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Article

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FINANCIAL ECONOMICS | RESEARCH ARTICLE

Liquidity-adjusted CAPM — An empirical analysis on Indian stock market

Gaurav Kumar^{1*} and Arun Kumar Misra²

Abstract: This article examines the impact of various sources of systematic liquidity risk and idiosyncratic liquidity risk on expected returns in the Indian stock market. The study tested the liquidity-adjusted capital asset pricing model (LCAPM) which is previously tested on developed markets. Systematic liquidity risk is found to be significant in impacting asset returns through various channels, viz. commonality in liquidity and illiquidity sensitivity to market returns. Covariance between individual stock returns and associated stock liquidity has a commanding influence as an idiosyncratic liquidity risk factor. The estimated asset pricing model is found to be robust across the two sub-time periods. The findings indicate that given the multi-dimensional nature of risk, the alternative of LCAPM along with the idiosyncratic risk is persuasive for consideration in investment decisions.

Subjects: Economics; Finance; Business, Management and Accounting

Keywords: illiquidity; liquidity risk; NSE; emerging market; liquidity-adjusted CAPM

JEL classification: G10; G12; G15

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PUBLIC INTEREST STATEMENT

The inability of the capital asset pricing model to explain the cross section of returns has led to the exploration of alternative factors in pricing assets. Liquidity is one of the key factors in determining cross-sectional stock returns. All else being equal, investors expect higher returns for holding illiquid stocks. Under the methodological framework of Akbas, Petkova, and Armstrong (2011), we find that, in addition to the systematic liquidity risk, idiosyncratic liquidity risk has independent explanatory power for cross-sectional return variation. This study reported that co-movement between stock liquidity and market liquidity, i.e., commonality in liquidity and illiquidity sensitivity to market returns, influences returns as systematic liquidity risk factors. On the other hand, covariance between individual stock returns and associated stock liquidity influences returns as an idiosyncratic liquidity risk factor. The results have important implications for investors who should take into account the systematic and idiosyncratic liquidity risk in order to make a better investment decision.¹

1. Introduction

In the capital asset pricing model (CAPM), factors are priced only if they pose a form of undiversifiable risk or systematic risk (Sharpe, 1964; Lintner, 1965). Market beta measures this systematic risk, and initially, it was considered as the only form of systematic risk. However, the failure of market beta to explain the cross-sectional expected returns casts doubt on it being the sole important determinant of stock returns (Fama & French, 1992, 1993). Identification and empirical validation of factors, which explain the cross-sectional variation of expected stock returns, has been one of the key issues in investment management research. As a result, there have been numerous studies to investigate several systematic factors and firm characteristics that are associated with stock returns. Liquidity is one of the important factors that attracts investors in financial markets. Liquid stocks are considered to have lower trading costs. Recent empirical research in finance is focused on liquidity risk as a factor to explain the cross section of expected return better than the traditional asset pricing models (Amihud, 2002; Butt & Virk, 2015; Li, Sun, & Wang, 2014). This consideration is motivated by the idea that investors are averse to risk and thus require a premium over volatility in liquidity (Chordia et al., 2001). Various channels of transmission of liquidity risk on stock returns are further examined by Acharya and Pederson (2005).

Emerging markets have been a center of growth over the past 20 years. Economic prospects have improved in many emerging economies, especially in countries like China, India, and Brazil. Long-term investors have been rewarded for making investments in emerging markets, as returns have often been far stronger than what developed markets have produced over the same period. However, studies of various alternative empirical asset pricing models have mostly concentrated on developed markets which are arguably most liquid (Bekaert, Harvey, & Lundblad, 2007). Unlike developed markets, emerging markets are subject to higher risks affiliated with their governments, illiquidity of financial markets, transparency, and shareholder rights. In order to stress the importance of emerging markets for the relevance of liquidity premium, we investigated the pricing of total liquidity risk in the cross section of stock returns for the midcap stocks listed on National Stock Exchange (NSE), India. Midcap stocks have often been described as the “sweet spot” for investing in the emerging equity markets. As per Baron Asset Fund (2015), midcap stocks have lower volatility than small-cap stocks and more growth opportunities and less analyst coverage than large-cap stocks. Given the investment attractiveness of midcap stocks, they should be a key component of a well-diversified portfolio. Hence, from an equity research perspective, it is imperative to study midcap stocks.

The present study tested the liquidity-adjusted pricing model of Acharya and Pederson (2005) based on the empirical design of Akbas et al. (2011). The data sample consists of NSE midcap stocks for 14 quarters from 1 April 2012 to 30 September 2015. The result of the study indicates that idiosyncratic liquidity risk measured as total volatility of liquidity is priced in the presence of various sources of systematic liquidity risk. The sources of systematic liquidity risk are the covariance of stock returns with aggregate liquidity, the covariance of stock liquidity with aggregate liquidity, and the covariance of stock liquidity with the market return. The study also performed robustness test across two sub-time periods and provides strong evidence to support the pricing of liquidity risks on Indian stock markets. From a practical standpoint, the study is relevant because a number of investors have been attracted to midcap stocks. Pricing of liquidity risk is one of the major concerns for market participants. Exchanges try to increase and support liquidity in their markets to attract more participants, traders tend to make transactions with more liquid stocks, and regulators care about sudden liquidity evaporation that may force market crashes.

The remainder of this paper is organized as follows: Section 2 provides a brief review of the underlying theory and related literature and elaborates on the motivation behind this study. Section

3 discusses the variables, model specifications, and methodology that have been used for this analysis. Section 4 presents the empirical findings and discusses results. Section 5 offers conclusions.

