LAPPEENRANTA UNIVERSITY OF TECHNOLOGY

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Pricing of Liquidity Risks in London Stock Exchange

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ABSTRACT

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This thesis aims to investigate pricing of liquidity risks in London Stock Exchange. Liquidity Adjusted Capital Asset Pricing Model i.e. LCAPM developed by Acharya and Pedersen (2005) is being applied to test the influence of various liquidity risks on stock returns in London Stock Exchange. The Liquidity Adjusted Capital Asset Pricing model provides a unified framework for the testing of liquidity risks. All the common stocks listed and delisted for the period of 2000 to 2014 are included in the data sample. The study has incorporated three different measures of liquidity – Percent Quoted Spread, Amihud (2002) and Turnover. The reason behind the application of three different liquidity measures is the multi-dimensional nature of liquidity. Firm fixed effects panel regression is applied for the estimation of LCAPM. However, the results are robust according to Fama-Macbeth regressions. The results of the study indicates that liquidity risks in the form of (i) level of liquidity, (ii) commonality in liquidity (iii) flight to liquidity, (iv) depressed wealth effect and market return as well as aggregate liquidity risk are priced at London Stock Exchange. However, the results are sensitive to the choice of liquidity measures.

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Saira Saman

Vantaa, May 2016

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LIST OF ABBREVIATIONS

AMEX - American Stock Exchange

CAPM – (Traditional) Capital Asset Pricing Model

ICAPM – Intertemporal Capital Asset Pricing Model

LCAPM - Liquidity Adjusted Asset Pricing Model

LSE – London Stock Exchange

MOM – Momentum

NASDAQ – National Association of Securities Dealers Automated Quotation

NYSE- New York Stock Exchange

PQS- Percent Quoted Spread

RML- Relative Measure of Liquidity

SHSE - Shanghai Stock Exchange

SIZE – Market capitalization of firm

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1. INTRODUCTION

In the wake of recent financial crisis the phenomenon of liquidity has gained pronounced attention in empirical finance. Illiquid assets are well known in the financial world. Because these assets are difficult to trade due to higher cost of trading associated with them. Additionally, sudden decrease in liquidity of the market can create panic, therefore regulators keep a close eye on the liquidity of the market and take measures to keep liquidity of the market stable. Market participants require liquid markets in order to effectively manage risks and their own funding needs. Liquidity the ease of converting an asset is a multidimensional concept. As it encompasses dynamics of the market from its width, depth, immediacy to resiliency (discussed in section 2). Major sources of illiquidity are termed to be trading costs, asymmetric information, inventory risk, search frictions and ownership structure (discussed in section 2).

The variations in risk premium among the stocks has been a vital topic of research in finance since the 1960s. Several competing theories are available in the literature concerning risks that should be priced, and varying opinions on asset pricing models, that which model has the best ability to explain the risk. The liquidity risk is determined to be a significant factor to explain risk premiums, as illiquid stocks have higher returns (Amihud, 2002). Pastor and Stambaugh (2003) argue that a premium is paid on stocks, who have high returns when the total market is illiquid. Certain number of liquidity-augmented models have been determined to perform empirically better than the traditional models of asset pricing (Amihud & Mendelsen (1986), Hasbrouck and Seppi (2001) and Sadka (2003)). A possible reason is that the liquidity models are able to capture bigger part of risk by relaxing the restrictive assumptions of the traditional models.

The influence of various types of liquidity risk on stock returns still remains a largely untapped research area. However, Acharya and Pedersen (2005) were able to develop a unified framework by incorporating the identified liquidity risks namely level of liquidity, commonality in liquidity, flight to liquidity and depressed wealth effect. Very few studies are available that have applied this model to investigate the pricing of liquidity risks on stock returns. This model has been tested on the US market by Acharya & Pedersen (2005) and Kim & Lee (2014), on Australian Stock Market by Vu, Chai and Do (2015) and on global level by Lee (2011). The key findings of these study include that the liquidity risks could influence or be completely insignificant with respect to stock returns in various regions. Additionally these findings were also sensitive to liquidity measures used.

This study will test Liquidity Adjusted Capital Asset Pricing Model developed by Acharya and Pedersen (2005) for stocks listed at London Stock Exchange. The decision to carry out this study for London Stock Exchange stems from the fact that it is world's 3rd and Europe's largest stock exchange market. Foran, Hutchinson and O'Sullivan (2015) investigated pricing of commonality in liquidity for UK market and their study shows that commonality in liquidity positively effects the stock returns. Angelidis and Andrikopoulos (2010) also conducted a study on the London Stock Exchange and the findings of their study helps to conclude that liquidity and idiosyncratic risk should be considered as the determinants of the cross section of expected stock returns. Thus, findings of this study regarding pricing of liquidity risk in LSE can provide important insights to UK investors and European investors. Over the years the market capital of the London Stock Exchange has grown to over US$ 3.5 trillion and volumes close to US$ 2 trillion monthly (London Stock Exchange, 2016a). This study will use all the stocks listed and delisted on the London Stock Exchange from 2000 to 2014. The liquidity measures applied to the study include Percent Quoted Spread developed by Chung and Zhang (2014), Amihud (2002) the most widely applied measure in studies relating to liquidity risk and lastly the Turnover. The decision to use these measures is based upon their ability to capture various aspects of liquidity. The research question for study states ***how are the identified liquidity risks priced in UK equities?*** Figure 1 illustrates the research focus of the study.

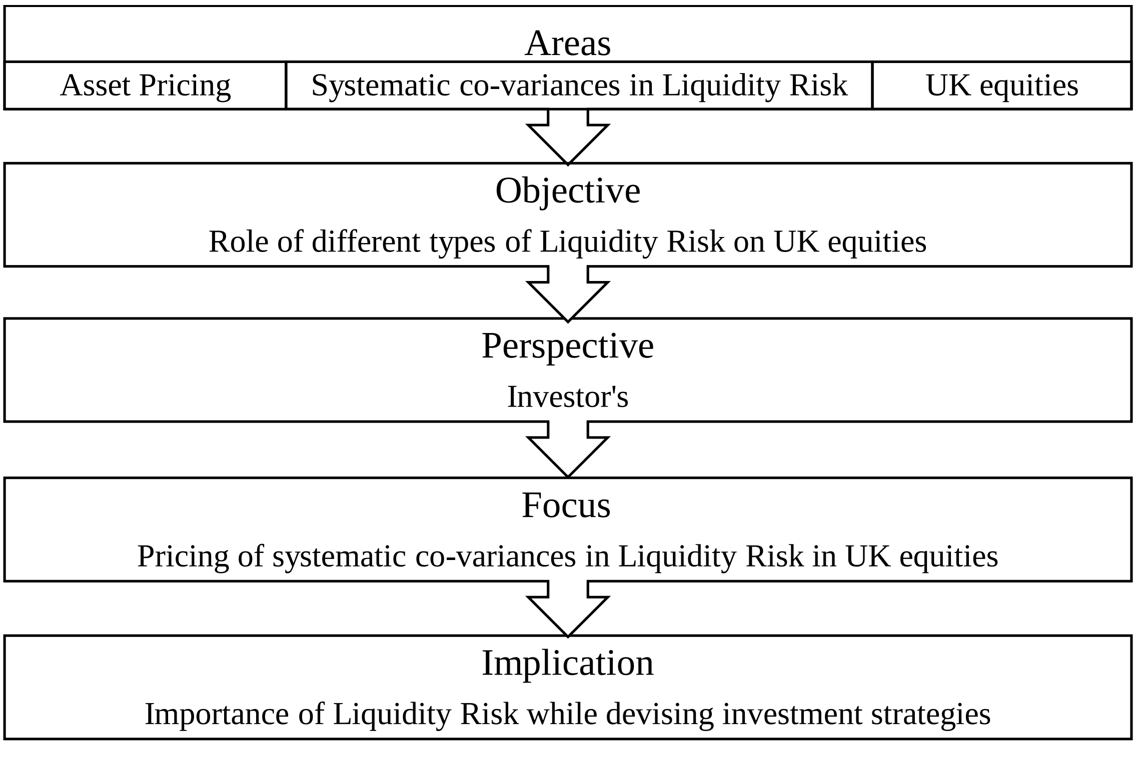


Figure 1. Research Focus

For this study the LCAPM is tested with fixed effect panel regression. This study is able to provide evidence in regard to existence of pricing of level of liquidity, commonality in liquidity, flight to liquidity, depressed wealth effect and aggregate liquidity risk. The results indicate that the level of illiquidity has a positive effect on stock returns for UK market. Covariance between stock illiquidity and market illiquidity i.e. commonality in liquidity has a positive effect on stock returns for UK market. Flight to liquidity, covariance between stock return and market illiquidity has a negative effect on stock returns for UK market. The depressed wealth effect i.e. covariance between stock illiquidity and market return has a negative effect on stock returns for UK market. Additionally, aggregate liquidity risk is priced in stocks returns for UK market. However, the results are sensitive to the choice of liquidity measures. The contribution of this study to the existing literature in regard of pricing of liquidity risks on stock returns includes (1) application of LCAPM developed by Acharya and Pedersen (2005) on UK market (2) investigation of liquidity risk in the form of depressed wealth effect on UK equities (3) influence of aggregate liquidity risk on stock returns for UK market.

The rest of the paper is organized as follows: Section 2 presents the Theoretical background of the study that covers the various aspects pertaining to the phenomenon of liquidity. Section 3 presents the Data used in the study and the preparatory processes carried out on the data as well as the descriptive statistics. Section 4 covers the methodology adapted for the study. Section 5 presents the Results. Section 6 covers the Discussion of the study followed up with the final section 7 i.e. Conclusion.

2. THEORETICAL BACKGROUND

This chapter presents theoretical background relating to the topic of liquidity. The chapter will present definitions for liquidity, importance of liquidity and sources of illiquidity. Liquidity dimensions and measures of liquidity estimated for the study shall also be presented in this chapter. Previous literature in regard to liquidity risk is also provided. Capital asset pricing models, their deficiencies as well as liquidity models are also presented. Hypotheses drawn for the study are presented at the end of this chapter.

2.1 Liquidity

Modern finance theory is based on the idea that financial markets are free of frictions and efficient. Thus, trade of an asset is possible at any point of time, as buy and sell sides at the same price for any given volume are available. According to this view, only risk and return determine investor's investment decision (Markowitz, 1952). In contrast, market microstructure theory is based upon market frictions (Cohen, Maier & Schwartz, 1986). Stoll (2000) has distinguished these frictions into two categories: Real frictions, are deficits in the market organization, consume real resources and influence all market participants in similar manner, whereas informational friction reallocate wealth between the market participants. Therefore, liquidity becomes an additional factor for investment decision criterion.

The concept of liquidity is complex and has been defined in several ways in the literature. Baker (1996) asserts that there is no specific or widely recognized definition of liquidity available in the literature. And economists such as Wyss (2004) argue that lack of an absolute definition for the concept of liquidity is because of its multi-dimensionality. The dimensions of liquidity identified in the literature include, width, depth and resilience, immediacy and resilience (Harris, 1990). The dimensions of liquidity are discussed further in the next section of this chapter. One extensively used definition of liquidity states that, "an ability to trade large quantities quickly at low cost with little price impact" (Chollete, Næs, & Skjeltorp, 2007, p. 6). This definition is able to encompass various dimensions of liquidity, depth ("large quantities), immediacy ("quickly"), width ("low cost") and resilience ("little price impact"). Unlike the definition by Chollete et al. (2007) other definitions are only able to capture one of the several dimensions of liquidity. The definition by Aitken and Comerton-Forde (2003, p. 45) focuses only on width, "the ability to convert shares into cash (and converse) at the lowest transaction costs". Whereas, Amihud (2002, p. 33) uses only dimension of resilience in his definition, by stating that, "illiquidity reflects the impact of order flow on price – the discount that a seller concedes or the premium that a buyer pays when executing a market order – that results from adverse selection costs and inventory costs".

The definitions presented above express important features of liquidity. However, for this study the definition by Chollete et al. (2007) is preferred, as it able to capture various dimensions of liquidity. Conversely, Illiquidity is the complete opposite of liquidity, which is observed when large spreads exist, trading a security in large quantity moves its price substantially, or when it takes significant amount to unload a position.

Companies go public by floating their shares in the market to fuel their growth thus making financial markets another source of financing other than banks etc. Moreover, these financial markets provide investors with opportunities to invest and earn profit. Importance of liquidity is highlighted as follows:

- It has been presented in the studies by Beck and Levine (2003) and Caporale, Howells & Soliman (2004) that the liquid stock markets are important indicator of present and future rates of economic growth for a country.

- A low liquidity premium also lowers issuance costs for corporates (Damodaran, 2005). Butler, Grullon & Weston (2002) have determined that, after controlling for other factors, investment banks charge lower fees to firms with more liquid stocks since they need to manage less risk.

- Guay (1999), Jina and Jorian (2006) argue that deep and liquid financial markets are important to financial stability. Market participants require liquid markets in order to effectively manage risks and their own funding needs (Bartram, Brown & Conrad, 2008).

Tinic (1972) , Menyal & Paudyal (2000) have indicated that liquidity of individual asset is dictated by number of factors including order flow, trading volume, volatility, number of institutional investors holding the stock, the number of market makers assigned to each stock and the number of different markets a specific stock is traded in. Whereas, the fundamental assumption of a liquid market is the presence of significant number of buyers and sellers at all times.

The capability to absorb large transactions without significant price impacts. Sarr and Lybek (2002) opine that there is no unanimously recognised measure to determine a market's degree of liquidity due to market specific factors and individualities.

Similar to the definition of liquidity the literature doesn't have unanimously accepted sources of illiquidity. However, the most widely found sources of illiquidity in the literature are presented here. The sources of illiquidity discussed as follows include trading costs, asymmetric information, inventory risk, search frictions and ownership structure/dispersion.

Trading costs refer to the costs associated with trading an asset. Real markets are not frictionless, and these market frictions effect stock prices. Consequently, these frictions should be taken into account for asset pricing. Amihud and Mendelson (1986) studied the effects of transaction costs on stock prices, and determined that assets with higher bid-ask spreads, yield higher returns. Additionally they identified that cost associated with trade can increase due to time variations in transactional costs. A sudden decline in liquidity can force investors to liquidate their positions, therefore holding periods become uncertain. However, transaction cost depreciate over the holding period, thereby making the impact of transaction cost uncertain. Similarly, investors are uncertain about the future transaction costs that will incur at the time of sale. The fluctuations in the transaction cost are representative of systematic risk.

Transaction costs lead to segmentation of the market, as long-term investors hold relatively more illiquid assets compared to short-term investors. Although, investors can choose to avoid securities which are associated with high transaction cost and if the returns are same long-term investors would prefer assets with low transaction costs. However, Amihud & Mendelson (1986) determined that expected return is an increasing and concave function of transaction costs. Additionally, investors with longer expected holding periods can receive a liquidity premium that surpasses the expected transaction costs by holding high spread stocks (Amihud, Mendelson & Pedersen, 2006). Compared to short term investors, long-term investors are not exposed to transaction costs on regular basis. The expected transaction cost can be depreciated over a longer holding period.

Asymmetric information occurs when one of the counterparts involved in trade holds private information regarding to the trade that the other part does not, which results in a trading loss for the uninformed part (Amihud et al., 2006). Information relevant to a trade decision may include information specific to company, information relating to future trades, or information regarding future market prospects. Asymmetric information can be considered as a source of systematic risk, as informed investors will always have an advantage over uninformed investors. The uninformed investors can never be certain when assigning weights to stocks since they do not have the right expectations concerning risk and return. This is supported by O'Hara (2003), who claims that investors hold different portfolios according to the information they possess. Brennan and Subrahmanyam (1996), Easley, Hvidkjaer, and O'Hara (2002) and O'Hara (2003) all provide supporting evidence that illiquidity is associated with information costs.

Brennan and Subrahmanyam (1996) claim that informed investors create illiquidity costs for investors who do not possess any private information, and this information asymmetry leads to stock's illiquidity. Easley et al. (2002) and O'Hara (2003) claim that information based trading increases risk premiums, assets with large fraction of private information have higher risk premiums.

Inventory risk links to demand pressure. Inventory risk arises when there is no significant demand for a particular stock. Instead of waiting for a buyer to appear, the investor might resort to sell stock to a market maker[1] at her bid price. Consequently, this market maker will hold inventory bearing the risk that the price of the stock may fall. The market maker would want to be compensated for the risk of holding this inventory, so market maker makes the quotes of bid and ask prices such as to make sure that the present value of the expected future losses is covered.

Search frictions refers to the lack of availability of buyers or sellers when an investor needs to execute a transaction. This situation creates a trade-off for the investor to choose between immediate execution of a less attractive trade or search for a better trade opportunity, and thus imposing search costs (Amihud et al., 2006). Weill (2008) supports the idea that search frictions are a source of illiquidity, who determined cross-sectional differences in stock returns is caused by cross-sectional differences in the number of tradeable shares. Furthermore, higher number of tradeable shares are linked to decreased search frictions and higher liquidity.

[1] Market Makers play a vital role in providing liquidity in financial markets. They absorb temporary supply and demand imbalances in the market and help decrease the impact of market volatility.

Search frictions are found to be dependent on market conditions. Decrease in market liquidity results in an increase in search frictions because it becomes more costly to carry out a trade due to lack of availability of trading counterpart.

Ownership structure/dispersion denotes firm specific characteristics that source illiquidity. Jacoby and Zheng (2010) studied the relationship between market liquidity and ownership dispersion. The results of the study indicate that higher ownership dispersion improves market liquidity. Baber, Brandt, Cosemans and Verardo (2012) in their research investigated the relationship between institutional investors, liquidity, and liquidity risk. They determined that institutional ownership generally predicts higher stock liquidity. Additionally, the stocks with concentrated institutional ownership and especially hedge fund ownership incline to have lower returns with high market illiquidity, indicating that crowded trading strategies have a negative impact on returns when market is illiquid. Næs (2004) studied the relationship of market liquidity with company ownership for Norway Stock Exchange using a panel regression approach. This also study reports owner concentration to be negatively related to spreads and information costs.

As discussed in the above section, the sources of illiquidity leads to differences in the absolute level of liquidity among assets and also to differences in how assets are affected by systematic fluctuations in liquidity. In this scenario, rational investors will require a premium for holding assets which are influenced by these sources of illiquidity.

2.2 Liquidity Measures

The liquidity concept is widely applied in research and practise still there is no agreement on how to measure it (Kempf & Korn, 1999). There are various liquidity measures, which are estimated from either trade or order data, and capture various dimensions of liquidity.

Liquidity is considered to have four dimensions, namely width, depth, immediacy and resiliency (Harris, 1990).

