Illusory Nature of Pricing of Illiquidity Risk: The Test Case of Australian Stock Market

Hilal Anwar Butt*
Ihsan Ullah Badshah**
Muhammad Tahir Suleman***

*Department of Economics and Finance, Institute of Business Administration Karachi, Pakistan.
** Department of Finance, Auckland University of Technology, Private Bag 92006, 1020 Auckland, New Zealand.
*** School of Economics and Finance, Victoria University, Wellington, New Zealand.
Illusory Nature of Pricing of Illiquidity Effect: The Test Case of Australian Stock Market

Positive illiquidity premium is documented to be linked with level and risk of illiquidity effect across global markets. Our study shows that this evidence is subject to variation from one measure of illiquidity to another with one potential implication. That the magnitude of illiquidity premium across global markets is less in previous studies, mainly because only one measure of illiquidity is implied. To elaborate this point the test case of Australian stock market is taken and likely strategy to determine the maximum illiquidity premium across the international markets is proposed. Further it is shown that stock based asset pricing tests are more appropriate to segregate level and risk of illiquidity effect.

**JEL Codes:** G10, G12, G15

**Keywords:** Asset pricing, Australian stock market, Illiquidity Premium, Illiquidity level, illiquidity risks, Illiquidity measures.
1 Introduction

The impact of illiquidity on the stock prices has extensively been studied for numerous markets internationally. It is reported that illiquidity both as a stock related characteristic (illiquidity level) and as systematic risk (illiquidity risk) is priced. These results are important in their own right however the chink in the armor for illiquidity related literature is that there is no consensual definition of the illiquidity. Resultantly the choice of illiquidity measure for any study, among many proposed in literature (see Roll, 1984; Lesmond, Ogden and Trzcinka, 1999; Amihud, 2002; Fong, Holden and Trzcinka, 2011; Corwin and Schultz, 2012 etc.) is arbitrary. Does this have any impact for the magnitude of illiquidity premium reported in previous studies? This question is overlooked and it may result in confounding and conflicting evidence for number of markets. To make this point concrete we take the example of Australian stock market and compare the results of Amihud et al. (2014) and Lee (2001) and discuss the likely reasons.

Lee (2011) finds that there is no illiquidity premium (see, Table 3 in Lee (2011)) associated with local illiquidity risks for the panel of developed markets (including Australia) when estimated using Acharya and Pedersen (2005) model. The local illiquidity risk for each country is measured by average monthly shocks in zero returns, a measure of illiquidity proposed by Lesmond et al. (1999). As the premium is estimated for panel of countries with the possibility that there are some countries at margins. Therefore we estimate the illiquidity premium individually for Australian market using the same measure of illiquidity and model as of Lee (2011) and find similar results. This allude to the notion that there is in fact no compensation of local illiquidity risk in Australia. However the results are in sharp contrast with Amihud et al. (2014).
In the study of Amihud et al. (2014) illiquidity is estimated as a response of per dollar traded volume upon absolute returns of any firm, a measure proposed in Amihud (2002) and referred as price impact. The illiquidity premium for Australian market associated with price impact is 24.41% on annual basis\(^1\) for equally weighted portfolios. Admittedly the scope of the study of Amihud et al. (2014) and Lee (2011) is different. As former study links the level of illiquidity and later illiquidity risk with illiquidity premium in international markets. In such a case the evidence of the impact of illiquidity for Australian stock market in Amihud et al. (2014) and Lee (2011) may reconcile if we find that the level of illiquidity is priced whereas, illiquidity risk is not.

However we show that such is not the case. To enunciate it we construct 20 test portfolios based on previous month’s illiquidity of the stocks, which is measured in two different ways. The return structure of ten of these portfolios is linked with price impact measure and for other ten it is associated with a measure of illiquidity proposed by Fong et al. (2011), referred as FTH in the literature. The illiquidity premium as an annual average return dispersion between the most illiquid portfolio \(P_{-10}\) and the most liquid portfolio \(P_{-1}\) is 17.95\% for the price impact measure. Similarly for FTH this annual illiquidity premium is 16.95\%. Of these 20 portfolios the illiquidity risk is estimated with price impact and plugged in Acharya and Pedersen (2005) model. This procedure is same as in Lee (2011) to estimate the illiquidity premium associated with illiquidity risk, the only difference is in the choice of illiquidity measure. Now the illiquidity risk is quite comprehensively priced. For instant the estimated illiquidity premium is

---
\(^1\)This result is available as the supplementary material of the paper Amihud et al. (2014) in its available online version Amihud at al. (2012).
19.98% and 18.40% on annual basis for price impact and FTH related portfolios. As stated before with zero measure, the estimated illiquidity premium associated with illiquidity risk is insignificant.

These results have only one implication that pricing of illiquidity risk is intrinsically linked with the selection of illiquidity measure. This variation in pricing of illiquidity owing to different measure of illiquidity is also reported in Kim and Lee (2014) for the US market. Surprisingly the impact of these findings on the magnitude of illiquidity premium for international stock markets is ignored. One of the potential implication is that the extent of illiquidity premium in Lee (2011) might be underestimated if along with Australian market there are other markets for which illiquidity risk cannot be established with zero measure. Since there is significant presence of illiquidity premium through price impact measure therefore that contribution of premium of Australian market is missed out for the developed markets in Lee (2011).

This choice of illiquidity measure is not only relevant for pricing of illiquidity risk it is also crucial for magnitude of illiquidity premium associated with the level of illiquidity. The later aspect of illiquidity is analyzed in Amihud (2014) et al. by using price impact measure for 45 international stock markets. In one of the study by Butt and Virk (2015), the illiquidity premium associated with zero return is shown to be higher for Finland in comparison to price impact measure. We then replicated the portfolios formation procedure and time span, that is 1997-2011 of Amihud et al. (2011) and find that premium associated with zero returns is 6.95% for Finland, whereas the same for price impact is 1.28% on annual basis\(^2\). This again leads to a same

\(^2\) Different set of sorting procedure were used and we find consistent higher premium associated with zero measure, these results can be furnished upon request.
conjecture that the magnitude of illiquidity premium linked with illiquidity level for any market is subject to variation and depends upon the choice of illiquidity measure.

Our results show that the use of one measure of illiquidity for a number of countries as in previous studies may result in underestimation of total illiquidity premium. The main reason is that the best proxy measure of illiquidity cannot be ascertained on ex-ante basis for each market. Therefore the best strategy for upper limit of illiquidity premium for any market, or for number of markets, is to analyze its magnitude associated with either level of illiquidity, or with illiquidity risk, by implying all possible measures of illiquidity proposed in the literature. This may results in selection of different measures of illiquidity for different countries. With the benefit that the maximum illiquidity premium across the international stock markets will be determined.

Lastly the studies that compare the premium associated with the level of illiquidity and illiquidity risk (Acharya and Pedersen (2005) and Hagstromer et al. (2013) and others) are also reliant for their results on the choice of measure of illiquidity. As there is a possibility that with few measures of illiquidity, the level of illiquidity is priced but illiquidity risk is not. This may lead to a confounding conclusion about the relative importance of illiquidity level over illiquidity risk and vice versa.

As with portfolios based analysis used in this paper, it is hard to disentangle the strong correlation structure between level and risk associated with illiquidity. Therefore, we conduct stock based cross-sectional tests, this way the correlations between level and risk are reduced and
testing the relative importance of these two effects become possible. We find that with stock based analysis using price impact, the total predicted annual illiquidity premium is 18.10%. Of this the illiquidity risk explains 12.28% and illiquidity level 5.82%. However with FTH measure the illiquidity related risks have no explanation and level is the only important contributor towards illiquidity premium. Same is the case with zero returns. Here again the relative importance of level and risk associated with illiquidity effect is linked with illiquidity measure, and therefore rendering generalization improbable.

The paper is organized as follows: Section 2 briefly discusses the liquidity adjusted CAPM model. Section 3 discusses the data, and elaborates on the construction of illiquidity measures and of portfolios. Section 4 is reserved for the methodology and section 5 enunciates the evidence of pricing of illiquidity risk for the Australian stock market. Lastly, section 6 concludes.

2 Capital Asset Pricing Model Adjusted for Illiquidity Risk

One of the general findings from the liquidity literature is that the illiquid stocks pay higher returns in comparison to liquid stocks. Alternatively it can be said that a zero-investment strategy of being short in liquid stocks and long in illiquid stocks yields positive returns. These positive returns are generally not explained by the capital asset pricing model (CAPM). One among many possible reasons is that the model assumes that liquidity risk does not exist. As a consequence, therefore, the market beta is generally lower for illiquid (and higher for liquid) stocks. To correct the CAPM for liquidity related risk, Acharya and Pedersen (2005) proposed an illiquidity based
adjustment. If returns are seen in their net denomination (that is, gross returns in excess of illiquidity related cost), then CAPM (subject to additional assumptions) can be expressed as the illiquidity adjusted CAPM (LCAPM), in which returns are a function of stock’s expected illiquidity and three additional illiquidity related betas (in addition to the market beta).