2. Theoretical foundation and literature review

Liquidity is defined as the degree with which one can quickly trade a large quantity of an asset at a low cost. Ideally, all assets should be liquid and can be traded with minimal price impact. In reality, however, most of the frequently traded assets are not perfectly liquid. Investors often have to incur transaction costs and suffer price reduction in order to liquidate their positions. Therefore, low stock market liquidity may increase the cost of equity. Investment decisions should thus depend not only on the idiosyncratic risk inherent in equity but also on its liquidity. Furthermore, it is imperative to note that, while an investor can reduce idiosyncratic risk by holding a diversified portfolio, there is little scope that he can avoid the cost of illiquidity on its own.

An important link between asset pricing and liquidity is developed by Amihud and Mendelson (1986). They find a significant positive relationship between stock's illiquidity computed using bid-ask spreads and its returns on the New York Stock Exchange (NYSE). Eleswarapu and Reinganum (1993) find that this relationship is restricted to the month of January. Fujimoto (2003) points that over the past two decades research on liquidity has been focused on measuring its impact on asset prices.

There are two strands of empirical studies that test the relationship between asset pricing and liquidity. The first strand emphasizes the correlation between individual stock's liquidity levels and associated returns. Amihud and Mendelson (1986) find a positive relationship between an asset's level of illiquidity and expected returns. Chang, Faff, and Hawang (2009) analyze the effect of liquidity on stock returns on the Tokyo Stock Exchange. Negative association is reported between expected stock returns and liquidity measures even after factoring risk adjustments in place of raw returns. The study further explores that liquidity is priced during the expansionary phase of the business cycle but not significantly priced during the contraction phase. This is inconsistent with the notion that liquidity is more important in bad time which is a kind of liquidity puzzle. Narayan and Zheng (2011) study the impact of liquidity on returns on the Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE). Liquidity negatively impacts returns in a stronger manner on SHSE than on SZSE. However, this evidence is not resilient across all three different proxies for liquidity, viz. Trading Volume, Trading Probability, and Turnover Rate. Chordia et al. (2001) demonstrate the importance of trading activity-related variables in the cross section of expected returns. A strong negative relationship is reported between both the level of liquidity, its volatility, and expected returns using monthly data from NYSE and AMEX stock exchanges. Chordia et al. (2001) argue that their finding is puzzling as risk-averse investors require a premium for holding volatile liquid stocks. Additionally, Hubers (2012) studies the relationship between asset prices and liquidity on the London Stock Exchange and suggests that the decreasing liquidity increases returns.

The empirical evidence on the commonality in liquidity reported by Chordia, Roll, and Subrahmanyam (2000) has changed the focus of asset pricing research. The change is towards investigating aggregate market liquidity risk, rather than the individual stock liquidity risk, in asset pricing. The second strand of literature has been exploring the commonality effect of market liquidity on asset prices. Market liquidity refers to the extent to which a stock market allows assets to be bought and sold with minimal price impact. This strand suggests that expected returns are higher in stocks if their returns are positively correlated with market liquidity. Pastor and Stambaugh (2003) find evidence that market-wide liquidity is a key state variable for asset pricing on NYSE, AMEX, and NASDAQ. Stocks expected returns are cross-sectionally related to the sensitivities of the returns to fluctuations in aggregate liquidity. Using four liquidity measures and empirical design of Pastor and Stambaugh (2003), Wu and Hwa (2015) find market liquidity risk to be systematically priced on SHSE. Bekaert et al. (2007) examine the effect of systematic variation in liquidity on expected returns in 19 emerging equity markets using VAR estimates. They found that liquidity is priced and persistent and predicts future returns. Uddin (2009) argues

that a stock cannot be illiquid just because it is not traded frequently if the average market liquidity as a whole is low. He examines the relationship between the relative measure of liquidity (RML) and returns on NYSE and AMEX using an RML instead of absolute measure. RML links individual stock liquidity with market-wide liquidity which more closely represents systematic liquidity risk. The study reports a negative but insignificant relationship between the excess stock return and liquidity as measured by RML.

Acharya and Pederson (2005) derive a simple model to factor liquidity risk in asset pricing. The model shows that the CAPM applies for returns net of illiquidity costs. This model gives an integrated view of the existing empirical evidence related to liquidity and liquidity risk, and it generates new testable predictions. Their study finds that the liquidity-adjusted CAPM explains the data better than the standard CAPM. Vu, Chai, and Do (2014) examine the pricing of liquidity risk in the Australian market. They explore the impact of various liquidity risk measures on stock returns using the liquidity-adjusted CAPM model developed by Acharya and Pederson (2005). The study finds strong evidence of co-movements (i) between individual stock illiquidity and market illiquidity, (ii) between stock returns and market illiquidity, and (iii) between stock illiquidity and market returns.

Unlike the low-frequency data set used in asset pricing studies, Foran, Hutchinson, and O'Sullivan (2014) employ a high-frequency intra-day data set. The study provides evidence on the pricing of market liquidity risk during the financial crisis on UK equity markets. They report that liquidity risk mimicking portfolios exhibit a statistically significant return premium among high-liquidity-risk stocks. The results are not altered even after controlling for stock liquidity levels, market, size, and value risk. The findings of Shih and Su. (2016) report the asymmetric relationship between liquidity and stock returns on the Taiwan Stock Exchange. The results suggest that market-wide variations of the down-market component of liquidity are priced, while the same is not true for the up-market component. Flight-to-quality/liquidity is better captured by down-market liquidity factor. Moshirian, Qian, Wee, and Zhang (2017) extended commonality pricing evidence in 39 markets. On the other hand, Quirós, Quirós, and Oliveira (2017) do not find evidence to support the role of systematic illiquidity in asset pricing on Euronext Lisbon Stock Exchange over a 26-year period. However, individual illiquidity is found to be negatively priced within a CAPM framework augmented by the illiquidity level. Recently, Kim and Na (2018) explore the existence of a relationship between three higher-moment liquidity risks and asset prices on NYSE and AMEX nonfinancial stocks.

