APPLIED ECONOMETRICS GROUP ASSIGNMENT

STOCK LIQUIDITY AND CORPORATE FUTURE INVESTMENT

A Report on

Stock Liquidity and Corporate Future Investment

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Introduction

This research investigates the influence of stock liquidity on future investments in India. A positive relationship between future investments and stock liquidity is expected since stock liquidity is an essential factor in the cost of equity. In the corporate finance literature, the relationship between stock market liquidity and corporate dividends and reinvestments has long been a source of debate. Because the cost of equity is a factor in discounting future cash flows, it is logical to predict that a decrease in the cost of equity produced by increased stock liquidity will eventually result in increased future investment growth. This study looks at the influence of stock liquidity on future investments from a strictly Indian perspective. India is an emerging market; thus, financial constraints are more severe. Due to a lack of external capital, a financially constrained company may be more responsive to a lower cost of equity achieved through increased liquidity. This report also attempts to determine whether the stock liquidity effect differs amongst enterprises with varying levels of constraints. Multiple well-recognized metrics have to be used to represent this analysis's financial constraints.

The hypothesis for this paper:

- H1: When other variables are held constant, a firm's stock liquidity has a beneficial impact on future investments due to the lower cost of equity.
- H2: When other variables are held constant, the impact of stock liquidity on future investments is more substantial in more financially restricted enterprises due to limited access to alternative external resources.

A modified version of the well-known corporate investment equation has been utilized to conduct a baseline regression of the liquidity relation, whose explanatory variables also include free cash flow, sales, and leverage to complete the model. Two-stage panel regressions have been employed to solve the potential endogeneity problem, while the Kleibergan–Paap test and Hansen's J Test, and Huber-White Corrected standard errors have been employed to ensure the validity of the instrumental variables used.

Multiple proxies for liquidity and financial constraints have been used to obtain results. Turnover ratio and the widely used Amihud ratio (e.g., Amihud, 2002; Amihud, Hameed, Kang, & Zhang, 2015; Bai & Qin, 2015; Karolyi et al., 2012) have been used to represent liquidity, while three metrics have been used to describe financial constraints.

Literature Review

Liquidity in stock securities and associated effects on several financial variables, including investment, have been extensively discussed in economic Literature within diverse geographical and financial settings. A growing amount of empirical work explores the relationship between corporate finance and the microstructure of a company's stock market. This association has been studied through multiple complex angles.

Several reports have produced supporting evidence for the claim that an increase in stock liquidity augments future corporate investments. The influence of stock liquidity on future investment in firms listed on the Tehran Stock Exchange was investigated by **Nadafi and Pourali (2020).** According to the study's findings, stock illiquidity has a negative and considerable impact on the company's future investment. The results reveal no statistically significant difference between stock liquidity and future corporate investment in large and small firms, as well as organizations with information symmetry and asymmetry.

Amihud and Levi (2019) argued that stock market liquidity impacts business investment and output. Findings from the report stated that since illiquidity raises enterprises' cost of capital, it reduces investment in capital assets, R&D, and inventories. After correcting for endogeneity with exogenous liquidity shocks, the 2001 decimalization, and the 1997 Nasdaq reform, this influence continues. Regardless of a firm's financial restrictions, illiquidity impacts investment.

Using data from four Latin American nations as a sample (Argentina, Brazil, Chile, and Mexico), **Munoz (2013)** discovered that liquidity has a beneficial influence on future investments. This benefit is less evident in big businesses and firms with a larger book-to-market ratio but more pronounced in share-issuing enterprises.

Studies have scrutinized the stock liquidity and investment relationship for firms with differentiated financial constraints. **Alhassan and Naka (2020)** researched the linkage between stock market liquidity and corporate investment decisions for numerous firms from 21 emerging nations, emphasizing stock liquidity interaction with firms' financial constraints and the extent of development of the financial ecosystem of the host nation.

Gopalan, Kadan, and Pevzner (2009) made a model that generates predictions on how the relationship between asset liquidity and stock liquidity will vary with a firm's investment opportunities and financial constraints. In their empirical investigation, they put the model's predictions to the test and found strong support.

Quah, Haman, and Naidu (2020) showed that increasing stock liquidity has a more significant impact on decreasing under-investment in businesses with more financial restrictions. The findings imply that stock liquidity is more ubiquitous in this context for enterprises with severe financial limitations and information asymmetry issues.

Riddiough and Wu (2009) identified the significant disparities in business investment and liquidity management strategies, with more (less) financially limited companies in selected samples exhibiting high (low) investment and liquidity management sensitivity to factors measuring financial market frictions.

Lins, Strickland, and Zenner (2005) and Hail and Leuz (2009) use cross-listings in the United States to investigate how the degree of financial restriction affects the number of advantages a firm may obtain from an increase in liquidity.

Certain studies inspected the repercussion of stock illiquidity through leverage and transaction and banking fees channels. Lowering the cost of equity, according to Lipson and Mortal (2009), promotes managers to employ stock rather than debt. They discover a significant inverse link between a firm's leverage and stock liquidity. Improved leverage position significantly impacts firms' ability to undertake investment projects. **Asem, Chung, Cui, and Tian (2016)** investigated the impact of market liquidity on Indian firms' cost of raising external capital from secondary debt markets.