The detailed assumptions\(^3\) under which the LCAPM is derived are spelled out in Acharya and Pedersen (2005) and Amihud et al. (2005). One can infer from these assumptions that the CAPM in frictionless economy of Sharpe (1964), Linter (1964) and Mossin (1966) and Black (1972) translates into LCAPM in which frictions to trade do exist. That is, the investor’s equilibrium gross returns on some stock \(R_u\) and overall market returns \(R_{mt}\) in the CAPM are feasible and optimal in their net returns denominations such as, \(R_u - C_u\) and \(R_{mt} - C_{mt}\) in the LCAPM under some reduced investment opportunity set for the investors, this reduced opportunity set is direct outcome of additional assumptions implied in Acharya and Pedersen (2005). In the foregoing net returns, \(C_u\) and \(C_{mt}\) are the liquidation cost (cost of selling), of some stock and of overall market respectively.\(^4\) This simple relationship between gross returns and net returns means the CAPM can be expressed as

\[
E_t(R_{i,t+1} - C_{i,t+1}) = R_f + \lambda_t \left( \frac{Cov_t(R_{i,t+1} - C_{i,t+1}, R_{m,t+1} - C_{m,t+1})}{Var_t(R_{m,t+1} - C_{m,t+1})} \right).
\]  

(1)

The above equation adjusts the future expected returns for the stochastic effect of illiquidity for the information that is available at time \(t\). The unconditional version for testing the illiquidity

\(^3\) For interested reader we refer Acharya and Pedersen (2005) and Amihud et al. (2005) for the detailed assumption of LCAMP models.

\(^4\) As discussed in Campbell et al. (2007) the Acharya and Pedersen (2005) model is a transaction cost based model. However it can be applied to other illiquidity measures as well. Stocks which have higher illiquidity must have higher transaction costs, therefore there is a direct link between any illiquidity measure and transaction costs.
effect can be written as below, by assuming (as in Acharya and Pedersen (2005)) that the conditional covariance in equation (1) is constant:

\[ E(R_i - C_i) = E(C_i) + \lambda \beta_{i,m} + \lambda \beta_{i,l1} - \lambda \beta_{i,l2} - \lambda \beta_{i,l3} \]  

(2)

The respective betas are,

\[ \beta_{i,m} = \frac{\text{Cov}(R_{i,t}, R_{m,t})}{\text{Var}(R_{m,t} - C_{m,t})}, \]  

(3)

\[ \beta_{i,l1} = \frac{\text{Cov}(C_{i,t}, C_{m,t})}{\text{Var}(R_{m,t} - C_{m,t})}, \]  

(4)

\[ \beta_{i,l2} = \frac{\text{Cov}(R_{i,t}, R_{m,t})}{\text{Var}(R_{m,t} - C_{m,t})}, \]  

(5)

\[ \beta_{i,l3} = \frac{\text{Cov}(C_{i,t}, R_{m,t})}{\text{Var}(R_{m,t} - C_{m,t})}. \]  

(6)

In addition to the above betas, Acharya and Pedersen (2005) and Lee (2011), to segregate the effect of market beta from illiquidity related betas, have also calculated two additional betas as

\[ \beta_{i,net} = \beta_{i,m} + \beta_{i,l1} - \beta_{i,l2} - \beta_{i,l3} \quad \text{and} \quad \beta_{i,l5} = \beta_{i,l1} - \beta_{i,l2} - \beta_{i,l3}, \]  

respectively. However, in the section 5.1, we show that this segregation is only possible if these betas are not highly correlated with each other.

The detailed interpretation of these betas is given in Acharya and Pedersen (2005). The market beta \( \beta_{i,m} \) signifies the risk of stocks in conjunction with market returns. If the stock’s return has higher covariance with market returns, then it shows the riskiness of that respective stock in terms of higher value of \( \beta_{i,m} \). That is, if the market gives lower returns then such stock gives lower returns than market returns; therefore their higher returns on average is basically...
compensation for not being hedged against poor market-wide performance. Similarly, for other illiquidity related betas, the pricing implication is the same. For example, $\beta_{i,L1}$ (the commonality in liquidity, first studied by Chordia et al. (2002)) signifies the covariance between idiosyncratic illiquidity of the stock and the market’s illiquidity. If a stock becomes illiquid when the overall market is illiquid, then an investor requires the illiquidity premium for investing in such a stock, as it becomes hard to liquidate the position when stock market illiquidity is higher.

Similarly, $\beta_{i,L2}$ which is the covariance between stock $i$’s return and overall market illiquidity is generally priced negatively. If market illiquidity increases and the return on a stock also increases and vice-versa, then such a stock provides a hedge against the illiquidity risk and should earn a lower return accordingly. Lastly, $\beta_{i,L3}$ captures the covariance between overall market returns and stock illiquidity. When stock market returns are depressed and illiquidity of a stock also reduces (and vice-versa), then such stocks allow an investor to easily liquidate his/her position when market returns are low. That is such stocks are hedged against the worst economic conditions.

3 Data, Illiquidity Measure and Portfolios Formation

3.1 Data

We obtain data from DataStream for the period of February, 1988 to June, 2014 (1988-2014, hereafter) for the Australian equity market. The initial sample consists of more than 3500 firms which include both active and dead firms in the sample. We include dead firms in order to avoid survivorship bias. To create a trustworthy sample, we first filter the non-common equity stocks from the sample. Detail about the non-common equity firms in Australia is explained in
Appendix 1. We follow Griffin et al. (2010), Lee (2011), and Ince and Porter (2006) cleaning procedures. After this, we end up with 2822 firms. The number of firms is quite similar to the one reported in Amihud et al. (2014) for the Australian stock Market.\(^5\) Following Griffin et al. (2010) and Ince and Porter (2006), to avoid extreme observations prevalent in the DataStream, the daily returns are considered to be missing if any daily return \(r_{t-1} > 100\%\) or \(r_t > 100\%\) and \((1 + r_t) \ast (1 + r_{t-1}) - 1 \leq 50\%\). Further, we also set a daily return to missing if it is greater than \(200\%\). This cleaning of daily returns is done as it is important for calculating one of the illiquidity measures: the price impact. For the monthly returns following Griffin et al (2010), we set those monthly return to be zero if \(r_{t-1} > 300\%\) or \(r_t > 300\%\) and \((1 + r_t) \ast (1 + r_{t-1}) - 1 \leq 50\%\). In addition to this we set all monthly returns that are greater than \(800\%\) to be missing.\(^6\)

In addition to these cleaning procedures, we have also opted to remove all those stocks which in their previous month have prices lower than \$AU 0.1. As noted in footnote 3 of Ince and Porter (2006), the impact of implausible observations can be reduced by using alternative price screens like 1, 0.25 and 0.1. We find this observation very relevant for the Australian stock market. For example, even after applying various cleaning procedure the stocks with prices lower than \$AU 0.1, have average monthly returns of 5.08%. Further, the monthly price impact of these stocks, (which traces an impact of one \$AU traded volume on returns) is 0.82 on average. Indeed, there are stocks which have a monthly ratio over 1000. In light of this, we can safely say that the stocks retain for the analysis for our study are void of extreme observations. As a comparison,

\(^5\) Amihud et al. (2014) reported the number of firms for the Australian markets is 2,699 from January, 1990 to December, 2011. Slightly higher number of firms in our sample is due to longer coverage of data sample.

\(^6\) Griffin et al. (2010) cleaning procedures are defined for weekly returns, therefore to make them applicable for monthly returns we adjust the cut-offs.
the price impact measure provided in Amihud et al. (2014) for the Australian market is 0.090 and in our study the same is 0.052. After using these filters, the average number of firms in our study is 890, as compared in Amihud et al. (2014) 928.

### 3.2 Illiquidity Measure

To test the pricing implications of illiquidity risk, three different proxy measures of illiquidity are selected. First, we use the price impact measure as proposed by Amihud (2002), which has been used by a number of studies. Second, we use FHT (2011), which has been proposed by Fong et al. (2011) as the best measure of illiquidity in the context of global stock markets. Lastly, we use the zero-return measure as proposed by Lesmond et al. (1999) and used by Bekaert et al. (2007) and Lee (2011) in the global context.