Around this general conclusion that systematic liquidity risk is priced, there is another associated aspect of liquidity risk, which is idiosyncratic liquidity risk. Akbas et al. (2011) investigate the relationship between the volatility of liquidity and expected returns employing Amihud (2002) illiquidity proxy on daily data derived from NYSE and AMEX stock exchanges. A positive and robust relationship is documented between the volatility of liquidity and expected returns in regressions after controlling for various variables, systematic risk factors, and different subperiods. On the other hand, Bradrania, Peat, and Satchell (2015) present inconsistent results for the association of idiosyncratic volatility and stock expected returns. The results confirm that liquidity costs can explain the positive association between expected idiosyncratic volatility and expected returns for value-weighted portfolios. However, idiosyncratic volatility is not able to predict returns for equally weighted portfolios.

In summary, the question of how and through which channels liquidity affects asset returns has remained unresolved thus far. This question is important since illiquidity is a risk, and it significantly influences asset pricing. A large majority of studies in this area are conducted in the US and other developed markets. The difference in market microstructure between the US and other emerging stock markets calls for additional evidence from other markets. Reporting empirical results from other markets is also important to check the robustness of the available results and avoiding data snooping problem (Lo & MacKinlay, 1990). More recently, Kumar and Misra (2018)

report commonality evidence in midcap stocks listed on NSE of India. Given the evidence of commonality as a systemic risk factor is now established in the literature, this study makes a further contribution by incorporating systematic risk factors and idiosyncratic risk factors simultaneously in examining the asset pricing on NSE. We focus on NSE (India) data set while obtaining results of general interest in terms of empirical design and results.

3. Methodology

The study is confined to midcap stocks which have relatively high liquidity levels than small-cap stocks and low liquid levels than large-cap stocks. The time period of the study is 14 quarters, i.e., from 1 April 2012 to 30 September 2015. The studied time period coincides with the timings of the general elections in India. Political uncertainty can have a material impact on the liquidity of stock markets around election time. This time period includes both scenarios of low liquidity when uncertainty was high (T1) and high liquidity when stable and strong central government was formed in India (T2). Time periods T1 and T2 are used to check the robustness of the results across two time periods. The study analyzes price and associated volume of around 44,800 daily transactions, comprising 50 midcap stocks on 896 trading days. Chordia, Subrahmanyam, and Anshuman (2001) employ monthly data, while the study of Akbas et al. (2011) uses daily data. This study uses daily data as the investors unwind their positions in a short span of time in case of immediate liquidity needs arising because of margin calls, forced liquidations, or portfolio rebalancing.

The study requires pricing of systematic and idiosyncratic volatility and their covariance in the asset pricing models. To carry out this objective, empirical model, given by Acharya and Pederson (2005), is applied. The illiquidity cost, c_i in the model, is defined as the cost of selling security i . Uncertainty about the illiquidity cost which generates the liquidity risk is factored in the model. With the assumption of risk-averse investors, illiquidity, and risky dividends, Acharya and Pederson (2005) show that the conditional expected net return of security i in the unique linear equilibrium is

$$E_t(r_{it+1} - c_{it+1}) = r_f + \lambda_t \frac{\text{Cov}_t(r_{it+1} - c_{it+1}, R_{Mt+1} - C_{Mt+1})}{\text{Var}(R_{Mt+1} - C_{Mt+1})} \quad (1)$$

where $r_{it+1} - c_{it+1}$ is the return of security i net of liquidity cost c_i , $R_{Mt+1} - C_{Mt+1}$ is the return of the market portfolio net of the aggregate liquidity cost C_M , and r_f is the risk-free rate. Equivalently, Equation (1) can be written as

$$E_t(r_{it+1} - c_{it+1}) = E_t(c_{it+1}) + \lambda_t \frac{\text{Cov}_t(r_{it+1}, R_{Mt+1})}{\text{Var}(R_{Mt+1} - C_{Mt+1})} + \lambda_t \frac{\text{Cov}_t(c_{it+1}, C_{Mt+1})}{\text{Var}(R_{Mt+1} - C_{Mt+1})} - \lambda_t \frac{\text{Cov}_t(r_{it+1}, C_{Mt+1})}{\text{Var}(R_{Mt+1} - C_{Mt+1})} - \lambda_t \frac{\text{Cov}_t(c_{it+1}, R_{Mt+1})}{\text{Var}(R_{Mt+1} - C_{Mt+1})} \quad (2)$$

Equation (2) states that the required excess return is the expected relative illiquidity cost, $E_t(c_i)$, plus four β 's (covariances) times the price of risk λ . For convenience, the study denotes the four covariance terms above as β_r^R , β_c^C , β_r^C , and β_c^R , respectively. As in the standard CAPM, the model shows that the excess return on an asset increases with market beta (β_r^R). The model of Acharya and Pederson (2005) contains three additional β s which represent three different types of liquidity risk.

