequently, a higher level of investment would require additional external finance, leading to increased costs of debt and subsequently higher default risk. This effect suggests that to avoid increased borrowing and repayment expenses associated with heightened default risk, a company might strive to maintain a constant investment level. This implies that a decrease in cash flow results in a reduction in investment. Conversely, the downward slope of the U-shaped relationship is associated with a negative cash flow and investment correlation. This scenario is observed in firms with negative or a scarcity of internal funds. For these companies, a decrease in cash flow prompts a rise in investment, aiming to generate sufficient revenue for servicing existing debt or covering fixed costs. A U-shaped relationship is also identified in the work of Allayannis and Mozumdar (2004), Borri et al. (2022) and Lawrenz and Oberndorfer (2023).

Within the framework of the Vietnamese economy, although there is a scarcity of studies elucidating the investment and cash flow relationship, the empirical results linked to this association are a matter of debate. Notably, Nguyen (2013) finds a significant and positive statistical correlation between investment and cash flow. Their finding suggests that cash flow serves as a crucial factor affecting firm-level investment choices, indicating that higher resources lead to increased investment spending. Thoa and Uyen (2017) provide evidence of a U-shaped relationship between investment and cash flow in both the overall sample and subsets comprising state-controlled and non-state-controlled firms. They also find that the investment levels in state-controlled listed companies are more responsive to cash flows compared to those in non-state-controlled firms. De Ceuster Marc et al. (2016) demonstrate that listed state-controlled firms confront greater financial constraints compared to private firms. The financial constraint severity for these listed state-dominated firms is found to be heightened, especially following the establishment and swift growth of equity markets and the privatisation trend that commenced in the 1990s. The U-shaped investment–cashflow relation is also identified in Tran and Le (2017). As suggested by the previous studies using the same context, we propose a hypothesis as follows:

H1: There is a non-linear relationship between investment and cash flow in listed companies in Vietnam.

According to the corporate life cycle hypothesis, Hovakimian (2009) finds an inverse association between investment and cash flow. This negative relationship can be explained by the alterations in the firms' range of growth prospects over their lifespan. Particularly, companies experiencing a negative investment–cash flow correlation are typically in the initial stages of their existence as public firms. Despite having insufficient levels of internal cash flow and suffering significant financial constraints, they harbour valuable growth prospects. Consequently, they rely predominantly on external financing for their investments, even with insufficient current cash flows. This strategy is driven by the expectation that markets view their investment projects as highly profitable. Based on the corporate life cycle hypothesis, as a firm matures, its past investments begin yielding higher cash flows. The investment rates of these matured firms decrease as their once-attractive investment opportunities become less compelling (Can et al., 2023). As a result, the simultaneous opposite trends in internal funds and investment levels result in a negative empirical relationship between investment and cash flow. Based on these arguments, we expect that in different stages of the business life cycle (e.g., introduction, growth, maturity, decline), the patterns of investment-cash flow sensitivity might change, and build the second hypothesis as follows:

H2: The patterns of non-linear investment-cash flow sensitivity changes over stages of the business life cycle.

METHODOLOGY

Data

The data for our study is taken from FinPro and covers the period from 2010 to 2021. Given the more reliable nature of data from listed firms in a developing market like Vietnam, we include only publicly listed firms for our investigation. We exclude financial institutions because of significant differences in their investment and financing decisions compared to other sectors. To handle outliers, we winsorise all firm-level variables 1% in each tail[2]. As a result, our panel sample consists of 6,129 observations from 669 firms.

Research Model

Following previous studies, including Cleary et al. (2007) and Firth et al. (2012), we include the squared value of cash flow into the investment-cash flow model to find the existence of a non-linear correlation between the two factors, which is as follows:

$$INV_{i,t} = \beta_0 + \beta_1 INV_{i,t-1} + \beta_2 CF_{i,t-1} + \beta_3 CFsquared_{i,t-1} + \sum CONTROL_{I,t-1} + \sum Year + \sum Industry + u_{i,t} \quad (1)$$

where $INV_{i,t}$ is the capital expenditure of firm i at time t, which equals the value of capital expenditure excluding the sale of property, plant and equipment in year t divided by total assets in year $t - 1$. $CF_{i,t-1}$ denotes the cash flow of firm i at time $t - 1$. Control variables, including firm size (Size), debt ratio (Lev), Tobin's Q (TobinQ), cash holdings (CH), state and foreign ownership (State and Foreign, respectively), which are selected following the previous research on the same topic such as Hovakimian (2009), Mulier et al. (2016), Wei and Zhang (2008), Carpenter and Guariglia (2008), etc. The description of all variables is presented in Appendix A.