Amihud (2002) proposes a measure of illiquidity which captures the impact of trading volume upon the absolute return of a stock. Stocks that are illiquid respond more to the trading volume in comparison with liquid stocks due to the information asymmetry, which is much higher for illiquid stocks. Numerous studies (Amihud (2002), Amihud et al. (2014), Acharya and Pedersen (2005), and Karolyi et al. (2011)) use this measure to estimate stock illiquidity. For the daily return of a stock on given day, \( r_{i,d} \), with the daily trading in Australian dollar, \( \text{volume}_{i,d} \) the price impact is a ratio \( \frac{r_{i,d}}{\text{volume}_{i,d}} \), which is averaged across the number of days for which stock is traded in a month. Mathematically:

\[
PI_{i,t} = \frac{1}{N_{i,t}} \sum_d |r_{i,d}| / \text{volume}_{i,d}
\]  

(7)
Where, $N_{i,t}$, is number of days in a month for which the stock is traded. The price impact, $P_{i,t}$, measure is then averaged within each month for each stock and for the overall Australian stock market. In the seminal paper by Amihud (2002), there are a number of restrictions imposed on $PI$’s calculation. One of them is that a stock is traded for at least 15 days in a month. However, this restriction is relaxed in recent studies (for instance in Amihud et al. (2014)). The obvious reason for relaxing this restriction is that by only accounting for stocks that are traded for 15 days leads to the removal of most illiquid stocks from the sample.

One of the simplest illiquidity measures is proposed by Lesmond et al. (1999). That is, the number of zero returns for a stock in a given month. If these zero returns are higher for a given stock, then it implies illiquidity for that stock is higher. The intuition is simple, for instance, if a stock is not traded for any given day when absolute return for the overall market is not zero, implies that the transaction cost for trading that stock is higher than the profit one would earn by trading it; therefore, a rational investor would abstain from trading the stock on that day. Thus, we would find zero-return for that stock. Consequently, the higher is the number of zero returns, the more illiquid is the stock. This measure can be calculated as

$$\text{Zero returns} = \frac{ZRD_{i,t}}{TD_{i,t}}$$

Where, $ZRD_{i,t}$, shows number of zero return days in a month for a stock and, $TD_{i,t}$, shows the number of trading days in a month. This simple ratio gives the zero return measure, which is estimated for each stock and for the whole Australian stock market.

Fong et al. (2011) followed the intuition of Lesmond et al. (1999) limited dependent model for extracting the transaction cost for a given stock. The study indicates that the FTH dominates
globally all prior illiquidity related cost proxies. As spelled out in later work, that true returns, $R^T$, differ from their counterpart observed return, $R^O$, owing to transaction cost. The three different regions were demarcated in Lesmond et al. (1999), two in which the threshold of transaction cost due to the cost of buying and the cost of selling are breached by real returns, $R^T$. In one region such bounds are not breached, which results in a zero return that is, the stock is not traded owing to higher transaction cost. Fong at al. (2011) assume that these cost of buying and selling are symmetric for any stock and can be represented as $S/2$, and $-S/2$. Thus, the total round trip percent transaction cost for a given stock is $S$. Under these new costs of buying and selling the Lesmond et al. (1999) model can be represented as

$$R^o = R^T + S/2 \quad \text{when} \quad R^T < -S/2,$$

(9)

$$R^o = 0 \quad \text{when} \quad -S/2 < R^T < S/2,$$

(10)

$$R^o = R^T - S/2 \quad \text{when} \quad S/2 < R^T,$$

(11)

Moreover, it is assumed that true returns, $R^T$, for any individual stock on a given day follows normal distribution with mean zero and variance $\sigma^2$. Evidently the probability that $R^T$ lies between the lower and upper bounds of $-S/2$ and $S/2$, is, $P(-S/2 < R^T < S/2) = P(R^T < S/2) - P(R^T < -S/2)$, which can be written as

$$\phi(S/2\sigma) - \phi(-S/2\sigma)$$

(12)

The observed probability of zero return (probability of middle region) is shown in equation (8). Hence by equating the theoretical and observed probabilities and using the properties of the normal distribution Fong et al. (2011) derived the following relationship for transaction cost of any stock

---

7 For interested reader we refer the paper of Fong et al. 2011 for detailed analysis of FTH in comparison to other proxy measure of liquidities.
\[ FHT \equiv S = 2 \phi^{-1} \left( \frac{1 + \text{Zero-returns}}{2} \right), \]  

(13)

where, \( \phi^{-1} \), is an inverse function of cumulative normal distribution. Thus FHT (2011) relates the transaction cost for a stock with the number of monthly zero returns and volatility of the return distribution. This measure is estimated for each stock and for the whole Australian stock market.

### 3.3 Portfolio Construction

To find the effect of illiquidity, we form portfolios on the basis of three different illiquidity measures. Using each measure of illiquidity we form ten portfolios for each illiquidity proxy. We use a monthly sorting procedure for the construction of portfolios. \(^8\) That is for, each month, illiquidity of a stock is estimated through price impact, FHT, and zero-return. The stocks are split into ten deciles, based on their previous month’s illiquidity. Portfolio P-1 (decile 1) is composed of the stocks that are the most liquid 10 percent stocks in our sample. By comparison, the most illiquid portfolio P-10 (decile 10) contains stocks which are the most illiquid.

Table 1 shows the average illiquidities and average returns for the ten decile portfolios which are sorted on the basis of previous months of illiquidity. As can be seen, each portfolio is increasing in the respective measure of illiquidity which is calculated through price impact, FHT and zero-return. Furthermore, there is a quite sizable economic premium related to illiquidity, particularly through price impact and FHT. For instance, the yearly premium for the most illiquid portfolio

---

\(^8\) As described in footnote 21 of Sadka (2005), that the factor loadings which we estimate for each portfolio using the whole sample period using equation (3),(4),(5) and (6) for whole sample are fixed, they are yet conditional at firms level due to monthly sorting procedure.
P-10 over P-1 is 17.95%, when illiquidity is measured by price impact. The yearly return dispersion for the same portfolios for the FHT measure is 16.95%. However, the return dispersion is not that sizable when zero-return as a measure of illiquidity is used, as it is only 7.33% per annum. This indicates that the zero-return produced the minimum illiquidity premium. However, we note that the sorting procedure with zero-returns is advantageous for the most illiquid portfolio as number of average firms is quite lower for the most illiquid portfolios. Generally the average numbers of firms are quite similar for each portfolio when the same are sorted with price impact and FHT.

[Insert Table 1 here]

4 Estimation Procedure

Previous studies that relate illiquidity effects to asset returns use innovations in the illiquidity series. Sadka (2005) suggests using innovation (surprises) in illiquidity instead of the level of illiquidity series. We follow Sadka (2005) and Lee (2011) and trace out innovations from the fitted AR(2) models for thirty three illiquidity series, whereas the thirty illiquidity series are of the thirty portfolios which are constructed in the previous section. Lastly the remaining three series are representing market-wide illiquidity. The following AR(2) model is estimated

\[ L_i^t = c + \sum_{i=1}^{2} \Psi_i L_{i-i}^t + \varepsilon_i^t, \]  

(14)

Where, \( L_i^t \), represents the respective illiquidity series, \( \Psi_i \), is the coefficients on the lag \( i \). More importantly: \( \varepsilon_i^t \) is the innovation in the illiquidity series. As discussed earlier, the illiquidity

\[ 9 \text{ The number of firms is un-equal with zero-returns in some deciles, as many firms have same number of monthly zero returns, therefore the sorting procedure allocate unequal number of stocks to different portfolios.} \]
series are quite persistent. Accordingly, we find the coefficients on the two lags for the market-wide illiquidity, when it is estimated through price impact, are 0.52 and 0.21. Similarly, when the market-wide illiquidity is calculated using FHT, the coefficients on the two lags are 0.68 and 0.26, respectively. Moreover, the coefficients on the two lags are 0.67 and 0.25 for the market-wide illiquidity estimated through the zero return measure. At the portfolio level the coefficients for the two lags are also quite high. Therefore, it seems that AR(2) fits reasonably well across different illiquidity series. Figure 1 gives a graphical illustration of the market-wide innovation in the illiquidity series for the three different measures of illiquidity. These graphs indicate that when innovations in market-wide illiquidity are estimated through price impact, then episodes of higher illiquidity and lower illiquidity are often quite distinctive in comparison with other measures of illiquidity.

[Insert Figure 1 here]

5 Empirical Results

5.1 Illiquidity sorted portfolios for the Australian stock market

We estimate four betas using equations (3), (4), (5) and (6) using monthly portfolio returns, innovation in portfolios illiquidity, market returns, and innovation in market illiquidity. In Tables 2 Panel A,B and C we report four betas estimated for each portfolio based on the price impact, FHT and zero-return illiquidity measures. As can be seen, the first two illiquidity related betas for price impact portfolios, representing the risk with commonality in illiquidity, $\beta_{l1}$, and representing the risk with wealth effect, $\beta_{l3}$, are well in line with the expected illiquidity of these portfolios. However, the illiquidity related beta, $\beta_{l2}$ (representing the flight to liquidity effect) is not monotonic for the most illiquid portfolios in relation as the others.
Table 2 Panel B, reports variations in the market beta, and three illiquidity related betas for ten portfolios sorted on the FHT illiquidity measure. The expected illiquidity increases for a portfolio that has higher illiquidity in the previous month. The pattern of illiquidity related to \( \beta_{L3} \) seems quite similar to that of price impact measure. However, there is a difference in magnitude, for instance with the price impact measure, P-10’s \( \beta_{L3} \) is economically larger than that of P-1, whereas for FHT the proportional increase in \( \beta_{L3} \) is not that comparable. A similar pattern can be observed in the commonality in liquidity risk, \( \beta_{L1} \), these differences are expected to affect overall success of the asset pricing test for each illiquidity measure. Furthermore, with both illiquidity measures, the effect of illiquidity risk captured through \( \beta_{L2} \) is not that intuitive. This sheds further light upon the selection of specific illiquidity risk, in addition to measure of illiquidity: it is quite possible that a specific risk may not be priced; however, illiquidity effect may still be there through other illiquidity related risks.