Width refers to the cost associated with transaction of securities, often expressed by the spread. Bid-ask spread represent the difference between immediate buy and sell at the spread without the change in the order book[2]. For transaction volumes that do not surpass the volumes given at the bid and ask prices, the difference is exactly equal to the bid ask spread. This is based on the assumption that true current value of the asset is presented by the median between the

[2] Order book lists the number of shares being traded.

highest bid prices and the lowest ask prices. Therefore, high spreads are indicative of high transaction costs.

Depth denotes the ability to carry out a transaction without any impact on quoted price (Chollete et al., 2007), and can be expressed by the volumes of trades or orders. The following relation holds: the more units of an asset can be bought or sold at a defined price the deeper the limit order book is. A market is considered deep when large number of trading orders on both the buy and sell side are available.

Immediacy also referred to as trading time, is the time associated with completing a transaction (buy or sell) of a given size at prevailing price. It is often argued that immediacy is implicitly assumed in trading systems that offer continuous trading. Market makers are vital source of immediacy for financial markets.

Resiliency is termed as the pace at which prices return to their original levels after a large transaction has taken place. This is based on the assumption that when a large transaction causes a change in price without influencing the underlying value of the asset, the asset price should move back to its equilibrium level (Hasbrouck,1988). In contrast to the other dimensions that are determined through certain point in time, resilience can only be determined through time. Here, through time implies amount of time required by the asset to get back to its equilibrium level. Whereas, certain point in time refers to time taken to complete a transaction without influencing its price. Resiliency takes into account supply and demand situation of the market.

Figure 2 has been reproduced from study by Ranaldo (2001) that presents the aspects of liquidity as discussed above. The horizontal axis depicts the bid and ask volumes. The volumes of bid and ask differ from each other due to demand and supply difference but the sum of two accounts for market depth. The vertical axis of the figure presents the price. Two different prices exist in market: the ask price, at which securities are offered to be sold, and the bid price, at which securities are offered to be bought. The difference between bid and ask price is the measure of width. And the elasticities of the supply and demand curve depict the resilience dimension of liquidity. As immediacy is termed as the time associated with executing the transaction, hence, depicting it in figure is bit difficult.

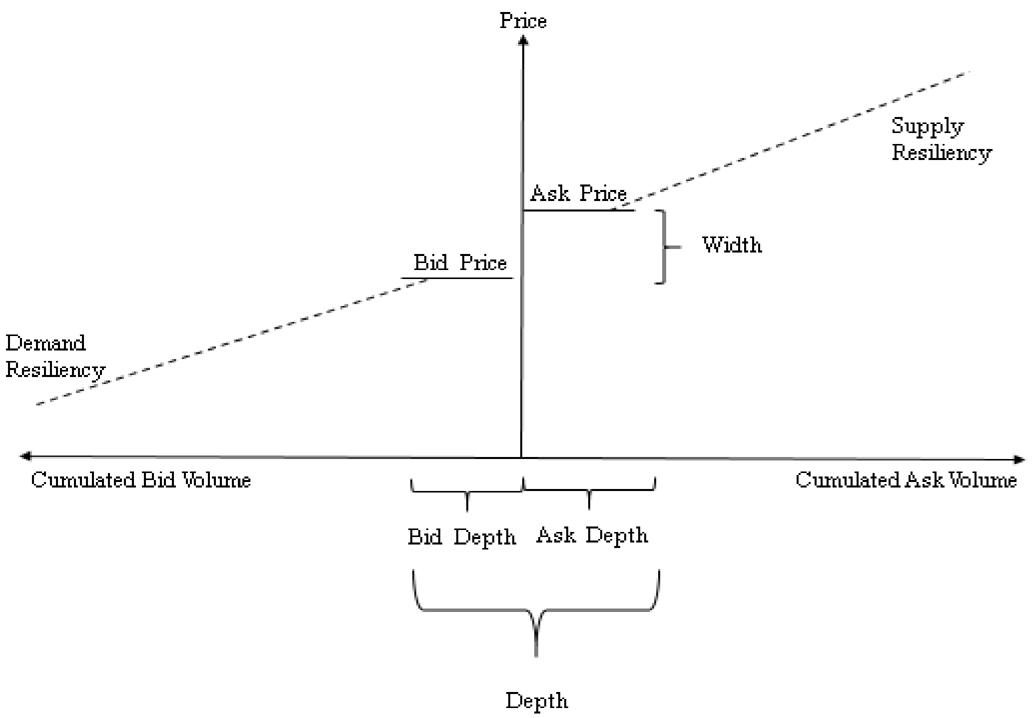


Figure 2. Dimensions of Liquidity *Source: Ronaldo(2001)*

The dimensions of liquidity are related to various sources of illiquidity. The dimension of width captures transaction costs, as the spread is an indicator of the cost investors have to pay in order to carry out the trade. Asymmetric information leads to lowered trading in the market due to lack of participation from the uninformed investors, this affects the depth and immediacy dimensions since stocks are traded in smaller amounts and at lower frequency. Search frictions affect the immediacy dimension of liquidity, when it becomes more time consuming for investors to trade. The different dimensions of liquidity not only refer to the ways of categorizing liquidity measures but also reflect various sources of illiquidity. However, ambiguity still holds as to which sources each dimension is associated with, as the illiquidity sources are most likely to decrease liquidity with respect to more than one dimension.

The perceived liquidity of an asset depends upon which of its dimension is being focused on. An asset might not necessarily be liquid according to one dimension even if it is liquid according to another dimension. For instance, an asset being traded frequently can be termed as liquid, but that asset might be traded in small quantities and consequently also have illiquid characteristics. However, Chollete, Næs & Skjeltorp (2006) argue that the liquidity measures of different dimensions are highly correlated, and the most liquid stocks are liquid according to all the dimensions.

Apart from liquidity dimensions another distinction between liquidity measures lies based on trade- and order-based measures. Trade-based measures are based on the information relating to the trades that have been executed, whereas, order-based measures are based on the information about orders placed in the market and express the available liquidity for potential trades (Chollete et al., 2007). Aitken and Comerton-Forde (2003) claim that order-based measures are best to empirically predict time variations in return, as they are based on the available liquidity at a certain point of time instead of the ex post trading activity. On the other hand, Chollete et al. (2006) find trade-based measures to be most relevant. A likely reason for this is that the order data can be strongly influenced by noise, the investors can place orders without the intention of trading at the current prices. For instance, frequent offers from stock trading algorithms, which places many offers that only last for a very short time, and such offers disturb the data when analysing trading opportunities. Additionally, the computation of many of order-based measures require high frequency (intraday) data that can be difficult to obtain and analyse, whereas, the trade based measures can be estimated comparatively easily from daily data. However, Aitken and Comerton-Forde (2003) and Chollete et al. (2007) find low correlation between trade- and order-based measures, and therefore emphasize that it is important to include measures from both categories.

Liquidity itself is not observable and therefore, has to be proxied by different liquidity measures. Table1 presents the three liquidity measures that have been selected for this study in order to capture the multi-dimensionality.

Table 1. Dimensions of the selected Liquidity Measures

Measure	**Dimension(s)**
Percent Quoted Spread	• Order based • Width • Depth
Amihud trade Impact	• Trade based • Resiliency
Turnover	• Trade based • Immediacy • Depth

Percent Quoted Spread

In order to encompass width and depth dimensions of liquidity, Percent Quoted Spread has been added to the study which is an order based measure. As described earlier width accounts for spread and depth accounts for available ask and bid prices in the market, hence, this measure is able to capture both of these dimensions. The difference between ask price and bid price and such related measures gives an approximation of the cost sustained when executing a trading. In addition to commission, brokerage fees and taxes, the trader has to pay the spread as cost for the immediate execution of a trade. Thus, quoted spread is an intuitive measure of cost small round trip of transaction. Equation (1) presents the Percent Quoted Spread by Chung and Zhang (2014, 97).

$$\mathbf{PQS}_{s,m} = \frac{1}{n_{s,m}} * \sum_{t=1}^{n_{s,m}} \frac{P_{s,t}^{A}-P_{s,t}^{B}}{m_{s,t}} \quad (1)$$

Where, $P_{s,t}^{A}$ is the ask price for stock s on day *t*, $P_{s,t}^{B}$ is the bid price for stock s on day *t* . And $m_{s,t} = P_{s,t}^{A} + P_{s,t}^{B}/2$ is the midpoint of the bid-ask prices. $n_{s,m}$ is the number of daily observations in the month m. Higher the level of Percent Quoted Spread for a stock lower the liquidity of that particular stock for the respective month.

Amihud (2002)

Amihud (2002) is the most widely applied measure in the literature and conceptually is linked to illiquidity and is also called as Illiquidity (ILLIQ). This measure has been added in the study to capture the resiliency dimension of liquidity and is a trade based measure. Resiliency accounts for price elasticity arising due to supply and demand and Amihud (2002) measure aims to capture the inclination for the price of illiquid stocks to have greater sensitivity to trades. As it expresses volume of shares required to move stock price by one percentage. The measure is a low frequency price impact proxy for liquidity. Amihud (2002) measure is presented by equation (2) is as follows:

$$\mathbf{Amihud}_{s,m} = \frac{1}{n_{s,m}} * \sum_{t=1}^{n_{s,m}} \frac{|r_{s,t}|}{vol_{s,t}} \quad (2)$$

Where, $r_{s,t}$ is the return for stock s on day t and $vol_{s,t}$ is the pound trading volume on day t, $n_{s,m}$ is the number of daily observations in the month m. Higher the level of Amihud (2002) for a stock lower the liquidity of that particular stock for the respective month. Amihud measure does has a limitation as this measure does not include days without trading, which itself contains considerable information regarding illiquidity.

Turnover

In number of studies turnover is used as measure of liquidity and recent ones include from Tsung-wu and Shu-Hwa (2015) for Shanghai Stock Market, Foran, Hutchinson and O'Sullivan (2015) for UK Stock Market and Vu, Chai and Do (2015) for Australian Stock Market. Turnover has the ability to capture the immediacy and depth dimensions of liquidity and is trade based measure. Number of shares are attributed to immediacy dimension of liquidity, additionally turnover is associated with quantity of shares traded, and hence, it is able to capture aspects of depth as well.

This measure has strong linkage to inventory based models of liquidity as described by Stoll (1978) and the trading pattern models of Foster and Viswanathan (1990) in which liquidity is expected to rise in phases of concentrated trading with smaller spreads. In contrast, views exist that suggest that turnover may not be representative of liquidity. Subrahmanyam(2005) claims that turnover may instead be linked to momentum, where it is found that high turnover for stocks with high recent performance predicts better future returns and contrary in case for stocks with poor recent performance.

The applicability of turnover to liquidity studies is still open for discussion. However, for comparison with past studies the measure is included in the study. Equation (3) presents the Turnover.

$$\mathbf{Turn}_{s,m} = \frac{1}{n_{s,m}} * \sum_{t=1}^{n_{s,m}} \frac{dVol_{s,t}}{SO_{s,t}} \quad (3)$$

Where, $dVol_{s,t}$ is the number of share traded of stock s on day t and $SO_{s,t}$ is the number of shares outstanding of stock s on day t. Higher the Turnover for a stock higher is the level of liquidity.

2.3 Literature Review

In this section of theoretical background chapter earlier studies in regard to liquidity risk shall be presented. Moreover, CAPM and LCAPM shall be discussed.

2.3.1 Liquidity Risk

Liquidity risk is the risk arising from the lack of marketability of an asset that cannot be traded swiftly enough to avoid or lessen a loss. The liquidity risk can be categorized into two divisions: liquidity risk in trading and liquidity risk in funding. Liquidity risk in trading, which is also termed as market liquidity risk originates from the features of the market, such as: number of the participants, entry and exit at zero cost and transparent information (Bervas, 2006).Whereas, Funding liquidity risk is connected to asset liability management framework, which relates to the financial institution's balance sheet and the possibility that the financial institution drains out its liquidity to repay debt (Marrison, 2002). As liquidity risk in funding falls outside the domain of this study, hence, liquidity in reference to trading shall be discussed further. Acharya and Pedersen (2005) identified four main sources of liquidity risk in trading, as follows:

- **Level of liquidity:** The liquidity risk is associated with added costs of illiquidity that influence the return of the asset.
- **Commonality in Liquidity:** Commonality in liquidity refers to the proposition that individual assets liquidity is determined by market wide factors besides well documented idiosyncratic factors such as volatility, trading volume and number of trades etc.
- **Flight to liquidity:** Occurs when investors (or a sub-group of investors) want to reduce their holdings of illiquid assets toward holding more liquid assets. Liquidity risk due to covariation between a security's return and the market illiquidity.
- **Depressed wealth effect:** The liquidity risk arising due to covariation between asset's illiquidity and the market return.

Liquidity seems to effect returns due to difference between stocks level of liquidity and due to systematic fluctuation in liquidity. Financial analysts consider liquidity as an important factor in affecting price of the stocks while constructing investment portfolios (Amihud & Medelson, 1991).This section of the chapter will discuss how aspects of liquidity risk are related to equity risk premiums and how they are linked to each other.

Level of Liquidity of assets may influence expected returns of assets. Amihud and Mendelson (1986) studied the effect of bid ask spread or illiquidity on asset pricing. The focus of their study was to explore the area of market microstructure in relation to stock returns. Their model predicts that higher the bid ask spread higher will be expected returns, net of trading costs. Investors hold high spread securities for longer holding period because of the clientele effect. Brennan and Subrahmanyam (1996) and Chalmers and Kadlec (1998) also provide supporting evidence that asset prices reflect level of liquidity. However, Næs and Skjeltorp (2006) question whether these studies have adequately carried out the risk adjustment of the returns and the proposed relation between liquidity costs and return in these studies might be due to measurement error in the risk of the asset.

Bali, Peng, Shen and Tang (2013) determined that stock market shows an under-reaction to the shocks in stock level liquidity, their study included New York Stock Exchange (NYSE), American Stock Exchange (AMEX) and NASDAQ exchanges. The authors indicate that drivers of this under-reaction include investor inattention and illiquidity. This study finds evidence on the mechanism of processing information about stock level liquidity shocks. The authors suggested that limited investor attention and illiquidity prevents public information being incorporated in security prices. However, Bali et al. (2013) found that immediate liquidity shocks have positive effect on contemporaneous stock returns. They applied double sorted portfolios using Fama-MacBeth regressions to confirm the significant relationship between future returns and liquidity shocks. The authors had also incorporated large set of control variables including level of illiquidity, systematic liquidity risk, size, book to market and price momentum.

Faff, Chang and Hwang (2010) analysed the impact of liquidity on stock returns for Tokyo Stock Exchange (TSE). The authors reported a negative relation between expected stock returns and liquidity measures even after factoring risk adjustments in place of raw returns. Additionally, this study found that liquidity is priced during growing phase of business cycle but not significantly priced during contraction phase. This results contradicts with the notion that liquidity is more important in bad time which is a kind of liquidity puzzle. Narayan and Zheng (2011) investigated the impact of liquidity on returns for Shanghai Stock Exchange (SHSE) and the Shenzhen stock exchange (SZSE). In this study the authors were able to deduce that liquidity has strong negative effect on SHSE in comparison to SZSE.

Uddin (2009) investigated the relationship between relative measure of liquidity and returns on NYSE and AMEX. The author applied relative measure of liquidity (RML) instead of absolute measure in his study. RML links individual stock liquidity with market wide liquidity which more closely represents systematic liquidity risk. From the results of this study the author was able to provide opinion that a stock cannot be categorized as illiquid just because it is not traded frequently if the average market liquidity as a whole is low.

Hubers (2012) investigated the relationship between asset prices and liquidity for stocks listed at London Stock Exchange (LSE). The author applied three models viz. CAPM, CAPM with a liquidity factor and; CAPM with a liquidity factor along with the Fama-French factors. The portfolios were sorted on the basis of size and liquidity and then the returns were regressed against liquidity in each model. The results of the study provide evidence regarding existence of positive relationship between liquidity and asset prices.

Commonality in Liquidity can also be termed as systematic fluctuations in liquidity. Chordia, Roll and Subrahmanyam (2001) empirically studied underlying determining factors of time series movements in liquidity, also termed as commonality. Their study suggests that co-variation in liquidity is much stronger for portfolios than individual stocks. However, Fabre and Frino (2004) argue that commonality in liquidity might be attributed to market design. High level of commonality signifies high level of systematic risk, consequently higher liquidity premium for holding such assets (Fujimoto, 2003). Construction of diversified portfolios turns out to be a difficult task due to the presence of commonality in liquidity (Domowitz and Wang, 2002).

Sadka (2003) provides evidence for variations in liquidity across stocks as well as over time, and claims that commonality in liquidity is priced. Amihud et al. (2006) argue that fluctuations in liquidity effect the volatility of asset prices and investors require a liquidity premium due to time-variations in liquidity costs. Pastor and Stambaugh (2003) find stocks with returns which exhibit higher sensitivity to fluctuations in market-wide liquidity to provide higher expected returns, after controlling for factors including market return and size, value, and momentum. Acharya and Pedersen (2005) have determined that liquidity in US stock market is priced in the cross-section of asset returns. Lee (2011) applied Liquidity Adjusted Capital Asset pricing model developed by Acharya and Pedersen (2005) by using 25,000 individual stocks from 48 developed and emerging countries around the world for years 1988 to 2004. The key finding of this study conducted by Lee (2011) is that a US security’s required return in dependent upon its expected illiquidity and on the covariance of its own return and illiquidity with global market returns.

Sadka (2006) distinguishes his study by investigating the component of liquidity risk that can explain asset pricing anomalies in the contest of momentum and post earnings announcement drift. Sadka (2006) decomposed liquidity into variable and fixed components and determined that variable component in the US market is priced. Martinez, Nieto, Rubio and Tapia (2005) conducted a study for commonality in liquidity risk for Spanish Stock market. The sample period of this study was from year 1991 through 2000. The results of the study indicate that commonality in liquidity is significantly priced in Spanish Stock market especially when betas are estimated in relation to the illiquidity risk factor , which is based on the stock price reaction to one euro of trading volume.

Zheng and Zhang (2006) examined the degree at which liquidity is driven in China that has adopted an order-driven trading system. Commonality is found to be stronger during bear period than bull period, indicating investors are more anxious of macroeconomic news in comparison to performance of firm. Additionally, market liquidity is termed to be an important indicator of the state of the economy, as the market, and particularly illiquid stocks, become less liquid prior to market downturns (Næs, Skjeltorp, & Ødegaard, 2011).

