The Implications of Liquidity Ratios: Evidence from Pakistan Stock Exchange Limited

Abstract

In this paper we test two recently developed liquidity measures the Return-to-Turnover (hereafter RtoTR) proposed by Florackis et al. (2011) and Return-to-Volume (hereafter RtoV) recommended by Amihud (2002), for 386 companies listed on the Pakistani Stock Exchange (PSX). Our data is obtained from January 2005 to December 2019. We firstly show the Amihud (2002) ratio has limited ability to distinguish illiquidity from size effects in asset pricing. Second, the Florackis et al. (2011) measure has distinct features to overcome the limitations of the Amihud (2002) ratio in the PSX. Our results show that the Capital Asset Pricing Model cannot completely account for the significant RtoV premium. However, this weak evidence for the existence of this premium disappears when Fama–French or Carhart alphas are considered as measures of risk-adjusted performance. This suggests that the RtoTR price impact ratio is more effective in the PSX compared to the RtoV ratio. Our findings suggest that both trading frequency and trading cost are significant factors in examining the returns. The RtoV ratio has a negative correlation with the market capitalization, which suggests that small stocks are inherently illiquid.

Key words: Asset pricing, Illiquidity, Price impact ratio and Emerging markets

JEL Classification: F65, G1, G32, N25, O16

1 Introduction

Liquidity is commonly considered a fundamental characteristic of financial assets. It plays a significant role in the operations of financial markets. The performance of stocks during the crisis can be better described by their historical liquidity betas (risk) than by their historical liquidity levels. Liquidity refers to the capability to buy and sell assets effortlessly, and this attribute allows buyer and sellers to trade within the financial markets, either by injecting money, or by closing their positions swiftly without exerting a large impact on stock prices (O'Hara, 2004). Liquidity allows investors to cope with unforeseen financial requirements without experiencing major losses. It is also considered to be one of the important determinants of a firm's cost of capital, subsequently affecting investors' portfolio decision making, because lower transaction costs imply higher liquidity and vice versa.

On the other hand, illiquid assets are difficult to trade, owing to the high cost of trading associated with such securities. Overall, liquidity is a multidimensional concept, which captures the dynamics of the market from its depth, immediacy and resiliency. Prior research shows that illiquidity arises from the underlying trading costs, asymmetric information, inventory risk, search frictions and ownership structure (Kyle 1985).

To provide an illustration and the characteristics of liquidity, a complete view of liquidity measurement appears to be nearly indefinable (Amihud, 2002; Pastor and Stambaugh, 2003; Chordia et al., 2009). Therefore, distinctive measures have been used as proxies for the liquidity of a market (for e.g. trading costs, trading quantity, trading speed and price impact). These measures includes the bid-ask spread (Amihud and Mendelson, 1986a), relative spread (Amihud and Mendelson, 1986b; Loderer and Roth, 2005), effective spread (Heflin and Shaw, 2000), amortized spread (Chalmers and Kadlec, 1998), Kyle's lambda (Kyle, 1985; Brennan and Subrahmanyam, 1996), trading volume (Brennan et al., 1998), turnover rate (Datar et al., 1998; Chordia et al., 2001), number of zero-return days (Bekaert et al., 2007) and price sensitivity to order flow (Pastor and Stambaugh, 2003). Essentially spreads capture news and uniqueness and price impact ratios capture long-term financial stability[1].

The liquidity proxies based on price impact ratios developed by Amihud (2002) and Florackis et al. (2011) are calculated using the average monthly ratio of absolute returns to daily trading volume in currency value, (see e.g. Acharya and Pedersen 2005; Korajczyk and Sadka 2008; Goyenko and Ukhov 2009; Næs et al. 2011). To the best of our knowledge, the ratios have not been empirically tested on the South Asian markets with the exception of the Chinese market (for e.g. Tang and Wang 2011; Sun et al. 2009). Hence, it is interesting to explore whether these ratios yield similar results in the institutional environment of an emerging market. In particular, we want to investigate the price impact in the Pakistan Stock Exchange (PSX).

The main contribution of this paper is the investigation of the two major price impact ratios in the financial literature i.e. Amihud (2002) and Florackis et al. (2011) on the PSX. Our paper contributes to two novel factors. First, the trading volume of stock in monetary terms shows a positive connection with market value, suggesting that it is not comparable across stocks with different market values. Therefore, the Amihud (2002) ratio has limited ability to distinguish illiquidity from size effects in asset pricing.

[1] Comprehensive review of the liquidity measures literature, see Le and Gregoriou (2020).

Second, the Florackis et al. (2011) measure has distinct features to overcome the limitations of the Amihud (2002) ratio in the PSX.

Emerging economies are unique in terms of their legal systems, regulatory environment, and weaker investor protection with relatively underdeveloped capital markets (Khan et al. 2017; Shah et al. 2017 and Khan et al. 2017). In terms of the significance of the PSX, a recent survey by Bloomberg (2017) ranked the PSX[2] in the top ten stock markets (by U.S dollar returns) in the year 2016 in all markets (refer to Table 1). In particular, after the recent currency swings, the PSX lies in fifth position with respect to that ranking.

The reminder of the paper is organized in the following way. Section 2 provides justification for the use of the RtoV ratio developed by Amihud (2002), and the RtoTR ratio of Florackis et al. (2011) in an emerging economy. Section 3 discusses the empirical literature on the relationship between liquidity and stock returns. Section 4 presents the data and descriptive analysis. Section 5 describe the asset pricing models and finally section 6 concludes.