Equation (1) contains the lagged value of the investment; thus, we estimate it by the method of system-GMM (Blundell & Bond, 1998)—as suggested by previous studies on the same topic, including Gugler (2003), Pindado et al. (2011), Colombo et al. (2013), Ha and Thai (2023), etc. To address the potential

delayed effect of investment determinants and mitigate endogeneity arising from omitted variable bias and simultaneous causality, one-year lagged cash flow—our main explanatory variable, and one-year lagged control variables are used as instruments. Additionally, tests for second-order autocorrelations (AR2 test) and over-identifying restrictions (Hansen test) are conducted to ensure that serial correlation is absent and the instruments are valid.

Summary of Variables

Table 1 presents the statistical summary of all used variables.

Table 1
Statistic description

Variable	Obs.	Mean	Std. Dev.	Min	Max
INV	6,129	0.0142	0.0423	0.0000	0.2755
CF	6,129	0.0797	0.0945	–0.0996	0.5228
Size	6,129	27.3180	1.5652	23.6791	31.5847
Lev	6,129	0.2189	0.1840	0.0000	0.6909
TobinQ	6,129	0.7422	0.5369	–0.0046	3.2518
CH	6,129	0.0946	0.1045	0.0010	0.5221
State	6,129	0.2403	0.2554	0.0000	0.9000
Foreign	6,129	0.0939	0.1320	0.0000	0.4900

Notes: INV = capital expenditure; CF = cash flow. Other variables include firm size (Size), debt ratio (Lev), Tobin's Q (TobinQ), cash holdings (CH), state (State) and foreign (Foreign) ownership.

As shown in Table 1, the average amount of cash flow is 0.0797, revealing that many Vietnamese firms are still inadequate in terms of internal cash flow. Besides, the debt is only one-fifth of the total assets.

Table 2 shows correlation coefficients between variables in our model. As presented, firm cash flow has a negative correlation coefficient of –0.0425 with investment. In addition, size and foreign ownership have positive correlations with investment level while other control variables show negative associations with investment level.

Table 2
Correlation matrix

	INV	CF	Size	Lev	TobinQ	CH	State	Foreign
INV	1							
CF	–0.0425	1						
Size	0.0820	–0.0284	1					
Lev	–0.0866	–0.3211	0.3734	1				
TobinQ	–0.0863	0.4682	0.1470	0.0045	1			
CH	–0.0012	0.3354	–0.1741	–0.3518	0.0081	1		
State	–0.0237	0.0499	–0.0618	–0.0539	–0.0278	0.1285	1	
Foreign	0.0128	0.2150	0.2637	–0.0913	0.1908	0.1371	–0.1442	1

Note: The table presents the pairwise correlation matrix of all used variables. INV is capital expenditure and CF denotes cash flow. Other variables include firm size (Size), debt ratio (Lev), Tobin's Q (TobinQ), cash holdings (CH), state (State), and foreign (Foreign) ownership.

RESULT

Investment–Cash Flow Sensitivity

Table 3 presents the regression outcomes obtained from Equation (1) regarding the association between investment level and cash flow for the full sample (column 1), pre- and COVID-19 periods (columns 2 and 3), state-owned and non-state-owned firms (columns 4 and 5) and for different exchange markets (columns 6 and 7), respectively. As shown in column 1, when internal cash flow is insufficient, firms tend to avoid making more investments, leading to a negative association between CF and INV. Then, in response to the increase in the internal cash flow, there is a corresponding increase in investment levels, which is shown through the positive coefficient of CF_squared. The results indicate that firms tend to fund their positively predicted NPV projects whenever there is a significant accumulation of cash flow. This situation forms a U-shaped relation between firm cash flow and investment levels. Our findings corroborate the U-shaped relationship proposed by the research of Cleary et al. (2007), Borri et al. (2022) and Lawrenz and Oberndorfer (2023).