Pukthuanthong-Le and Visaltanachoti (2009) investigated commonality in liquidity for stocks listed on Stock Exchange of Thailand (SET) using eight years of tick data. The study provides empirical evidence in support of market wide commonality across various liquidity proxies. Also, the authors found that industry wide commonality is stronger than market wide commonality. Tayah, Bino, Ghunmi & Tayem (2015) argue that for most of the emerging economies intraday data is not available. They studied commonality in liquidity for Amman Stock Exchange by employing daily liquidity measures. The study reports evidence of commonality across all size based portfolios for the proxies applied except for price impact. Additionally, for Amman stock exchange the study reports weak evidence of industry-wide commonality which is in contrast with the previous studies.

Now, having a look on evidence of commonality in liquidity and its pricing in the UK market. Galariotis and Giouvris (2007) conducted a study in order to investigate commonality in liquidity for UK using FTSE 100 (comprising of 100 largest companies at LSE) and FTSE 250 (comprising of 101st to 350th largest companies at LSE) stocks for years 1996 through 2001. In this study the authors accounted for the changes in trading regimes at London Stock exchange, the shift from quote driven markets, where market maker is obliged to provide liquidity to order driven market where market maker has no such obligation. Findings of this study indicate commonality is quite strong for FTSE 100 shares for both individual and portfolio level, whereas FTSE 250 exhibit strong commonality at portfolio level. Additionally, commonality on average similar across trading regimes, regardless of the nature of liquidity provision.

Galariotis and Giouvris (2009) provided robustness to their findings in 2007 by adapting different methodology to identify the presence of common liquidity factor by using principle component analysis. The presence of commonality was consistent to their earlier study, however for changes in trading regimes they found out that in order driven regimes the effect of commonality on asset pricing is reduced. Foran, Hutchinson and O'Sullivan (2015) investigated the pricing of liquidity commonality with a large set of data that included all the listed delisted stocks of London Stock Exchange during year 1991 to 2013. Their findings suggest that systematic liquidity risk is positively priced in the cross section stock returns. Foran, Hutchinson and O'Sullivan (2014) employed a high frequency data (tick data and best price data) for year 1997 to 2009 to investigate the asset pricing effects of market liquidity shocks. The authors provide evidence for strong commonality and also found that liquidity shocks persist up to a year for UK market.

Flight to Liquidity, level of liquidity appears to be related to systematic fluctuations in liquidity, as stocks with low levels of liquidity tend to have highest reduction in their liquidity during recessions. Together, level of liquidity and systematic fluctuations in liquidity seem to contribute to the presence of liquidity premium .This phenomenon is termed as flight to liquidity, and is being supported by e.g. Amihud (2002), Vayanos (2004) and Acharya and Pedersen (2005).

Liu (2006) tested the theory of the liquidity risk premium for a longer period of time, from year 1926 to 2005. The author also tested two subsamples within this period (data split on 1963). The results of this research present that the liquidity risk premium is strong for both periods. Næs et al. (2011) also find evidence of flight to liquidity in regard to recessions, as investors' holdings in stocks which are assumed to perform particularly poor during economic downturns decrease when the market liquidity worsens. The authors claim that flight to liquidity and flight to quality often appear together because risky assets also tend to be less liquid. These phenomena act as catalyst and accelerates the poor situation of the market, as investors liquidate equity positions or invest in more liquid assets. Kamara, Lou & Sadka (2010) investigated that how illiquidity is priced in different periods of crisis. They found that in these periods the liquid stocks under- perform when compared to illiquid stocks. In their research it is highlighted that not only the level of liquidity is important, but also the liquidity risk is important. Scholes (2000) suggests that liquid assets have an option-type characteristic as they provide their owner the option to convert them easily into cash i.e. liquidate them if needed.

Vayanos (2004) determined that the transaction costs of frequently traded stocks decrease, whereas the transaction costs of infrequently traded stocks increase. It was also found that the price of a stock declines when the transaction cost of a relatively more liquid stock declines. Petkova, Akbas and Armstrong (2011) studied relationship between volatility of liquidity and expected returns employing Amihud (2002) as liquidity proxy on daily data derived from New York Stock Exchange (NYSE) and American Stock Exchange (AMEX). The study provides positive and robust relationship between volatility of liquidity and expected returns in regressions after controlling for various variables, systematic risk factors, and different sub periods. Rubio, Martinez, Nieto & Taipa (2005) investigated explanatory power of systematic liquidity on asset pricing for Spanish stock market. Their dataset was based on 10 years, the study cross sectionally regressed average returns against betas estimated relative to market wide liquidity risk factors. Market wide liquidity is an important factor to be incorporated in asset pricing models but according to this study none of the liquidity factors appears to be priced in stocks for Spanish market. Chordia, Roll & Subrahmanyam (2001) demonstrated the importance of trading activity related variables in the cross section of expected returns. 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.

Angelidis and Andrikopoulos (2010) conducted a study on London Stock Exchange (LSE) for years 1987 to 2007. The findings of this study help to conclude that liquidity and idiosyncratic risk should be considered as the determinants of the cross section of expected stock returns. Additionally, the study provides evidence of asymmetric liquidity spillovers, supporting that market wide information is first incorporated in the behaviour large-cap investors and is then transferred in the trading of small-cap investors. Cotter, O’Sullivan and Rossi (2015) aimed to investigate the conditional pricing of systematic and idiosyncratic risk for securities listed at the UK equity market. The study claims that idiosyncratic volatility is significantly priced in stock returns in down markets, although literature provides counter intuitive findings for this result.

Depressed wealth Effect, this source of liquidity risk was identified by Acharya and Pederson (2005). They described this liquidity as the covariation between stock's illiquidity and market return. This risk arises when investors show lack of interest in assets with a liquidity provision, especially this being the case for capital intensive assets such as high margin assets. Wagner (2011) further explains this channel of liquidity risk: if several number of investors want to sell their assets at the same time i.e. similar to fire-sales as observed in the recent financial crisis, prices of the assets come under pressure. In this scenario the investors are ready to sell their stocks at a lower price and they are also willing to pay a premium to sell their stocks. Wanger (2011) termed this phenomena as liquidation risk.

As mentioned above Acharya and Pederson (2005) were first to identify and test this source of liquidity risk in their study. For their selected market i.e. stocks listed at New York Stock Exchange (NYSE) and American Stock Exchange (AMEX) they found this liquidity risk to be priced. Lee (2011) also tested this source of liquidity risk, compromising of big sample of developed and emerging markets. Their sample consisted of 48 countries. Out of these 48 countries, 26 countries were from emerging markets including, Argentina, Brazil, Chile, China, Colombia, Czech Republic, Greece, Hungry, India, Indonesia, Israel, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Portugal, South Africa, South Korea, Sri Lanka, Taiwan, Thailand, Turkey, Venezuela and Zimbabwe. And 22 countries were from developed markets of the world including, Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Italy, Japan, Luxemburg, Netherlands, New Zealand, Norway, Singapore, Spain, Sweden, Switzerland, United Kingdom and United States. They found this source of liquidity risk to be negative and significant after controlling for firm characteristics such as market capitalization and book-to-market ratio. This significant premium varied from -0.572 to -0.14. Vu, Chai and Do (2015) studied this liquidity risk for Australian market and found it to negative and significant at 5% level.

There are studies available in the literature that provide evidence against the presence of liquidity premium. Transaction costs are often insignificant, and discovering liquidity effects among the noise in asset returns is difficult. Some studies are criticized for overemphasizing the influence of transaction costs, as this will have larger impact on asset returns when the holding period over which the transaction costs are amortized is shorter (Chalmers & Kadlec, 1998).

Constantinides (1986) argues the risk premium arising because of transaction costs to be minor, and therefore does not consider it significant to account for transaction costs in asset pricing. In the study, Constantinides (1986) assumes a relatively long holding period, and argues that investors tend to reduce the frequency and volume of their trades when transaction costs become large, and that bid-ask spreads only have a second order impact on asset returns. However, this approach of assuming constant transaction cost is being criticized by Sadka (2003), who argues that constant transaction in reality in not possible in financial markets and investors can freely choose when to trade. Eleswarapu and Reinganum (1993) relate liquidity effect to the January effect as they found positive liquidity premium to exist only in January. Based to this study, they doubt the connection between equity premium and liquidity risk.

Despite the presence of studies against of liquidity risk, the majority of research on liquidity risk provides evidence in support of a liquidity premium.

2.3.2 CAPM & Liquidity Adjusted CAPM

This section briefly introduces capital asset pricing models that help examine differences in stock prices. Additionally, deficiencies in capital asset pricing model shall also be discussed here and the background for liquidity models will be presented.

CAPM

As investors are concerned about variations in their total wealth and consumption rather than variations in the value of each single stock in their portfolio, risk should only be priced if it is systematic. The systematic risk of stocks can be termed as the correlation with the return on the stock market, as specified in the capital asset pricing model (CAPM) by Sharpe (1964), Lintner (1965) and Mossin (1966). However, rational investors diversify their holdings across various asset classes including bonds, real estate, private equity and derivatives, as well as stocks from international markets. Therefore, it is needed that systematic risk of stocks should also be considered in relation to these asset classes.

Several improvements have been made to CAPM, for instance the ICAPM by Merton (1973) and the consumption CAPM by Lucas (1978) and Breeden (1979). These models claim that the systematic risk factors are not only related to the value of equity holdings but are also related to variations in the consumption and wealth opportunities of investors. Jangannathan and Wang (1996) presented the conditional CAPM, which takes into account the changes in investment opportunities by including the systematic risk of changes in the correlation between asset and market return.

Equilibrium models described above, which relate systematic risk directly to the correlation between the asset and measures of wealth or consumption, in contrast to them the models based on arbitrage pricing theory (Ross,1973) relate the systematic risk factors to return comparatively indirectly. Arbitrage pricing theory based models focus greatly on stock characteristics that could be considered indicators of underlying risks. Fama and French (1992) incorporate firm-specific factors, whereas the macroeconomic models in the tradition of Chen, Roll and Ross (1986) include different macroeconomic risk factors. For these models, the most important selection criterion for variables is how well the factors contribute to explain differences in return between stocks.

Asset pricing models have brought forth number of factors that link return of assets to systematic risk. However, room for improvement still lies for CAPM and the other models. The CAPM has been criticized for its restrictive assumptions and poor empirical performance (Merton, 1973). Jensen (1972) argue that the assumptions of frictionless markets, borrowing free of risk and one period investment decisions can be reasons for the CAPM to unable to explain returns adequately. Problems also lie in regard to finding the correct input variables, for instance good market return proxy (Roll, 1977). With all these criticism and shortcomings CAPM is easy to interpret and apply, and it remains one of the most widely applied models both for asset pricing purposes and as a reference model to assess the performance of other models.

The CAPM faces another criticism for including only one risk factor. Although, it is widely recognized that there are several sources of risk that give rise to high returns (Cochrane, 1999). This provides basis for the establishment of multifactor models in order to improve CAPM. But it appears to be a daunting task to find one common factor that is able encompass all the relevant systematic risk, as different risk aspects affect asset returns in different ways. Statistically, a model’s ability to explain variations in returns increases with the number of factors added in it. However, this does come with a downside as by adding insignificant factors give insignificant improvements and can lead to statistical issues if the factors are correlated. However, multifactor models are still found to be superior compared to single-factor models.

The new models have lesser restrictive assumptions and comprise of more risk factors than the CAPM. However, the equilibrium models are still quite restrictive as they relax only a few of the CAPM assumptions. The ICAPM and the macroeconomic models have been criticized for not clearly defining the risk factors, and the consumption CAPM has poor empirical performance. The main issue regarding Fama-French model is the lack of economic rationale of the factors incorporated in it (Kothari, Shanken, & Sloan, 1995, MacKinlay, 1995). Nonetheless, the Fama-French model tends to perform better empirically than the CAPM.

With the evidence provided in favour of liquidity risk premium these models still fall short of incorporating liquidity risk as one of the factors that contributes to the systematic risk. As Archarya and Pedersen (2005), Liu (2006) and Sadka (2003) claim these factors to correlate with liquidity factors.

Liquidity Adjusted CAPM

A common practise observed in the literature that is in order to account for liquidity risk a liquidity measure is added to the CAPM or Fama-French model. Amihud and Mendelson (1986) and Sadka (2003) added a liquidity measure directly to the CAPM, in order to investigate the influence the effects of liquidity on stocks.

Another method observed frequently in the literature is the use of factor analysis, in which a set of various liquidity measures are grouped into common liquidity factors. Hasbrouck and Seppi (2001), Eckbo and Norli (2002), Chen (2005), Chollete et al. (2006; 2007; 2008), and Korajczyk and Sadka (2008) applied factor analysis in their respective studies by adding one or more of the common factors to the CAPM or the Fama-French model. Liu (2006) aimed to capture multiple dimensions of liquidity by algebraically combining several liquidity measures and added the factor to the CAPM.

Amihud and Mendelson (1986) and Sadka (2003), claim that the models which include liquidity effects better explain cross-sectional returns than the CAPM or the Fama-French model. Additionally, Hasbrouck and Seppi (2001) find that results from factor analysis also verify that the liquidity adjusted models outperform the traditional CAPM and Fama-French model. Results from these studies indicate that liquidity risk is priced, and that incorporating liquidity to asset pricing models increases their ability to explain returns. However, there is no definitive answer to how to optimally incorporate liquidity to asset pricing models, as the liquidity models apparently perform well for most of the methods applied.

Liquidity adjusted Asset Pricing model (LCAPM) was developed by Acharya and Pedersen (2005). The authors of LCAPM revisited the assumption of frictionless capital markets and changed it to capital markets that have the stochastic trading costs. Hence, LCAPM was established on the idea that risk averse investors maximize their expected utility under wealth constraint. Thereby, this model distinguishes from the traditional Capital Asset Pricing Model by incorporating trading costs to the cost free stock price.

The key advantage of this model comes from the inclusion of various channels of liquidity risk to single model, including level liquidity cost, commonality in liquidity, flight to liquidity and depressed wealth effect. This provides a unified framework to examine the effects of liquidity risk on stock returns. Acharya and Pedersen (2005) developed this model using all the common stocks listed at New York Stock Exchange (NYSE) and American Stock Exchange (AMEX). The sample period is from July 1st, 1962 to December 31st, 1999. They used Amihud (2002) ***ILLIQ*** as the liquidity measure. In order to keep liquidity measure consistent across all the stocks under study NASDAQ had to be dropped as its volume data includes interdealer trades and starts only from 1982. The data for the study was acquired from COMPUSTAT.

Equation (4) presents the conditional version of LCAPM, in which the

$$E_{t-1}\left(R_{i,t} - R_F\right) = E_{t-1}\left(C_{i,t}\right) + \lambda_{t-1}\,cov_{t-1}\left(R_{i,t}, R_{M,t}\right) + \lambda_{t-1}\,cov_{t-1}\left(C_{i,t}, C_{M,t}\right) - \lambda_{t-1}cov_{t-1}\left(R_{i,t}, C_{M,t}\right) - \lambda_{t-1}\,cov_{t-1}\left(R_{i.t}, C_{M,t}\right) \quad (4)$$

Where, in equation (4) $R_{i,t}$ is the gross return for stock i at month t, R_F is the risk free return, $R_{M,t}$ market return at month t, $C_{i,t}$ is the trading cost for stock i at month t and $C_{M,t}$ is the trading cost for market at month t.

Equation (5) presents the unconditional LCAPM, which is derived on the assumption of constant risk premium or constant conditional variances.

$$E\left(r_t^i - r_t^f\right) = \alpha + k\,E\left(c_{i,t}\right) + \lambda\beta^{1i} + \lambda\beta^{2i} - \lambda\beta^{3i} - \lambda\beta^{4i} \quad (5)$$

As it can been seen from the above equation (5) that base model of the LCAPM consists of four separate betas. Each of the four betas are derived from a regression between the market and the portfolios, and by different combinations between the returns and illiquidities. In order to prevent for autocorrelation in the illiquidities, these are transformed into innovations. This transformation is carried out by retrieving the residual terms from an autoregressive process 2. These betas are estimated on portfolio level, 25 illiquidity portfolios were formed in the study.

For each portfolio including the market portfolio, its return in month *t* is computed as follows:

$$r_t^p = \sum_{i\ in\ p} w_t^{ip}\, r_t^i \quad (6)$$

Where, sum is taken of all the stocks included in the portfolio *p* in the month *t* and w_t^{ip} are either present equal weight or value based weights.

The normalized illiquidity of portfolio p is as specified as follows:

$$c_t^p = \sum_{i \text{ in } p} w_t^{ip} c_t^i \quad (7)$$

Similarly, sum of illiquidities of all the stocks included in the portfolio *p* in the month *t* is taken. Where the betas of equation (5) are defined as follows:

$$\beta^{1i} = \frac{\text{cov}\left(r_t^i, r_t^M - E_{t-1}\left(r_t^M\right)\right)}{\text{var}\left(r_t^M - E_{t-1}\left(r_t^M\right) - [c_t^M - E_{t-1}\left(c_t^M\right)\right)} \quad (8)$$

β^{1i} channels the liquidity risk in the model which arises due to level of liquidity. And is the market return adjusted for liquidity risk.

$$\beta^{2i} = \frac{\text{cov}\left(c_t^i - E_{t-1}(c_t^i), c_t^M - E_{t-1}\left(c_t^M\right)\right)}{\text{var}\left(r_t^M - E_{t-1}\left(r_t^M\right) - [c_t^M - E_{t-1}\left(c_t^M\right)\right)} \quad (9)$$

β^{2i} caters for 'Commonality in Liquidity', the liquidity risk arising from covariance of individual stock illiquidity with market illiquidity. The phenomenon of commonality in liquidity was first discovered by Chordia, Roll, and Subrahmanyam (2001) for New York Stock Exchange (NYSE). The anticipation is that there is a positive relationship between commonality in liquidity and the expected excess returns. The reasoning behind this is that investors would like to be compensated for holding stocks with declining liquidity when the liquidity on the market declines. Acharya and Pedersen found a return premium of 0.08% for the commonality in liquidity for the U.S. market.

$$\beta^{3i} = \frac{\text{cov}\left(r_t^i, c_t^M - E_{t-1}\left(c_t^M\right)\right)}{\text{var}\left(r_t^M - E_{t-1}\left(r_t^M\right) - [c_t^M - E_{t-1}\left(c_t^M\right)\right)} \quad (10)$$

β^{3i} channel's the liquidity risk in the model arising due to covariance between stock returns with market illiquidity, also known as 'Flight to liquidity'. Originally founded by Pastor and Stambaugh (2003); they state that a return premium is paid if a security has high returns when the total market is illiquid. In this scenario investors are willing to accept lower returns if a particular stock has higher returns when the market is illiquid. The expectations is that there is a negative relationship between flight to liquidity and the expected excess returns. Acharya and Pedersen reported a return premium of 0.16% for flight to liquidity for U.S. market.

$$\beta^{4i} = \frac{\text{cov}\,(c_t^i - E_{t-1}(c_t^i), r_t^M - E_{t-1}(r_t^M))}{\text{var}\,(r_t^M - E_{t-1}(r_t^M) - [c_t^M - E_{t-1}(c_t^M))} \tag{11}$$

β^{4i} represents the covariance between stock illiquidity and market return, also known as 'Depressed wealth effect'. This source of liquidity risk is added by Acharya and Pedersen themselves and state that investors are willing to pay a premium for a security that is liquid when the market return is low. Expected is that there is a negative relationship between depressed wealth effect and the expected excess returns. Acharya and Pedersen reported a return premium of 0.82% for depressed wealth effect for U.S. market under this model.