Table 2 Panel C, reports variations in the market beta, and three illiquidity related betas for ten portfolios sorted on the zero-return illiquidity measure. A portfolio’s zero-returns increase in conjunction with the previous month’s zero returns. However, illiquidity related betas do not take the expected patterns that we observe in Tables 2 Panel A and B. For example, the most illiquid portfolio (P-10) does not have the highest, \( \beta_{L1} \), nor the highest, \( \beta_{L3} \). However, there is some monotonicity with, \( \beta_{L2} \). This does not line up either with the expected illiquidity or with the realized returns of the portfolios. One can safely say that when Illiquidity in the Australian stock market is estimated through the zero-returns measure, we do not see the expected results.
5.2 Empirical results from cross-section regressions

We estimate the following testable form of LCA model, equation (2), for twenty equally weighted portfolios for the Australian stock market for the period for 1988-2014.

\[
E(R_i) = \alpha + \psi_i E(C_i) + \lambda_m \beta_{m,i} + \lambda_{L1} \beta_{L1,i} + \lambda_{L2} \beta_{L2,i} + \lambda_{L3} \beta_{L3,i}
\]  

(15)

Of the twenty portfolios, ten are sorted with price impact and other ten are sorted with FTH measure. As these portfolios give significant illiquidity premium there we included them for the cross-section tests and dropped those ten portfolios which are sorted on the basis of monthly zero-returns. Because, as discussed previously, that with zero-returns the dispersion of portfolios return between the most illiquid and liquid is not that high. However to give each illiquidity measure equal chance to price these twenty test portfolios\textsuperscript{10} we estimate illiquidity level and risks of these twenty portfolios using all three measures of illiquidity used in this study.

The above model is a slight variant of original LCA model proposed by Acharya and Pedersen (2005), as we estimate separately the each price of risk associated with the model related risk factors. This sort of testing is necessary owing to the high degree of correlation among the risk factors (as shown in Table 3). For example, in Acharya and Pedersen (2005), net beta is calculated as \( \beta_{net,i} = \beta_{m,i} + \beta_{L1,i} - \beta_{L2,i} - \beta_{L3,i} \) and its premium is estimated along with \( \beta_{m,i} \) and \( E(C_i) \) using a second pass regression of \( E(R_i) = \alpha + \psi_i E(C_i) + \lambda_m \beta_{m,i} + \lambda_{net,i} \beta_{net,i} \).

However, when illiquidity risk is estimated by the price impact measure, the risk factors \( \beta_{net,i} \) and

\textsuperscript{10} The results are consistent when the cross-section of thirty portfolios is used, these can be provided upon request.
\( \beta_{m,i} \) have correlation of 0.7709, and with the FHT measure, correlation between these betas is as high as 0.9984. Furthermore, the \( \beta_{net,i} \) is also highly correlated with the expected illiquidity \( E(C_i) \): these correlations are 0.9405 with the price impact sorted portfolios and 0.7748 with the FHT sorted portfolios. In Lee (2011), all beta related risk factors, along with overall illiquidity related beta (calculated as \( \beta_{5,i} = \beta_{L1,i} - \beta_{L2,i} - \beta_{L3,i} \)) are estimated with the expected illiquidity \( E(C_i) \) and market risk \( \beta_{m,i} \) in a separate regression. As is obvious \( \beta_{5,i} \) is also highly correlated with these factors.

[Insert Table 3 here]

Therefore we estimate the above model, equation (14), separately for each factor, and it is conjectured that the factor that has the most significant pricing capacity, should reveal through its respective price of risk \( \lambda \) associated with the factor, and through the regression’s \( R^2 \). Table 4 provides results for the LCAPM model for individual factor models. We thus fit six versions of equation (15): M1 with the expected liquidity level, M2 with the market risk, M3 with the liquidity commonality risk, M4 with the flight to liquidity risk, M5 with the depressed wealth risk, and M6 includes all four illiquidity related risks.

In Table 4 Panel A, with price impact in M1, the expected illiquidity \( E(C^t) \) is related positively and statistically significant, the coefficient is 0.06 with a \( t-stat \) of 10.29 and associated \( R^2 \) is 84.70%. This result shows that level of illiquidity is positively compensated. M2 alludes to the pricing implication of market risk. The price of risk is positive as expected; however, it is insignificant with a \( t-stat \) value of 1.24, and with the lowest adjusted \( R^2 \) value (7.90%). M3
estimates the price of risk associated with commonality in illiquidity effect. The risk premium associated with this illiquidity related beta is 0.0239 with t-stat of 8.60 and adjusted $R^2$ of 80.4%. The commonality is illiquidity is also positively compensated as expected.

M4 (when $\beta_{iL2}$ is used as illiquidity related risk) has the expected sign on the price of risk. However, it is marginally significant; furthermore, it has the lowest adjusted $R^2$ among all illiquidity related risks specifications. It is pertinent to mention that many studies initially (Amihud, 2002; Pastor and Stambaugh, 2003; among others) have only used this illiquidity related risk. The results from M4 suggest that using a single illiquidity risk factor would lead us to conclude that illiquidity risk is not priced.

Lastly, M5 uses $\beta_{iL3}$ as illiquidity related beta, which accounts for the risk of increase in a stock’s illiquidity in relation with market returns. As expected we find that the price of risk for $\beta_{iL3}$ is negative: -0.0372, with a t-stat of -13.34, and the highest amongst all five models with the adjusted $R^2$ of 90.30%. In order to understand the economic significance of $\beta_{iL3}$, we estimate its predicted premium using the associated price of risk in model (15) as follows,

$$\lambda_{iL3}(\beta_{iL3,p-10} - \beta_{iL3,p-1})$$

Where p-10 is the most illiquid portfolio and p-1 is the most liquid portfolio. These exposures are provided in Table 2. The illiquidity related betas are -0.4476 and 0.0001 for these portfolios and the price of risk associated with this beta is -0.0372. Using the above relationship, gives us 19.98% factor premium, whereas the realized premium is 17.64% for the price impact related portfolios. Similarly using the model based illiquidity betas $\beta_{iL3}$ and associated price of risk, the
price impact measure predicts an illiquidity premium for the FHT sorted portfolio as 18.45%\textsuperscript{11}, whereas the realized premium is 16.95%. These calculations reveal that the model related illiquidity risk predicts a sizable economic premium for the Australian equity market.

In Table 4 Panel B, we test the pricing implication of FHT. Here we find the price of risk associated with different illiquidity related factors is quite different from Table 4 Panel A. Among all tested models, in M1 the expected illiquidity $E(C_t)$ is the most significant. The coefficient as expected is positive 0.210 with a $t$-stat of 4.85 and adjusted $R^2$ value of 56.70%. Among the illiquidity related beta risks the commonality in illiquidity $\beta_{L1,i}$ in M3 is positive and significantly priced with the highest adjusted $R^2$. Furthermore, $\beta_{L2,i}$ in M4 is not that significant and $\beta_{L3,i}$ in M5 does not have that high an adjusted $R^2$ as we find with the price impact measure. The results indicate that not only the pricing implication of each illiquidity measures varies but also the constituent illiquidity related factors vary depending upon the measure of illiquidity.

[Insert Table 4 here]

Lastly, we conduct the LCAPM model test, equation (15), using the zero-returns measure to estimate the effect of illiquidity risk on the test portfolios. Results are reported in Table 4 Panel C. As it is quite obvious that the performance of illiquidity related factors is not comparable with the other measures of illiquidity. Although the risk of commonality in illiquidity in M3 is

\textsuperscript{11} Portfolio returns are predicted on the previous month’s FHT measure; however, we replace the stock’s illiquidity with the price impact measure, and consequently the illiquidity related constructs are estimated through the price impact measure. The value of $\beta_{L3,p-10}$ is -0.41254 and $\beta_{L3,p-1}$ is -0.00032, the detail relating to magnitude of the exposure of all illiquidity related betas estimated through price impact measure for the FTH sorted portfolios can be furnished upon request.
significantly priced, the sign is counter intuitive, as we do not expect that stocks that become illiquid when the overall stock market becomes illiquid will provide any hedging advantage. In Table 2, we have already seen that \( \beta_{L,i} \) is quite low for the most illiquide portfolio (P-10). The most important result is that the price of risk associated with \( \beta_{L,i} \) in M4 is statistically insignificant. In fact the adjusted \( R^2 \) is negative -5.50%. Unsurprisingly, there is no premium for bearing \( \beta_{L,i} \) illiquidity risk. Nevertheless, with zero-returns the results of none pricing of illiquidity risks are in line with Lee (2011) for the developed stock markets in which the Australian stock market is included.