The first liquidity beta (β_c^C) is positive for most assets due to commonality in liquidity. Since investors need to be compensated for holding a security that becomes illiquid, when the market, in general, becomes illiquid, the expected excess returns increase with β_c^C in the model. The second liquidity beta β_r^C measures the sensitivity of asset returns to market-wide illiquidity. It is usually negative since an increase in market illiquidity implies that asset values will go down (Amihud, 2002). This liquidity β has a negative effect on excess returns since investors are willing to accept a lower return on an asset whose return is higher in states of high market illiquidity. The third liquidity beta β_c^R is also negative for most stocks (e.g., Acharya & Pederson, 2005 and Chordia, Sarkar, & Subrahmanyam, 2006). It has a negative effect on excess returns since investors are willing to accept a lower expected return on a security that is liquid in a down market. Acharya and

Pederson (2005) provide only systematic liquidity risk which commands risk premium in cross section of stocks. However, it requires estimating risk premium for idiosyncratic risk also.

To estimate the idiosyncratic risk, the study follows Akbas et al. (2011) where the systematic risk and idiosyncratic risk are factored into CAPM, which is similar to Acharya and Pederson (2005). Akbas et al. (2011) estimate the stock level liquidity (Amihud, 2002) on a daily basis and mean level liquidity.

Our study measures daily price impact of order flow using Amihud illiquidity measure (2002)

$$c_{id} = \frac{|r_{id}|}{dvol_{id}} \quad (3)$$

where r_{id} is the return of stock i on day d and $dvol_{id}$ is the rupee trading volume for stock i on day d . Using market model, time series regression on daily liquidity variation of an individual stock will be decomposed into systematic components with the help of regression Equations (4 and 5).

In order to fetch the systematic and idiosyncratic risk in the CAPM model, liquidity costs involving four θ 's (β_r^R , β_c^C , β_r^C , and β_c^R) need to be estimated. The study has used Akbas et al. (2011) model, where firm level illiquidity change and excess market return are modeled in the following equation:

$$c_{id} = \alpha_i + \beta_{ci}^C \Delta C_{Md} + \beta_{ci}^R (R_{Md} - r_{fd}) + U_{id} \quad (4)$$

$$r_{id} - r_{fd} = \alpha_i + \beta_{ri}^C \Delta C_{Md} + \beta_{ri}^R (R_{Md} - r_{fd}) + V_{id} \quad (5)$$

On the basis of the above two equations (Equations 5 and 6), the study computes four betas:

- (1) β_r^R , this is similar to CAPM β
- (2) β_c^C , this represents the co-movement of individual liquidity cost and market liquidity cost, i.e., liquidity commonality
- (3) β_r^C , this represents co-movement between stock return and market liquidity
- (4) β_c^R , this represents co-movement of individual liquidity and market return

The study would empirically verify Acharya and Pederson (2005) model using Fama-Macbeth (1973) regression in which the dependent variable is excess stock return. The benchmark model to be examined is as follows:

$$r_{it+1} - r_{ft+1} = \gamma_0 + \gamma_1 \beta_{rit}^R + \gamma_2 \beta_{cit}^C + \gamma_3 \beta_{rit}^C + \gamma_4 \beta_{cit}^R + \varepsilon_{it+1} \quad (6)$$

Four θ 's estimated from the previous equations will be the independent variables in Equation (6). The significance of coefficient attached to each θ would empirically verify for pricing of illiquidity in the returns.

Further, our study adds idiosyncratic volatility of liquidity in the empirical model of Acharya and Pederson (2005) and estimate the following equation:

$$r_{it+1} - r_{ft+1} = \gamma_0 + \gamma_1 \beta_{rit}^R + \gamma_2 \beta_{cit}^C + \gamma_3 \beta_{rit}^C + \gamma_4 \beta_{cit}^R + \gamma_5 Cov_t(r_{it+1}, c_{it+1}) + \gamma_6 IVOL_{it} + \varepsilon_{it+1} \quad (7)$$

In Equation (7), the covariance of liquidity and returns and idiosyncratic volatility of returns represent idiosyncratic risk, while four θ 's represent channels of systematic risk. $IVOL$ is idiosyncratic return volatility and computed as the standard deviation of the errors in the cross-sectional regression between excess stock returns and excess market returns. The significance of coefficient of systematic risk variables and idiosyncratic risk variable would justify the pricing of systematic and idiosyncratic risk of liquidity.

4. Empirical results

Previous studies by Acharya and Pederson (2005) and Vu et al. (2014) consider only systematic liquidity risk factors in pricing the returns. Using Akbas et al. (2011) methodology, our study investigates total liquidity risk comprising both systemic and idiosyncratic liquidity risk factors. Section 4.1 describes the basic features of the data. Section 4.2 explores the effect of systemic and idiosyncratic risk on returns on the basis of Equations (6) and (7). Finally, in Section 4.3, the sample is divided into two halves to examine the robustness of the relation between the stock returns and total liquidity risk.

4.1. Descriptive statistics

Table 1 reports the summary statistics of the variables required to compute four β s. These variables are captured in a daily frequency.

Based on the variables reported in Table 1, the study computed four β s, risk premium, idiosyncratic volatility of returns, covariance between stock return and its liquidity, for each stock on a quarterly basis. Table 2 reports the summary statistics of the variables required to run the cross sections of asset pricing models using regression Equations (6 and 7).