According to the researchers, investment banking fees are higher in seasoned equity offerings (SEOs), and the price discount is more significant for firms with less liquid equities. **Butler, Grullon, and Weston (2005)** and **Gao and Ritter (2010)** confirmed these effects.

Higher stock market illiquidity hurts equity issuance over time across global markets resulting in a long-term detrimental impact on the investment opportunity set, as seen in a study done by **Hanselaar, Stulz, and van Dijk (2016).**

Stock addition to recognized market indexes is often associated with an elevation in stock liquidity. Such exogenous liquidity shocks have been documented and researched extensively to determine the significance of the effect of liquidity on various financial metrics. **Becker-Blease and Paul (2008)** examined the relationship between stock liquidity and investment opportunities in a sample of firms that had experienced an extrinsic liquidity dump as a result of S&P 500 index additions and discovered a positive correlation between changes in capital expenditures and changes in stock liquidity, indicating that stock liquidity influences corporate investment decisions. This relationship is consistent with an equity liquidity premium and is unaffected by numerous indications of growth potential. When the cost of borrowing falls, an increase in liquidity effectively widens the set of positive NPV projects. Liquidity-enhancing events, according to the research, assist shareholders in diversifying their growth options.

On the other hand, **Gregoriou and Nguyen (2010)** observed no statistically significant relationship between stock liquidity and investment opportunities for firms that experienced an external negative liquidity shock as a consequence of deletion from the FTSE100 Stock Index. These findings contradict sharply with the stated favorable relationship between liquidity and investment possibilities in US equities markets. Because there is no substantial change in the cost of capital, this one-of-a-kind outcome on the London Stock Exchange implies that removal from a primary stock index does not affect business investment choices.

Mazouz, Daya, and Yin (2014) later reaffirmed the preexisting findings and showed that adding a business to the FTSE100 index decreases liquidity risk and lowers stock cost; however, index removals have no meaningful effect on liquidity risk or the cost of equity and subsequently, concerning firm's investment decisions.

While several reports provide evidence regarding the advantages emerging from an increase in stock liquidity**, Fang, Tian, and Tice (2014)** discovered that more liquidity reduces future innovation and hence the quality of corporate capital investments. Two plausible methods by which liquidity impedes innovation were identified: increased exposure to hostile takeovers and a more significant presence of institutional investors who do not actively participate obtain or analyzing information.

Cash dividend and stock repurchase duality is another well-reviewed channel through which stock liquidity affects firm activities and investments decisions. **Banerjee, Gatchev, and Spindt (2007, 2009)** provided evidence regarding a relationship between a company's dividend policy and stock market liquidity. Stock liquidity seems to have a negative impact on cash dividends received by common stockholders. Predictions of the share of dividend payers based on cross-sectional estimates from 1963 to 1977 account for the majority of the decline in the propensity of enterprises to pay dividends, as reported by Fama and French (2001).

Similar results were obtained by **Brockman, Howe, and Mortal (2008),** who found that companies with better liquidity are more likely to employ repurchases than cash dividends.

Jiang, Ma, and Shi (2017) investigated the informational link between stock liquidity and payments and discovered that payouts rise with market liquidity due to information asymmetry's lower cost.

Increased stock liquidity also has a behavioral impact on institutional ownership and firm management. **Agarwal (2007)** studied the relationship between institutional ownership and stock liquidity, emphasizing the influence of institutional knowledge advantage on liquidity. He showed that institutional investor characteristics such as investment horizon and risk aversion impact liquidity. Liquidity declines when the proportion of equities held by long-term investors increases, as does institutional investors' risk aversion, which results in more speculative corporate investments.

The relationship between Stock Liquidity and investment has been modeled using various econometric methods.

Gregoriou and Nguyen (2010) observed the association between stock liquidity and investment possibilities for enterprises using a multivariate testable relationship. Because the investment opportunity set is unobservable, capital expenditure is employed as a proxy for it, and capital expenditures indicate organizational efforts to capitalize on existing investment possibilities. In a manner similar to **Denis (1994)**, they have utilized capital expenditure as a proxy for the investment opportunity set. Capital spending was regressed on stock market liquidity, business size, and book-to-market equity. The GMM estimator developed by Blundell and Bond (1998) has also been utilized to capture the possibilities of endogeneity and joint determination between stock liquidity and the investment opportunity set in this empirical model system.

Research Gap in Existing Literature

This paper primarily aims to plug two significant gaps within the Current Literature. A vast majority of reports documenting the analysis of the relationship between stock liquidity and corporate investments have been conducted on data samples from developed nations. Replicating similar studies in financial markets across several emerging countries is paramount. This report aims to examine the linkage between stock liquidity and investment in the Indian ecosystem. Many findings in the domain have been tabulated through relatively small suboptimal sample sizes, which might not capture the nuisances of several diverse firms and industries. This report aims to conduct a study on more than 300 Indian firms to provide a meticulous assessment of the effect of stock liquidity on corporate investments.