### 5.3 Stock based analysis

In the above section we witnessed that that cross-section is only comprised of twenty observations. Further by using one illiquidity related characteristic each, a set of ten portfolios constructed with the possibility that most of portfolios have the same stocks. This shortcoming can easily be tackled with stock based analysis, which along with increasing the degree of freedom also uses the maximum information available in the stock returns that tends to be averaged out in portfolios returns.

First we use ten portfolios which are sorted on the previous month’s price impact. As a procedure each stock is allotted its portfolio’s respective market risk and illiquidity risks to reduce the estimating error, which is sever once these risks are estimated for each stock as indicated in previous literature. Further each stock is assigned its previous month illiquidity level. This procedure is more likely to disentangle the correlation between level and risk associated with illiquidity effect. As it keeps betas constant and let illiquidity level varies over
time. In fact the correlation between expected illiquidity $E(C_i)$ and $\beta_{L2}$ is 0.2300 and with $E(C_i)$ and $\beta_{L3}$ is -0.2399 respectively and shown in Table 5 Panel A. With portfolio based methodology these correlation are 0.9608 and -0.9818 with price impact as shown in Table 3 Panel A. These reduced correlations make possible to compare the respective premiums associated with level and risk of illiquidity effect by avoiding multicollinearity issues.

[Insert Table 5 here]

Accordingly in Table 6 panel A, the models M2, M3, M4, and M5 compare the level of illiquidity with market and illiquidity risks using Fama and Macbeth (1973) regressions for LCAPM. In M1 the level of illiquidity is highly significant and it retains the size of coefficient and its significance for M2 and M4. That is the market risk $\beta_m$ and flight to liquidity effect $\beta_{L2}$ has no additional information available over level of illiquidity. However, in model M3 and M5 the level of illiquidity and illiquidity risks both are significant. To gauge the contribution of level of illiquidity and illiquidity risk towards total premium we estimate following relationship

$$\phi(C_{i,p-10} - C_{i,p-1}) + \lambda_i(\beta_{i,p-10} - \beta_{i,p-1}),$$

where $\phi$ and $\lambda_i$ are illiquidity premium associated with level and risks, the estimated coefficients for M3 are, 0.01615 with $t-stat$ of 2.37 and 0.01422 with $t-stat$ of 2.38 and for M5 are 0.01482 with $t-stat$ 2.10 and -0.02287 with $t-stat$ -2.76. Whereas, $(C_{i,p-10} - C_{i,p-1})$ is difference of average level of illiquidity of the stocks in P-10 and P-1, which is 0.32736 and $(\beta_{i,p-10} - \beta_{i,p-1})$ for $\beta_{L2}$ and $\beta_{L3}$ is 0.59393 and -0.44766 as per Table 2 Panel A and B. Using these estimates for the above relationship the premium associated with level is 6.34% and with $\beta_{L2}$ is 10.13%, the total premium is 16.47% whereas for M5 the premium associated with level
is 5.82% and with $\beta_{L3}$ is 12.28% and total premium is 18.10%. These results not only indicate the pronounced effect of illiquidity for the Australian market, they also hint that contribution of illiquidity risk is far more than illiquidity level. Provided the illiquidity of this market is measured through price impact.

In Table 5 Panel B, the same estimation is repeated with FTH. The significance of the estimated coefficients of $E(C_i)$, $\beta_{L2}$ and $\beta_{L3}$ are generally lesser than price impact measure. To compare the performance of level and risk associated with FTH we repeat the analysis of previous paragraph, the estimated coefficients is on $E(C_i)$ and $\beta_{L2}$ are 0.14365 with $t$-stat 3.16 and -0.96126 with $t$-stat of -0.34 respectively, similarly the coefficients on $E(C_i)$ and $\beta_{L3}$ are 0.16425 with $t$-stat 2.68 and 0.05514 with $t$-stat 0.49 respectively. These results show that with FTH, the illiquidity risks are not important. Therefore we estimate the premium associated with level of illiquidity using coefficient of 0.117 for M1 given in Table 5 Panel B and multiplying it with the average difference between stocks illiquidity falling in P-10 and P-1. The premium is 12.12%, this indicates that level of illiquidity is more important for Australian market when FTH measure of illiquidity is implied.

In Table 5, Panel C the model implied coefficients are estimated using zero-returns. With zero returns as well the level of illiquidity is important as shown in M1. Similarly the compensation for illiquidity risks is not independent from illiquidity level. As once the level is included in the regression with either $\beta_{L2}$ or $\beta_{L3}$, both risks become insignificant, with later even the level is also insignificant. Evidently the zero-returns as a illiquidity measure does not adequately links the illiquidity risks with stock returns.
6 Conclusion

This study discusses two aspects of illiquidity related literature. The magnitude of illiquidity premium across the international stock markets and relative contribution of level and risks of illiquidity effect. We show that both of these questions are linked with the choice of illiquidity measure by taking Australian stock market as a test case. Once we use three different measures of illiquidity which are, price impact, FTH and zero-returns. We find that the magnitude of illiquidity is subject to variation even within country analysis, with price impact it is the highest and with zero-return the lowest. Further it is not necessary that price impact measure consistently give high premium for other markets. As a case in point for Finland, the illiquidity premium with zero return is higher than with price impact. Therefore it will not be a surprise that a bouquet of illiquidity premiums may surface for different markets. The main reason for such results is that on ex ante basis no researcher can determine which measure of illiquidity may yield the maximum premium. This enigmatic situation leaves two options provided the quest of illiquidity premium is a main question. Firstly to use all measures of illiquidity so, far suggested in the literature to analyze with which the maximum illiquidity premium is associated within the context of each country. Secondly to explore the relevance of illiquidity measure within the idiosyncratic settling of each country. Both of these questions are left for future research.

As is with the magnitude of illiquidity premium this study suggests that the contribution of level of illiquidity and illiquidity risks towards total illiquidity premium is also intrinsically linked with the choice of illiquidity measure. For Australian market, illiquidity risks contributes over level of illiquidity with price impact, however such results are turned on its head when FTH and zero measure are used. Although these results are consistent with previous work of Amihud et al. (2014) that level of illiquidity is priced for Australia with price impact and the illiquidity risk is
not priced as per Lee (2011) with zero returns. But is that the illiquidity risk is really not priced, we find that such is not the case with price impact. Therefore, the main purport of this study is to highlight that the evidence of illiquidity effect whether through level of illiquidity or by illiquidity risk is illusory.

References

Acharya, V.V, Pedersen, L.H., 2005. Asset pricing with liquidity risk. Journal of Financial Economics 77, 375-410.

Amihud, Y., 2002. Illiquidity and stock returns: cross-section and time-series effect. Journal of Financial Markets 5, 31-56.

Amihud, Y., Mendelson, H., & Pedersen, L. H. (2005). Liquidity and Asset Prices. Published in: Foundations and Trends in Finance , Vol. 1, No. 4 (2005): pp. 269-364.

Amihud, Y., Hameed, A., Kang, W., Zhang, H., 2014. The illiquidity premium: International evidence. Journal of Financial Economics, forthcoming.

Amihud, Y., Mendelson, H., 1986. Asset pricing and bid-ask spread. Journal of Financial Economics 17, 223-249.

Bekaert, G., Harvey, C., Lundblad, C., 2007. Liquidity and expected returns: lessons from emerging markets. Review of Financial Studies 20, 1783-1831.

Black, F. (1972), ‘Capital market equilibrium with restricted borrowing’, Journal of business, pp. 444–455.

Chai, D., Faff, R., Gharghori, P., 2013. Liquidity in asset pricing: new evidence using low frequency data. Australian Journal of Management 38, 375-400.

Chan, H., Faff, R., 2005. Asset pricing and illiquidity premium. Financial Review 40, 429-458.

Chang, Y.Y., Faff, R., Hwang, C., 2010. Liquidity and stock returns in Japan: new evidence. Pacific-Basin Finance Journal 18, 90-115.

Chordia, T., Roll, R. & Subrahmanyam, A. (2002), ‘Order imbalance, liquidity, and market returns’, Journal of Financial economics 65(1), 111–130.

Corwin, S.A., Schultz, P., 2012. A simple way to estimate bid-ask spreads from daily high and low prices. Journal of Finance 67, 719-760.
Fama, E.F., French, K.R., 1993. Common risk factors in the returns on stocks and bonds. Journal of Financial Economics 33,3-56.