Table 1. Descriptive statistics: variables used in quarterly regressions

| Variables | Mean | Standard deviation | Median |
|--|---------|--------------------|---------|
| Amihud illiquidity (C_{id}) | 0.0094 | 0.0173 | 0.0049 |
| Stock return (R_{id}) | 0.0002 | 0.0261 | -0.0001 |
| Market return (R_m) | 0.0002 | 0.0155 | 0.0011 |
| Risk-free return (R_f) | 0.0002 | 0.0000 | 0.0002 |
| Excess stock return ($R_i - R_f$) | -0.0001 | 0.0261 | -0.0004 |
| Excess market return ($R_m - R_f$) | -0.0001 | 0.0155 | 0.0008 |
| Aggregate market illiquidity (C_{md}) | 0.0094 | 0.0061 | 0.0082 |
| Change in aggregate market illiquidity (ΔC_{md}) | 0.1112 | 0.6044 | 0.0059 |

Table 2. Descriptive statistics: variables used in liquidity-adjusted capital asset pricing model

| Variable | Mean | Standard deviation | Median |
|--|-----------------|--------------------|-----------------|
| Excess stock return ($R_i - R_f$) | $-3.900e^{-05}$ | 0.0037 | -0.0002 |
| Idiosyncratic volatility of liquidity ($IVOL$) | 0.0189 | 0.0064 | 0.0180 |
| Covariance between stock return and its illiquidity $Cov(rc)$ | $-2.800e^{-05}$ | $8.7700e^{-05}$ | $-1.400e^{-05}$ |
| Liquidity commonality beta (β_{cC}) | 0.0049 | 0.0091 | 0.0028 |
| Co-movement of individual liquidity and market return (β_{cR}) | -0.0331 | 0.1782 | -0.0126 |
| Co-movement between stock return and market liquidity (β_{rC}) | $3.3700e^{-19}$ | 0.0051 | -0.0002 |
| CAPM beta (β_{rR}) | 1 | 0.4618 | 0.9796 |

Variability in CAPM beta (β_r^R) is more in comparison to other variables, while the variability in covariance between stock returns and associated liquidity $Cov(rc)$ is least.

Table 3 reports that the correlation between four liquidity β s is very less. This indicates that four channels of liquidity risk do not capture the same effect.

4.2. Pricing of systematic risk and idiosyncratic risk

This section investigates the explanatory power of systematic risk and the explanatory power of the combination of systematic and idiosyncratic risk in explaining the cross section of stock returns. The results, presented in Table 4, report that all four channels of systematic liquidity risk (β_{cC} , β_{cR} , β_{rC} , and β_{rR}) are significantly related to expected returns. β_{cC} which is positively related to expected returns implies that the expected returns will increase with the co-movement between market illiquidity and asset's illiquidity. β_{rC} which is positively related to expected returns implies that investors may demand more return when the market is less liquid. β_{cR} depicts that higher the stock's liquidity sensitivity to market returns, the higher will be the expected returns. Wald test is conducted to test the joint significance of four β s. The null hypothesis, which states that the sum of all four liquidity β s is equal to zero, is rejected at 1% significance level.

The results presented in Table 5 report four channels of systematic liquidity risk along with the channels representing an idiosyncratic risk. Adjusted R^2 of the model improves on adding idiosyncratic risk channels to the model. The study reported the significance of four β 's representing systematic liquidity risk, along with covariance between asset illiquidity and its returns. Thus, both channels of liquidity risk make the overall net effect on asset pricing. As the covariance between asset illiquidity and its returns (COV_{rc}) is positively related to expected returns, this implies that

Table 3. Correlation matrix of four β 's

| | β_{cC} | β_{cR} | β_{rC} | β_{rR} |
|--------------|--------------|--------------|--------------|--------------|
| β_{cC} | 1 | | | |
| β_{cR} | 0.1406 | 1 | | |
| β_{rC} | 0.0571 | 0.1363 | 1 | |
| β_{rR} | -0.0445 | 0.0322 | 0.2328 | 1 |

Table 4. Total sample period (Q1–Q14): systematic factors

| | Coefficient | Std. Error | t-Ratio | Sig. |
|---|-------------|------------|------------------------|------|
| <i>Intercept</i> | 0.0002 | 0.0004 | 0.7047 | |
| β_{cC} | 0.0753 | 0.0152 | 4.9709 | *** |
| β_{cR} | -0.0048 | 0.0008 | -6.1605 | *** |
| β_{rC} | 0.0472 | 0.0284 | 1.6638 | * |
| β_{rR} | -0.0007 | 0.0003 | -2.2804 | ** |
| Adjusted R-squared | | | 0.0829 | |
| Wald test | | | Chi² | |
| $(\beta_{cC} + \beta_{cR} + \beta_{rC} + \beta_{rR}) = 0$ | | | 14.1429 | *** |
| Residual diagnostics | | | | |
| J-B test of residual normality | | | 92.4163 | *** |
| Durbin-Watson statistic | | | 2.0878 | |

Notes: The table reports the results of the cross-sectional regressions on the basis of Equations (6). The dependent variable is individual excess stock return, measured by stock return at a quarter minus one quarter T-bill returns. The independent variables are all four channels of systematic liquidity risk (β_{cC} , β_{cR} , β_{rC} , and β_{rR}). ***, **, and * represent statistical significance at 1%, 5%, and 10% levels, respectively.

Table 5. Sample period (Q1–Q14): systematic and unsystematic factors

| | Coefficient | Std. Error | t-Ratio | Sig. |
|---|-------------|------------|------------------------|------|
| Intercept | -0.0001 | 0.001 | -0.1248 | |
| β_{cC} | 0.0869 | 0.0149 | 5.845 | *** |
| β_{cR} | -0.0058 | 0.0008 | -7.5133 | *** |
| β_{rC} | 0.0458 | 0.0276 | 1.6626 | * |
| β_{rR} | -0.0008 | 0.0004 | -2.1057 | ** |
| COV_{rc} | 11.0402 | 1.6543 | 6.6736 | *** |
| $IVOL$ | 0.0155 | 0.0232 | 0.6702 | |
| Adjusted R-squared | | | 0.1393 | |
| Wald test | | | Chi² | |
| $(\beta_{cC} + \beta_{cR} + \beta_{rC} + \beta_{rR}) = 0$ | | | 17.025 | *** |
| Coefficient ($COV_{rc} + IVOL = 0$) | | | 44.5505 | *** |
| $(\beta_{cC} + \beta_{cR} + \beta_{rC} + \beta_{rR} + Cov_{rc} + IVOL) = 0$ | | | 45.4643 | *** |
| Residual diagnostics | | | | |
| J-B test of residual normality (J-B test) | | | 105.8460 | *** |
| Durbin-Watson statistic | | | 2.1168 | |