Another field that displays the inadequacy in the existing Literature is the subpar modeling of the financial constraints and liquidity. Several reports have used a singular metric to account for financial constraints. The severity of financial constraints Indian firms face in general differs vastly from their counterparts from developed nations due to the relatively inefficient financial market. Multiple metrics tracking the financial constraints are imperative to provide an unbiased assessment. This report has used three noted metrics, the KZ. Index d(Kaplan and Zingales, 1997), firm leverage (Greenaway, Guariglia, and Kneller, 2007), and firm payout ratio (Lamont et al., 1998), to identify the varying level of financial restriction. To circumvent potential bias brought by the metric of choice, this report has also used two proxies for liquidity, Amihud (Amihud, 2002) and Turnover Ratio.

Objectives

The report aims to achieve two primary objectives:

1) To estimate the effect of a firm's stock liquidity on its future corporate investments using a modified variant of the corporate investment equation using multiple metrics as proxies for stock liquidity and multiple future time periods to observe investments being carried out.

2) To observe the significance of the effect of a firm's stock liquidity on its future corporate investments under a variable degree of financial constraints using a modified variant of the corporate investment equation and multiple proxy metrics for representing the severity of financial constraints.

Methodology

Mathematical Model

We employ the well-known corporate investment equation and modify it for our empirical study to investigate the effect of future company investments on stock liquidity. We begin by estimating the following baseline regression model for the first objective:

$$\frac{I_{i,t+j}}{TA_{i,t}} = \alpha_i + \beta_1 Liquidity_{i,t} + \beta_2 \frac{FCF_{i,t+j}}{TA_{i,t}} + \beta_3 \frac{Leverage_{i,t}}{TA_{i,t}} + \beta_4 \frac{Sales_{i,t}}{TA_{i,t}} + \beta_5 \frac{Cash_{i,t}}{TA_{i,t}} + \beta_6 q_{i,t} + \varepsilon_{i,t}$$

- The capital expenditure (I) of the firm at time t + j is scaled by starting period total Assets (TA) is the dependent variable (I/TA).
- We also employ different future periods (j = 1, 2) because the gain in investment from the increase in stock liquidity may not manifest itself immediately.
- Beginning period total assets (TA) is also used to scale all independent variables except for Tobin's q and liquidity for robustness.

For the second objective, the following model will be employed where FC represents Financial Constraint

$$\frac{I_{i,t+1}}{K_{i,t}} = \alpha_i + \alpha_t + \beta_1 Liquidity_{i,t} + \beta_2 (Liquidity_{i,t} \times FC_{i,t}) + \beta_3 \frac{FCF_{i,t+1}}{TA_{i,t}} + \beta_4 \frac{Leverage_{i,t}}{TA_{i,t}} + \beta_5 \frac{Sales_{i,t}}{TA_{i,t}} + \beta_6 \frac{Cash_{i,t}}{TA_{i,t}} + \beta_7 q_{i,t} + \varepsilon_{i,t}$$

FC is included in the investment equation as the interaction term because our financial constraint determinants are potentially time-variant.

Discussion of explanatory variables

The primary explanatory variable is ***liquidity.*** We use two well-known proxies for a company's stock liquidity, Amihud, and Turnover. They only require daily frequencies and have been used in previous studies that analyze multiple firm data (e.g., Amihud, 2002; Amihud, Hameed, Kang, & Zhang, 2015; Bai & Qin, 2015; Karolyi et al., 2012). According to our first hypothesis, stock liquidity will improve future investments, and hence coefficient β_1 is expected to be positive.

We multiply the original Amihud's illiquidity metric by a negative one to get a liquidity measure:

$$Amihud_{i,d} = -log\left(1 + \frac{|R_{i,d}|}{P_{i,d} VO_{i,d}}\right) * (10^4)$$

where $R_{i,d}$ is the daily return in Rupees, $P_{i,d}$ is the daily price in Rupees, and $VO_{i,d}$ is the daily volume. A multiple of 10^4 was introduced to scale the variable appropriately following Sen (2015).

Turnover is defined as:

$$Turnover_{i,d} = log\left(1 + \frac{VO_{i,d}}{Shares_{i,y}}\right)$$

where $Shares_{i,y}$ is the total number of outstanding shares annually.

We introduce several control variables identified in previous studies to capture some of the changes in corporate investment among the firms and to avoid omitted variable bias. They are as follows:

- ***Free cash flow (FCF)*** is the sum of earnings before interest, taxes, depreciation, and dividends at time t + 1 or t + 2. Fazzari et al. (1988) believe that firms' corporate investments are favorably related to their internal financing capability since external financing is expensive. A positive coefficient β_2 is expected, consistent with the investment–cash sensitivity hypothesis.
- ***Leverage*** is defined as total debt. The smaller the debt capacity or ability to raise funds when needed, the higher the leverage. According to Lang, Ofek, and Stulz (1996) and Hovakimian (2009), leverage negatively links future investments. As a result, we anticipate a negative value for β_3.
- ***Sales*** is defined as Total revenue. Sales are included in the corporate investment equation as a proxy for productivity by Hoshi, Kashyap, and Scharfstein (1991) and Lins et al. (2005). Sales may have an accelerator effect on corporate investments. When firms' productivity rises sharply, they are more likely to invest, and we predict β_4 to be good.
- ***Cash*** is defined as total cash and liquid asset holdings. Cash holdings represent a company's financial slack. According to Myers and Majluf's (1984) model, organizations with more financial margins are more likely to be able to pursue positive NPV initiatives when there is information asymmetry. Results from Love (2003) and Lins et al. (2005), among others, are in line with this prediction. As a result, we anticipate a positive β_5.
- ***Tobin's q*** is the sum of the market value of equity and the book value of debt, divided by T.A. Tobin's q is included in the regression equation to account for changes in growth opportunities. The greater a company's Tobin's q, the more prospects for growth it has. Other research has revealed a link between positive relation between Tobin's q and future investments, and we predict β_6 to be the same.