[INSERT TABLE 1 HERE]

[2] In early 2000, the PSX was announced to be one of the best-performing markets in the world, as declared by the International magazine called Business Week, April 10, 2003. Similarly, USA Today newspaper on September 19, 2002, declared PSX (formerly called Karachi stock exchange) as one of the best performing stock markets in the world.

2 Price impact ratios

2.1 Importance of Amihud's (2002) Price Impact Ratio (RtoV)

The liquidity ratio presented by Amihud (2002) is one of the most cited measures of liquidity. It is defined as the average of the ratio of daily absolute returns divided by the daily volume in dollars. Following Amihud (2002), the RtoV ratio of the price impact is as follows:

$$R\ to\ V_{it} = \frac{1}{D_{it}} \sum_{d=1}^{D_{it}} \frac{|R_{itd}|}{V_{itd}} \quad (1)$$

where D_{it} is the number of trading days, R_{itd} is the return on day t and V_{itd} is the daily volume in dollar terms (millions). Moreover, the day-t impact represents the price of the volume traded in the respective ratio. The measure of liquidity in the above equation presents the average of the daily prices on a specified sample period of the given data set. The RtoV ratio itself shows the relationship between the trade volume (in dollars) and the price impact.

An advantage of using Amihud's liquidity ratio is its simplicity in terms of structure. Price impact is related to the daily absolute value of returns to trading volume. In subsequent research, Florackis et al. (2011) identified the advantages of the RtoV ratio and emphasized that it is straightforward to determine for long periods and the volume and return data are widely accessible in comparison with high-frequency microstructure data, which are challenging to acquire for long periods. Acharya and Pedersen (2005) and Florackis et al., (2011) claimed that the RtoV ratio has an influence on the trade-volume effect on stock price movements, and resulted in the impact on transaction costs.

The second advantage is a positive return premium associated with the RtoV ratio, which is generally known as a liquidity premium that rewards liquidity costs (see, e.g., Amihud, 2002; Chordia et al., 2009). Cochrane (2005a) argues that RtoV has a significant advantage (called the 'price discovery' factor) due to trading activity that is influenced by information or potential prospects based on future stock price movements. Previously, Kyle (1985) introduced the concept of lambda, and the recent RtoV ratio is a robust empirical measure of this theoretical concept.

2.2 Importance of Florackis et al.'s (2011) Price Impact Ratio (RtoTR)

Cochrane (2005b) argues that the RtoV ratio is much higher for stocks representing small market capitalization firms. Discussing the bias associated with this approach, Cochrane (2005a:p.5) warns that researchers may draw inappropriate theoretical conclusions using RtoV ratios.

A recent interesting liquidity measurement was developed by Florackis et al. (2011), to address the shortcomings of Amihud's (2002) RtoV ratio. According to Florackis et al. (2011), the RtoV ratio could not be used to compare stocks with diverse market capitalization, as there is a possibility of substantial size bias with the ratio. This is because the trading volume is represented in monetary terms and operationally has a positive correlation with the market capitalization in cross-sectional settings. Therefore, it is not an equivalent measure to be compared across firms with different market values.

According to Amihud and Mandelson (1986b), liquidity has a positive correlation with trading frequency. Moreover, Datar et al. (1998) and Nguyen et al. (2007a) discover a negative relationship between liquidity and trading frequency. They argue that stocks with a higher turnover ratio are observed to have superior trading speed and are considered to be highly liquid stocks.

Florackis et al. (2011) further highlight these concerns, arguing that the RtoV ratio assumes identical trading frequency across all stocks. The RtoV measure is used as a proxy to determine transaction costs. On the other hand, it is difficult to examine the trading frequency at which this cost is obtained. Moreover, Florackis et al. (2011) criticizes the RtoV ratio by demonstrating that the ratio is tangential to the order flow inequality effect analyzed by Pastor and Stambaugh (2003).

Florackis et al. (2011) recommended a substitute price impact ratio known as RtoTR, which essentially uses trade volume (in dollars) of stock with its turnover ratio in the denominator. Florackis et al.'s (2011) RtoTR ratio can be expressed as follows:

$$R\ to\ TR_{it} = \frac{1}{D_{it}} \sum_{D=1}^{D_{it}} \left(\frac{|R_{itd}|}{TR_{itd}}\right) \quad (2)$$

$R_{itd}\ to\ TR_{itd}$ is the return on stock i on day t, TR_{itd} represents the turnover ratio and D_{it} is the number of days collected for stock i for the time period of t.

Florackis et al. (2011) document that the RtoTR ratio is appropriate to eliminate the concerns about the price impact arising from the size effect. They argue that the turnover ratio is adopted to measure the price impact ratio, and the use of this ratio controls for the significance of trading cost and trading frequency within asset pricing. They showed that, for a risk-neutral trader with trading intensity represented as μ, the required return on security i is:

$$E\,(r)^i = r^f + u\,\frac{C^i}{P^i} \qquad (3)$$

C^i is the liquidity cost and P^i indicates the price of asset i. The main theoretical premises suggest that higher transaction costs require higher expected returns, if all other things remain constant. On the other hand, higher expected returns increase the asset's trading frequency. Therefore, the effect of the trading frequency must be considered as a whole, rather than in isolation (Florackis et al., 2011).