Notes: The table reports the results of the cross-sectional regressions on the basis of Equations (7). The dependent variable is individual excess stock return, measured by stock return at a quarter minus one quarter T-bill returns. The independent variables are all four channels of systematic liquidity risk (β_{cC} , β_{cR} , β_{rC} , β_{rR}) and unsystematic factors, viz. covariance between stock return and stock illiquidity (COV_{rc}) and idiosyncratic volatility of liquidity ($IVOL$). ***, **, and * represent statistical significance at 1%, 5%, and 10% levels, respectively.

investors will require a premium for holding assets whose COV_{rc} is high. $IVOL$, computed using Fama-MacBeth regressions (1973), is not found significant. However, it has joint significance with COV_{rc} in explaining expected returns as per the Wald tests.

The systematic factors, represented by four β 's, along with idiosyncratic factors, represented by $IVOL$ and COV_{rc} , found jointly significant in explaining expected returns.

4.3. Subsample analysis

In this section, the study examined the robustness of asset pricing models across two time periods (T1 and T2). T1 covers seven quarters spanning from April 2012 to December 2013. Table 6 presents the results of testing asset pricing model in T1 time period taking only systematic factor. β_{cC} , β_{cR} , and β_{rR} are found to be significant systematic factors in explaining expected returns. As expected, β_{rC} is positively associated with the expected returns, but it is not significantly different from zero. The Wald test suggests that the sum of all four liquidity β s is significantly different from zero.

Table 7 presents the results of testing asset pricing model in the T1 time period taking both systematic factors and idiosyncratic factors. β_{cC} , β_{cR} , and β_{rR} are found to be significant systematic factors in explaining expected returns. Both COV_{rc} and $IVOL$ are found to be significant idiosyncratic factors in explaining expected returns. The Wald test suggests that the sum of all four liquidity β 's is significantly different from zero. Also, the Wald test suggests that the sum of systematic factors and idiosyncratic factors is significantly different from zero. Thus, both channels of liquidity risk make the overall net impact on expected returns. Adjusted R^2 of the model improves on adding idiosyncratic risk channels to the model.

T2 covers seven quarters spanning from January 2014 to September 2015. Table 8 presents the results of testing asset pricing model in T2 time period taking only systematic factor. β_{cC} , β_{cR} , and β_{rR} are found to be significant systematic factors in explaining expected returns. As expected, β_{rC} is

Table 6. Sample period (Q1–Q7): systematic and unsystematic factors

| | Coefficient | Std. Error | t-Ratio | Sig. |
|---|-------------|------------|------------------------|------|
| Intercept | -0.0004 | 0.0004 | -0.8421 | |
| β_{cC} | 0.075 | 0.0142 | 5.2714 | *** |
| β_{cR} | -0.0039 | 0.0008 | -5.1137 | *** |
| β_{rC} | 0.0545 | 0.0418 | 1.3039 | |
| β_{rR} | -0.0006 | 0.0004 | -1.6896 | * |
| Adjusted R-squared | | | 0.1338 | |
| Wald test | | | Chi² | |
| $(\beta_{cC} + \beta_{cR} + \beta_{rC} + \beta_{rR}) = 0$ | | | 8.5099 | *** |
| Residual diagnostics | | | | |
| J-B test of residual normality | | | 0.8780 | |
| Durbin-Watson statistic | | | 1.9240 | |

Notes: The table reports the results of the cross-sectional regressions on the basis of Equations (6). The dependent variable is individual excess stock return, measured by stock return at a quarter minus one quarter T-bill returns. The independent variables are all four channels of systematic liquidity risk (β_{cC} , β_{cR} , β_{rC} , β_{rR}). ***, **, and * represent statistical significance at 1%, 5%, and 10% levels, respectively.

Table 7. Sample period (Q1–Q7): systematic factors and idiosyncratic factors

| | Coefficient | Std. Error | t-Ratio | Sig. |
|---|-------------|------------|------------------------|------|
| C | -0.0014 | 0.0013 | -1.1101 | |
| β_{cC} | 0.0777 | 0.0138 | 5.624 | *** |
| β_{cR} | -0.0047 | 0.0008 | -6.1071 | *** |
| β_{rC} | 0.0367 | 0.0404 | 0.9067 | |
| β_{rR} | -0.0009 | 0.0004 | -2.2071 | ** |
| COV _{rc} | 7.5556 | 1.5281 | 4.9444 | *** |
| IVOL | 0.0829 | 0.0294 | 2.8237 | *** |
| Adjusted R-squared | | | 0.211 | |
| Wald test | | | Chi² | |
| $(\beta_{cC} + \beta_{cR} + \beta_{rC} + \beta_{rR}) = 0$ | | | 6.6478 | ** |
| Coefficient (COV _{rc} +IVOL) = 0 | | | 24.8974 | *** |
| $(\beta_{cC} + \beta_{cR} + \beta_{rC} + \beta_{rR} + \text{Cov}_{rc} + \text{IVOL}) = 0$ | | | 25.5412 | *** |
| Residual diagnostics | | | | |
| J-B test of residual normality | | | 0.4240 | |
| Durbin-Watson statistic | | | 2.0322 | |

Notes: The table reports the results of the cross-sectional regressions on the basis of Equations (7). The dependent variable is individual excess stock return, measured by stock return at a quarter minus one quarter T-bill returns. The independent variables are all four channels of systematic liquidity risk (β_{cC} , β_{cR} , β_{rC} , β_{rR}) and unsystematic factors, viz. covariance between stock return and stock illiquidity (COV_{rc}) and idiosyncratic volatility of liquidity (IVOL). ***, **, and * represent statistical significance at 1%, 5%, and 10% levels, respectively.

positively associated with the expected returns, but it is not significantly different from zero. The Wald test suggests that the sum of all four liquidity β 's is significantly different from zero.