Three metrics will be considered to represent the degree of financial constraint.

- ***Firm Leverage Ratio*** is an indicator of financial restrictions (e.g., Greenaway, Guariglia, & Kneller, 2007). It is calculated by dividing long-term debt by TA. We expect high-leverage companies to have a lower debt capacity or the ability to raise extra money to fund new projects. To compensate for industry heterogeneities across industries, we use Lang et al. (1996)'s industry adjustment technique.
- ***Payout Ratio*** is another widely used proxy for financial restrictions. It is calculated by dividing the total of cash dividends and stock repurchases by net income before extraordinary items. Low-dividend companies have less internal financing capacity, making them more reliant on outside money to fund future initiatives (Hennessy & Whited, 2007). According to Fazzari, Hubbard, Petersen, Blinder, and Poterba (1988), financially unconstrained enterprises are more likely to have more excellent payout ratios.
- ***KZ. index*** is another proxy for financial restrictions used in various related studies and was established by Kaplan and Zingales (1997). They use annual data from limited businesses to create a scale variable that classifies companies according to their financial restrictions. The next run is an ordered logit regression on this scale variable based on various business variables.

The following formula has been used to compute the KZ. index.

$$KZ\ Index = \left(-1.001909 \times \frac{Cash\ flows}{K}\right) + (0.2826389 \times Q) + \left(3.139193 \times \frac{Debt}{Total\ capital}\right) + \left(-39.3678 \times \frac{Dividends}{K}\right) + \left(-1.314759 \times \frac{Cash}{K}\right)$$

where

$$Cash\ flows = Income\ before\ Extraordinary\ Items_t + Total\ Depreciation\ and\ Amortization_t$$

$$K = Plant, Property\ and\ Equipment_{t-1}$$

$$Q = \frac{(Market\ Capitalization_t + Total\ Shareholder's\ Equity_t - Book\ Value\ of\ Common\ Equity_t - Deferred\ Tax\ Assets_t)}{Total\ Shareholder's\ Equity_t}$$

$$Debt = Total\ Long\ Term\ Debt_t + Note\ Payable_t + Current\ Portion\ of\ Long\ Term\ Debt_t$$

$$Dividends = Total\ Cash\ Dividends\ Paid_t$$

$$Cash = Cash_t + Short\ Term\ Investments_t$$

Estimation Strategy

A total of 4 panel regressions were conducted under the first objective, and another 12 were performed for the second objective.

Two tests were conducted to ensure the state of the panel data before the model was selected: the **VIF test for multicollinearity** and the **White test for heteroskedasticity**.

Table 1

Objective 1		
	VIF Test Statistic	**White Test Chi - Statistic**
One Future period (j = 1), Liquidity Variable: Amihud Ratio	1.05	751.62
One Future period (j = 1), Liquidity Variable: Turnover Ratio	1.05	650.84
Two Future period (j = 2), Liquidity Variable: Amihud Ratio	1.05	771.83
Two Future period (j = 2), Liquidity Variable: Turnover Ratio	1.05	669.95
Objective 2		
	Firm Leverage Ratio	
	VIF Test Statistic	**White Test Chi - Statistic**
One Future period (j = 1), Liquidity Variable: Amihud Ratio	1.12	767.64
One Future period (j = 1), Liquidity Variable: Turnover Ratio	1.12	664.88
Two Future period (j = 2), Liquidity Variable: Amihud Ratio	1.1	784.09
Two Future period (j = 2), Liquidity Variable: Turnover Ratio	1.11	677.91
	Payout Ratio	
	VIF Test Statistic	**White Test Chi - Statistic**
One Future period (j = 1), Liquidity Variable: Amihud Ratio	1.04	771.61
One Future period (j = 1), Liquidity Variable: Turnover Ratio	1.05	653.05
Two Future period (j = 2), Liquidity Variable: Amihud Ratio	1.05	781.53
Two Future period (j = 2), Liquidity Variable: Turnover Ratio	1.06	679.03
	KZ Index	
	VIF Test Statistic	**White Test Chi - Statistic**
One Future period (j = 1), Liquidity Variable: Amihud Ratio	1.05	763.55
One Future period (j = 1), Liquidity Variable: Turnover Ratio	1.05	658.4
Two Future period (j = 2), Liquidity Variable: Amihud Ratio	1.06	777.6
Two Future period (j = 2), Liquidity Variable: Turnover Ratio	1.06	675.01

VIF test statistic greater than 5 indicates the presence of multicollinearity
The number of degrees of freedom for the White Test Chi Statistic is 27. Hence, the critical value at a 5% significance level is 40.113. The null hypothesis has been rejected for all panel regressions indicating the presence of heteroskedasticity.

VIF test indicated the absence of multicollinearity in the data for all panel regressions. **Huber- White-corrected standard errors** (clustered at the firm level) were adopted to account for serial dependency and heteroscedasticity in the residuals as indicated by the White test.