Florackis et al. (2011) assert that the RtoTR ratio explains the substitute for the 'amortized spread' applied by Chalmers and Kadlec (1998), who also investigate the combined impact of trading frequency and transaction costs. According to Florackis et al. (2011), the main drawback of Chalmers and Kadlec's (1998) proxy is the use of bid–ask prices in their analysis. Market makers influence and manipulate the standards of data leading to substantial problems in collecting stock information quoted at a daily frequency. Moreover, stocks become illiquid when the estimated trading cost rises, which will not appeal to investors unless they carry a return premium. The aim of this paper is to quantify the commonality risk premium (for e.g. see Anderson et al. 2015)

3 Related literature

The literature mainly covers the impact of liquidity on trading volume, turnover ratio, volatility, and simultaneously, how momentum effects liquidity measures. Liu (2000) examined the impact of variations in the Nikkei 500 on stock prices and trade volumes. However, he did not find any evidence of liquidity effects. Another significant study conducted by Harris and Gurel (1986) used surroundings announcements of price and volume for S&P 500 list changes. Since these changes provide investors with an opportunity to trade the affected securities and since it is unlikely that changes convey information about the future prospects of these securities, they provide an outstanding opportunity to study the price pressure. Moreover, Liu (2006) examined the price and trade volume effects related to the rebalancing of the Nikkei 225, and he identified that the price effects are permanent for both addition and deletion despite significant price reversals around both the announcement and effective days.

Acharya and Pedersen (2005) establish an integrated theoretical model and suggest three betas indicating different forms of liquidity risk: (a) the commonality of liquidity, which is based on the study by Chordia, Roll and Subrahmanyam (2000); (b) co-variance between the asset liquidity and the market return in Pastor and Stambaugh (2003); and (c) liquidity risk premium, which is mentioned in various studies, such as those by Amihud and Mendelson (1986), Brennan, Chordia and Subrahmanyam (1998) and Chordia, Subrahmanyam and Anshuman (2001).

Huberman and Halka (2001) investigate four systematic measures, namely the bid–ask spread, proportional spread (spread/price), depth (averaged number of shares traded at the bid–ask price) and dollar intensity (number of shares traded times transaction price). They find a positive relationship between the liquidity proxies and stock returns, however, they find a negative relationship between liquidity and volatility. Cheung and Roca (2013) describe the influence of returns, risk and liquidity of stocks, particularly in Asia Pacific markets. They examine trade volumes and bid–ask spreads to determine liquidity.

Furthermore, the liquidity risk premium has been examined through liquidity features using long–short methods in empirical research (e.g. Sadka, 2003; Liu, 2006 and Florakis et al, 2011). Pereira and Zhang (2010) report a negative association between stock returns and volatility of liquidity. Barinov (2011) find that the relationship between the volatility of turnover and asset returns is negative due to the assets' idiosyncratic risk, which has a positive relationship with turnover variability and aggregate return volatility (e.g. Campbell and Ammar, 1993; Chen, Firth and Gao 2002; Ang, Hodrick and Xing and Zhang, 2006). Chordia, Subrahmanyam and Anshuman (2001) follow the methodology of Brennan, Chordia and Subrahmanyam (1998) and they discover that the level of liquidity is significantly priced in asset returns.

Momentum is an important aspect for measuring liquidity. It is observed by determining whether the volatility of market liquidity controls the levels of market liquidity in relation to affecting and forecasting momentum profits. Jegadeesh (1990) reveal momentum with respect to forecasting the month forward continuous performance of asset returns. The later study by Jegadeesh and Titman (1993) examines the momentum effect of future months and find that assets that have a healthy performance in the last few months would remain as leaders. Other studies discussing the momentum effect for higher turnover assets include Grinblatt and Moskowitz 1999; Grundy and Martin 2001; Lee and Swaminathan 2000; Glaser and Weber 2003 and Sadka 2003.

The most recent literature is linking the momentum anomaly to market liquidity (e.g. Chordia, Subrahmanyam and Tong 2014). Avramov, Cheng and Hameed (2015) provided empirical support for the suggestion that the results of momentum portfolios rely significantly on market illiquidity. They studied the influence of market illiquidity on momentum profit, observing decreased (increased) momentum profit in an illiquid (liquid). Stoll (2000) observe a negative relationship between transaction costs and market capitalization. The fundamental reason for this association is liquidity provision.

The emerging markets literature suggests that government and family members within the company possibly interfere in the capital market (Bhanot and Kadapkkam 2006). The contrary argument presented by Chan et al. (2004), find a positive association between the price effect and the government's holdings or a fall in the free float. Mostly the literature covers the liquidity impact of the Amihud (2002) price impact ratio in developed markets. The present study integrating the two different price impact ratios in the context of PSX, will also give an interesting perspective on emerging markets.

4 Data and Sample

The preliminary sample of common stocks was collected from the 386 companies listed on the PSX from January 2005 to December 2019. Listed and delisted stocks were considered and companies that were delisted in the sample period are included in our analysis to avoid any survivorship bias (see, e.g., Florackis et al., 2011). Stock data was collected from DataStream and the dataset was compared with the official data source of the PSX. We obtain daily data on a broad set of variables including trading volume (the number of shares traded for a stock on a particular day), turnover (the ratio of the trading volume to the number of shares outstanding), market value (the share price multiplied by the number of outstanding ordinary shares) and the price-to-book value ratio (the share price divided by the book value per share).

4.1 Research Methodology

We apply two alternative price impact ratios, namely, the price impact ratio developed by Amihud (2002), (RtoV), which is measured on the basis of the average ratio of the absolute daily return to the equivalent PKR trading volume. The second new price impact ratio (RtoTR), aims to determine the monthly average ratio of the absolute daily returns to the equivalent turnover rate (Florackis et al., 2011).