Given our observed period is from 2010 to 2021—which covers the duration when corporate decisions are significantly influenced by the severe consequences of the COVID-19 pandemic (see Thai et al., 2023, Vo et al., 2022), it is necessary to take into the possible effect of the COVID-19 on the U-shape relationship between cash flow and investment. As can be seen from columns 2

and 3 of Table 3, while there is a significant U-shaped relationship between cash flow and investment during the pre-COVID-19 period, that relation disappears under the effects of the pandemic. This finding is in line with the study of Thai et al. (2023) who suggest that during the pandemic, the investment–cash flow sensitivity faded because of the existence of government aid and cash reserves. Besides, the decrease in investment opportunity during the COVID-19 is another possible explanation. Similar results are documented by Jiang et al. (2021).

Additionally, since the Vietnamese equity market is dominated by state ownership (Dang et al., 2020; OECD, 2020), we further consider the non-linear relation between investment and cash flow for SOE and non-SOE firms. As presented in columns 4 and 5, the U-shape relationship between investment and cash flow is confirmed for both types of firms. This result is in line with Thoa and Uyen (2017). We also report the regression results for firms listed on two different exchanges, including HSX and HOSE (columns 6 and 7, respectively). The results remain unchanged.

Table 3
Investment–cash flow sensitivity

Variables	All firms	Pre-COVID-19	COVID-19	SOE	Non-SOE	HSX	HOSE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
INV	0.8643***	0.6795***	0.8500***	0.8342***	0.8086***	0.6363***	0.7847***
	(0.0036)	(0.0110)	(0.0630)	(0.0004)	(0.0026)	(0.0015)	(0.0018)
CF	–0.1673***	–0.2870***	–0.0081	–0.0392***	–0.2027***	–0.1789***	–0.3263***
	(0.0080)	(0.0163)	(0.0911)	(0.0010)	(0.0070)	(0.0013)	(0.0032)
CF^2	0.4312***	0.7737***	–0.0037	0.0909***	0.5558***	0.5185***	0.8215***
	(0.0239)	(0.0436)	(0.3369)	(0.0015)	(0.0217)	(0.0032)	(0.0080)
Size	0.0004**	0.0011***	–0.00004	0.0008***	0.0005**	0.0008***	0.0010***
	(0.0002)	(0.0003)	(0.0006)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
Lev	–0.0095***	–0.0130***	–0.0049	–0.0068***	–0.0087***	–0.0127***	–0.0196***
	(0.0016)	(0.0024)	(0.0041)	(0.0003)	(0.0017)	(0.0011)	(0.0011)
TobinQ	0.0008	–0.001	0.0019	–0.0003***	0.0007	0.0002	–0.0019***
	(0.0007)	(0.0010)	(0.0023)	(0.0001)	(0.0007)	(0.0003)	(0.0004)
CH	0.0081***	0.0077**	0.0004	–0.0045***	0.0127***	0.0108***	0.0022
	(0.0027)	(0.0037)	(0.0087)	(0.0003)	(0.0027)	(0.0010)	(0.0017)
State	–0.0002	0.0005	–0.0002	–0.0003	0.0029	0.0024***	0.0007
	(0.0009)	(0.0016)	(0.0021)	(0.0006)	(0.0018)	(0.0009)	(0.0011)
Foreign	0.00004	0.0011	–0.0016	–0.0050***	0.0001	–0.0021*	0.0077***
	(0.0019)	(0.0032)	(0.0044)	(0.0005)	(0.0020)	(0.0011)	(0.0013)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	6,129	4,871	1,258	1,669	4,460	2,945	3,184

(*Continued on next page*)

Table 3 (*Continued*)

Variables	All firms	Pre-COVID-19	COVID-19	SOE	Non-SOE	HSX	HOSE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AR2	0.1285	0.1036	0.1522	0.1802	0.1851	0.0563	0.5501
Hansen	0.1291	0.2167	0.1295	0.1016	0.1394	0.1182	0.1198

Notes: The table presents the results for all firms using Equation (1). INV is capital expenditure and CF denotes cash flow. Control variables include firm size (Size), debt ratio (Lev), Tobin's Q (TobinQ), cash holdings (CH), state (State), and foreign (Foreign) ownership. Robust standard errors are in brackets. *, ** and *** are significance levels at 0.1, 0.05 and 0.01, respectively.