Tobin's q incorporation in the business investment equation introduces an endogeneity problem which can also arise due to measurement inaccuracies, according to Bond & Van Reenen (2008) and Almeida, Campello, and Galvao (2010). Following the recommendations of Almeida et al. (2010), a **two-stage Least Square panel regression** was utilized to remove the endogeneity problem with the variable Tobin's q being instrumented with two lags of its initial difference. To ensure the validity of the instrumental variables utilized in this research, we apply the **Kleibergen–Paap test** and **Hansen's J Test**.

Furthermore, **Durbin–Wu–Hausman tests** were conducted, which determined that the **Fixed Effects model** would be a better fit.

Table 3

Objective 1			
	Hausman Specification test - Statitstic	**Kleibergan-Paap P Value**	**Hansen J - P Value**
One Future period (j = 1), Liquidity Variable: Amihud Ratio	99.37	(0.0303)	(0.9638)
One Future period (j = 1), Liquidity Variable: Turnover Ratio	84.16	(0.0373)	(0.2388)
Two Future period (j = 2), Liquidity Variable: Amihud Ratio	70.14	(0.0312)	(0.9451)
Two Future period (j = 2), Liquidity Variable: Turnover Ratio	64	(0.0378)	(0.2315)
Objective 2			
		Firm Leverage Ratio	
	Hausman Specification test - Statitstic	**Kleibergan-Paap P Value**	**Hansen J - P Value**
One Future period (j = 1), Liquidity Variable: Amihud Ratio	98.77	(0.0301)	(0.9744)
One Future period (j = 1), Liquidity Variable: Turnover Ratio	83.29	(0.0372)	(0.2392)
Two Future period (j = 2), Liquidity Variable: Amihud Ratio	72.51	(0.0372)	(0.9840)
Two Future period (j = 2), Liquidity Variable: Turnover Ratio	64.51	(0.0393)	(0.2344)
		Payout Ratio	
	Hausman Specification test - Statitstic	**Kleibergan-Paap P Value**	**Hansen J - P Value**
One Future period (j = 1), Liquidity Variable: Amihud Ratio	93.15	(0.0306)	(0.9789)
One Future period (j = 1), Liquidity Variable: Turnover Ratio	78.71	(0.0380)	(0.2382)
Two Future period (j = 2), Liquidity Variable: Amihud Ratio	70.17	(0.0305)	(0.9395)
Two Future period (j = 2), Liquidity Variable: Turnover Ratio	64.77	(0.0371)	(0.2317)
		KZ Index	
	Hausman Specification test - Statitstic	**Kleibergan-Paap P Value**	**Hansen J - P Value**
One Future period (j = 1), Liquidity Variable: Amihud Ratio	66.63	(0.0267)	(0.9554)
One Future period (j = 1), Liquidity Variable: Turnover Ratio	43.1	(0.0312)	(0.2262)
Two Future period (j = 2), Liquidity Variable: Amihud Ratio	79.46	(0.0310)	(0.9447)
Two Future period (j = 2), Liquidity Variable: Turnover Ratio	70.86	(0.0374)	(0.2367)

The number of degrees of freedom for the Hausman Test Chi Statistic is 6. Hence, the critical value at a 5% significance level is 12.592. The null hypothesis has been rejected for all panel regressions indicating that the FE model should be preferred.
The under-identification test (Kleibergan–Paap) tests the null hypothesis that the correlation between the endogenous variable (q) and the instruments is zero. The over-identification test (Hansen's J) tests the null hypothesis that the correlation between the instruments and the error terms is zero. The validity of the estimation procedure requires the former to be statistically significant and the latter to be statistically insignificant. These two requirements hold for all results. These requirements are satisfied as the test stat for the KP test is significant at a 5% level for all panel regressions, and Hansen's J test stat is insignificant for all panel regressions.

Since the dependent variable is generally always between 0 and 1, logistic transformation $\ln[y/1-y]$ where y is the dependent variable, has been used to make it more suited for the regression framework (Karolyi, Lee, & Van Dijk 2012; Morck, Yeung, & Yu, 2000).

To avoid outliers, we take the natural logarithm of all the independent variables (except Tobin's q) and add one to them, as recommended by Malmendier and Tate (2005), rather than using other procedures that discard the information.

For the second objective, firms are ranked annually by the financial constraint metrics into four quartiles, and a dummy variable is constructed that takes the value 1 if the firm is assigned in the top ratio quartile and zero otherwise. The dummy variables for the leverage ratio, payout ratio, and KZ index are High_FLR, High_PR, and High_KZ, respectively. For firm leverage ratio and KZ index top quartile indicates the most financially constrained firms, while the for the payout ratio, the top quartile indicates the least financially constrained firms, hence hypothesizing that the effect of stock liquidity on future corporate investments is more pronounced for financially constrained firms, the coefficient of the liquidity and the FC dummy variable can be anticipated to be positive for leverage ratio and KZ index and negative for payout ratio.

Data Description

Initially, over 2053 NSE listed and permitted firms were considered, but several firms were eliminated subsequently.