The combined effect of the liquidity risks beta is defined as:

$$\beta^{5i} = \beta^{2i} - \beta^{3i} - \beta^{4i} \tag{12}$$

Finally, the aggregate systematic risk can be defined as:

$$\beta^{6i} = \beta^{1i} + \beta^{2i} - \beta^{3i} - \beta^{4i} \tag{13}$$

In the spirit of Acharya and Pedersen (2005) and Lee (2011), Vu, Chai and Do (2015) estimated seven alternative LCAPM specifications by adding firm size, momentum, and book-to-market as control variables. Fama and French (1992) presented in their study that book-to-market ratio of individual stocks has the ability to explain the cross sectional variation in the stock returns. Kothari and Shanken (1997) used in their study Bayesian framework and the findings illustrate that book-to-market ratio of the Dow Jones Industrial Index (DJIA) predicts market returns over the period 1926 to 1991.It was demonstrated by Banz(1981) that small cap stocks generate higher returns, this over performance was attributed to the compensation of an additional risk factor. This phenomenon is also termed as size effect. Contrary to this finding, Reinganum (1999) argues that size effect could be predicted and during economics crisis large cap companies outperformed small cap companies. Levy (1967) provided evidence that stocks with higher average past returns show abnormal future returns. Chan, Jegadeesh and Lakonishok (1996) argue that momentum is an important indicator of future performance of stocks and it is not subsumed by market risk, size and value. By adding these control variable which are known to have influence the returns of the stock adds to explanatory capacity of the original LCAPM model.

Vu et al. (2015) tested out their version of LCAPM for Australian market for year 1995 to 2010. The liquidity measures used in their study included Amihud (2002), Turnover, Return reversal measure, Turnover-adjusted number of zero daily volume and Zero-return measure. The data for this study came from two sources Securities Industry Research Centre of Asia-Pacific database (SIRCA) and Centre of Research in Finance database.

Equations. (14) to (20) below outline the seven alternative specifications devised by Vu et al. to be applied in the study are as follows:

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1\ \mu^{i}_{t} + \lambda_2\ \beta^{1i}_{t} + \varphi_1\ BM_t + \varphi_2\ SIZE_t + \varphi_3\ MOM_t \quad (14)$$

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1\ \mu^{i}_{t} + \lambda_2\ \beta^{1i}_{t} + \lambda_3\ \beta^{2i}_{t} + \varphi_1\ BM_t + \varphi_2\ SIZE_t + \varphi_3\ MOM_t \quad (15)$$

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1\ \mu^{i}_{t} + \lambda_2\ \beta^{1i}_{t} + \lambda_3\ \beta^{3i}_{t} + \varphi_1\ BM_t + \varphi_2\ SIZE_t + \varphi_3\ MOM_t \quad (16)$$

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1\ \mu^{i}_{t} + \lambda_2\ \beta^{1i}_{t} + \lambda_3\ \beta^{4i}_{t} + \varphi_1\ BM_t + \varphi_2\ SIZE_t + \varphi_3\ MOM_t \quad (17)$$

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1\ \mu^{i}_{t} + \lambda_2\ \beta^{1i}_{t} + \lambda_3\ \beta^{5i}_{t} + \varphi_1\ BM_t + \varphi_2\ SIZE_t + \varphi_3\ MOM_t \quad (18)$$

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1\ \mu^{i}_{t} + \lambda_2\ \beta^{6i}_{t} + \varphi_1\ BM_t + \varphi_2\ SIZE_t + \varphi_3\ MOM_t \quad (19)$$

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1\ \mu^{i}_{t} + \lambda_2\ \beta^{1i}_{t} + \lambda_3\ \beta^{2i}_{t} + \lambda_4\ \beta^{3i}_{t} + \lambda_5\ \beta^{4i}_{t} + \varphi_1\ BM_t + \varphi_2\ SIZE_t + \varphi_3\ MOM_t \quad (20)$$

Where, excess return is presented by $r^{i}_{t+1} - r^{f}_{t+1}$ and $\lambda_1\ \mu^{i}_{t}$ is the residual of autoregressive process 2. Betas 1 to 4 are as described in above section, whereas, beta 5 and beta 6 represent combined effect of liquidity risk and beta 6 the aggregate systematic liquidity risk.

2.4 Hypotheses

The presented literaure in the earlier section of this chapter provides evidence of existence of various types of liquidity as well as of liquidity premium. Most of the earlier studies in regard to liquidity and lquidity premium have been carried out for the US market. However, this study is carried out on UK market. Trading on the UK stock market differs from that to the US Market. In the UK all trading takes place on the London Stock Exchange while in the US stocks trade mostly on two main exchanges, the NASDAQ and NYSE.The UK and US markets also differ in trading regimes. As on UK market trading is a mix of order book driven and hybrid quote/order book driven system, whereas for US, the trading on NASDAQ is order book driven and NYSE has a hybrid system. The difference between market structure of UK and US leads to difference in liquidity characteristics between the two (Huang & Stoll, 2001). This study aims to investigate whether the systematic liquidity risk as identified by Chordia et al. (2001), Pástor and Stambaugh (2003), and Acharya and Pedersen (2005) by applying the LCAPM of Acharya and Pedersen (2005).

I would like to mention here that the Vu et al. (2015) specification for LCAPM that shall be used is presented in methodology section by equations (22) to (28). The only difference between the Vu et al. (2015) specification presented in equations (14) to (20) and specification presented in equations (22) and (28) is the absence of control variable Book to Market ratio. The control variable had to be dropped due to lack of avaibalbility of book value data for the stocks. Additionally, the hypothesis presented below will only be accepted if the respective coefficients resgression estimated by panel regressions are significant(discussed further in methodology section).

The hypotheses drawn for the study are as follows:

H1: The level of illiquidity has a positive effect on stock returns for UK market.

The β^1 of the model presented in equation (8) represents level of illiquidity. Amihud and Mendelson (1986), Brennan and Subrahmanyam (1996) and Chalmers and Kadlec (1998) also provide supporting evidence that asset prices reflect level of illiquidity. Model presented in equation (22) will be run for this hypothesis testing.

H2: Covariance between stock illiquidity and market illiquidity has a positive effect on stock returns for UK market.

The hypothesis 2 is based on the assumption that the investors require a compensation in the form of higher a return for a stock whose level of liquidity decreases with market liquidty. This hypothesis tests commonality in liquidity for UK market. Galariotis and Giouvris (2007, 2009) and Foran, Hutchinson and O'Sullivan (2015) have provided evidence in support of existence of commonality in liquidity at London Stock Exchange.

The β^2 of the model presented in equation (9) represents the covariance between stock illiquidity and market illiquidity. The model preseted in equation (23) will be run to test this hypothesis.

H3: Covariance between stock return and market illiquidity has a negative effect on stock returns for UK market.

Flight to liquidity is tested for UK market under this hypothesis. In line with Pastor and Stambaugh (2003) study, stocks are considered risky whose returns are sensitive to market liquidity and investors demand a compenstion for holding such assets. Angelidis and Andrikopoulos (2010) and Cotter, O'Sullivan and Rossi (2015) have determined flight to liquidity risk as one of the priced factors in the cross section of expected stock returns for the UK market.

The β^3 of the model presented in equation (10) represents covariance between stock return and market illiquidity. To test this hypothesis model presented in equation (24) will be run.

H4: Covariance between stock illiquidity and market return has a negative effect on the stock returns.

Depressed wealth effect presented by equation (11) is studied under this hypothesis. Investors are willing to accept lower returns on stocks that are easy to trade in market downturns, which is consistent with the findings of Acharya and Pedersen (2005). Hypothesis is tested by running model presented in equation (25).

The liquidity co-movements stated above correspond to the liquidity risks in the LCAPM of Acharya and Pedersen (2005). The stated relationships under Hypotheses 1 to 4 are based on theoretical arguments put forward by Archarya and Pedersen (2005).

H5: Aggregate liquidity risk is priced in stocks for UK market.

The hypothesis is based on the notion that stocks with higher level of liquidity risk exhibit higher level of expected returns.

The β^5 in equation (12) presents the combined effect liquidity risk a. Whereas, β^6 presented in equation (13) presents aggregate systematic risk. The coefficient of regression estimated by panel regression for β^5 and β^6 are significant then H5 shall be accepted.

3. DATA

This section describes the dataset used for the study, and explains the preparatory process carried out on the data. The descriptive statistics are also presented in this chapter.

3.1 The London Stock Exchange (LSE)

London Stock Exchange is the primary stock exchange in the U.K. and the largest in Europe. The London Stock Exchange is one of the oldest stock exchanges in the world and was founded in the year 1801. This makes it one of the only stock exchanges that have been functioning for well over two centuries. Over the years the market capital of the London Stock Exchange has grown to over US$ 3.5 trillion and volumes close to US$ 2 trillion monthly (London Stock Exchange, 2016a). London Stock Exchange's markets include the Main Market and AIM. The Main Market is London's leading venue for debt and exchange traded products. Whereas, AIM is designed for small and growing companies to raise capital. London Stock Exchange provides a series of FTSE UK indices. The FTSE is similar to Standard & Poor's in the United States, these indices provide market participants with performance of all capital and industry segments of the UK equity market. (London Stock Exchange, 2016b)

3.2 Sample size, Variables and Filtering procedure

The dataset is acquired from Datastream. The variables acquired for this study include closing prices, ask-bid prices, number of shares outstanding and number of shares traded on a day. Sample period of the study is from January 2000 to December 2014. The initial dataset compromised of 4850 stocks. But this initial dataset shall pass through the following described preparatory process.

Non- trading days were removed from the dataset. Non trading days included Christmas, New Year, Easter and other bank holidays for UK.

No. of observations for a stock to be included for a month it should have at least 15 days of daily observations for that respective month. This restriction on no. of observations is also observed by Vu et al. (2015) and Foran et al. (2015).

Survivor bias excluding stocks that are not listed for the entire selected sample period may lead to survivorship bias. This would result in a skewed dataset as only the most successful stocks of the market are included, and the return of these stocks may be above average. In order to control for survivor bias and account for the stocks that had contributed to the liquidity for the given time period of the sample, all stocks listed delisted during the sample period are included.

Penny stocks can lead to noise in the dataset. In order to control for this noise, stocks with closing prices less than one pound are removed from the dataset.

Look ahead bias assumes that future time series is known at any point of time during the sample period. The prices of stocks can fluctuate over the period of their listing. It was observed the prices of stock got higher or lower one pound. Excluding such stocks would lead to look ahead bias resulting inaccuracy in the estimations. So, the period during which the price of stock becomes less than one is replaced to a missing value.

3.3 Descriptive Statistics

It can be observed in the Table 2 the number observations for each measure vary this is due to the fact that the computation of each liquidity measure requires different inputs such as volume, no. of shares etc. Percent Quoted Spread has the highest value of 8.20%, whereas Amihud (2002) has the lowest value among the three. All three liquidity measures have positive skewness implying on average frequent small decline in the liquidity. Excess Kurtosis is noted for the measures, hence, low risk of extreme decline in the liquidity of the stocks. The average standard deviation for Percent Quoted Spread is lower than the mean indicating that the fluctuation in liquidity from its mean in not high implying low risk of loss in liquidity. The statistics regarding returns of the stocks are also presented. The mean of returns in 1.2 % i.e. on average the stocks in the dataset have positive return

Table 2. Descriptive Statistics for Liquidity Measures and Stock Returns

	Turnover	**PQS**	**Amihud(2002)**	**Returns**
No. of observations	625500	806040	546300	824940
No. of missing observations	398961	453525	347415	476275
Minimum value	0	-0.1306	0	-4.445
Maximum value	15.093	0.998	0.799	4.528
Mean	0.004	0.082	0.001	0.012
Median	0.001	0.044	0.0001	0
Variance	0.002	0.012	8.40E-05	0.029
Standard Deviation	0.053	0.110	0.009	0.170
Skewness	168.762	3.018	24.462	-0.9224
Kurtosis	37.390	12.437	10.667	26.397

Table 3 presents the correlation matrix for the Amihud (2002), Turnover and Percent Quoted Spread. It can be noted that there exists a strong positive correlation between Amihud (2002) and Percent Quoted Spread. However, Turnover and Percent Quoted Spread exhibit low correlation and similar is the case between Amihud (2002) and Turnover. All three measures have positive correlation between them.

Table 3 Correlation Matrix for the Liquidity Measures

	Amihud(2002)	**Turnover**	**Percent Quoted Spread**
Amihud(2002)	1		
Turnover	0.222	1	
Percent Quoted Spread	0.586	0.167	1

Figure 3 illustrates Market liquidity, which is formed by using equal weighted aggregate of each liquidity ratio. Additionally, estimation of market liquidity comprises of all the stocks listed on the stock exchange for the particular month. For ease of comparison Z scores have been estimated for each of the measure. The upper spikes noticed for Turnover and Amihud (2002) for year 2000 coincide with events of dot-com bubble. Similarly, high peaks are observed for year 2001, which are directing towards the 9/11 terrorists attack in the USA. Highest peaks are noted from year 2007 to year 2008 which are due to the global crisis that hit financial markets of the world.

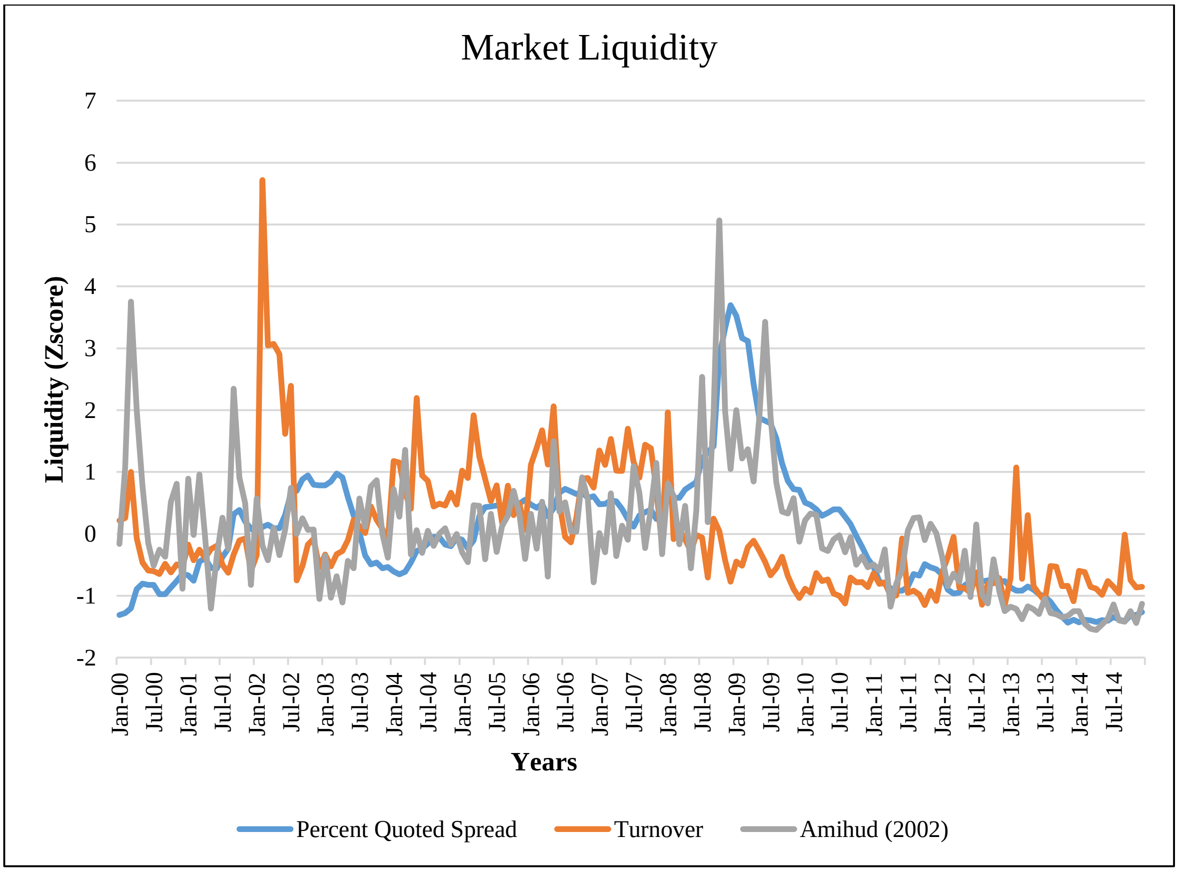


Figure 3. Market Liquidity w.r.t selected Liquidity Measures

4. METHODOLOGY

This chapter will walk through the methodology adapted for the study. Furthermore, the fitness test applied, the innovation in illiquidity, beta estimations and panel regressions are discussed in this chapter.

4.1 Fitness tests

As this study has several number of time series so, it is important to test for unit root otherwise the results can be biased. For this purpose Augmented Dickey Fuller Test was used. For the return series of all the stocks in the dataset the Augmented Dickey Fuller Test shows that the series are stationary. However, the series of liquidity measures were not stationary before the autoregressive process 2 transformations (explained in the next section) of each individual stock the liquidity series, hence, more evidence for carrying out AR (2) process. In order to test the validity of approach of using Fixed Effect Panel regression Hausman test has been used.

4.2 Innovations in illiquidity

As reported by Vu et al. (2015) liquidity is highly persistent. The presence of autocorrelation in the data can lead to measurement error. In order to tackle this autocorrelation problem, all the three liquidity measures estimated for the study are transformed by autoregressive process 2. Furthermore, the residuals acquired from this AR (2) would be used in further analysis. As residuals are uncorrelated they would help cater the problem of persistence of liquidity otherwise the results could be biased. An autoregressive process works under the premise that past values have an influence on the current values. A process considered AR (1) is termed as first order process, meaning that the current value is based on the immediately preceding value. An AR (2) process has the current value based on the previous two values.