Fong, K., Holden, C.W., Trzcinka, C.A., 2011. What are the best liquidity proxies for global research. Working paper, Indiana University.

Gharghori, P., Lee, R., Veeraraghavan, M., 2009. Anomalies and stock returns: Australian evidence. Accounting and Finance 49, 555-576.

Griffin, J. M., Kelly, P. J. & Nardari, F. (2010), ‘Do market efficiency measures yield correct inferences? A comparison of developed and emerging markets’, Review of Financial Studies p. hhq044.

Hou, K., Karolyi, G. A. & Kho, B.-C. (2011), ‘What factors drive global stock returns?’, Review of Financial Studies 24(8), 2527–2574.

Ince, O. S. & Porter, R. B. (2006), ‘Individual equity return data from thomson datastream: Handle with care!’, Journal of Financial Research 29(4), 463–479.

Lam, K.S.K., Tam, L.H.K., 2011. Liquidity and asset pricing: evidence from the Hong Kong stock market. Journal of Banking and Finance 35, 2217-2230.

Lee, K., 2011. The world price of liquidity risk. Journal of Financial Economics 99, 136-161.

Lintner, J., 1965. The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. Review of Economics and Statistics 47, 13-37.

Liu, W., 2006. A liquidity-augmented capital asset pricing model. Journal of Financial Economics 82, 631-671.

Marshall, B.R., 2006. Liquidity and stock returns: evidence from a pure order-driven market using a new liquidity proxy. International Review of Financial Analysis 15, 21-38.

Marshall, B.R., Young, M.R.2003. Liquidity and stock returns in pure order-driven markets: evidence from the Australian stock market. International Review of Financial Analysis 12, 173-

Mossin, J. (1966), ‘Equilibrium in a capital asset market’, Econometrica: Journal of the econometric society pp. 768–783.

Nguyen, Nhut H and Lo, Ka Hei 2013. Asset returns and liquidity effects: Evidence from a developed but small market. Pacific-Basin Finance Journal, 21(1), 1175–1190.

Pastor, L., Stambaugh, R.F., 2003. Liquidity risk and expected stock returns. Journal of Political Economy 111, 642-685.
Roll, R. (1984), ‘A simple implicit measure of the effective bid-ask spread in an efficient market’, The Journal of Finance, 39(4), 1127–1139.

Sadka, R. (2006), ‘Momentum and post-earnings-announcement drift anomalies: The role of liquidity risk’, Journal of Financial Economics, 80(2), 309–349.

Sharpe, W.F., 1964. Capital asset prices: a theory of market equilibrium under conditions of risk. Journal of Finance 19, 425-442.
Appendix 1

List of non-common equity security codes

| Non-common equity          | Non-common equity security codes                                      |
|----------------------------|-----------------------------------------------------------------------|
| Debt                       | DEB DB DCB DEBT DEBENTURES DEBENTURE                                  |
| Deferred                   | DEF DFD DEFF                                                           |
| Duplicates                 | DUPLICATE DUPL DUP DUPE DULP DUPLI                                    |
| Expired securities         | EXPIRED EXPD EXPIRY EXPY                                              |
| Fully and partially paid   | PAID PR                                                               |
| Investment (Unit Trust)    | RLST IT, INVESTMENT TRUST, INV TST, UNIT TRUST, UNT TST, TRUST UNITS, TST UNITS, TRUST UNIT, TST UNIT UT IT. IT |
| Rights                     | RTS                                                                   |
| Trusts                     | RLST IT, TST, TRUST                                                  |
| Warrants                   | WARRANT WARRANTS WTS WTS2 WARRT                                       |
| Ince and Porter (2006)     | 500 BOND DEFER DEP DEPY ELKS ETF FUND FD IDX INDEX LP MIPS MITS MITT MPS NIKKEI NOTE PERQS PINES PRTF PTNS PTSHP QUIBS QUIDS RATE RCPTS RECEIPTS REIT RETUR SCORE SPDR STRYPES TOPRS UNIT UNT UTS WTS XXXXX YIELD YLD |
Table 1: Construction of Portfolios.

Three different measures of monthly Illiquidity are calculated for each stock using equation (7),(8) and (13) for the period of 1988-2014. In Panel A, the price impact measure which gauges an impact of one AUSS traded volume upon absolute returns is shown for each portfolio. Returns show the average of monthly return (equally weighted) for the stocks falling in each portfolio. Firms show the average number of firms falling in each portfolio. In Panel B, the same information is presented through FHT measure, which estimates the illiquidity of stocks as a combination of monthly zero returns and the volatility of returns distribution. Similarly panel C presents the same information with zero returns, where zero returns is the number of zero returns for any given stock within any month.

| Portfolio | Panel A | Panel B | Panel C |
|-----------|---------|---------|---------|
|           | Price Impact | Returns | Firms | FHT Returns | Firms | Zero-Returns | Returns | Firms |
| P-1 | 0.004 | 0.957 | 80 | 0.179 | 0.926 | 81 | 15.136 | 0.672 | 111 |
| P-2 | 0.052 | 0.813 | 79 | 0.347 | 0.964 | 80 | 23.780 | 0.703 | 74 |
| P-3 | 0.150 | 0.802 | 79 | 0.563 | 0.674 | 80 | 30.730 | 0.590 | 80 |
| P-4 | 0.344 | 0.794 | 79 | 0.837 | 0.700 | 80 | 37.607 | 0.810 | 78 |
| P-5 | 0.751 | 0.931 | 79 | 1.163 | 0.768 | 80 | 44.026 | 0.843 | 75 |
| P-6 | 1.333 | 0.788 | 78 | 1.585 | 0.600 | 79 | 50.547 | 1.051 | 77 |
| P-7 | 2.674 | 0.777 | 78 | 2.180 | 0.801 | 79 | 57.505 | 1.263 | 74 |
| P-8 | 4.113 | 0.774 | 77 | 2.853 | 0.876 | 78 | 65.595 | 1.282 | 77 |
| P-9 | 8.106 | 0.685 | 76 | 3.799 | 1.002 | 77 | 74.577 | 1.319 | 74 |
| P-10 | 26.108 | 2.453 | 75 | 6.266 | 2.339 | 75 | 82.966 | 1.283 | 62 |
Table 2: Variation in Betas with three different illiquidity measures

Table provides different characteristics for ten equally weighted portfolios sorted on the basis of three different measures of illiquidity. The expected Illiquidity, shown as $E(C_i)$ is calculated as monthly averages of price impact, FTH and zero measure for each portfolio. The market beta $\beta_m$ and three illiquidity related betas $\beta_{L,1}, \beta_{L,2}$ and $\beta_{L,3}$ are estimated using equations (3), (4), (5) and (6). The illiquidity related characteristics are measured using all three measures of illiquidity and results shown as Panel A, B and C for the Australian stock market using the whole sample of 1988-2014.

**Panel A: Price impact measure**

| Portfolio | $E(C_i)$ | $\beta_m$ | $\beta_{L,1}$ | $\beta_{L,2}$ | $\beta_{L,3}$ |
|-----------|----------|-----------|---------------|---------------|---------------|
| P-1       | 0.00004  | 0.35263   | 0.00008       | -0.01574      | 0.00002       |
| P-2       | 0.00052  | 0.56827   | 0.00115       | -0.03995      | -0.00134      |
| P-3       | 0.00150  | 0.64919   | 0.00084       | -0.06573      | -0.00186      |
| P-4       | 0.00344  | 0.69675   | 0.00519       | -0.06374      | -0.00792      |
| P-5       | 0.00751  | 0.64002   | 0.00987       | -0.06560      | -0.01115      |
| P-6       | 0.01333  | 0.67485   | 0.02100       | -0.08760      | -0.02337      |
| P-7       | 0.02674  | 0.68061   | 0.20440       | -0.07921      | -0.07741      |
| P-8       | 0.04113  | 0.72264   | 0.05559       | -0.11151      | -0.05942      |
| P-9       | 0.08106  | 0.76041   | 0.14522       | -0.12751      | -0.03676      |
| P-10      | 0.26108  | 0.74924   | 0.59401       | -0.11305      | -0.44764      |

**Panel B: FTH**

| Portfolio | $E(C_i)$ | $\beta_m$ | $\beta_{L,1}$ | $\beta_{L,2}$ | $\beta_{L,3}$ |
|-----------|----------|-----------|---------------|---------------|---------------|
| P-1       | 0.00179  | 0.62578   | 0.00000       | -0.00274      | -0.00204      |
| P-2       | 0.00347  | 0.74275   | 0.00007       | -0.00375      | -0.00358      |
| P-3       | 0.00563  | 0.86659   | 0.00004       | -0.00348      | -0.00650      |
| P-4       | 0.00837  | 0.94097   | 0.00024       | -0.00562      | -0.00920      |
| P-5       | 0.01163  | 1.04640   | 0.00031       | -0.00451      | -0.01234      |
| P-6       | 0.01585  | 1.09241   | 0.00028       | -0.00621      | -0.01939      |
| P-7       | 0.02180  | 1.17818   | 0.00051       | -0.00748      | -0.02492      |
| P-8       | 0.02853  | 1.20401   | 0.00122       | -0.00567      | -0.02663      |
| P-9       | 0.03799  | 1.21732   | 0.00079       | -0.00730      | -0.03888      |
| P-10      | 0.06266  | 1.27889   | 0.00108       | -0.00729      | -0.05002      |