- Firms from the Financial Services Industry were eliminated because several fundamental metrics used to develop the explanatory variables for the model would be invalid for these firms.
- The time period selected for the analysis lasts from 2006 to 2021; hence firms listed after 2006 and firms with an inadequate number of data points were also removed.
- The $\ln[y/1-y]$ logistic transformation was applied to the dependent variable to make it more suitable for the regression framework. Few firms with the dependent variable observations greater than one were dropped from the analysis to keep the panel data balanced. Similarly, firms with out of range values for independent variable FCF_{t+j} scaled by TA were also dropped to apply $\ln[1+x]$ logistic transformation.

Finally, 319 firms were considered for the analysis. Fundamental data from firms' annual reports to calculate the regression model inputs and the securities data to compute the liquidity proxy metrics, the Amihud Ratio, and the Turnover Ratio, were obtained from the **CMIE Prowess Database.** Refer to Appendix A for the calculation details.

Empirical Analysis

For the first objective, results of regression with multiple combinations of the proxies chosen for liquidity and future periods (j = 1,2) are presented in Table 4

Table 3 – Objective 1

	LT(I/TA_1)	LT(I/TA_2)	LT(I/TA_1)	LT(I/TA_2)
TQ	0.0201* (2.43)	0.01 (1.34)	0.0200* (2.41)	0.01 (1.32)
Amihud	0.0227* (2.33)	0.01 (1.04)		
Turnover			9.96* (2.67)	13.72 (1.08)
LT(FCF_1,2)	-4.037*** (-12.33)	-3.417*** (-9.79)	-4.047*** (-12.30)	-3.410*** (-9.81)
LT(Leverage)	0.25 (1.37)	0.36 (1.84)	0.29 (1.55)	0.38 (1.93)
LT(Sales)	2.269*** (11.05)	2.280*** (9.39)	2.256*** (11.05)	2.267*** (9.38)
LT(Cash)	-0.31 (-0.78)	-1.274* (-2.43)	-0.27 (-0.68)	-1.225* (-2.35)
Observations	3,828	3,509	3,828	3,509
R-squared	0.1369	0.1377	0.1388	0.1376
No. of Firms	319	319	319	319
No. of Observations	12	11	12	11
t statistics in parenthesis				
*** p<0.05 ** p<0.01 *** p<0.001**				
LT implies Logistic Transformation				

The first column presents the results of panel regression of CAPEX scaled by Total Assets (one future period ahead) on the Amihud ratio and other independent variables. The second column presents the results of panel regression of CAPEX scaled by Total Assets (two future periods ahead) on the Amihud ratio and other independent variables. The second and third columns represent results for panel regression conducted with the Turnover ratio. The future period for the FCF regressor is the same as the dependent variable in all cases.

The coefficient for the liquidity independent variable is positive in all cases for both proxy measures, Amihud and Turnover ratio, and are significant at a 5% level for one future period dependent variable but are insignificant for the two future periods dependent variable. This indicates that the gains in corporate investment from the increase in the firm's stock liquidity are more likely to be manifested in the following year and not after that. This confirms similar results obtained by Alhassan and Naka (2020) in their international analysis of the relationship between stock liquidity and future investment.

Positive coefficient values were expected for the FCF regressor going by the investment–cash sensitivity hypothesis, but the results revealed a strong negative and statistically significant relationship between capital expenditure and FCF. Since we had defined FCF as Net Cash flow from Operating Activities substracted by capital expenditure, a negative relationship indicates that there hasn't been a commensurate increase in Cash flow from Operating Activities.

The coefficients for the leverage independent variable, while positive, were insignificant in all cases. A positive and highly significant relationship was obtained between Sales and investments, confirming the previously stated hypothesis. The analysis also indicated a negative relationship between future corporate investments and cash holdings. The coefficients for the cash independent variable were only significant for two periods future dependent variable. Current Literature has produced contrasting evidence in this regard. While Anand et al. (2013) reported a positive relationship between cash holdings and CAPEX for Indian firms, Gupta and Bedi (2019) produced a study that suggested otherwise.

For the second objective, results from the analysis of all three financial constraint metrics satisfied the hypothesis that the effect of stock liquidity on future corporate investments is more pronounced for financially constrained firms. The coefficients for the interaction term between the FC dummy variable and the liquidity variable were positive for Firm Leverage Ratio and KZ index and negative for the payout ratio as was hypothesized, but the results were only significant for one future period investment dependent variable.

Key research findings

- An increase in a firm's stock liquidity positively influences future corporate investments. These gains in capital expenditure are more likely to be manifested in the year after there was an increase in stock liquidity and not after that.
- The positive relation between a firm's stock liquidity and future corporate investments is more prominent for financially constrained firms.