Table 9 presents the results of testing asset pricing model in T2 time period taking both systematic factors and idiosyncratic factors. β_{cC} and β_{cR} are found to be significant systematic factors in explaining expected returns. COV_{rc} is found to be significant idiosyncratic factor in explaining expected returns. Adjusted R² of the model improves on adding idiosyncratic risk channels to the model. The Wald test suggests that the sum of all four liquidity β 's is significantly different from zero. Also, the Wald test suggests that the sum of systematic factors and

Table 8. Sample period (Q8-Q14): systematic factors

| | Coefficient | Std. Error | t-Ratio | Sig. |
|---|-------------|------------|------------------------|------|
| C | 0.0004 | 0.0007 | 0.5738 | |
| θ_{cC} | 0.2314 | 0.0815 | 2.8397 | *** |
| θ_{cR} | -0.0104 | 0.0023 | -4.4898 | *** |
| θ_{rC} | 0.0701 | 0.043 | 1.6318 | |
| θ_{rR} | -0.0011 | 0.0006 | -1.8842 | * |
| Adjusted R-squared | | | 0.1096 | |
| Wald test | | | Chi² | |
| $(\theta_{cC} + \theta_{cR} + \theta_{rC} + \theta_{rR}) = 0$ | | | 10.1712 | *** |
| Residual diagnostics | | | | |
| J-B test of residual normality | | | 54.3660 | *** |
| Durbin-Watson statistic | | | 2.3571 | |

Notes: The table reports the results of the cross-sectional regressions on the basis of Equations (6). The dependent variable is individual excess stock return, measured by stock return at a quarter minus one quarter T-bill returns. The independent variables are all four channels of systematic liquidity risk (θ_{cC} , θ_{cR} , θ_{rC} , θ_{rR}). ***, **, and * represent statistical significance at 1%, 5%, and 10% levels, respectively.

Table 9. Sample period (Q8-Q14): systematic factors and idiosyncratic factors

| | Coefficient | Std. Error | t-Ratio | Sig. |
|---|-------------|------------|------------------------|------|
| C | 0.0004 | 0.0018 | 0.2391 | |
| θ_{cC} | 0.3103 | 0.0775 | 4.0062 | *** |
| θ_{cR} | -0.0077 | 0.0021 | -3.6014 | *** |
| θ_{rC} | 0.0388 | 0.0394 | 0.9842 | |
| θ_{rR} | -0.0007 | 0.0007 | -1.081 | |
| COV _{rc} | 50.3666 | 6.472 | 7.7822 | *** |
| IVOL | -0.0465 | 0.0436 | -1.0645 | |
| Adjusted R-squared | | | 0.2614 | |
| Wald test | | | Chi² | |
| $(\theta_{cC} + \theta_{cR} + \theta_{rC} + \theta_{rR}) = 0$ | | | 15.5719 | *** |
| Coefficient (COV _{rc} +IVOL) = 0 | | | 60.3779 | *** |
| $(\theta_{cC} + \theta_{cR} + \theta_{rC} + \theta_{rR} + \text{Cov}_{rc} + \text{IVOL}) = 0$ | | | 60.9865 | *** |
| Residual diagnostics | | | | |
| J-B test of residual normality | | | 44.5234 | *** |
| Durbin-Watson statistic | | | 2.2490 | |

Notes: The table reports the results of the cross-sectional regressions on the basis of Equations (7). The dependent variable is individual excess stock return, measured by stock return at a quarter minus one quarter T-bill returns. The independent variables are all four channels of systematic liquidity risk (θ_{cC} , θ_{cR} , θ_{rC} , θ_{rR}) and unsystematic factors, viz. covariance between stock return and stock illiquidity (COV_{rc}) and idiosyncratic volatility of liquidity (IVOL). ***, **, and * represent statistical significance at 1%, 5%, and 10% levels, respectively.

idiosyncratic factors is significantly different from zero. Thus, both channels of liquidity risk make the overall effect on asset pricing.

We find that expected excess stock returns are increasing the function of commonality risk and the covariance between stock returns and market liquidity. This relationship supports the argument that investors require compensation for holding a stock that becomes illiquid when the market, in general, is illiquid (Acharya & Pederson, 2005). In other words, investors would prefer stocks whose liquidity has low levels of covariance with market liquidity. Also, the expected excess stock returns are decreasing the

function of covariance between stock liquidity and market returns and covariance between stock returns and market returns. As per Akbas et al. (2011), idiosyncratic liquidity risk may be an omitted source in pricing liquidity risk. We also observe that the relation between various channels of systemic risk and returns persists, and R^2 improves after adding idiosyncratic factors to the model. This shows greater importance of idiosyncratic factors in accessing liquidity risks. In particular, we find that excess stock returns are strongly related to the systemic and idiosyncratic liquidity risks throughout the sample period. Finally, we subdivide our data set into two time periods. We observe that the liquidity risks are significant in the first as well as in the second time periods, suggesting that our results are not driven by a few influential outliers. In all the scenarios, sensitivity of stock returns to fluctuations in aggregate market liquidity is positively related to expected returns, but it is not significantly different from zero.