**Panel C: Zero-returns**

| Portfolio | $E(C_i)$ | $\beta_m$ | $\beta_{L,1}$ | $\beta_{L,2}$ | $\beta_{L,3}$ |
|-----------|----------|-----------|---------------|---------------|---------------|
| P-1       | 0.15136  | 0.49836   | 0.34633       | -0.01736      | -0.00557      |
| P-2       | 0.23780  | 0.58704   | 0.35961       | -0.04963      | -0.01487      |
| P-3       | 0.30730  | 0.64215   | 0.38114       | -0.04831      | -0.03541      |
| P-4       | 0.37607  | 0.67146   | 0.37386       | -0.07047      | -0.04863      |
| P-5       | 0.44026  | 0.66211   | 0.36160       | -0.06804      | -0.10504      |
| P-6       | 0.50547  | 0.68869   | 0.37118       | -0.07844      | -0.11836      |
| P-7       | 0.57505  | 0.63161   | 0.34248       | -0.0845       | -0.09536      |
| P-8       | 0.65595  | 0.58769   | 0.29888       | -0.05966      | -0.09728      |
| P-9       | 0.74577  | 0.50581   | 0.22052       | -0.05068      | -0.0816       |
| P-10      | 0.82966  | 0.36519   | 0.13699       | -0.07396      | -0.04018      |
Table 3: Correlation Structure of level and risk of illiquidity with three measures of illiquidity.

Table shows the correlation structure among various variables, expected illiquidity $E(C_i)$, market beta $\beta_m$, the three individual illiquidity related beta risk $\beta_{L1}, \beta_{L2}$ and $\beta_{L3}$. Moreover, two additional illiquidity adjusted betas $\beta_5$ and $\beta_{net}$, which are calculated as $\beta_{5,i} = \beta_{L1,i} - \beta_{L2,i} - \beta_{L3,i}$ and $\beta_{net,i} = \beta_{m,i} + \beta_{L1,i} - \beta_{L2,i} - \beta_{L3,i}$ as per Lee (2011) and Acharya and Pedersen (2005) are also included in the correlation matrix. These characteristics are estimated for twenty portfolios, ten are constructed with the price impact measure and the other ten are constructed with the FHT measure. However, the illiquidity for each portfolio and for the market portfolio is estimated using all three proxy of illiquidity measures used in this paper, these shown in Panel A, B & C.

Panel A: Price Impact

|        | $E(C_i)$  | $\beta_{L1}$ | $\beta_{L2}$ | $\beta_{L3}$ | $\beta_{L4}$ | $\beta_5$ | $\beta_{net}$ |
|--------|-----------|--------------|--------------|--------------|--------------|-----------|--------------|
| $E(C_i)$ | 1         |              |              |              |              |           |              |
| $\beta_{L1}$ | 0.5466    | 1            |              |              |              |           |              |
| $\beta_{L2}$ | 0.9608    | 0.5420       | 1            |              |              |           |              |
| $\beta_{L3}$ | -0.6519   | -0.9275      | -0.6157      | 1            |              |           |              |
| $\beta_{L4}$ | -0.9818   | -0.5073      | -0.9653      | 0.5824       | 1            |           |              |
| $\beta_5$    | 0.9802    | 0.5936       | 0.9919       | -0.6731      | -0.9822      | 1         |              |
| $\beta_{net}$ | 0.9405    | 0.7709       | 0.9484       | -0.8107      | -0.9303      | 0.9708    | 1            |

Panel B: FTH

|        | $E(C_i)$  | $\beta_{L1}$ | $\beta_{L2}$ | $\beta_{L3}$ | $\beta_{L4}$ | $\beta_5$ | $\beta_{net}$ |
|--------|-----------|--------------|--------------|--------------|--------------|-----------|--------------|
| $E(C_i)$ | 1         |              |              |              |              |           |              |
| $\beta_{L1}$ | 0.7528    | 1            |              |              |              |           |              |
| $\beta_{L2}$ | 0.7097    | 0.4582       | 1            |              |              |           |              |
| $\beta_{L3}$ | -0.2542   | -0.2972      | -0.6071      | 1            |              |           |              |
| $\beta_{L4}$ | -0.9221   | -0.8302      | -0.5428      | 0.2816       | 1            |           |              |
| $\beta_5$    | 0.8462    | 0.7792       | 0.7191       | -0.6579      | -0.9068      | 1         |              |
| $\beta_{net}$ | 0.7748    | 0.9984       | 0.4898       | -0.3348      | -0.8521      | 0.8130    | 1            |

Panel C: Zero-Returns

|        | $E(C_i)$  | $\beta_{L1}$ | $\beta_{L2}$ | $\beta_{L3}$ | $\beta_{L4}$ | $\beta_5$ | $\beta_{net}$ |
|--------|-----------|--------------|--------------|--------------|--------------|-----------|--------------|
| $E(C_i)$ | 1         |              |              |              |              |           |              |
| $\beta_{L1}$ | 0.9249    | 1            |              |              |              |           |              |
| $\beta_{L2}$ | -0.6938   | -0.4582      | 1            |              |              |           |              |
| $\beta_{L3}$ | -0.9556   | -0.9646      | 0.5422       | 1            |              |           |              |
| $\beta_{L4}$ | -0.8199   | -0.7891      | 0.2776       | 0.8192       | 1            |           |              |
| $\beta_5$    | 0.4407    | 0.6016       | 0.3163       | -0.5722      | -0.8004      | 1         |              |
| $\beta_{net}$ | 0.8171    | 0.9378       | -0.1702      | -0.9011      | -0.8816      | 0.8171    | 1            |
Table 4: Pricing of Illiquidity effect with different measures of illiquidity.

Table presents the estimation results for the LCAPM model, equation (15), for the twenty equally weighted portfolios for the Australian stock market for the period of 1988-2014, the illiquidity is estimated in three different ways and their results are shown in Panel A, B and C. M1 is expected illiquidity shown as $E(C_t)$, M2 is a simple CAPM, and M3, M4 and M5 are estimated, $\beta_{L1}$, $\beta_{L2}$, $\beta_{L3}$, respectively. Whereas, M6 specification includes all beta risks. The $R^2$ and adjusted $R^2$ is shown in parenthesis the last .Similarly, for each coefficient associated t-stats are provided in parenthesis.

**Panel A: Price impact**

| Constant | $E(C_t)$ | $\beta_m$ | $\beta_{L1}$ | $\beta_{L2}$ | $\beta_{L3}$ | $R^2$ |
|----------|----------|-----------|---------------|---------------|---------------|-------|
| M1       | 0.0071   | 0.0600    |               |               |               | 0.855 |
|          | (13.90)  | (10.29)   |               |               |               | (0.847) |
| M2       | 0.0025   | 0.0111    |               |               |               | 0.079 |
|          | (0.42)   | (1.24)    |               |               |               | (0.028) |
| M3       | 0.0071   | 0.0239    |               |               |               | 0.804 |
|          | (12.09)  | (8.60)    |               |               |               | (0.793) |
| M4       | 0.0058   | -0.0501   |               |               |               | 0.132 |
|          | (2.19)   | (-1.65)   |               |               |               | (0.084) |
| M5       | 0.0071   | -0.0372   |               |               |               | 0.908 |
|          | (17.93)  | (-13.34)  |               |               |               | (0.903) |
| M6       | 0.0119   | -0.0054   | -0.0031       | 0.0208        | -0.0476       | 0.967 |
|          | (5.84)   | (-1.08)   | (-0.62)       | (1.12)        | (-6.79)       | (0.958) |

**Panel B: FTH**

| Constant | $E(C_t)$ | $\beta_m$ | $\beta_{L1}$ | $\beta_{L2}$ | $\beta_{L3}$ | $R^2$ |
|----------|----------|-----------|---------------|---------------|---------------|-------|
| M1       | 0.0056   | 0.210     |               |               |               | 0.567 |
|          | (4.93)   | (4.85)    |               |               |               | (0.543) |
| M2       | 0.0025   | 0.0071    |               |               |               | 0.079 |
|          | (0.43)   | (1.24)    |               |               |               | (0.027) |
| M3       | 0.0071   | 2.801     | -0.0356       |               |               | 0.385 |
|          | (6.00)   | (3.36)    | (-0.23)       |               |               | (0.351) |
| M4       | 0.0093   |           |               |               |               | 0.003 |
|          | (4.28)   |           |               |               |               | (-0.052) |
| M5       | 0.0066   |           |               | -0.165        |               | 0.224 |
|          | (3.92)   |           |               | (-2.28)       |               | (0.180) |
| M6       | 0.0147   | -0.0073   | 3.712         | 0.305         | -0.138        | 0.591 |
|          | (2.39)   | (-0.95)   | (3.45)        | (2.24)        | (-1.25)       | (0.482) |