Table 4 – Objective 2

Firm Leverage Ratio				
	LT(I/TA_1)	LT(I/TA_2)	LT(I/TA_1)	LT(I/TA_2)
TQ	0.0199*	0.01	0.0200*	0.01
	(2.42)	(1.33)	(2.42)	(1.32)
Amihud	0.0150**	0.01		
	(2.75)	(0.86)		
Amihud X High_FLR	0.0447*	0.01		
	(2.43)	(0.46)		
Turnover			0.366*	10.43
			(2.04)	(0.92)
Turnover X High_FLR			24.77**	8.59
			(2.85)	(0.65)
LT(FCF_1,2)	-4.038***	-3.417***	-4.034***	-3.416***
	(-12.36)	(-9.79)	(-12.34)	(-9.79)
LT(Leverage)	0.25	0.36	0.23	0.36
	1.36	1.84	1.22	1.80
LT(Sales)	2.274***	2.281***	2.283***	2.276***
	11.07	9.41	11.26	9.46
LT(Cash)	-0.31	-1.274*	-0.29	-1.237*
	(-0.78)	(-2.43)	(-0.75)	(-2.37)
Observations	3,828	3,509	3,828	3,509
R-squared	0.1365	0.1376	0.1399	0.1375
No. of Firms	319	319	319	319
No. of Observations per Firm	12	11	12	11

Payment Ratio				
	LT(I/TA_1)	LT(I/TA_2)	LT(I/TA_1)	LT(I/TA_2)
TQ	0.0199*	0.01	0.0200*	0.01
	(2.42)	(1.33)	(2.41)	(1.32)
Amihud	-0.0227*	-0.008		
	(-2.34)	(1.04)		
Amihud X High_PR	-0.163***	(0.02)		
	(-4.49)	(-0.92)		
Turnover			-10.05	-14.11
			(-1.06)	(-1.15)
Turnover X High_PR			-0.643*	-2.91
			(-2.06)	(-0.25)
LT(FCF_1,2)	-4.039***	-3.416***	-4.046***	-3.410***
	(-12.34)	(-9.78)	(-12.29)	(-9.81)
LT(Leverage)	0.25	0.36	0.29	0.38
	(1.37)	(1.84)	(1.55)	(1.93)
LT(Sales)	2.273***	2.281***	2.256***	2.267***
	(11.06)	(9.39)	(11.03)	(9.38)
LT(Cash)	-0.31	-1.274*	-0.27	-1.226*
	(-0.78)	(-2.43)	(-0.68)	(-2.35)
Observations	3,828	3,509	3,828	3,509
R-squared	0.1369	0.1377	0.1387	0.1376
No. of Firms	319	319	319	319
No. of Observations per Firm	12	11	12	11

KZ Index				
	LT(I/TA_1)	LT(I/TA_2)	LT(I/TA_1)	LT(I/TA_2)
TQ	0.0202*	0.00902	0.0202*	0.00944
	(2.44)	(1.33)	(2.43)	(1.39)
Amihud	0.0226*	0.00764		
	(2.33)	(1.04)		
Amihud X High_KZ	0.0202*	0.00259		
	(2.66)	(0.11)		
Turnover			12.58	26.83*
			(1.16)	(1.98)
Turnover X High_KZ			7.626*	36.51**
			(2.85)	(3.84)
LT(FCF_1,2)	-4.038***	-3.417***	-4.044***	-3.382***
	(-12.33)	(-9.76)	(-12.31)	(-9.81)
LT(Leverage)	0.255	0.363	0.281	0.338
	(1.37)	(1.83)	(1.50)	(1.73)
LT(Sales)	2.269***	2.280***	2.255***	2.262***
	(11.04)	(9.39)	(11.03)	(9.35)
LT(Cash)	-0.306	-1.274*	-0.270	-1.247*
	(-0.78)	(-2.43)	(-0.69)	(-2.38)
Observations	3,828	3,509	3,828	3,509
R-squared	0.1368	0.1377	0.1388	0.1394
No. of Firms	319	319	319	319
No. of Observations per Firm	12	11	12	11

t statistics in parentheses
*** p<0.05 ** p<0.01 *** p<0.001**
LT implies Logistic Transformation

Four panel regressions similar to the analysis done for the first objective (refer to Table 2) are for each financial constraint metric with an additional regressor, an interaction term between liquidity, and a dummy variable for the financial constraint metric.

Conclusion and Policy Recommendations

This study attempts to investigate the relationship between stock liquidity and future investment decisions in the Indian financial ecosystem. The initial hypothesis for this study's primary objective states that the potential reduction in the cost of equity due to increases in stock liquidity influences investment growth. The secondary objective of this study is to determine whether this effect is more notable in financially constrained firms due to their limited access to other external capital.

Using a sample of 319 Indian firms for the period between 2006 and 2021, this analysis produces significant evidence for supporting the initial hypothesis for both objectives. Methodical research involving multiple metrics for liquidity (Amihud ratio and the Turnover ratio) and financial constraints (Leverage ratio, Payout Ratio, and KZ index) have produced supporting evidence confirming the initial conjecture.

These findings produce vital ramifications for policymakers and managers alike.

- Company management in growth companies should attempt to bolster liquidity through splits, cross-listing, meeting index criteria, etc.
- Financially constrained firms should direct more significant efforts toward increasing the firm's stock liquidity.
- Policymakers should recognize the need to improve aggregate liquidity to aid capital market expansion through liquidity-enhancing strategies such as opening the market to foreign investors or relaxing financial restrictions.