The AR (2) process as specified as Vu et al. (2015) is as follows:

$$C_t^i = \alpha_0 + \alpha_1 C_{t-1}^i + \alpha_2 C_{t-2}^i + \cdots + \alpha_x C_{t-x}^i + \mu_t^i \quad (21)$$

Figure 4, 5 and 6 present AR(2) transformation for Market liquidity, which is formed by using equal weighted aggregate of each liquidity ratio estimated in this study. All the stocks listed at the stock exchange for the particular month were used in the estimation of market liquidity. It can be observed that innovations in liquidity for the three measures are not similar in nature approving of the fact that they capture different dimensions of liquidity.

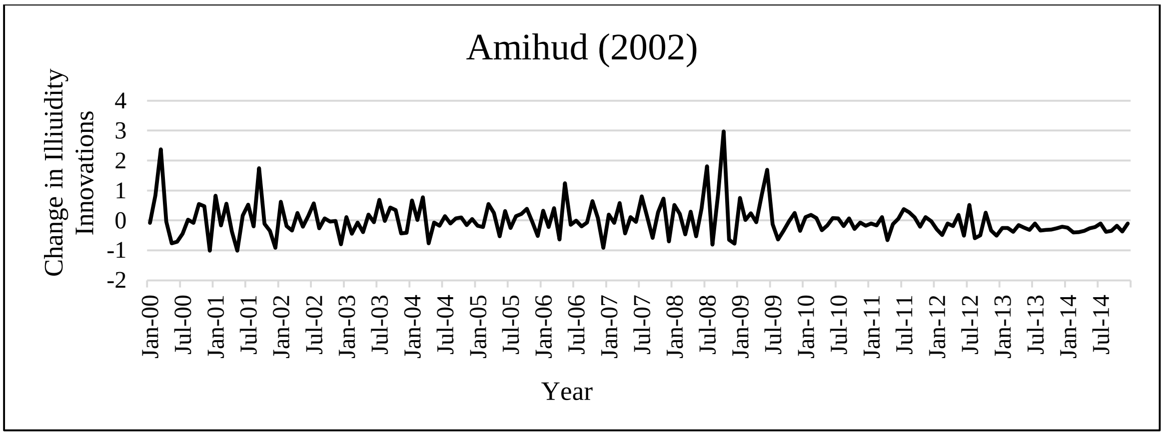


Figure 4. Innovations in Illiquidity for Amihud (2002)

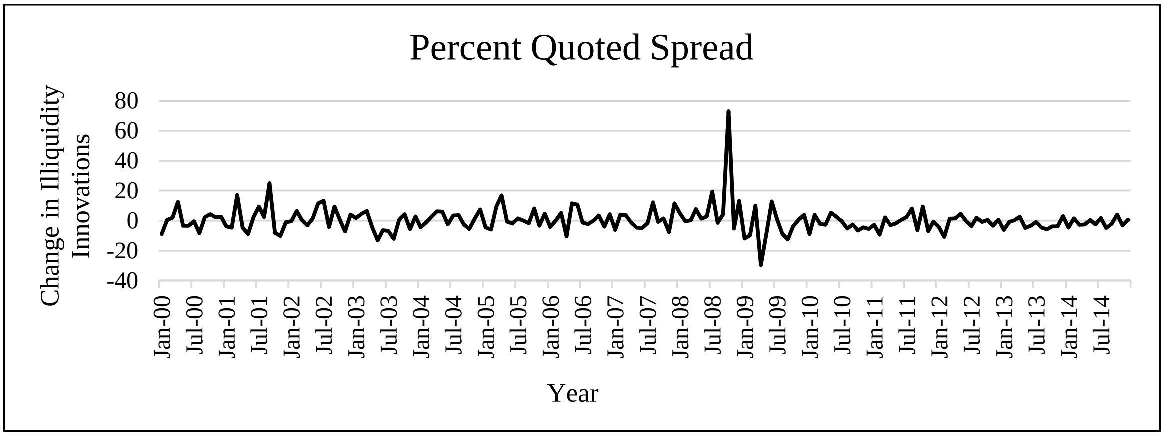


Figure 5. Innovations in Illiquidity for Percent Quoted Spread

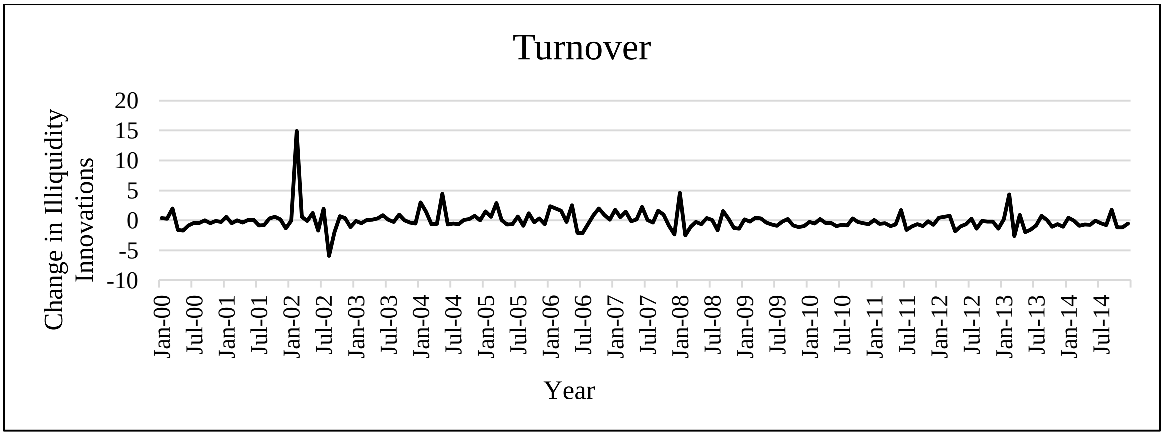


Figure 6. Innovations in Illiquidity for Turnover

4.3 Beta estimation

Estimating liquidity betas for individual stocks based on equations (8) to (13) would help avoid spurious results as well as loss of information which is attributed to portfolio formation. But this approach does come with the downside as well which is the higher level of noise due to individual stock level beta. In order to mitigate this measurement error, the betas are calculated at the portfolio level and then these betas are assigned to individual stocks of the respective portfolio.

Portfolio formation, previous studies that have used large set of stock data in regard to liquidity risk testing have used equally weighted decile portfolios, these studies include by Vu et al. (2015) and specifically for UK market Foran, Hutchinson and O'Sullivan (2015) who tested commonality in liquidity, formed decile portfolio in their study. So, in line with those studies decile portfolios are formed for this study as well.

Following steps explain decile portfolio formation process:

i. **Ranking of stocks**, first of all on the basis of each liquidity measure i.e. Amihud (2002), Percent Quoted Spread and Turnover estimated for the stocks in the dataset, the stocks are ranked by the level of their liquidity over a past ranking period *R*, *R* = one year for this study.

ii. **Ordering of stock**, after the ranking the stocks are ordered from lowest liquidity to highest liquidity level. Then, these stocks are sorted into equally weighted decile portfolios i.e. ten portfolio are formed by grouping stocks of similar liquidity levels.

iii. **Resorting**, these decile portfolios are then held for forward looking holding period *H*, *H* = one year for this study. The equally weighted portfolios are reformed at end of the holding period.

So, the betas of the LCAPM presented in equations (8) to (13) are calculated for the equally weighted decile portfolios. So, at the beginning of each year decile portfolios are formed on the basis of their liquidity level from the measures estimated. Then betas presented in equation (8) to (13) for these portfolios formed are estimated using data from the previous 60 months. This will consequently result in loss of five year data of the original fifteen year data of this study and the analysis of the study shall start from year 2005.The portfolio betas estimated are then assigned to the stocks in the respective portfolios.

Inputs to the beta shall be discussed as follows:

r_t^i, is the equal weighted portfolio returns for month *t*.

$r_t^M - E_{t-1}(r_t^M)$, market return for London Stock Exchange. This is computed by using all the stocks that were listed on the exchange for the particular month.

$c_t^i - E_{t-1}(c_t^i)$, the residual of an AR (2) process of the equally weighted illiquidity ratio.

$c_t^M - E_{t-1}(c_t^M)$, the residual of an AR (2) process of the equal weighted market aggregate portfolio illiquidity ratio. All the stocks were listed on the stock exchange for the particular month were used in calculating market liquidity.

4.4 Control variables

The controls variables applied are discussed as follows:

Market capitalization frequently referred to as "market cap" is the total dollar market value of a firm's shares outstanding. It is calculated by multiplying a firm's shares outstanding by current market price of one share of the firm. However, this study is being conducted for UK market, therefore market capitalization is pound market value of a firm's shares outstanding.

SIZE presented in equations (22) to (28) is the natural logarithm of market capitalization, illustrated as follows:

Market capitalization = ln (Market capitalization at the end of month)

Momentum is defined as the rate of acceleration of a stock's price or volume. Main idea of momentum is that stock's price is most likely to keep moving in same direction than to change directions. Usually, momentum is considered as an oscillator which helps to identify trend lines in a stock's price.

For this study, MOM presented in equations (22) to (28) i.e. momentum is the cumulative returns over the past twelve months with one month lag.

The original specification developed by Vu et al. (2015) presented in equations (14) to (20) includes BM ratio. However, due to lack of data this control variable i.e. BM ratio had to be dropped from this study.

The specifications that shall be carried out in this study are as follows:

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1 \mu^{i}_{t} + \lambda_2 \beta^{1i}_{t} + \varphi_2 SIZE_t + \varphi_3 MOM_t \quad (22)$$

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1 \mu^{i}_{t} + \lambda_2 \beta^{1i}_{t} + \lambda_3 \beta^{2i}_{t} + \varphi_2 SIZE_t + \varphi_3 MOM_t \quad (23)$$

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1 \mu^{i}_{t} + \lambda_2 \beta^{1i}_{t} + \lambda_3 \beta^{3i}_{t} + \varphi_2 SIZE_t + \varphi_3 MOM_t \quad (24)$$

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1 \mu^{i}_{t} + \lambda_2 \beta^{1i}_{t} + \lambda_3 \beta^{4i}_{t} + \varphi_2 SIZE_t + \varphi_3 MOM_t \quad (25)$$

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1 \mu^{i}_{t} + \lambda_2 \beta^{1i}_{t} + \lambda_3 \beta^{5i}_{t} + \varphi_2 SIZE_t + \varphi_3 MOM_t \quad (26)$$

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1 \mu^{i}_{t} + \lambda_2 \beta^{6i}_{t} + \varphi_2 SIZE_t + \varphi_3 MOM_t \quad (27)$$

$$r^{i}_{t+1} - r^{f}_{t+1} = \alpha_t + \lambda_1 \mu^{i}_{t} + \lambda_2 \beta^{1i}_{t} + \lambda_3 \beta^{2i}_{t} + \lambda_4 \beta^{3i}_{t} + \lambda_5 \beta^{4i}_{t} + \varphi_2 SIZE_t + \varphi_3 MOM_t \quad (28)$$

In equations (22) to (28) $r^{i}_{t+1} - r^{f}_{t+1}$ represents the excess returns. Where, r^{f}_{t+1} is risk free return and for the study 12 Month LIBOR is being used as the decile portfolios formed are held for 12 months.

4.5 Panel Regression

For this study, the LCAPM is tested by using panel regressions. The specifications presented in equations (22) to (28) shall be carried out by panel regressions. The decision to use panel regressions instead of Fama and Macbeth (1973) cross sections regressions is due to the fact that Fama- Macbeth (1973) are subject to statistical biases as demonstrated by Petersen (2009). Specifically, Fama-Macbeth regressions fail to account for serial correlations and are only able to account for cross sectional correlations. In order to avoid e measurement errors caused by serial correlation arising from the use of Fama-Macbeth, this study is using firm fixed panel regressions technique suggested by Petersen (2009). The Hausman test is used to test the validity of the use of fixed panel regressions.

5. RESULTS

This chapter will present the results. As various measures of liquidity are applied, hence, results of each liquidity measure shall be discussed separately in this chapter.

5.1 Percent Quoted Spread

Results for average betas for decile portfolios, correlation matrix for Percent Quoted Spread and panel regressions are discussed as follows:

5.1.1 Average betas for Decile Portfolios

Table 4 presents the times series average betas estimated for ten portfolios based on the Percent Quoted Spread. The portfolios have been sorted on the basis of lowest to highest illiquidity level.

Table 4. Average betas for Percent Quoted Spread

Illiquidity ratio	β1	β 2	β 3	β 4	β 5	β 6
(Lowest) 1	0.7293	0.0302	-0.0340	0.7010	-0.6972	0.0320
2	0.9748	0.0430	-0.0540	0.8573	-0.8463	0.1285
3	0.9129	0.0450	-0.0536	0.7958	-0.7872	0.1258
4	0.9243	0.0464	-0.0562	0.7904	-0.7807	0.1436
5	0.9328	0.0489	-0.0580	0.8091	-0.8000	0.1328
6	0.9351	0.0550	-0.0611	0.8421	-0.8360	0.0991
7	0.9680	0.0471	-0.0585	0.8095	-0.7982	0.1699
8	0.9190	0.0469	-0.0573	0.7635	-0.7531	0.1659
9	0.8952	0.0496	-0.0592	0.7707	-0.7612	0.1340
(Highest) 10	0.8007	0.0397	-0.0469	0.7181	-0.7109	0.0898

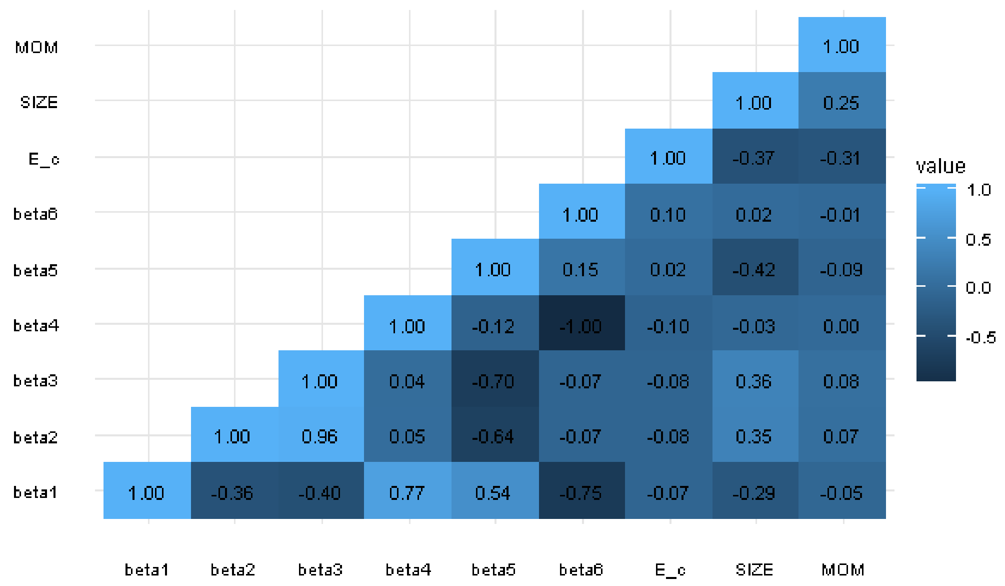
Beta 1 the level of liquidity beta is showing a mixed trend. Initially the β1 increased with the illiquidity level till portfolio 8, however, from portfolio 9 a downward trend in the value of the beta 1 is observed. It can also be noted that there isn’t magnificent decline in the value of β1 from 8 to 9 and 10 portfolios. Similar, trend is observed in the study by Vu et al. (2015) for the Australian Stock Market. Overall, it can be concluded that the β1 increases with the increase in the level of illiquidity of stock in the respective portfolio. These results are in line with Acharya and Pedersen (2005) and Lee (2011) who also have documented an upward trend in studies carried out for USA and USA and global stocks respectively. Beta 2 the commonality beta is showing an upward trend for the portfolios sorted from lowest to highest level of liquidity in respect to the Percent Quoted Spread measure. The possible reasoning behind the increasing trend of β2 lies in the reaction of market participants to the declining market liquidity. The results are in line with Acharya and Pedersen (2005), Lee (2011) and Vu et al. (2015) who have documented an upward trend in the β2 as the illiquidity level increases.

Beta 3 the flight to liquidity beta is negative and increasing with the level of illiquidity. Indicating the fact flight to liquidity under Percent Quoted Spread has a negative and increasing effect with the level of illiquidity of stocks in the respective portfolios. Lee (2011) and Vu et al. (2015) have reported similar results regarding the upward trend in the beta 3, however, Acharya and Pedersen (2005) reported results in contrast to this. Beta 4 depressed wealth effect liquidity beta depicts a mixed trend with initially increasing but after portfolio 6 starts declining. Vu et al. (2015) also report a similar trend in their study for beta 4. Beta 5 and beta 6 representing the combined effect and aggregate liquidity risk respectively. Beta 5 is negative and increasing, whereas, Beta 6 is positive and increasing till portfolio then a sudden decrease in observed. Overall, both of the betas are depicting trends in line with results of Vu et al. (2015).

5.1.2 Correlation Matrix

Table 5 presents the correlation matrix between the estimated betas for Percent Quoted Spread, E_c is the residual of the AR (2) of the Percent Quoted Spread. SIZE and MOM (momentum) are the control variables.

Table 5. Correlation matrix for Percent Quoted Spread



It can be observed from the Table 5 beta 1 and beta 4 are highly correlated with each other. Whereas, Beta 1 and beta 6 have high but negative correlation between them. While, correlation for beta1 & beta 2 and beta1 & beta 3 is moderate and negative. But there is a very weak correlation between beta 1, residuals, control variables Momentum (MOM) and SIZE.

Beta 2 and beta 3, beta 2 and beta 5 are highly correlated. Beta 2 and beta 5 are negatively correlated. Moderate correlation exists between beta 2 and control variable SIZE. Whereas, correlation between beta 2 and rest of the betas, AR (2) residuals i.e. E_c for Percent Quoted Spread and control variable SIZE is weak. Beta 3 and beta 5 have strong negative correlation. Beta 3 and control variable SIZE have positive moderate correlation. Beta 3, beta 4, beta 6, E_c and control variable MOM have weak correlation. Beta 3, E_c and beta 6 exhibit negative correlation. Beta 6 and control variable Size exhibit moderate negative correlation. Whereas, correlation between beta 5, beta 6, E_c and Control variable Momentum is weak. Beta 6, E_c and control variables have weak correlation between them. Control variables have weak correlation between them.

5.1.3 Panel Regression Results

Table 6 presents the Panel regression results for the Percent Quoted Spread according to equation (22) to (28). The columns (1) to (7) under the heading models on Table 6 correspond to estimations for equations (22) to (28). The results of Hausman test can be found in APPENDIX 1.