When investigating the link between cash flow and investment, the potential effects of firms' different financial situations should be considered. Equation (1) is subsequently re-estimated under two distinct scenarios, denoted as financial constraints and unconstraints. The results are presented in Table 4. In columns 1 and 2, we use the method Frank and Goyal (2003) to measure deficit value:

> Deficit = (dividend + investments + change in working capital – operating cash flow after interest and taxes)/ Total assets

If the deficit value is larger than 0, the firm is in deficit and vice versa. In columns 3 and 4, the paying-dividend situation is used to recognise financial constraints, in which firms not paying dividends belong to the "constrained" group. Then, positive and negative cash flows define firms as less- or more-constrained firms, respectively. In short, when employing different financial constraint classification criteria, including deficit value, dividend pay-out situation, and the magnitude of cash flow, the U-shaped relationship is still found.

Table 4
Investment-cash flow sensitivity of more- and less-constrained firms

Variables	Deficit	Surplus	Not pay dividend	Pay dividend	CF < 0	CF > 0
	(1)	(2)	(3)	(4)	(5)	(6)
INV	0.8012***	0.2250***	0.6580***	0.7116***	0.5733***	0.8175***
	(0.0066)	(0.0009)	(0.0017)	(0.0012)	(0.0039)	(0.0047)
CF	–0.2505***	–0.0760***	–0.0275***	–0.0533***	–0.0216***	–0.1304***
	(0.0134)	(0.0007)	(0.0014)	(0.0022)	(0.0016)	(0.0066)
CF^2	0.6783***	0.2066***	0.0387***	0.1627***	0.2266***	0.2836***
	(0.0376)	(0.0009)	(0.0031)	(0.0057)	(0.0207)	(0.0179)
Size	0.0011***	0.0009***	0.0013***	0.0011***	0.0007***	0.0003**
	(0.0003)	(0.0001)	(0.0002)	(0.0001)	(0.0002)	(0.0002)
Lev	–0.0150***	–0.0070***	–0.0161***	–0.0123***	–0.0219***	–0.0097***
	(0.0021)	(0.0002)	(0.0007)	(0.0006)	(0.0013)	(0.0014)

(*Continued on next page*)

Table 4 (*Continued*)

Variables	Deficit	Surplus	Not pay dividend	Pay dividend	CF < 0	CF > 0
	(1)	(2)	(3)	(4)	(5)	(6)
TobinQ	–0.0002	–0.0014***	0.0019***	–0.0011***	–0.0008***	0.0011*
	(0.0008)	(0.0001)	(0.0002)	(0.0002)	(0.0003)	(0.0006)
CH	0.0042	0.0057***	–0.0004	–0.0003	0.0071***	0.0046**
	(0.0035)	(0.0003)	(0.0008)	(0.0010)	(0.0018)	(0.0023)
State	0.0001	–0.0038***	0.0020***	–0.0010*	0.0029***	–0.0003
	(0.0015)	(0.0002)	(0.0006)	(0.0005)	(0.0011)	(0.0008)
Foreign	–0.0008	–0.0006	–0.0093***	–0.0015*	0.0018	0.0012
	(0.0027)	(0.0005)	(0.0009)	(0.0008)	(0.0027)	(0.0016)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	4,975	1,154	2,243	2,904	496	5,629
AR2	0.1411	0.1947	0.0615	0.8931	0.3595	0.1473
Hansen	0.2382	0.1254	0.1613	0.1102	0.1763	0.1125

Notes: The table presents the results for 2 subsets, including more and less constrained firms, using Equation (1). INV is capital expenditure and CF denotes cash flow. Control variables include firm size (Size), debt ratio (Lev), Tobin's Q (TobinQ), cash holdings (CH), state (State), and foreign (Foreign) ownership. Robust standard errors are in brackets. *, **, *** are significance levels at 0.1, 0.05 and 0.01, respectively.

THE BUSINESS LIFE CYCLE'S ROLE

Inspired by Hovakimian's (2009) study, we further investigate the sensitivity of investment to cash flow over the four phases of the firm life cycle. Firm stages are classified following Dickinson's (2011) study, which suggests that the pattern of corporate cash flow is a reliable measure of the firm's life cycle. Dickinson (2011) argues that changes in cash flow reflect a firm's reactions to changes happening within and outside the firm environment. Table 5 presents the method of Dickinson (2011) to define firm stages of life.