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Appendix

Appendix A – Metrics Calculation for CMIE Prowess Database

Metric	**CMIE Metric Calculation**
CAPEX (I)	Cash (outflow) due to purchase of fixed assets
FCF	Net cash flow from operating activities - CAPEX
Leverage	Long term borrowings excl current portion + Short-term borrowings + Current maturities of long term debt & lease
Sales	Total Income
Cash	Cash Balance + Bank balance (short term)
Total assets (TA)	Total assets
Book Value of Debt (BVD)	Long term borrowings excl current portion + Short term trade payables and acceptances + Current maturities of long term debt & lease
Firm Leverage Ratio	(Long term borrowings excl current portion) / Total assets
Payout Ratio	(Cash (outflow) due to dividend paid) / (Net profit before tax and extra ordinary items)
Tobin's Q	(Market Capitalization + BVD) / TA
KZ Index Input Calculations	
Q	(Market Capitalization + Net worth - Paid up equity capital (net of forfeited equity capital) - Deferred tax assets) / Net worth
Capital (K)	Net fixed assets (t-1)
Depreciation (DA)	Depreciation / Amortisation (net of transfer from revaluation reserves) + Amortisation
Cash Flows (CF)	Net profit before tax and extra ordinary items + DA
Total Capital	Total capital
Dividends	Cash (outflow) due to dividend paid
Cash	Cash Balance + Bank balance (short term)
Debt	BVD

Appendix B – VIF Test

As the name suggests, a variance inflation factor (VIF) quantifies how much the variance is inflated. But what variance? Recall that we learned previously that the estimated coefficients' standard errors — and hence the conflicts — are extended when multicollinearity exists. A variance inflation factor exists for each of the predictors in a multiple regression model. For example, the variance inflation factor for the estimated regression coefficient b_j —denoted VIF_j —is just the factor by which the variance of b_j is "inflated" by the existence of correlation among the predictor variables in the model.

In particular, the variance inflation factor for the j^{th} predictor is:

$$VIF_j = \frac{1}{1 - R_j^2}$$

Where R^2_j is the R^2-value obtained by regressing the j^{th} predictor on the remaining predictors.

A VIF of 1 means that there is no correlation between the j^{th} predictor and the remaining predictor variables, and hence the variance of b_j is not inflated at all. The general rule of thumb is that VIFs exceeding four further warrant investigation, while VIFs exceeding 10 are signs of serious multicollinearity requiring correction.

Appendix C – White Test

In econometrics, a widespread test for heteroskedasticity is the White test, which begins by allowing the heteroskedasticity process to be a function of one or more of your independent variables. It's similar to the Breusch-Pagan test, but the White test allows the independent variable to have a nonlinear and interactive effect on the error variance.

The null hypothesis for White's test is that the variances for the errors are equal. In math terms, that's:

$$H_0 = \sigma^2_i = \sigma^2$$

The alternate hypothesis (the one we're testing), is that the variances are not equal:

$$H_1 = \sigma^2_i \neq \sigma^2$$

The only difference between White's test and the Breusch-Pagan is that its auxiliary regression doesn't include cross-terms or the original squared variables. Other than that, the steps are exactly the same.

The White test is based on the estimation of the following:

$$\hat{\varepsilon}_i = \alpha_0 + \alpha_1 X_{i1} + \cdots + \alpha_p X_{ip} + \alpha_{p+1} X_{ip}^2 + \cdots \alpha_{2p} X_{ip}^2 + \alpha_{2p+1}(X_{i1} X_{i2}) + \cdots + u_i$$

Alternatively, a White test can be performed by estimating

$$\hat{\varepsilon}_i = \delta_0 + \delta_1 \hat{Y}_i + \delta_2 \hat{Y}_i^{\,2}$$

where $\hat{Y}_i$ represents the predicted values from

$$\hat{Y}_i = \hat{\beta}_0 + \hat{\beta}_1 X_{i1} + \cdots + \hat{\beta}_p X_{ip}$$

Appendix D – Hausman Test

The Hausman Test (also called the Hausman specification test) detects endogenous regressors (predictor variables) in a regression model. Endogenous variables have values that are determined by other variables in the system. Having endogenous regressors in a model will cause ordinary least squares estimators to fail, as one of the assumptions of OLS is that there is no correlation between a predictor variable and the error term. Instrumental variables estimators can be used as an alternative in this case. This test is also called the Durbin–Wu–Hausman (DWH) test or the augmented regression test for endogeneity.

The Hausman test is sometimes described as a test for model misspecification. In panel data analysis (the analysis of data over time), the Hausman test can determine a better fit between a fixed-effects model or a random-effects model. The null hypothesis is that the preferred model is random effects; The alternate hypothesis is that the model has fixed effects. Essentially, the tests look to see if there is a correlation between the unique errors and the regressors in the model. The null hypothesis is that there is no correlation between the two.

Appendix E –Hansen's J Test

The Sargan–Hansen test, often known as Sargan's J or Hansen's J test, is a statistical test for determining if a statistical model has over-identifying restrictions. It was proposed by John Denis Sargan in 1958[1], and he developed numerous variations in 1975. Lars Peter Hansen went over the derivations again and demonstrated that they could be used to general nonlinear GMM in a time series context.

The Sargan test assumes that model parameters are identified via a priori restrictions on the coefficients and tests the validity of over-identifying restrictions. The test statistic can be computed from residuals from instrumental variables regression by constructing a quadratic form based on the cross-product of the residuals and exogenous variables. Under the null hypothesis that the over-identifying restrictions are valid, the statistic is asymptotically distributed as a chi-square variable (m - k) degrees of freedom (where m is the number of instruments and k is the number of endogenous variables).