For empirical examination of the asset-pricing models, we employ a number of factors, such as size, value and momentum. Considering the size factor, all the listed firms are categorized according to their market capitalization in month t-1. The top 30% stocks are considered the 'big size' portfolio, and the bottom 30% reflect the 'small size' portfolio. The difference between the big and the small portfolios is defined as the size factor of the (Small minus Big) t return in month t.

In terms of the momentum factor, all the listed stocks are ranked in month t-1 based on their returns from month t-13 to month t-2. The first 30% (value-weighted) of the overall stocks are labelled as 'winners', and the last 30% are identified to be 'losers'. The difference between the monthly returns in month t is reflected as the momentum factor return (MOMt). The government treasury rates in Pakistan are used as proxies for the risk-free rate.

4.2 Descriptive Statistics

4.2.1 Return-to-Volume (RtoV) Price Impact Ratio

Table 2 shows the descriptive analysis of 10 portfolios based on the RtoV ratio. The portfolios with the highest RtoV ratios achieve considerably higher mean returns than the lowest RtoV ratio portfolio, but the opposite applies to the Market Value (MV) and Capital Asset Pricing Model (CAPM) beta. Moreover, analyzing portfolios 1 to 10 indicates that the average portfolio returns are increasing in all our descriptive analyses. This clearly shows that the highest trading volume stocks do not necessarily generate higher mean returns. The trend for P10 to perform better than P1 occurs in equally-weighted (EW) returns as well as value-weighted (VW) returns. The difference is observed as 28.419% p.a. (t = 7.346) for equally-weighted stocks, and 9.763% p.a. (t = 18.986) for valueweighted returns.

On the other hand, the average market capitalization of stocks in each portfolio declines almost monotonically. The RtoV exhibits high negative correlation with market capitalization. These results are aligned with those of Florackis et al. (2011), who also argue whether the spread noticed in Table 2 can be analyzed as a size or illiquidity premium. In Table 2, the remaining outcomes explain that portfolios constructed on lower and higher RtoV ratios tend to show higher average price-to-book ratios than portfolios of stocks established with central (P3 to P7) RtoV values. Lastly, the average beta of stocks reducesfrom one or close to one as the RtoV ratio becomes lower. This shows that stocks within portfolios are less volatile when moving from portfolio 1 to portfolio 10.

[INSERT TABLE 2 HERE]

4.2.2 Return-to-Turnover (RtoTR) Price Impact Ratio Descriptive Analysis

[INSERT TABLE 3 HERE]

Table 3 shows 10 portfolios developed on the basis of the RtoTR price impact ratio. The results indicate that portfolio 1 and portfolio 2 yield the lowest average returns (both equally and value-weighted) in contrast to the higher numbered portfolios. These results display that stocks with low RtoTR values generate lower average returns in comparison to stocks with high RtoTR values. Moreover, the spread of P1 - P10 in the equally weighted portfolios is 27.128% p.a. (t = 7.179) and 9.986% p.a. (t = 18.613) calculated for the value-weighted portfolios.

Another interesting feature from Table 3 is the average MV of each of these portfolios. The results do not possess a monotonic pattern across the 10 portfolios, indicating that the RtoTR spread does not reflect the size premium. These results are consistent with Florackis et al. (2011). Furthermore, Table 3 illustrates that the stocks in P2 and P10 reflect the highest average price-to-book values, and the average price-to-book values do not follow a monotonic pattern. Lastly, the average beta is close to one when the RtoTR ratio is lower, and when the RtoTR ratio is high, the beta is considerably less than one. This shows that the portfolios became less volatile moving from portfolio 1 to portfolio 10.

5 Asset-Pricing Models

5.1 Capital asset pricing model:

In the primary stage, Jensen's alpha is analyzed using three asset pricing models from the CAPM[3]:

$$r_{it} - r_{ft} = \alpha_i + \beta_{i,MKT} MKT_t + \varepsilon_{it} \qquad (4)$$

$r_{it} = return\ of\ portfolio\ i\ in\ month\ t$

$r_{ft} = risk - free\ rate\ for\ month\ t$

$r_{it} = return\ of\ portfolio\ i\ in\ month\ t$

$MKT_t = excess\ market\ portfolio\ return\ (r_{mt} - r_{ft})\ in\ month\ t$

5.2 Fama French three factor model

The second asset-pricing model is used to compute the Fama and French alpha, that is, the intercept from Fama and French's (1993) three-factor model, can be calculated as follows:

$$r_{it} - r_{ft} = \alpha_i + B_{i,MKT} MKT_t + B_{i,SMB} SMB_t + B_{i,HML} HML_t + \varepsilon_{it} \qquad (5)$$

$SMB_t and\ HML_t\ are\ known\ as\ size\ and\ value\ risk\ factors, respectively$

[3] The relationship between risk and return calculated using logarithmic returns will systematically differ from those calculated using simple returns. Indeed, when logarithmic returns are used, ceteris paribus, higher variance will automatically reduce expected returns as a matter of basic algebra (Hudson and Gregoriou 2014).

$\beta_{i,SMB}$ and $B_{i,HML}$ $are\ factor\ loadings\ (other\ than\ market\ \beta)$. This loading is characterized as the time series regression slope(s). α_{it} and ε_{it} are the intercept of regression equation and error term, respectively.

Adopting the Fama and French (1993, 1996) measures for portfolio construction, all stocks listed on the PSX are ranked based on the size (market price times the number of shares outstanding) in January of individual year $'t'$ from 2005 to 2019. The median of the PSX stock size is then used to divide those data into two portfolios. Stocks with a market value less than the median are classified as small, while stocks with a market value greater than the median value are classified as big. To examine the three-factor model SMB (small minus big) and HML (high minus low) portfolios are developed using the same portfolio method as Fama and French (1993 and 1996).