Consistent with the findings of Acharya and Pederson (2005), our study reports that most of the pricing effects are explained by the sensitivity of liquidity to market returns. In addition, our study also supports that commonality, i.e., covariance of stock liquidity and market liquidity has a positive effect on asset pricing, which is not supported by the study of Acharya and Pederson (2005). Also, our results are consistent with the findings of Galariotis and Giouvris (2009) and Martínez, Nieto, Rubio, and Tapia (2005) who show that liquidity risk plays a role in explaining the cross section of returns. In summary, we find that the total liquidity risk incorporated in the studied empirical model is robust and plays an important role in explaining the overall cross section of stock returns on Indian stock market.

5. Conclusions

This study investigates whether liquidity is a source of priced systematic risk and idiosyncratic risk in stock returns of the NSE in India. The motivation for this research is provided by the growing interest in financial literature about the channels through which systematic and idiosyncratic variation in liquidity matters for expected returns. Commonality as a systemic factor represents a source of non-diversifiable risk. Our study extends the empirical work of Acharya and Pederson (2005) using methodological framework of Akbas et al. (2011) for the midcap stocks listed on NSE.

The reported result presents evidence that liquidity risk factors play role in explaining the cross section of returns in India. The commonality in liquidity (β_{cC}) and the co-movement between individual stock illiquidity and market returns (β_{cR}) is the dominating systematic risk factor. Covariance between individual stock returns and associated stock liquidity is commanding idiosyncratic risk factor. Overall effect as reported by Wald tests shows that the sum of all liquidity risk factors is positive and significant across all model specifications. The results of the study are robust to different subperiods.

Our results suggest that liquidity forms part of the systematic and idiosyncratic risk. Therefore, failure to incorporate it into portfolio formulation strategies may lead investors on NSE to take erroneous investment decisions. Liquidity is a multidimensional concept. Hence, the studies on liquidity usually consider multiple liquidity measures in research. Using Amihud's illiquidity measure as the only measure in modeling asset pricing is one of the limitations of this study. Additional evidence should extend this line of research using multiple liquidity proxies. Also, given many anomalous return behaviors and differences in trading systems, which the present asset pricing models cannot explain, our article suggests that further investigation of channels of liquidity risk on a large set of stocks over a larger time period and across geographies can be a possible direction for future research. This will help to establish further generalizations regarding liquidity risk in financial literature.

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Appendix I
Midcap stocks selected for the study

| S. No. | Bloomberg code | Company name |
|---------------|-----------------------|------------------------------------|
| 1 | BATA | Bata India Ltd. |
| 2 | GDSP | Godrej Industries Ltd. |
| 3 | HAVL | Havells India Ltd. |
| 4 | JUBI | Jubilant Foodworks Ltd. |
| 5 | MCLR | McLeod Russel India Ltd. |
| 6 | TGBL | Tata Global Beverages Ltd. |
| 7 | SUNTV | Sun TV Network Ltd. |
| 8 | BIOS | Biocon Ltd. |
| 9 | STR | Strides Arcolab Ltd. |
| 10 | ABNL | Aditya Birla Nuvo Ltd. |
| 11 | ALBK | Allahabad Bank |
| 12 | ANDB | Andhra Bank |
| 13 | BOI | Bank of India |
| 14 | CBK | Canara Bank |
| 15 | IDBI | IDBI Bank Ltd. |
| 16 | IFCI | IFCI Ltd. |
| 17 | KBL | Karnataka Bank Ltd. |
| 18 | LTFH | L&T Finance Holdings Ltd. |
| 19 | OBC | Oriental Bank of Commerce |
| 20 | POWF | Power Finance Corporation Ltd. |
| 21 | RCAPT | Reliance Capital Ltd. |
| 22 | SKSM | SKS Microfinance Ltd. |
| 23 | SNDB | Syndicate Bank |
| 24 | UNBK | Union Bank of India |
| 25 | APTY | Apollo Tyres Ltd. |
| 26 | AL | Ashok Leyland Ltd. |
| 27 | MRF | MRF Ltd. |
| 28 | TVSL | TVS Motor Company Ltd. |
| 29 | TTCH | Tata Chemicals Ltd. |
| 30 | CRG | Crompton Greaves Ltd. |
| 31 | JI | Jain Irrigation Systems Ltd. |
| 32 | SIEM | Siemens Ltd. |
| 33 | ICEM | India Cements Ltd. |
| 34 | JPA | Jaiprakash Associates Ltd. |
| 35 | GMRI | GMR Infrastructure Ltd. |
| 36 | IRB | IRB Infrastructure Developers Ltd. |
| 37 | UT | Unitech Ltd. |

(Continued)

| S. No. | Bloomberg code | Company name |
|--------|----------------|---|
| 38 | VOLT | Voltas Ltd. |
| 39 | CESC | CESC Ltd. |
| 40 | HPCL | Hindustan Petroleum Corporation Ltd. |
| 41 | IGL | Indraprastha Gas Ltd. |
| 42 | JSW | JSW Energy Ltd. |
| 43 | NHPC | NHPC Ltd. |
| 44 | PLNG | Petronet LNG Ltd. |
| 45 | RELI | Reliance Infrastructure Ltd. |
| 46 | RPWR | Reliance Power Ltd. |
| 47 | JUST | Justdial Ltd. |
| 48 | OFSS | Oracle Financial Services Software Ltd. |
| 49 | HZ | Hindustan Zinc Ltd. |
| 50 | SAIL | Steel Authority of India Ltd. |

Source: Bloomberg Database.



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