Individual liquidity betas shall be discussed first. Regressions 1 to 4 reveal significance level of beta 1 to beta 4. From the results it can be observed that each liquidity beta is significant at 1% level. The beta 1 which exhibits the level of liquidity is positive and significant after controlling for factors such as SIZE and Momentum (MOM). Therefore, hypothesis 1 of the study is accepted that the level of illiquidity is positively priced in the stock returns of UK market. Beta 2, the commonality beta which is being investigated under the hypothesis 2 is positive and significant, which suggests that commonality in liquidity is positively priced in stock returns for UK market. The result of beta 2 is in line with studies carried out by Foran et al. (2015), Galariotis and Giouvris (2007, 2009) for UK market.

According to the results of regression 3 the beta 3 is negative and significant, thereby, the hypothesis 3 of the study is being accepted. The covariance between stock returns and market illiquidity is negatively associated with stock returns of UK market. Beta 4 is negative and significant at 1% level hence, the hypothesis 4 is accepted. Acceptance of hypothesis 4 suggests that covariance between stocks illiquidity and market returns is negatively related to stock returns for UK market. The results for beta 4 are consistent with findings of Acharya and Pederden (2005) for USA market and Vu et al. (2015) for Australian stock market. Having a look on the aggregate liquidity betas. The results for regressions 5 and 6 depict that beta 5, the combined liquidity risk and beta 6 the aggregate systematic risk. The coefficients for the beta 5 and beta 6 are positive and significant after controlling for factors such as SIZE and Momentum (MOM). Hence, the hypothesis 5 is being accepted. Having a look at results of model (7), it can be observed all the betas are significant. However, the coefficient of beta 4 has decreased compared with results of model (4). Over all, results for Percent Quoted Spread suggests that the identified liquidity risks are priced in UK equities.

Table 6. Panel Regression Results for Percent Quoted Spread

Models (1) to (7) represent equations (22) to (28). E_c presents residuals of AR (2), MOM and SIZE are control variables momentum and size. Values in the parenthesis indicate t-statistics for each coefficient.

Variable	**Models**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Constant	0.351 (34.33)	0.444 (42.86)	0.456 (43.92)	0.367 (35.98)	0.371 (36.35)	0.507 (54.55)	0.453 (43.56)
E_c	-0.202 (-25.03)	-0.204 (-25.51)	-0.211 (-26.32)	-0.195 (-24.30)	-0.197 (-24.45)	-0.159 (-19.94)	-0.211 (-26.23)
β 1	0.144 (23.36)	0.177 (28.75)	0.191 (30.78)	0.087 (8.72)	0.087 (9.038)		0.154 (12.99)
β 2		0.182 (4.5)					0.440 (3.00)
β 3			-0.165 (-48.05)				-1.930 (-14.91)
β 4				-0.289 (-29.35)			-0.045 (-3.87)
β 5					0.293 (30.88)		
β 6						0.201 (22.13)	
MOM	-0.018 (-19.50)	-0.023 (-29.14)	-0.023 (-28.85)	-0.022 (-27.69)	-0.0221 (-27.67)	-0.019 (-24.85)	-0.022 (-28.68)
SIZE	0.029 (52.63)	0.032 (57.30)	0.033 (59.09)	0.031 (55.90)	0.032 (56.33)	0.029 (52.38)	0.033 (59.24)
F-stat	3.57	4.34	4.44	3.89	3.93	3.55	4.45

All the coefficients of regression and F-stat values are significant at 1% level

5.2 Amihud (2002)

Results for average betas for decile portfolios, correlation matrix for Amihud (2002) and panel regressions are discussed as follows:

5.2.1 Average betas for Decile Portfolios

Table 7 presents the times series average betas estimated for ten portfolios based on the Amihud (2002).

Table 7. Average betas for Amihud (2002)

Illiquidity ratio	β1	β 2	β 3	β 4	β 5	β 6
(Lowest)1	0.8633	0.0037	-0.0040	-0.8088	-0.8085	0.0548
2	1.1265	0.0047	-0.0052	-0.9901	-0.9896	0.1370
3	1.1964	0.0046	-0.0048	-1.0413	-1.0411	0.1553
4	1.2205	0.0047	-0.0049	-1.0725	-1.0723	0.1482
5	1.1004	0.0043	-0.0045	-0.9243	-0.9241	0.1763
6	1.1383	0.0052	-0.0052	-1.0180	-1.0181	0.1203
7	1.0647	0.0044	-0.0045	-0.9175	-0.9175	0.1472
8	1.0878	0.0043	-0.0044	-0.9598	-0.9597	0.1282
9	1.0639	0.0043	-0.0045	-0.9078	-0.9076	0.1562
(Highest)10	1.1991	0.0045	-0.0047	-1.0303	-1.0300	0.1691

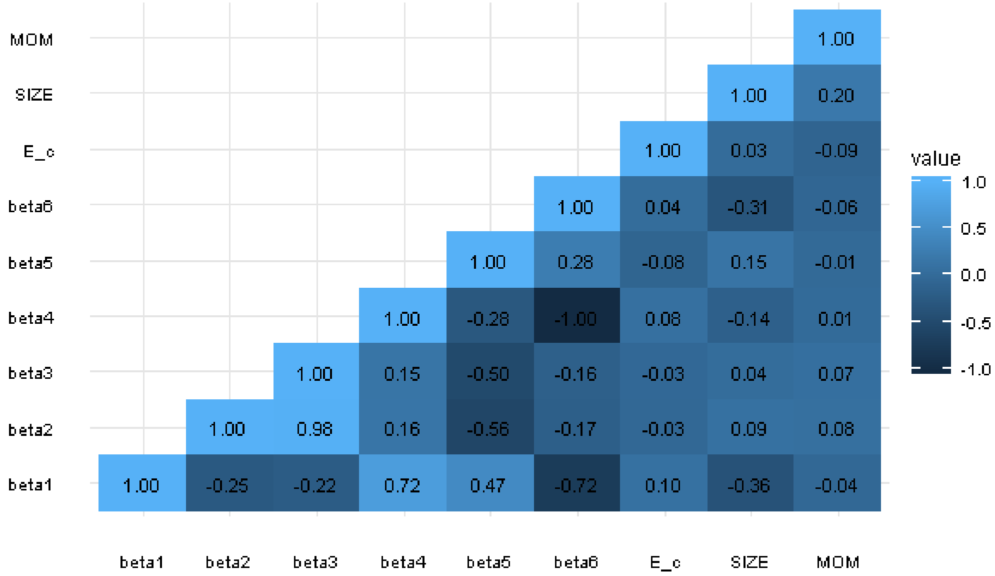
Beta 1 is depicting an increasing trend for decile portfolios sorted on the basis of Amihud (2002) illiquidity measure. It can be observed the values of beta 1 are high and positive. The results are in line with Acharya and Pedersen (2005). Vu et al. (2015) also reported increasing trend in the beta 1 but the values of the beta in their study under this measure are small. Beta 2 is also showing an increasing trend and has positive values through portfolio 1 to portfolio 10. The values of the beta 2 are small and a sudden jump in the value of beta 2 is observed for portfolio 6. These values of beta 2 contrast with the results reported by Vu et al. (2015) for Amihud (2005) measure, as the values get very large from portfolio 1 to portfolio 10.

Beta 3 values are negative and depict an increasing trend, however, the values are of small magnitude. These results for beta 3 are similar to Lee (2011) and Vu et al. (2015), however, contrast with Acharya and Pedersen (2005) results. Beta 4 which presents depressed wealth effect has values which are negative and of high magnitude .Moreover, the values of beta 4 are depicting an increasing trend i.e. with the level of illiquidity the beta 4 increases. These results are in line with Vu et al. (2015).Beta 5 and Beta 6 also show an increasing trend however beta 5 values are negative. The results of beta 6 are in line with Vu et al. (2015), however beta 5 are contradicting.

5.2.2 Correlation Matrix

Table 8 presents the correlation matrix between the estimated betas for Amihud (2002), E_c is the residual of the autoregressive process 2 of the Amihud (2002). SIZE and MOM (momentum) are the control variables.

Table 8. Correlation matrix for Amihud (2002)



	beta1	beta2	beta3	beta4	beta5	beta6	E_c	SIZE	MOM
MOM									1.00
SIZE								1.00	0.20
E_c							1.00	0.03	-0.09
beta6						1.00	0.04	-0.31	-0.06
beta5					1.00	0.28	-0.08	0.15	-0.01
beta4				1.00	-0.28	-1.00	0.08	-0.14	0.01
beta3			1.00	0.15	-0.50	-0.16	-0.03	0.04	0.07
beta2		1.00	0.98	0.16	-0.56	-0.17	-0.03	0.09	0.08
beta1	1.00	-0.25	-0.22	0.72	0.47	-0.72	0.10	-0.36	-0.04

Beta 1 and beta 6 are highly and negatively correlated. Beta1, beta 2, beta 3 and control variable SIZE have moderate negative correlation between them. Beta1 and control variable Momentum have very weak correlation. Beta 1 and beta 5 have significant positive correlation between them. The correlation between residuals of autoregressive process 2 for Amihud (2002) and beta 1 is weak. Beta 2 and beta 3 have a significantly high correlation between them. Beta 2 and beta 5 have significant but negative correlation between them. Whereas, correlation between beta 2 and beta 4, beta 2 and controls variables is very weak. The correlation between residuals of autoregressive process 2 for Amihud (2002) and beta 2 is almost zero.

Beta 3 and beta 5 exhibit significant negative correlation. Correlation between beta 3 and beta 6 is negative but very weak, whereas, correlation between beta 3 and beta 4 is very weak. Looking at the correlations between beta 3 and control variables Momentum and SIZE, very weak correlation is found. Correlation between beta 3 and between residuals of autoregressive process 2 for Amihud (2002) is almost zero. Beta 4 and beta 5 have weak negative correlation. The correlation between residuals of autoregressive process 2 for Amihud (2002) and beta 4 is near to zero. Beta 5 and beta 6 have moderate correlation. However, Beta 6 and control variable SIZE have moderate correlation and beta 6 and control variable Momentum (MOM) have almost zero correlation between them. Correlation between the control variables SIZE and Momentum is significantly weak.

5.2.3 Panel Regression Results

Table 9 presents the Panel regression results for the Amihud (2002) according to equation (22) to (28). The columns (1) to (7) under the heading models of Table 9 correspond to estimations for equations (22) to (28). The results of Hausman test can be found in APPENDIX 1.

Individual liquidity betas (beta1 to beta 4) after controlling for market risk, firm size past returns are all significant according to regressions 1 to 4. Beta 1 is also significant after controlling for firm size and momentum. Now, hypotheses of the study shall be discussed for betas estimated under Amihud (2002). Beta 1 the level of liquidity is positively priced in the cross section of returns for UK market. Hence, we shall accept hypothesis 1 of the study. This result is in line with Acharya and Pedersen (2005) and Vu et al. (2015). Second hypothesis deals with co-movement between individual stock illiquidity and market illiquidity, also termed as the commonality in liquidity. Having a look it at the significance level of the coefficient of beta 2, it can be concluded that commonality in liquidity is significantly priced for UK market. Which is line with results of studies carried out by Foran et al. (2015), Galariotis and Giouvris (2007, 2009) for UK market.

Beta 3 which captures the flight to liquidity phenomenon and is hypothesized that covariance between stock return and market illiquidity negatively effects stock returns for UK market. After controlling for factors such firm size and momentum the beta 3 has negative sign is significant at 1% level. From, these findings we are able to conclude that beta 3 is negatively priced at UK market. Beta 4 is negative and significant and therefore we accept the hypothesis 4 estimated under Amihud (2002). Now, aggregate betas shall be discussed for Amihud (2002). The results of regression (5) and regression (6) presented in Table 9 suggests that beta 5 (combined liquidity risk) and beta 6 (aggregate systematic risk) are positive and significant. Therefore, hypothesis 5 is accepted and it can be concluded that aggregate systematic risk is positively related to the stocks.

The results of model (7) in table 9 show that value of coefficient of beta 1 has decreased compared with model (1).

Table 9. Panel Regression Results for Amihud (2002)

Models (1) to (7) represent equations (22) to (28). E_c presents residuals of AR (2), MOM and SIZE are control variables momentum and size. Values in the parenthesis indicate t-statistics for each coefficient.

Variable	**Models**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Constant	0.587 (39.61)	0.639 (42.77)	0.635 (42.63)	0.588 (39.81)	0.588 (39.82)	0.657 (49.27)	0.605 (40.09)
E_c	-1.944 (-14.77)	-2.086 (-15.88)	-2.093 (-15.93)	-1.937 (-14.75)	-1.937 (-14.75)	-1.979 (-15.06)	-2.037 (-15.51)
β 1	0.033 (4.72)	0.065 (9.11)	0.065 (9.17)	0.080 (8.92)	0.080 (8.97)		0.28 (2.71)
β 2		0.905 (23.07)					0.217 (9.350)
β 3			-0.798 (-24.55)				-0.234 (-12.511)
β 4				-0.159 (-20.20)			-0.112 (-11.960)
β 5					0.160 (20.315)		
β 6						0.134 (17.865)	
MOM	-0.018 (-19.50)	-0.017 (-18.50)	-0.017 (-18.37)	-0.018 (-19.35)	-0.018 (-19.353)	-0.0185 (-19.134)	-0.017 (-18.45)
SIZE	0.036 (46.53)	0.039 (49.70)	0.039 (49.76)	0.038 (48.48)	0.038 (48.499)	0.037 (47.62)	0.039 (49.43)
F-stat	3.086	3.354	3.390	3.291	3.29	3.23	3.47

All the coefficients of regression and F-stat values are significant at 1% level

5.3 Turnover

Results for average betas for decile portfolios, correlation matrix for Turnover and panel regressions are discussed as follows:

5.3.1 Average betas for Decile Portfolios

Table 10 presents the times series average betas estimated for ten portfolios based on the Turnover ratio.

Table 10. Average betas for Turnover

Illiquidity Ratio	β1	β 2	β 3	β 4	β 5	β 6
(Lowest)1	1.0909	0.0002	0.0011	-0.9491	-0.9500	0.1408
2	1.0372	0.0013	0.00001	-0.8710	-0.8724	0.1648
3	0.9955	0.0019	-0.0006	-0.8392	-0.8404	0.1550
4	1.0344	0.0015	-0.0003	-0.8886	-0.8899	0.1445
5	1.0773	0.0022	-0.0008	-0.9130	-0.9144	0.1629
6	1.1363	0.0019	-0.00083	-1.0121	-1.0133	0.1230
7	1.1859	0.0018	-0.0006	-1.0174	-1.0186	0.1673
8	1.1436	0.0014	-0.0004	-1.0237	-1.0247	0.1189
9	1.1284	0.0013	-0.0005	-0.9934	-0.9943	0.1341
(Highest)10	1.2827	0.0015	-0.00049	-1.1320	-1.1330	0.1497

Beta 1 is depicting an increasing trend with level of illiquidity from portfolio 1 to portfolio 10. The values for beta 1 under the Turnover ratio are of high magnitude. It can be concluded that that the value of beta 1 increases with the level of illiquidity from 1 to 10 portfolios. These results are in line with the results reported by Acharya and Pedersen (2005), Lee (2011) and Vu et al. (2015). Beta 2 is also showing an increasing trend however the values of beta 2 are small. A sudden jump in the value of beta 2 is observed for portfolio 5. The results are similar to those reported by Vu et al. (2015) for Australian stock market.

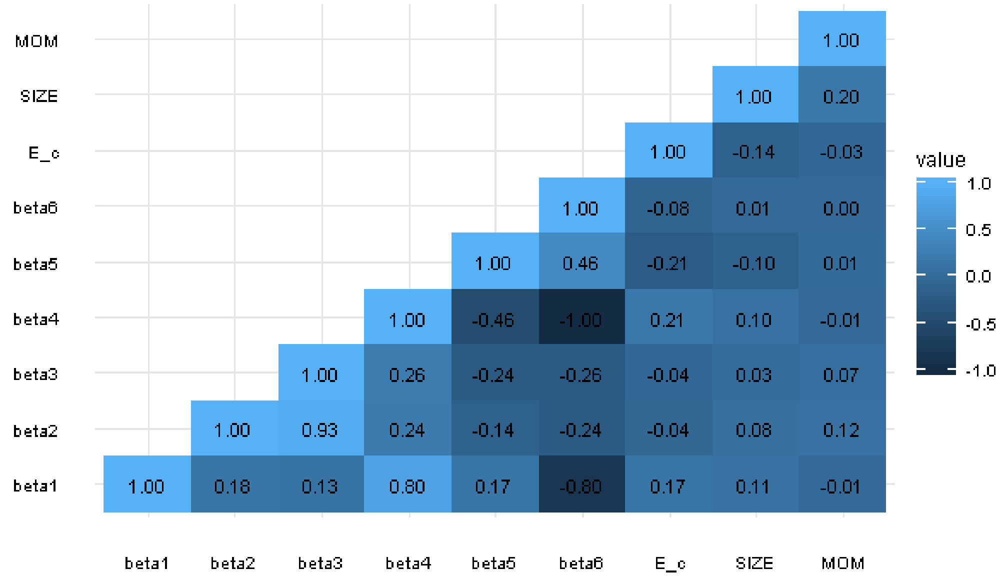
Beta 3 is also depicting an increasing trend, however, at portfolio 7 there is a sudden decrease in the value of beta 3. Additionally, for portfolio 1 and 2 the beta 3 is positive. These results of Beta 3 are in contradiction to results of Vu et al. (2015). Beta 4 is increasing from portfolio 1 to portfolio 10 and has negative values. The values of the beta 4 are of significant magnitude. Beta 5 is negative and increasing with the level of illiquidity level from portfolio 1 to portfolio 10. The value for beta 5 under the Turnover ratio turned out to be negative. The results of beta

5 are contradicting to the results of Vu et al. (2015). Beta 6 is showing a mixed trend but overall an increasing trend is observed for beta 6. The value of beta on average for portfolios 1 to 10 is positive and of significant magnitude. Vu et al. (2015) also reported similar results for the beta 6.

5.3.2 Correlation Matrix

Table 11 presents the correlation matrix between the estimated betas for Turnover ratio, E_c is the residual of the AR (2) of the Turnover ratio. SIZE and MOM (momentum) are the control variables.

Table 11. Correlation matrix for Turnover



The correlations between beta 1 and beta 4, and beta 1 and beta 6 are very high. Additionally beta 1 and beta 6 have negative correlation between them. Beta1 and beta 2, beta 1 and beta 3, beta 1 and beta 5 show weak correlations. Weak correlations also exist between beta 1 and control variable SIZE, beta 1 and control variable Momentum (negative correlation). The correlation between residuals of autoregressive process 2 for Turnover and beta 1 is significantly low. Beta 2 and beta 3 have a very high correlation. Whereas, Beta 2 and beta 4 have very weak correlation. The correlations between beta 2 and beta 5, beta 2 and beta 6 are weak and negative. The correlations between beta 2 and control variables SIZE and Momentum are very weak. The correlation between residuals of autoregressive process 2 for Turnover and beta 2 is almost zero.