5.3 Carhart four factor model

In Carhart's (1997) four-factor model, the first three-factors are explained in the same way as the Fama–French three-factor model, that is, R_m-R_f, SMB and HML. The only alteration is the inclusion of a fourth factor, namely MOM, which includes winners minus losers, and this factor is referred to as the momentum factor. The highest 30% (value weighted) of these stocks are classified as 'winners', and the lowest 30% are classified as 'losers'. The difference in their monthly returns in month t is considered as the momentum factor of return$[MOM_t]$.

$$r_{it} - r_{ft} = \alpha_i + B_{i,MKT}MKT_t + B_{i,SMB}SMB_t + B_{i,HML}HML_t + \beta_{i,MOM}MOM_t + \varepsilon_{it} \quad (6)$$

All the other explanatory variables have already been explained. The new momentum factor is represented as follows:

$MOM_t = return\ of\ the\ momentum\ factor$

$\beta_{i,MOM} = beta\ value\ of the\ independent\ variable\ MOM_t$

We use a system-based estimation for the test of joint significance of 10 portfolios of alphas in order to mitigate potential errors in variable problems. Moreover, we examine alphas estimation through GMM with standard errors corrected for heteroscedasticity and serial correlation (see for example Florackis et al. (2011).

6 Results

6.1 Alphas of Value-Weighted Portfolios Sorted by the Return-to-Volume (RtoV) Price Impact Ratio

The CAPM alpha is interpreted as the positive RtoV premium in Table 4. P1 has the smallest Jensen alpha (i.e. -0.14% p.a.) in comparison with P10, which shows the highest (1.34% p.a.). Moreover, in the CAPM there is a significant RtoV premium at P3 and P10 at the 1% significance level and P9 at the 10% significance level. In addition, the strong significant evidence for the existence of this premium also follows when Fama–French (P3 and P4 at 1% significance level, P5 at 5% significance level and P2 at 10% significance level) and Carhart alphas are considered as measures of risk-adjusted performance (P5 and P7 at 1% significance level). Furthermore, the CAPM alphas shown as the risk-adjusted performance have a significant positive spread of 1.53% p.a. (t = 2.392).

The spread of Fama–French (P1 - P10) is -0.42%, indicating that all the stock returns of the portfolios cannot beat the market benchmark return because of the negative alpha. Similarly, the Carhart alpha shows a negative spread of P1 - P10 (-0.2900%), indicating that on average the spread of the return from all the portfolios is less than the market returns. Thus, neither the Fama–French nor the Carhart models give statistically significant results.

Generally, all other portfolios are individually insignificant based on the results of the t-tests and spread (P1-P10) of all models. Therefore, the Wald test is adopted to test the joint significance of the estimated alphas of all 10 portfolios. None of the asset pricing models produce significant results. Overall, we observe weak results based on alphas of value-weighted portfolios sorted by the return-to-volume (RtoV) price impact ratio.

[INSERT TABLE 4 HERE]

6.2 Alphas of Value-Weighted Portfolios Sorted by the Return-to-Turnover Rate (RtoTR) Price Impact Ratio

The results are entirely different when implementing RtoTR, displayed in Table 5. The CAPM cannot completely account for the significant RtoTR premium. However, this weak evidence for the existence of this premium disappears when Fama–French or Carhart alphas are considered as measures of risk-adjusted performance. This indicates that the Florackis et al. (2011) price impact ratio is superior for modelling the PSX.

Moreover, further analysis indicating that Portfolio P1 gives the highest values of the estimated alpha taking into consideration all three asset-pricing models. From P1 to P10, the alpha estimates noticeably decline. P7 has the lowest Fama–French alpha estimate (-0.97%), and the lowest alpha estimates of Carhart alpha is P7 as well (-0.97%). Moreover, the premium, that is P1 to P10, is negative for the Fama–French specification of -1.60% p.a. (t = -1.8336) and the Carhart model indicates significant results of -1.73% (t= -1.8671*).

Comparing the two price impact ratios yield some very interesting results. Table 5 illustrates some important findings because the Florackis et al. (2011) ratio incorporates trading frequency in the proposed price impact ratio. Our results report that even after adjusting for market size, value and momentum risk, stocks having very high turnover rates and low RtoTR values show large premia. This result implies that the trading frequency effect dominates the transaction cost impact and also low transaction costs may cause high premia if they are frequently incurred. The results are strongly in line with fundamental theoretical results of Amihud and Mendelson (1986a) and Florackis et al. (2011). As per Florackis et al. (2011), our findings support the argument that ignoring the trading frequency effect would be misleading, while evaluating each effect in isolation may lead to inconclusive results. Therefore, one should consider trading cost and frequency effects jointly in conducting asset pricing investigations.

The premium is an indication that overall the 10 portfolios have statistically significant spreads and the difference between P10 and P1 shows an ability to perform above the benchmark by approximately 1.60% p.a. based on the Fama–French model and by 1.73% on the Carhart model. Another way to present these results is to endorse in risk-adjusted terms that a remarkable performance of stocks is evident in stocks with low RtoTR values compared to stocks with high RtoTR values. The Wald test for the CAPM, Fama–French and Carhart alphas do not reject the null hypothesis of joint zero alpha estimates.