Table 5
Business stages classification

Cash flow components	Introduction	Growth	Maturity	Decline
Operating	-	+	+	-
Investment	-	-	-	+
Financing	+	+	-	+ or -

The estimated coefficients of CF and CF_squared over the four different stages of business life are presented in Table 6. The non-linear association between investment and cash flow is validated across all stages of corporate life, spanning from introduction to decline. It is noteworthy that while companies in the introductory and growth stages exhibit the inverted U-shaped sensitivity, those in the maturity and decline stages display a U-pattern. We predict that during the first two stages of life, firms have many investment opportunities, and they have a tendency to invest more using internal cash flow resources, leading to a positive relationship between the investment and cash flow. Due to the abundance of development opportunities during these periods, investment continues to rise even as cash flow declines, as reflected by the negative coefficients of CF_squared. This results in an increased demand for external sources. For the maturity and decline stages, the observed tendency of cash flow sensitivity is similar to our baseline findings. We expect that cash flow accumulates significantly during these last two stages while firms face limited investment opportunities. However, if firms adopt successful strategies to enhance their market positions, cash flow may have a positive impact on investment as new recovery opportunities emerge.

Table 6
Investment–cash flow sensitivity over business life cycle

Variables	Introduction	Growth	Maturity	Decline
	(1)	(2)	(3)	(4)
INV	0.3609***	0.3303***	0.4416***	0.7368***
	(0.0021)	(0.0030)	(0.0025)	(0.0070)
CF	0.0430***	0.0456***	–0.0469***	–0.0921***
	(0.0024)	(0.0031)	(0.0040)	(0.0048)
CF^2	–0.1607***	–0.2351***	0.0825***	0.2845***
	(0.0078)	(0.0089)	(0.0091)	(0.0116)
Size	0.0026***	0.0046***	0.0016***	0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Lev	–0.0103***	–0.0324***	–0.0243***	–0.0177***
	(0.0004)	(0.0008)	(0.0009)	(0.0012)
TobinQ	–0.0003	0.0038***	–0.0032***	0.0044***
	(0.0002)	(0.0003)	(0.0002)	(0.0003)
CH	0.0064***	0.0135***	–0.0103***	–0.001
	(0.0010)	(0.0016)	(0.0009)	(0.0017)
State	0.0041***	–0.0087***	–0.0015	0.0014
	(0.0005)	(0.0014)	(0.0010)	(0.0011)
Foreign	–0.0057***	–0.0250***	–0.0032**	–0.0052***
	(0.0007)	(0.0015)	(0.0015)	(0.0018)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes

(*Continued on next page*)

Table 6 (*Continued*)

Variables	Introduction	Growth	Maturity	Decline
	(1)	(2)	(3)	(4)
N	981	1,033	2,100	738
AR2	0.1409	0.9522	0.6550	0.1332
Hansen	0.3110	0.2071	0.1842	0.1079

Notes: The table presents the results for four stages of business life using Equation (1). INV is capital expenditure and CF denotes cash flow. Control variables include firm size (Size), debt ratio (Lev), Tobin's Q (TobinQ), cash holdings (CH), state (State), and foreign (Foreign) ownership. Robust standard errors are in brackets. *, ** and *** are significance levels at 0.1, 0.05 and 0.01, respectively.

Next, we follow Hovakimian (2009) to use firm age to define business stages. The thresholds of 15 and 30 are suggested by Brown and Medoff (2003)[3] and Coad et al. (2016) when 5 is popularly used to define young firms (see Coad et al., 2018; Fort et al., 2013). As shown in Table 7, when using firm age as an alternative measurement of a firm life cycle, the results are basically in line with the outcomes presented in Table 6, except for firms younger than 5 years and those older than 30 years. We expect that the limited number of observations for these two groups may be a contributing factor.

Table 7
Investment–cash flow sensitivity over business life cycle – Robustness check

Variables	Age ≤ 5	5 < Age ≤ 15	15 < Age ≤ 30	30 < Age
	(1)	(2)	(3)	(4)
INV	0.7686***	0.6470***	0.4471***	0.8139***
	(0.0346)	(0.0018)	(0.0010)	(0.0126)
CF	0.1277	0.0245***	–0.0228***	–0.0053
	(0.1718)	(0.0029)	(0.0024)	(0.0211)
CF^2	–0.3343	–0.1550***	0.0221***	–0.0314
	(0.4516)	(0.0070)	(0.0045)	(0.0697)
Size	0.001	0.0014***	0.0019***	0.0005
	(0.0019)	(0.0001)	(0.0002)	(0.0006)
Lev	0.0107	–0.0119***	–0.0300***	–0.0104***
	(0.0148)	(0.0007)	(0.0008)	(0.0024)
TobinQ	0.0037	0.0020***	–0.0032***	0.0017**
	(0.0062)	(0.0002)	(0.0002)	(0.0007)
CH	0.0076	0.0052***	0.0142***	–0.0075
	(0.0100)	(0.0011)	(0.0008)	(0.0045)
State	–0.0076	–0.0009	–0.0185***	0.0027*
	(0.0062)	(0.0007)	(0.0006)	(0.0016)
Foreign	0.0097	–0.0055***	–0.0123***	–0.0025
	(0.0561)	(0.0010)	(0.0008)	(0.0031)