Correlations between beta 3 and beta 4, and beta 3 and beta 5 are weak and for latter it's negative as well. Very weak correlations are observed between beta 3 and control variables SIZE and momentum. Correlation between residuals of autoregressive process 2 for Turnover and beta 3 is almost zero. Beta 4 and beta 5 have moderate negative correlation between them. Whereas, beta 4 and control variable SIZE have very weak correlations between them. Beta 4 and control variable momentum (MOM) show very insignificant negative correlation. Correlation between residuals of autoregressive process 2 for Turnover and beta 4 is of low level.

Beta 5 and beta 6 have moderate positive correlation between them. For beta 5 and control variable SIZE a negative and weak correlation exists, however, very insignificant correlation exists between beta 5 and control variable momentum (MOM). Beta 6 and control variable Momentum have zero correlation. And beta 6 and control variable SIZE have very insignificant and almost zero correlation between them. The correlation between residuals of autoregressive process 2 for Turnover and beta 5 is low, whereas residuals of AR (2) for Turnover and beta 6 have almost zero correlation. The control variables SIZE and Momentum (MOM) have low correlation.

5.3.3 Panel Regressions Results

Table 12 presents the Panel regression results for the Turnover ratio according to equation (22) to (28). The columns (1) to (7) under the heading models of Table 12 correspond to estimations for equations (22) to (28). The results of Hausman test can be found in APPENDIX 1.

Betas at individual liquidity level estimated under Turnover ratio are significant. The hypothesis 1 is accepted as the beta 1 is significant at 1% level. This provides evidence that level of illiquidity positively effects stock returns for UK market. The hypothesis 2 which investigates the covariance between stock illiquidity and market illiquidity has a positive effect on stock returns for UK market. The hypothesis 2 is accepted as beta 2 is significant at 1% level after controlling for factors firm size and momentum. Beta 2 coefficient of regression is positive.

The coefficient of regression for beta 3 is negative and significant at 1% level. Hence, the hypothesis three is accepted for this study. The hypothesis 3 tests covariance between stock return and market illiquidity effects negatively stock returns of UK market. Hypothesis 4 is also accepted as beta 4 has in negative and significant at 1 % level. The hypothesis 5 which tests the pricing of aggregate systematic liquidity risk at UK market is also being accepted. The beta 5 and beta 6 are significant at 1% level and positive.

Table 12. Panel Regression Results for Turnover

Models (1) to (7) represent equations (22) to (28). E_c presents residuals of AR (2), MOM and SIZE are control variables momentum and size. Values in the parenthesis indicate t-statistics for each coefficient.

Variable	**Models**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Constant	0.592 (40.30)	0.589 (39.06)	0.620 (41.45)	0.611 (41.70)	0.611 (41.70)	0.670 (51.72)	0.564 (37.57)
E_c	3.044 (20.52)	3.045 (20.53)	3.029 (20.42)	3.345 (22.56)	3.347 (22.58)	3.180 (21.63)	3.324 (22.47)
β 1	0.019 (3.16)	0.021 (3.27)	0.009 (2.44)	0.160 (17.30)	0.161 (17.44)		0.105 (11.061)
β 2		0.234 (8.70)					1.8450 (24.095)
β 3			-2.310 (-9.81)				-1.5781 (-22.971)
β 4				-0.215 (-26.40)			-0.171 (-19.53)
β 5					0.216 (26.66)		
β 6						0.202 (25.42)	
Momentum	-0.017 (-18.45)	-0.017 (-18.46)	-0.017 (-18.178)	-0.018 (-18.72)	-0.018 (-18.77)	-0.018 (-18.79)	-0.021 (-22.21)
Size	0.035 (46.77)	0.035 (46.34)	0.036 (47.63)	0.037 (48.81)	0.037 (48.83)	0.037 (48.81)	0.036 (48.148)
F-stat	3.16	3.160	3.20	3.50	3.51	3.48	3.80

All the coefficients of regression and F-stat values are significant at 1% level

5.4 Robustness Checks

Robustness checks have been carried out in this section to provide the validity of results that have been acquired through the primary method i.e. firm fixed panel regression. The robustness checks for this study are carried out by using Fama-Macbeth regressions. The decision to choose Fama-Macbeth regressions is based on the fact that this is most widely applied method in the literature regarding liquidity and liquidity risk pricing. Additionally, Acharya and Pedersen (2005) who developed the LCAPM also applied Fama-Macbeth regression.

The Table 13 presents coefficients of regression for Percent Quoted Spread by Fama-Macbeth regressions. The results of β 1 indicate that level of illiquidity is positively priced, as β 1 is significant. The evidence of existence of commonality in liquidity is also provided as β 2 is positive and significant. Flight to liquidity is also negatively priced in the stock returns for UK market. β 4 indicated that depressed wealth effect is negatively priced in the UK market. The coefficients of β 5 and β 6 indicate that aggregate liquidity risk is priced. From table 14 it can be observed that coefficients of Fama-Macbeth regression for Amihud (2002) provide adequate evidence to accept the hypotheses of the study. The results are providing existence of liquidity risks that are level of illiquidity, commonality in liquidity, flight to liquidity, depressed wealth and aggregate liquidity risk as well. And from table 15 we can see the results for Fama-Macbeth regressions and we get the evidence of existence of all the identified liquidity risks for UK market under Turnover measure. The results between fixed firm panel regressions and Fama-Macbeth do vary but both provide evidence in support of hypotheses being tested in this study.

Table 13. Fama-Macbeth regression results for Percent Quoted Spread

Models (1) to (7) represent equations (22) to (28). E_c presents residuals of AR (2), MOM and SIZE are control variables momentum and size. Values in the parenthesis indicate t-statistics for each coefficient.

Variable	**Models**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Constant	0.078 (7.33)	0.079 (7.58)	0.079 (7.32)	0.075 (6.69)	0.075 (6.64)	0.081 (10.08)	0.065 (5.16)
E_c	-0.101 (-12.31)	-0.105 (-11.99)	-0.104 (-12.25)	-0.101 (-12.12)	-0.101 (-12.13)	-0.099 (-11.64)	-0.112 (-11.36)
β 1	0.011 (7.40)	0.012 (7.95)	0.032 (2.61)	0.057 (3.31)	0.055 (3.31)		0.052 (7.40)
β 2		0.444 (2.24)					0.452 (8.73)
β 3			-0.642 (-2.64)				-1.201 (11.73)
β 4				-0.065 (-3.75)			-0.018 (-5.71)
β 5					0.024 (3.03)		
β 6						0.049 (3.42)	
MOM	0.009 (3.46)	0.009 (3.43)	0.009 (3.40)	0.009 (3.42)	0.009 (3.42)	0.009 (3.46)	0.009 (3.36)
SIZE	0.003 (9.36)	0.004 (9.01)	0.004 (9.15)	0.004 (9.07)	0.004 (9.08)	0.004 (8.89)	0.004 (9.08)
F-stat	11.99	10.14	10.21	10.1	10.16185	12.05	7.95

All coefficients of regression and F-stat values are significant at 1% level

Table 14. Fama-Macbeth regression results for Amihud (2002)

Models (1) to (7) represent equations (22) to (28). E_c presents residuals of AR (2), MOM and SIZE are control variables momentum and size. Values in the parenthesis indicate t-statistics for each coefficient.

Variable	Models						
	1	2	3	4	5	6	7
Constant	0.168 (9.98)	0.171 (9.63)	0.169 (9.63)	0.176 (10.48)	0.176 (10.47)	0.138 (9.64)	0.18993 (10.26)
E_c	-1.614 (8.95)	-1.630 (-9.02)	-1.640 (-9.24)	-1.644 (-9.07)	-1.644 (-9.07)	-1.539 (-8.69)	-1.689 (-9.44)
β 1	0.035 (5.77)	0.041 (3.47)	0.05 (3.55)	0.094 (6.97)	0.094 (6.97)		0.075 (4.12)
β 2		0.95 (6.79)					17.83 (4.64)
β 3			-3.34 (-7.36)				17.23 (12.33)
β 4				-0.260 (- 4.17)			-0.034 (11.98)
β 5					0.166 (14.16)		
β 6						0.083 (8.19)	
Momentum	0.011 (3.62)	0.011 (3.59)	0.011 (3.57)	0.011 (3.55)	0.011 (3.55)	0.011 (3.66)	0.011 (3.47)
Size	0.007 (10.15)	0.007 (10.23)	0.007 (10.91)	0.007 (10.81)	0.007 (10.81)	0.007 (10.25)	0.008 (11.78)
F-stat	9.35	7.77	7.84	7.86	7.86	9.35	6.097

All the coefficients of regression and F stat values are significant at 1% level

Table 15. Fama-Macbeth regressions for Turnover

Models 1 to 7 represent equations (22) to (28). E_c presents residuals of AR (2), MOM and SIZE are control variables momentum and size. Values in the parenthesis indicate t-statistics for each coefficient.

Variable	**Models**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Constant	0.110 (6.79)	0.106 (5.81)	0.100 (5.74)	0.113 (6.912)	0.114 (6.922)	0.132 (9.916)	0.128 (5.973)
E_c	2.424 (5.18)	2.457 (5.20)	2.474 (5.23)	2.531 (5.46)	2.530 (5.46)	2.205 (4.89)	2.662 (5.69)
β 1	0.018 (12.008)	0.046 (14.38)	0.038 (7.45)	0.010 (5.51)	0.010 (10.516)		0.032 (11.13)
β 2		0.898 (5.42)					2.24 (2.79)
β 3			-0.702 (-4.44)				-0.121 (-11.411)
β 4				-0.105 (-10.90)			-0.017 (-7.669)
β 5					0.035 (7.88)		
β 6						0.015 (8.26)	
MOM	0.013 (4.22)	0.012 (3.977)	0.012 (4.09)	0.012 (4.14)	0.013 (4.16)	0.013 (4.27)	0.011 (3.77)
SIZE	0.0069 (11.25)	0.007 (10.99)	0.007 (11.40)	0.007 (11.40)	0.007 (11.41)	0.006 (10.86)	0.007 (11.66)
F-stat	12.31	10.39	10.35	10.18	10.18	11.97	7.94

All coefficients of regression and F-stat values are significant at 1% level

6. DISCUSSION

In this section, findings of the study are discussed by providing comparison of the measures used in the study. The difference of results between the liquidity measures applied is discussed. Furthermore, economic interpretation of the results is presented as well.

Figure 7 presents the comparison between the averages of beta 1 estimated for decile portfolios for Percent Quoted Spread, Amihud (2002) and Turnover. Beta 1 presents the level of liquidity. As anticipated all the three measures on average have positive values for beta 1. Percent Quoted spread on average has lowest values for beta 1 compared with Amihud (2002) and Turnover.

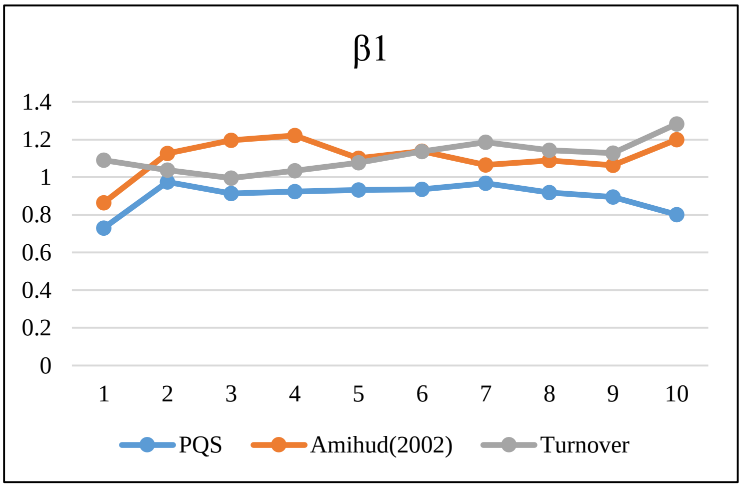


Figure 7. Beta 1 comparison between Liquidity measures.

From figure 8 it can be deduced that beta 2 estimated for Percent Quoted Spread has high values compared to Amihud (2002) and Turnover for decile portfolios. Beta 2 presents the commonality in liquidity. And on average all the three measures have positive values for beta 2, which was expected. Turnover shows the lowest values for beta 2. Hence, when liquidity is measured in terms of dimensions of immediacy and depth and by using a trade base measure i.e. Turnover the beta 2 has lower magnitude. Amihud (2002) presents second lowest values for beta 2.

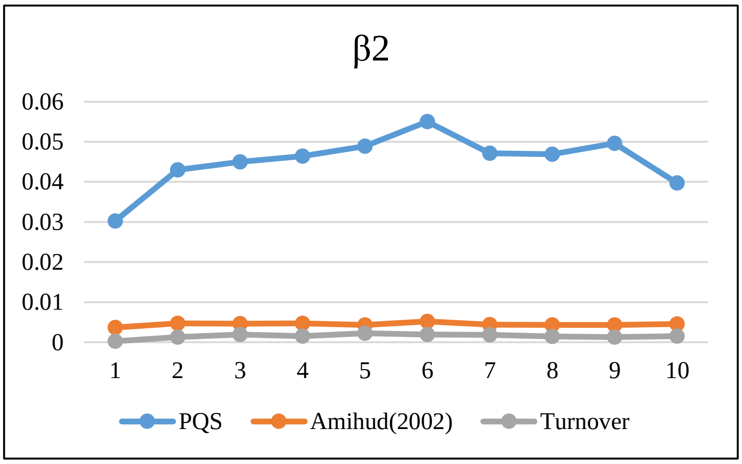


Figure 8. Beta 2 comparison between the Liquidity measures

Figure 9 gives the comparison between the average beta 3 for portfolio 1 to 10 for the three measures. Beta 3 presents flight to liquidity. Average value for beta 3 for all the three measures in negative, which was anticipated. The average betas for Percent Quoted Spread have the lowest values. However, when liquidity is measured in terms of immediacy by using a trade based measure i.e. Amihud (2002) the values of beta come out to be 2nd highest magnitude among the three measures used.

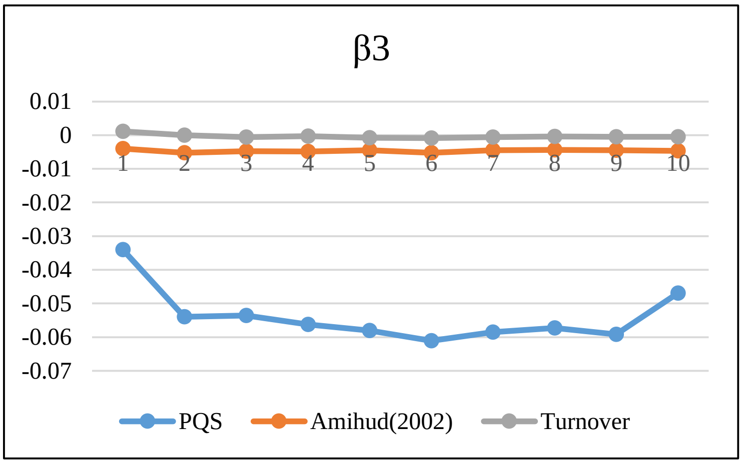


Figure 9. Beta 3 comparison between the Liquidity measures

From figure 10 we can observe a great contrast in the values for Beta 4 between Percent Quoted Spread, Amihud and Turnover. Beta 4 presents the depressed wealth effect. On average for decile portfolios the Percent quoted spread has positive values. Whereas, Amihud (2002) and Turnover have negative values for beta 4 from portfolio 1 to 10. Therefore, when liquidity is measured with Amihud (2002) and Turnover the beta 4 has negative values, whereas for Percent Quoted Spread the beta 4 has positive values.

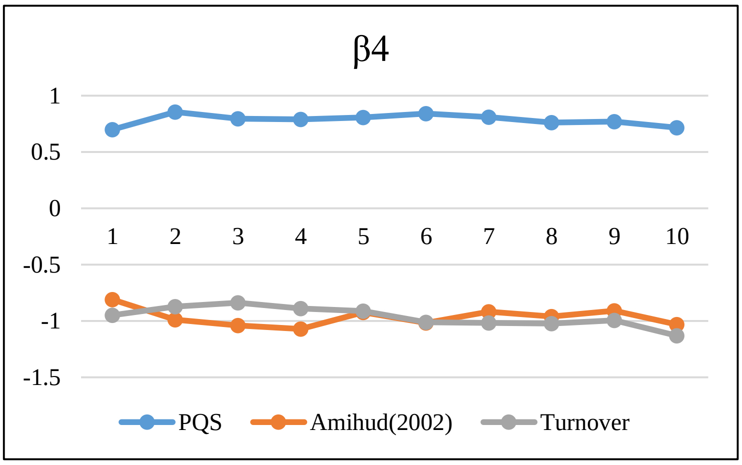


Figure 10. Beta 4 comparison between the Liquidity measures

Figure 11 presents the beta 5 and beta 6 for the measures. Beta 5 for all the three measures have negative values, whereas, or beta 6 all the measures have positive values. The values of beta 5 for all the measures appear to be of same magnitude, although the three measures are capturing different dimensions of liquidity. Similarly, the beta 6 values for the measures are almost of same magnitude.

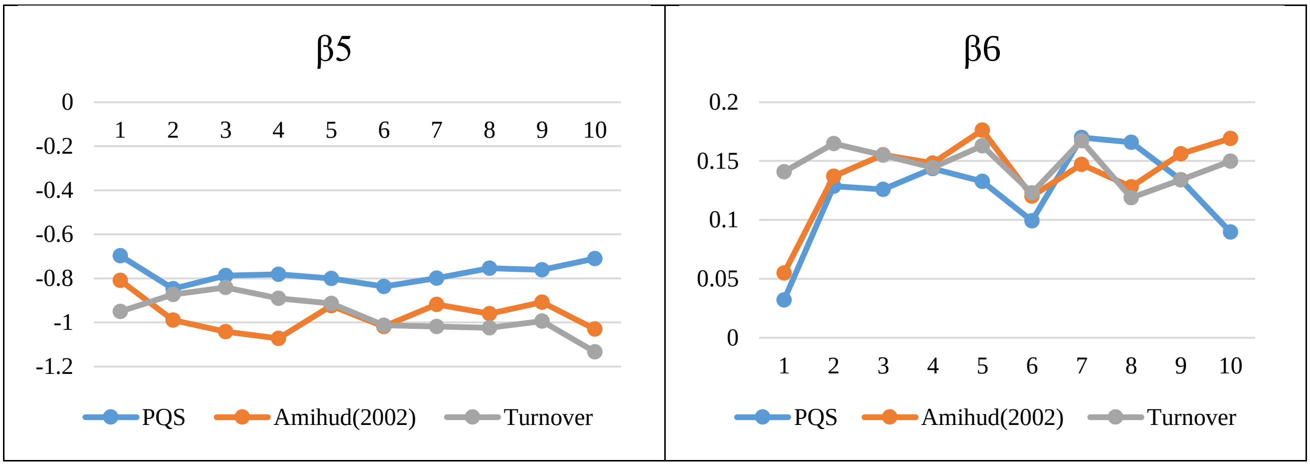


Figure 11. Beta 5 and Beta 6 comparison between Liquidity measures

Figure 12 provides the coefficients of regression of the betas acquired for the cross sectional excess returns.