[INSERT TABLE 5 HERE]

6.3 Robustness Test – Alphas of Equally Weighted Portfolios Sorted by the Return-to-Turnover Rate (RtoTR) Price Impact Ratio (Robustness of the Results)

In the robustness section, we use equally weighted portfolios arranged by the RtoTR ratio. Equally weighted returns have superior performance in relation to value-weighted returns in explaining the returns by the three-factor model. Lakonishkok, Shliefer and Vishny (1994) and Munesh and Segal (2001) also suggest the use of equally weighted portfolios.

In order to examine the robustness of the earlier alpha value-weighted results based on RtoTR, Table 6 calculates and measure the risk-adjusted performance of the equally weighted portfolios developed on the grounds of the RtoTR ratio. The premium (P1 - P10) is significantly positive for the Fama–French specification of 0.665% p.a. (t = 1.67) and the Carhart model of 0.590% (t = 1.98001). This indicates that the premium is an indication that the overall portfolios have a positive spread and perform above the benchmark of approximately 0.665% p.a. market, returns based on the Fama–French model and 0.590% based on the Carhart model.

[INSERT TABLE 6 HERE]

7 Conclusion

The study is based on two price impact ratios, Amihud's (2002) return-to-volume ratio (RtoV) and an alternative new price impact ratio, return to turnover (RtoTR), developed by Florackis et al. (2011). The paper comprises a sample of common stocks collected from the 386 companies listed on the PSX from January 2005 to December 2019. A major contribution of this paper is the examination of both price impact ratios in an emerging market, namely the Pakistani stock market. The rationale of this research is based on two factors. First, the trading volume of each stock in monetary terms shows a positive relationship with market value, suggesting that it is not comparable across stocks with different market values. Consequently, the RtoV has limited capability to differentiate illiquidity from size effects in asset pricing. On the other hand, the RtoTR has distinct features to overcome the limitations of the RtoV ratio.

We propose that the Florackis et al. (2011) RtoTR ratio has strong evidence in its favor in the context of the PSX when compared with the Amihud (2002) RtoV ratio. When implementing the RtoTR RtoV? price impact ratio, the CAPM cannot completely account for the significant RtoV? premium. However, this weak evidence for the existence of this premium disappears when Fama–French or Carhart alphas are considered as measures of risk-adjusted performance. Moreover, the RtoV ratio has weak supporting evidence using the Fama French three factor and Cahart four factor models.

The criticism made by Florackis et al. (2011) of the Amihud's RtoV ratio is realistic, and is based on the trading volume of stocks in monetary terms, which has a strong correlation with stock market value and thus creates a size bias. Florackis et al.'s (2011) RtoTR ratio is free from this bias and has the advantage of examining the cross-sectional variability in trading frequency.

This research will add value towards existing shareholders and stakeholders and help them to build investment strategies based on the recent performance of the PSX, which has been outstanding. It has become a top performer in all the Asian markets, generating 46% growth in 2016. Moreover, improved market efficiency and liquidity would make the market more attractive. Therefore, the current study helps to take the market towards the next level that is, becoming a developed market by 2025, by enabling a transparent flow of information to all investors and increasing the size of the market by building confidence among local and global investors.

The current growth in the stock market is also a perfect example of the potential within the market, and it is important to find the true prices of assets through demand and supply of the market. As a result, it will definitely encourage more investment, transparency and growth in the Pakistani economy.

The policy recommendations for authority and regulators is to take steps to enhance the liquidity within the market, by increasing the buying and selling volume in a transparent manner. Further, it is necessary to limit family ownership and welcome new industries for listing to the Pakistan Stock Exchange.

Appropriate regulations should be put in place to enhance the equity base of companies, which will ultimately increase the corporate debt market. Moreover, for common stock investors all companies should disclose correct, accurate and understandable financial reports. There is a need to improve the market norms by keeping checks on insider trading by directors and senior executives of companies, and they should be obliged to disclose their sales and purchases (see e.g. see Rehman et al. 2019 and Binner et al., 2018). Moreover, we also provide recommendations to expand our research idea to pre and post financial crisis and its liquidity position. This will widen the spectrum of the stakeholders.

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Table 1: Top 10 Stock Markets by U.S Dollar Returns

Year	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**9th**	**10th**
1997	Oman	Turkey	Russia	Botswana	Hungary	Mexico	Switzerland*	Portugal*	Greece*	Kuwait
1998	Greece*	South Korea	Spain*	France*	Netherlands*	Portugal*	U.S.*	Germany*	Morocco	Switzerland*
1999	Turkey	Russia	Malta*	Indonesia	South Korea	Mexico	Finland*	Japan*	Greece*	Egypt
2000	Vietnam	Mongolia	China	Nigeria	Latvia	Jamaica	Denmark*	Bulgaria	Tunisia	Saudi Arabia
2001	Russia	Mongolia	Latvia	Qatar	Botswana	Jordan	South Korea	Slovakia	Kuwait	Nigeria
2002	Pakistan	Romania	Bulgaria	Estonia	Kuwait	Russia	Czech Rep.	Qatar	Hungary	Slovakia
2003	Bulgaria	China H	Lithuania	Brazil	Thailand	Argentina	Turkey	Kuwait	India	Chile
2004	Dubai	Romania	Egypt	Montenegro	Colombia	Slovakia	Saudi Arabia	Czech Rep.	Lithuania	Hungary
2005	Montenegro	Kazakhstan	Dubai	Egypt	Colombia	Lebanon	Saudi Arabia	Russia	Kuwait	Mongolia
2006	Kazakhstan	Peru	Vietnam	China	Cyprus	Mongolia	Montenegro	China H	Serbia	Morocco
2007	Mongolia	Zambia	Montenegro	China	Slovenia	Nigeria	Croatia	Mauritius	Turkey	Brazil
2008	Tunisia	Ghana	Laos	New Zealand*	Morocco	Slovakia	Lebanon	Jordan	Japan*	Qatar
2009	Brazil	Russia	Srilanka	Peru	Indonesia	Norway*	Turkey	Argentina	Chile	India
2010	Mongolia	Srilanka	Peru	Ukraine	Estonia	Thailand	Indonesia	Chile	Argentina	Philippines
2011	Mongolia	Zambia	Jamaica	U.S.*	Philippines	Indonesia	Qatar	Mauritius	New Zealand*	Malaysia
2012	Turkey	Egypt	Philippines	Estonia	Nigeria	Thailand	Kenya	Pakistan	Greece*	Laos
2013	Dubai	Abu Dubai	Bulgaria	Nigeria	Kenya	Ghana	Argentina	Ireland*	Pakistan	Finland
2014	China	Pakistan	Egypt	India	Srilanka	Philippines	Argentina	Indonesia	Turkey	Qatar
2015	Jamaica	Lat Via	Hungary	Denmark*	Malta*	Slovakia	Ireland*	Japan*	Estonia	China
2016	Brazil	Kazakhstan	Peru	Russia	Pakistan	Namibia	Hungary	Morocco	Colombia	Bulgaria