**Panel C: Zero-returns**

| Constant | $E(C_t)$ | $\beta_m$ | $\beta_{L1}$ | $\beta_{L2}$ | $\beta_{L3}$ | $R^2$ |
|----------|----------|-----------|---------------|---------------|---------------|-------|
| M1       | 0.0044   | 0.0116    |               |               |               | 0.199 |
|          | (1.60)   | (2.11)    |               |               |               | (0.154) |
| M2       | 0.0025   | 0.0123    |               |               |               | 0.079 |
|          | (0.42)   | (1.24)    |               |               |               | (0.028) |
| M3       | 0.0329   | -0.0717   |               |               |               | 0.607 |
|          | (7.38)   | (-5.27)   |               |               |               | (0.585) |
| M4       | 0.0066   | -0.0525   |               |               |               | 0.122 |
|          | (2.97)   | (-1.58)   |               |               |               | (0.073) |
| M5       | 0.0098   |           |               |               | 0.0012        | 0.000 |
|          | (5.00)   |           |               |               | (0.05)        | (-0.055) |
| M6       | 0.0325   | -0.0059   | -0.0635       | -0.0848       | 0.0598        | 0.703 |
|          | (3.30)   | (-0.24)   | (-3.65)       | (-0.83)       | (2.12)        | (0.624) |
**Table 5**: Correlation Structure of level and risk of illiquidity with three measures of illiquidity.

Table shows the correlation structure among various variables for the stocks traded in Australian market, these variables are expected illiquidity $E(C_i)$, market beta $\beta_m$, and three individual illiquidity related beta risk $\beta_{L1}$, $\beta_{L2}$ and $\beta_{L3}$. The expected illiquidity for each stock $E(C_i)$ is its previous month’s illiquidity and it is estimated using price impact, FTH and zero returns using equation (7), (13) and (8). Whereas, for each stock the betas of the respective portfolios is allocated. That is, the ten portfolios are constructed on the basis of their previous month’s illiquidity and their respective betas are estimated using equation (3), (4), (5) and (6) and then these betas are assigned to each stock. The correlation structure are thus estimated using all three proxy of illiquidity measures used in this paper, the results are shown in Panel A, B & C.

**Panel A: Price Impact**

|         | $E(C_i)$ | $\beta_{L1}$ | $\beta_{L2}$ | $\beta_{L3}$ | $\beta_{L4}$ |
|---------|----------|--------------|--------------|--------------|--------------|
| $E(C_i)$ | 1        |              |              |              |              |
| $\beta_{L1}$ | 0.0848  | 1            |              |              |              |
| $\beta_{L2}$ | 0.2300  | 0.4327       | 1            |              |              |
| $\beta_{L3}$ | -0.1089 | -0.8898      | -0.5380      | 1            |              |
| $\beta_{L4}$ | -0.2399 | -0.3844      | -0.9700      | 0.4758       | 1            |

**Panel B: FTH**

|         | $E(C_i)$ | $\beta_{L1}$ | $\beta_{L2}$ | $\beta_{L3}$ | $\beta_{L4}$ |
|---------|----------|--------------|--------------|--------------|--------------|
| $E(C_i)$ | 1        |              |              |              |              |
| $\beta_{L1}$ | 0.4549  | 1            |              |              |              |
| $\beta_{L2}$ | 0.4967  | 0.8418       | 1            |              |              |
| $\beta_{L3}$ | -0.4260 | -0.9028      | -0.6992      | 1            |              |
| $\beta_{L4}$ | -0.5892 | -0.8864      | -0.8670      | 0.8524       | 1            |

**Panel C: Zero-Returns**

|         | $E(C_i)$ | $\beta_{L1}$ | $\beta_{L2}$ | $\beta_{L3}$ | $\beta_{L4}$ |
|---------|----------|--------------|--------------|--------------|--------------|
| $E(C_i)$ | 1        |              |              |              |              |
| $\beta_{L1}$ | -0.3110 | 1            |              |              |              |
| $\beta_{L2}$ | -0.7473 | 0.8174       | 1            |              |              |
| $\beta_{L3}$ | -0.5589 | -0.3918      | 0.1053       | 1            |              |
| $\beta_{L4}$ | -0.6958 | -0.2874      | 0.2729       | 0.7469       | 1            |
Table 6: Stock based analysis for Illiquidity effect using Fama-MacBeth regressions.

The stocks are grouped into ten portfolios based upon their previous month’s illiquidity, captured through price impact, FTH and zero-returns. Subsequently, each stock is assigned market and illiquidity related betas of the portfolio to which that stock belongs. These betas are calculated using equation (3),(4),(5) and (6). The expected illiquidity $E(C_i)$ is stock’s previous month illiquidity measure also captured in three different ways. The summary of the estimates of LCAPM model, equation (15) and their $t$-stats, associated with each measure of illiquidity.

| Panel A: Price-impact | M1          | M2          | M3          | M4          | M5          |
|-----------------------|-------------|-------------|-------------|-------------|-------------|
| $E(C_i)$              | 0.0287      | 0.0273      | 0.0161      | 0.0263      | 0.0149      |
|                       | (4.13)      | (4.27)      | (2.37)      | (4.33)      | (2.10)      |
| $\beta_m$            | -0.0011     | -0.0011     | -0.0011     | -0.0011     | -0.0011     |
|                       | (-0.14)     | (-0.14)     | (-0.14)     | (-0.14)     | (-0.14)     |
| $\beta_{L_1}$        | 0.0142      |             |             |             |             |
|                       | (2.38)      |             |             |             |             |
| $\beta_{L_2}$        |             |             | 0.0011      |             |             |
|                       |             |             | (2.38)      |             |             |
| $\beta_{L_3}$        |             |             |             | -0.0229     |             |
|                       |             |             |             | (-2.76)     |             |
| Constant              | 0.0089      | 0.0096      | 0.0078      | 0.0090      | 0.0079      |
|                       | (2.88)      | (2.24)      | (2.57)      | (3.03)      | (2.57)      |

| Panel B: FTH          | M1          | M2          | M3          | M4          | M5          |
|-----------------------|-------------|-------------|-------------|-------------|-------------|
| $E(C_i)$              | 0.117       | 0.1600      | 0.1440      | 0.1460      | 0.1640      |
|                       | (2.89)      | (3.65)      | (3.16)      | (3.46)      | (2.68)      |
| $\beta_m$            | -0.0059     | -0.0059     | -0.0059     | -0.0059     | -0.0059     |
|                       | (-1.05)     | (-1.05)     | (-1.05)     | (-1.05)     | (-1.05)     |
| $\beta_{L_1}$        | -0.9610     |             |             |             |             |
|                       | (-3.4)      |             |             |             |             |
| $\beta_{L_2}$        |             |             | 0.5710      |             |             |
|                       |             |             | (0.89)      |             |             |
| $\beta_{L_3}$        |             |             |             | 0.0551      |             |
|                       |             |             |             | (0.49)      |             |
| Constant              | 0.0074      | 0.0125      | 0.0072      | 0.0098      | 0.0073      |
|                       | (2.43)      | (2.76)      | (2.59)      | (3.16)      | (2.65)      |

| Panel C: Zero-returns | M1          | M2          | M3          | M4          | M5          |
|-----------------------|-------------|-------------|-------------|-------------|-------------|
| $E(C_i)$              | 0.0112      | 0.0107      | 0.0104      | 0.0115      | 0.0072      |
|                       | (3.36)      | (3.08)      | (2.23)      | (2.88)      | (1.48)      |
| $\beta_m$            | -0.0007     | -0.0007     | -0.0007     | -0.0007     | -0.0007     |
|                       | (0.09)      | (0.09)      | (0.09)      | (0.09)      | (0.09)      |
| $\beta_{L_1}$        | -0.0019     |             |             |             |             |
|                       | (-0.09)     |             |             |             |             |
| $\beta_{L_2}$        |             |             |             | 0.0077      |             |
|                       |             |             |             | (0.20)      |             |
| $\beta_{L_3}$        |             |             |             |             | -0.0213     |
|                       |             |             |             |             | (-0.92)     |
| Constant              | 0.0044      | 0.0041      | 0.0051      | 0.0049      | 0.0056      |
|                       | (1.20)      | (0.92)      | (0.76)      | (1.54)      | (1.45)      |
Figure 1. Graphs shows monthly innovation in market-wide illiquidity series estimated through price impact, FHT and zero-return illiquidity measure.