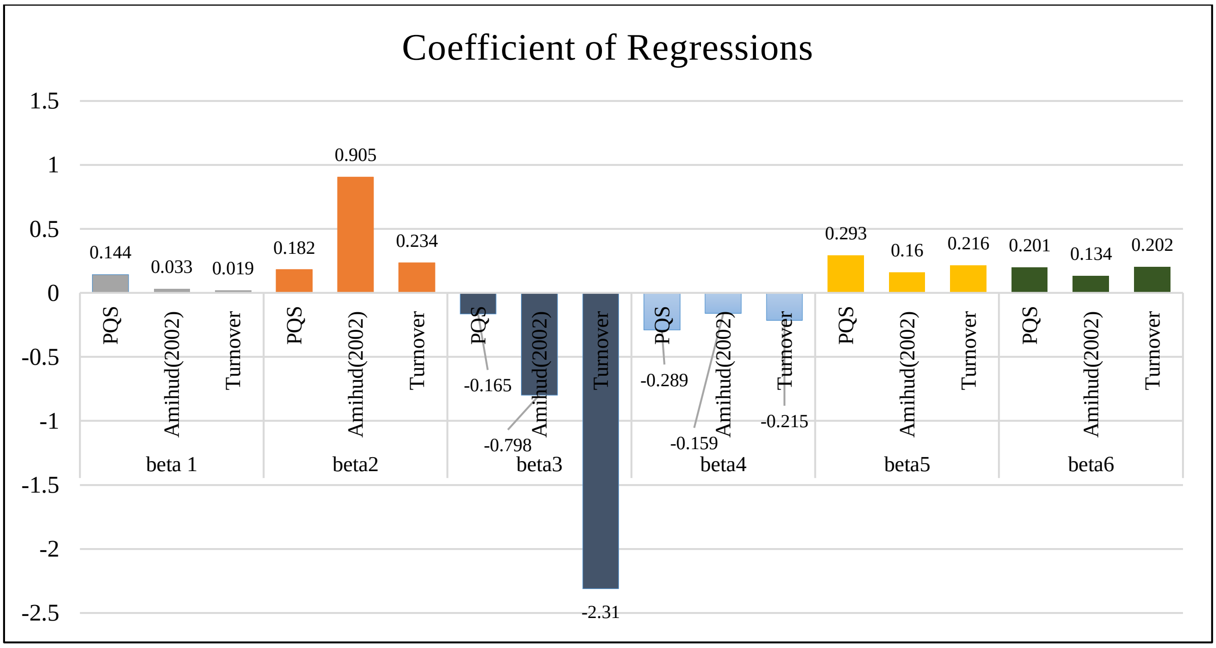


Figure 12.Comparison of coefficient of Regression for the Liquidity Measures

Level of Liquidity, level of liquidity which is hypothesized as, that the level of illiquidity has a positive relation with stock returns for UK market. The coefficients of regression for beta 1 are 0.144, 0.033 and 0.019 for PQS, Amihud (2002) and Turnover respectively (significance of the coefficients have been discussed in Results section). This can been drawn from the findings that level of liquidity is priced in stock returns. Although Turnover is providing weak evidence of pricing of this liquidity risk for UK stock market as the coefficient is very small. Thus liquidity adjusted prices do effect the stock returns. The results are in line with Amihud and Mendelson (1986), Brennan and Subrahmanyam (1996) and Chalmers and Kadlec (1998) also provide supporting evidence that asset prices reflect level of liquidity. Therefore, the investor should be compensated for stocks that have high trading costs.

Commonality is Liquidity Risk, The liquidity risk arising in the form of commonality liquidity that is covariance between stock illiquidity and market illiquidity is also found to be priced for stocks of UK market. The coefficients of regression for beta 2 are 0.182, 0.905 and 0.234 for PQS, Amihud (2002) and Turnover repectively. Under Amihud (2002) the commanality in liquidity risk is found to have highest value when compared to rest of the two measures. Galariotis and Giouvris (2007, 2009) and Foran, Hutchinson and O' Sullivan (2015) have provided evidence in support of existence of commonality in liquidity at London Stock Exchange. But the setting of those studies is different from this study, as this study has applied LCAPM. Therefore, it can be concluded that investors require a compensation for being exposed to systematic fluctuations in liquidity. Suggesting that when stock liquidity declines with the market liquidity the investors require higher expected return due to less willingness of investors to hold such stocks.

Flight to Liquidity Risk, the risk associated with covariance between stock return and market illiquidity is negatively priced for the UK market. The coefficients of regression are -0.165, -0.798 and -2.31 for PQS, Amihud (2002) and Turnover respectively. Turnover has the highest value for flight to liquidity risk beta i.e. beta 3. These results are in line with Pastor and Stambaugh (2003), who argue that stocks whose returns are sensitive to market liquidity are riskier.Therefore, investor require a compensation for holding such stocks whose return are sensitive to market liquidity.

Depressed wealth effect, the risk arsing from covariance between stock illiquidity and market return is also negatively priced at UK market. The coefficients of regression are -0.289, -0.159 and -0.215. Percent Quoted Spread has the highest coefficient of regression among the three measures. From the results this can be deduced that investor are willing to accept lower returns for stocks that are easy to trade when the market is in downturns. This finding is consistent with Acharya and Pedersen (2005).

Aggregate Liquidity Risk, beta 5 and beta 6 for all the measures are positive. The coefficients of regression for beta 5 are 0.295, 0.16 and 0.216 for PQS, Amihud (2002) and Turnover respectively. And for beta 6 are 0.201, 0.134 and 0.202 for PQS, Amihud (2002) and Turnover respectively. For beta 5 PQS has the highest value and beta 6 Turnover has the highest value. The aggregate liquidity risk is priced for stock listed at London Stock Exchange.

As mentioned earlier, the London Stock Exchange has grown to over US$ 3.5 trillion and volumes close to US$ 2 trillion, then the presence of liquidity risks is quite surprising. However, it should be noted that the market is quite vulnerable and has faced number of events that have significantly affected it. APPENDIX 2 provides a graph that illustrates the comparison of stock market losses for UK and US market during selected financial crisis from 1720 to 2008. It is observed that UK and US market had significantly high amount of losses due to these events, even when both of the markets are termed to be highly liquid.

The comparison presented above between the average betas of the liquidity measures and the coefficients of regression for the liquidity measures, it can be concluded that contradicting results have been obtained. Although, all the three measures have provided with the evidence regarding the pricing of identified liquidity risks, however the level at which they influence the stock returns is not similar. This creates a puzzle for the investor in regard to investment decisions. Small and private investors usually prefer spread measures because their transactions are not of that magnitude that can lead to movement of price of stock. So, the findings of Percent Quoted Spread which is based on Ask-Bid spread are more relatable to small and private investors. The results of Percent Quoted Spread indicate that level of illiquidity, commonality in liquidity, flight to liquidity, depressed wealth effect and aggregate liquidity risk do influence the stocks returns.

When we talk about institutional investors then results from Amihud (2002) and Turnover measure are much more relevant. As these measures encompass resiliency, immediacy and depth. The demand and supply levels in the market influence these dimensions of liquidity and institutional investors carry out transactions of huge magnitude. Therefore, the findings from Amihud (2002) and Turnover are more relatable to such investors. As the results from Amihud (2002) and Turnover suggest that level of illiquidity, commonality in liquidity, flight to liquidity, depressed wealth effect and aggregate liquidity risk do influence the stocks returns.

In order to help understand the magnitude of liquidity risk, annual illiquidity premiums for the identified liquidity risks shall be estimated. The liquidity premiums are calculated for all the three measures in the study. To avoid measurement errors that might arise due to multicollinearity, the premiums are calculated using aggregate risk beta i.e. β^6. Starting with Percent Quoted Spread, $\lambda\left(\beta^{1,p10} - \beta^{1,p1}\right)12 = 0.11\%$ which is the difference in annualized expected returns between the most illiquid and liquid portfolios attributable to level of liquidity risk. The estimated annualized illiquidity premiums for commonality in liquidity, flight to liquidity and depressed wealth effect are 0.13%, 0.34%, and 0.28%. The total annual illiquidity premium for the Percent Quoted Spread is 0.86 %. The liquidity premiums for Amihud (2002) are 0.21%, 0.37%, 0.45% and 0.58% for level of liquidity, commonality in liquidity, flight to liquidity and depressed wealth effect respectively. The total annual illiquidity premium for Amihud (2002) is 1.61%. The estimated liquidity premiums for Turnover are 0.54%, 0.39%, 0.21% and 0.23% for level of liquidity, commonality in liquidity, flight to liquidity and depressed wealth effect respectively. The total annual illiquidity premium for Turnover is 1.37%. The results of Percent Quoted Spread are comparable to Hagströmer, Hansson, & Nilsson (2013), who reported 0.46–0.83% annual illiquidity risk premium for the US market. The results of Amihud (2002) are close to Saad and Samet (2015) who have reported conditional illiquidity risk premium of 1.91% for emerging market.

Lastly, considering the limitations of Liquidity Adjusted Capital Asset Pricing Model. The model puts a restriction on selling and considers illiquidity parameter of the model as cost of selling. According to that, Percent Quoted Spread should be the best fit to the model as PQS measures trading cost in respect to stock price. Whereas, Amihud (2002) estimates price impact with respect to volume of transaction and Turnover captures the price impact in regard to volume of transaction to shares outstanding. In the model different liquidity risks are distinguished from each other but the multicollinearity problem forces to apply a constraint of equal premiums, $\lambda^1 = \lambda^2 = -\lambda^3 = -\lambda^4$, while running the regressions.

7. CONCLUSION

This study aimed to investigate role of various types of liquidity risks on stock returns for London Stock Exchange from year 2000 to 2014. For this purpose LCAPM developed by Acharya and Pedersen (2005) is used in the study, as it provides a unified framework to test liquidity risks. Liquidity is a multidimensional phenomenon, in order to capture it various dimensions three liquidity measures are applied. Percent Quoted Spread an order based measure which captures width and depth of liquidity dimensions. Amihud (2002) a trade based measure is used to encompass resilience of liquidity. Whereas, Turnover which is a trade based measure and is able to capture immediacy and depth of liquidity. The betas of the LCAPM are being estimated at portfolio level to mitigate this measurement errors, and then these betas are assigned to individual stocks of the respective portfolio.

The study has investigated five hypothesis in regard to liquidity pricing in London Stock Exchange. The results provide evidence of existence of influence of level of liquidity, commonality in liquidity, flight to liquidity, depressed wealth effect and aggregate effect of liquidity risk. It is noted that the three liquidity measures applied provide different levels of liquidity and this is owing to the fact that the liquidity measures are not able to encompass all the dimensions of liquidity. The results of fixed effects panel regression results help conclude that level of illiquidity, commonality in liquidity, flight to liquidity, depressed wealth effect and aggregate effect of liquidity risk have influence on the stock returns for UK market. The results are robust according to Fama-Macbeth regressions.

The earlier studies conducted on the London Stock Exchange have focused primarily in determining the effect of commonality in liquidity on stock returns for UK market, such studies are from Galariotis, & Giouvris (2007,2009) and Foran et al. (2015). And few studies are available for flight to liquidity in London Stock Exchange (Angelidis & Andrikopoulos (2010) and Cotter et al. (2014)). The common practise found in these studies is the incorporation of liquidity measure to CAPM or the application of principal component analysis technique. However, this study has applied LCAPM which has its own unique setting. This model has the ability to test the identified liquidity risks in a unified framework Thus, the findings of the study have contributed to existing literature in regard to pricing of liquidity risk by the application of LCAPM to UK stocks, testing of depressed wealth effect on UK stocks and influence of aggregate liquidity risk on UK stocks.

The news that Deutsche Boerse AG has agreed to acquire London Stock Exchange Group Plc, (Bloomberg, 2016). London Stock Exchange and Deutsche Boerse would be world's biggest exchange by revenue and second largest by market value (APPENDIX 3 for reference). The merger of two would result in synergies of 450 million euros every year after the deal. If this deal finalized it would be interesting to investigate the liquidity risks after this acquisition. Furthermore, much research is required in regard to adequately define and measure liquidity. It is important to establish evaluation criteria for comparing various liquidity measures.

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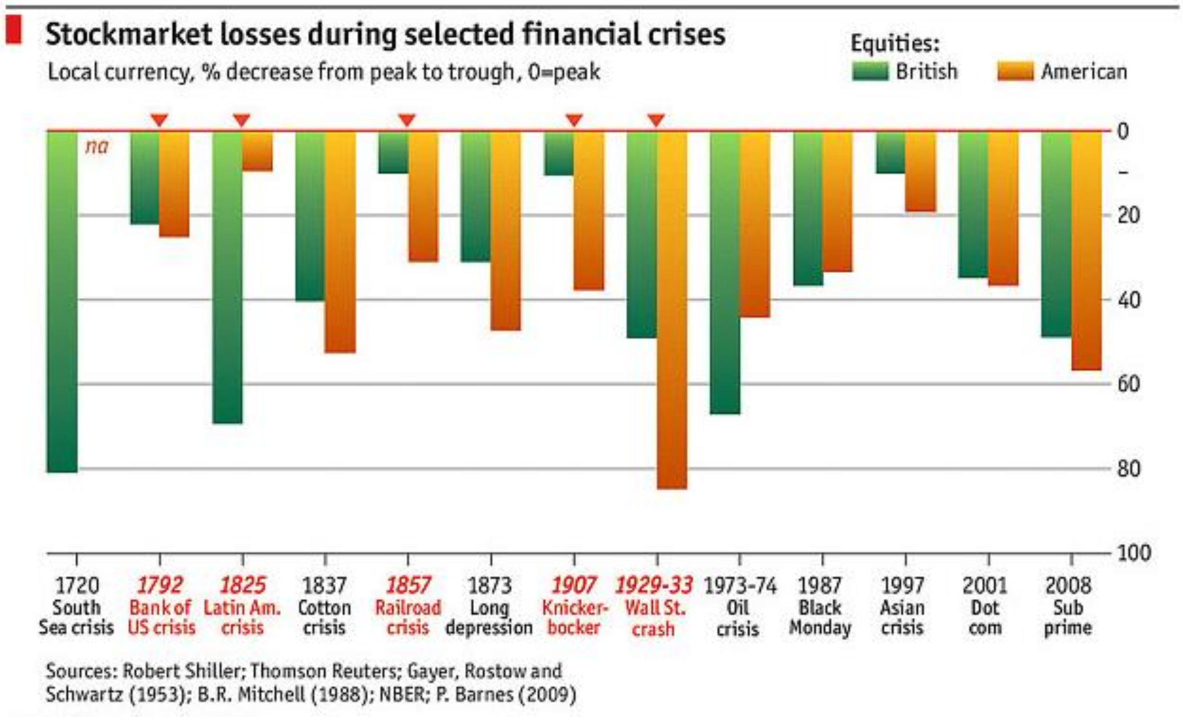
APPENDICES

APPENDIX 1. Hausman test

Hausman test holds the null hypothesis: The slope coefficients between fixed effect and random effect model do not differ. And by rejecting this null hypothesis we can assert that Fixed effect model is more suitable. The table represents the Chi-square test statistics with corresponding p-values below them. The columns marked 1 to 7 correspond to equations (22)–(28). All the values are significant for the models for the respective liquidity measures, hence, approving the use of fixed effects model.

Model	1	2	3	4	5	6	7
Panel A : Percent Quoted Spread							
Beta 1	110.67 (0.000)	105.04 (0.000)	117.27 (0.000)	110.11 (0.000)	120.34 (0.000)	112.68 (0.000)	110.97 (0.000)
Beta 2	115.35 (0.000)	110.79 (0.000)	105.30 (0.000)	108.25 (0.000)	117.45 (0.000)	114.57 (0.000)	112.36 (0.000)
Beta 3	135.82 (0.000)	117.65 (0.000)	114.75 (0.000)	110.58 (0.000)	120.33 (0.000)	105.03 (0.000)	110.80 (0.000)
Beta 4	114.46 (0.000)	120.63 (0.000)	116.45 (0.000)	135.28 (0.000)	107.37 (0.000)	116.01 (0.000)	114.34 (0.000)
Panel B : Amihud (2002)							
Beta 1	108.27 (0.000)	114.83 (0.000)	102.38 (0.000)	119.60 (0.000)	100.53 (0.000)	113.26 (0.000)	117.09 (0.000)
Beta 2	101.31 (0.000)	117.54 (0.000)	120.71 (0.000)	123.03 (0.000)	117.22 (0.000)	111.06 (0.000)	115.74 (0.000)
Beta 3	120.43 (0.000)	120.55 (0.000)	116.03 (0.000)	115.75 (0.000)	105.73 (0.000)	103.11 (0.000)	111.06 (0.000
Beta 4	116.2 (0.000)	124.50 (0.000)	112.63 (0.000)	125.04 (0.000)	117.45 (0.000)	127.01 (0.000)	132.58 (0.000)
Panel C : Turnover							
Beta 1	104.72 (0.000)	101.48 (0.000)	108.52 (0.000)	112.27 (0.000)	115.00 (0.000)	116.20 (0.000)	102.46 (0.000)
Beta 2	110.16 (0.000)	117.22 (0.000)	110.94 (0.000)	110.49 (0.000)	111.03 (0.000)	117.45 (0.000)	119.77 (0.000)
Beta 3	120.50 (0.000)	116.90 (0.000)	125.30 (0.000)	111.60 (0.000)	123.03 (0.000)	105.80 (0.000)	112.44 (0.000)
Beta 4	107.53 (0.000)	112.72 (0.000)	130.47 (0.000)	117.09 (0.000)	116.44 (0.000)	114.77 (0.000)	128.45 (0.000)

APPENDIX 2. Stock Market losses for UK and US during selected financial Crisis



APPENDIX 3. World's Biggest Exchanges

This presents the estimated market capitalization of Deutsche Boerse & LSEG if the deal is successful.