*Represent developed markets. The above data is based on 90 national equity benchmarks. Venezuela is excluded from calculations due to market distortion

Table 2: Performance and Characteristics of the Decile Portfolios Constructed on the Basis of the Return-to-Volume (RtoV)

Portfolios	EW returns	VW returns	RtoV ratio	MV	Price-to-book	CAPM beta
1	-10.432	0.286	0.086	53682.612	1.187	1.075
2	-13.716	-5.303	0.003	26879.189	2.489	1.174
3	-8.342	-1.716	0.020	10651.052	0.645	1.016
4	1.349	2.676	0.230	8028.574	1.411	0.816
5	4.913	5.677	0.502	5729.079	1.350	0.686
6	7.644	6.967	0.853	3641.893	1.149	0.585
7	15.647	7.442	0.846	2846.070	1.349	0.507
8	18.731	8.158	1.266	2739.724	1.842	0.456
9	17.979	9.283	2.035	3180.967	2.102	0.385
10	17.987	10.049	5.491	13987.243	3.780	0.300
Total	5.082	4.316	1.053	13198.703	1.721	0.702
P10-P1	28.419	9.763	5.405	-0.775	-39695.370	2.593
t-Test	7.346	18.986	16.212	-39.793	-26.021	5.684

The performance and attributes of 10 (decile) portfolios are developed in support of the return-to-volume (RtoV) price impact ratio. Table 2 identifies the main characteristics of the portfolios developed from Amihud's return-to-volume (RtoV) price impact ratio. All the portfolio stocks are listed on the PSX in the period from January 2005 to December 2019. These stocks are categorized in month t-1 in ascending order based on the results of the RtoV ratios. Further, on the basis of these ratios, they are formed into 10 portfolios. Portfolio 1 is the portfolio comprising the stocks with the lowest RtoV ratios, and portfolio 10 is the portfolio comprising the stocks with the highest RtoV ratios. Moreover, the excess returns of all the portfolios in month t are determined through post ranking of the returns. In addition, portfolios (10 – 1) are derived from the spread between portfolio 10 and portfolio 1. We applied a rebalancing approach, and the portfolios are rebalanced on a monthly basis. The EW returns represent the annualized average monthly returns of the equally weighted portfolios. The VW returns represent the annualized average monthly returns of the value-weighted portfolios. MV is considered as the average market value of stocks in each portfolio (in PKR million), and the calculation of MV is based on the share price multiplied by the number of ordinary shares outstanding. The ratio of price-to-book is calculated as the average ratio of the share price divided by the book value per share for the stocks in each portfolio. The Capital Asset Pricing Model (CAPM) beta is considered as the average stock beta in each portfolio determined through a 24-month rolling window. Finally, the t test is calculated on the basis of the following null hypothesis $H_o = There\ is\ no\ difference\ in\ means\ between\ the\ features\ of\ Portfolio\ 10'\ and\ Portfolio\ 1'$.

Table 3: Performance and Characteristics of the Decile Portfolios Constructed on the basis of the Return-to-Turnover Ratio

Portfolios	EW returns	VW returns	RtoTR ratio	MV	Price-to-book	CAPM beta
1	-10.628	-0.761	1.522	22803.970	0.893	1.116
2	-7.547	-1.875	0.370	23193.411	2.037	1.089
3	-5.334	0.536	1.434	18443.554	1.377	0.914
4	1.725	3.321	4.318	15147.193	1.432	0.768
5	9.743	4.743	13.063	10321.754	1.558	0.662
6	5.579	5.868	14.768	7856.207	1.778	0.580
7	13.006	6.806	24.567	5012.203	1.442	0.547
8	13.474	7.407	29.965	4367.161	1.363	0.498
9	14.889	8.124	42.936	5185.761	1.686	0.447
10	16.500	9.226	137.984	19567.364	3.696	0.387
Total	5.081	4.318	26.129	13199.076	1.721	0.702
P10-P1	27.128	9.986	136.461	-3236.606	2.803	-0.729
t-Test	7.179	18.613	12.156	-3.188	5.347	-38.024