(*Continued on next page*)

Table 7 (*Continued*)

Variables	Age ≤ 5	5 < Age ≤ 15	15 < Age ≤ 30	30 < Age
	(1)	(2)	(3)	(4)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
N	188	3,794	1,878	269
AR2	0.8046	0.1447	0.5581	0.2472
Hansen	0.3335	0.2150	0.1632	0.5860

Notes: The table presents the results for firms in different age groups, using Equation (1). INV is capital expenditure and CF denotes cash flow. Control variables include firm size (Size), debt ratio (Lev), Tobin's Q (TobinQ), cash holdings (CH), state (State) and foreign (Foreign) ownership. Robust standard errors are in brackets. *, ** and *** are significance levels at 0.1, 0.05 and 0.01, respectively.

CONCLUSION

By investigating a sample of Vietnamese listed companies during the time frame from 2010 to 2021, this article demonstrates a non-linear investment–cash flow relationship, which consistently holds across a range of firms' financial positions and ownership structures. This revelation provides novel perspectives to the ongoing discussion on investment and cash flow dynamics within emerging economies. Interestingly, the study finds that the presence of this U-pattern is absent under the influence of the COVID-19 pandemic. When considering the business life cycle, the results show that while companies in the two first stages of business life exhibit the inverted U-shaped sensitivity, those in the maturity and decline stages display a U-pattern.

This study, firstly, adds new evidence to the current corporate finance literature about the significant non-linear relationship between investment and cash flow sensitivity across diverse corporate contexts. The findings further confirm the influence of the firm's business life cycle on investment decisions. Given that the research is conducted in the Vietnamese market, a representative emerging market known for its dynamic financial environment, our study contributes to a deeper understanding of corporate decisions in emerging markets. Second, the outcome brings attention to the potential implications of the COVID-19 pandemic, which notably diminish the significance of the investment-cashflow relationship.

Practically, the findings provide valuable insight for various stakeholders. It suggests that firm managers should tailor their investment strategies and financial planning to align with the characteristics of each stage in the business life cycle. For instance, during the introduction and growth phases, managers need to

thoroughly plan for alternative funding sources to better respond to the increased investment opportunities. The rationale is that a firm at these stages may have insufficient internal funds to finance its profitable investment opportunities. From the investors' perspective, it is also crucial to consider the stages of the business life cycle when investing in a firm, as a firm's ability to transform internal cash flow into investment and ultimately to its growth can vary significantly depending on its current stage in the cycle. For policymakers, our findings imply the importance of considering the business life cycle when formulating regulations. For example, start-ups and firms in growth stages should be given broader access to venture capital, grants, and loans. In contrast, established and declining firms would benefit more from higher support for strategic investments in research and development or modernisation.

NOTES

1. Ownership structure is one of the most important determinants as shown by Derouiche et al. (2018) and Ding et al. (2019).
2. The unfavoured influence of outlier observations in financial data has been acknowledged widely so it is common to winsorise variables' each tail at 0.5% or 1% (Frank & Goyal, 2008).
3. These authors use 15, 30 and 60 but in our sample, the number of firms older than 60 years old is too small to run regression.

ACKNOWLEDGEMENT

This research is funded by the Ministry of Education and Training (Vietnam) under project number B2024.DNA.20.

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APPENDIX

Appendix A

Variable definition

Variable	Definition	Measurement
Inv	Total investment	Value of capital expenditure excluding sale of property, plant and equipment/Lagged total assets
CF	Cash flow	The sum of earnings before extraordinary items and depreciation/Lagged total assets
Size	Firm size	Natural logarithm of total assets
Lev	Book leverage	Total debt/Total assets
TobinQ	Tobin's Q	Market over book value of firms
CH	Cash holdings	Cash and cash equivalents/Total assets
Profit	Profitability	Earnings before interest, depreciation and taxes/ Total assets
Foreign	Foreign ownership	Number of shares hold by foreign investors/ Total outstanding shares
State	State ownership	Number of shares hold by the state / Total outstanding shares