The performance and attributes of the 10 (decile) portfolios developed in support of the return-to-turnover (RtoTR) price impact ratio. Table 3 identifies the return-to-turnover (RtoTR) price impact ratio developed by Florackis et al. (2011). These stocks are categorized in month t-1 in ascending order based on the results for the RtoTR ratios. Further, on the basis of these ratios, they are constructed into 10 portfolios. Portfolio 1 is the portfolio comprising the stocks with the lowest RtoTR ratios, and portfolio 10 is the portfolio comprising the stocks with the highest RtoTR ratios. Moreover, the excess returns of all the portfolios in month t are determined through ex-post ranking of the returns. In addition, portfolios (1 – 10) indicates the spread. The rebalancing approach is used, so the portfolios are rebalanced on a monthly basis. The EW returns represent the annualized average monthly returns of the equally weighted portfolios. The VW returns represent the annualized average monthly returns of the value-weighted portfolios. MV is the average market value of the stocks in each portfolio (in PKR million); MV is the share price multiplied by the number of ordinary shares outstanding. The price-to-book ratio is calculated as the average ratio of the share price divided by the book value per share for the stocks in each portfolio. The CAPM beta is the average stock beta in each portfolio determined through a 24-month rolling window. Finally, the t test is calculated on the basis of the following null hypothesis:

$$H_o = There\ is\ no\ difference\ in\ means\ between\ the\ features\ of\ portfolio\ 10\ and\ portfolio\ 1.$$

Table 4: Alphas of the Value-Weighted Portfolios Sorted by the Return-to-Volume (RtoV) Price Impact Ratio

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P1-P10	Wald
CAPM_alpha	-0.0014	-0.0113	-0.0088	-0.0052	0.0005	-0.0032	0.0006	-0.0023	0.0106	0.0134	0.0153	2.7200
T-value	-0.4614	-2.6495	-2.2644***	-1.4126	0.1216	-0.8158	0.1519	-0.5202	1.6475*	2.3018***	2.3920***	0.1008
Fama_French_alpha	0.0027	-0.0087	-0.0091	-0.0080	-0.0058	-0.0095	-0.0093	-0.0153	0.0037	-0.0063	-0.0042	4.0100
T_value	0.7665	-1.9379*	-2.4321***	- 2.3790***	-1.8309**	-3.0350	-2.8462	-3.9608	0.5050	-0.9284	-0.5284	0.0469
Carhart_alpha	0.0001	-0.0140	-0.0109	-0.0091	-0.0065	-0.0101	-0.0080	-0.0151	0.0042	-0.0064	-0.0029	3.6100
T_value	0.0356	-3.3957	-3.1272	-2.7745	-1.9949***	-3.0418	-2.3522***	-3.7517	0.5315	-0.8801	-0.3384	0.0594

The alpha of the value-weighted portfolios arranged on the basis of the return-to-volume (RtoV) price impact ratio. The table illustrates the abnormal performance of the 10 value-weighted portfolios. Among the 10 portfolios, P1 comprises the stocks with the lowest RtoV ratio and P10 contains those with the highest RtoV price impact ratio. The spread between the portfolios is represented as (P10 – P1). The CAPM alpha is determined as the annualized alpha estimate resulting from the capital asset-pricing model (CAPM). In addition, the Fama–French alpha is calculated as the annualized alpha estimate resulting from the Fama–French three-factor model. Moreover, the final model is based on the Carhart four-factor model and the Carhart annualized alpha estimate is derived from the Carhart four-factor model. T-values are reported under each model alpha. Finally, the last column of the table represents the chi-square statistics obtained through the Wald test testing to the null hypothesis H_0 = The alphas of the 10 portfolios are jointly equal to zero. p-values are reported below the statistics. *,**, and *** indicate significance at 10%, 5% and 1% respectively.

Table 5: Alphas of the Value-Weighted Portfolios Sorted by the Return-to-Turnover Rate (RtoTR) Price Impact Ratio

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P1-P10	Wald
CAPM_alpha	-0.0013	-0.0113	-0.0023	-0.0051	0.0019	-0.0047	-0.0015	-0.0046	0.0094	0.0059	-0.0018	-0.0014
T-value	-0.3554	-3.0925	-0.6217	-1.3488	0.4476	-1.2272	-0.3738	-0.8498	1.4839	1.2800	-0.2579	-0.7234
Fama_French_alpha	0.0007	-0.0036	-0.0017	-0.0091	-0.0085	-0.0114	-0.0097	-0.0136	-0.0054	-0.0015	-0.0160	-0.0064
T_value	0.1544	-1.0413	-0.4883	-2.5995	-2.0369***	-3.4386	-2.7615	-3.2627	-0.7210	-0.2739	-1.8336*	-4.2273
Carhart_alpha	-0.0014	-0.0050	-0.0058	-0.0091	-0.0077	-0.0108	-0.0097	-0.0105	-0.0027	-0.0021	-0.0173	-0.0065
T_value	-0.3400	-1.5644	-1.8174**	-2.5668***	-1.7931*	-3.0056	-2.6614	-2.3406***	-0.3341	-0.3484	-1.8671*	-5.7101

The alpha of the value-weighted portfolios arranged on the basis of the return-to-turnover (RtoTR) price impact ratio. The table illustrates the abnormal performance of the 10 value-weighted portfolios. Among the 10 portfolios, P1 comprises the stocks with the lowest RtoTR ratio and P10 contains those with the highest RtoTR price impact ratio. The spread between the portfolios is represented as (P1 – P10). The CAPM alpha is determined as the annualized alpha estimate resulting from the capital asset-pricing model (CAPM). In addition, the Fama–French alpha is calculated as the annualized alpha estimate resulting from the Fama–French three-factor model. Moreover, the final model is based on the Carhart four-factor model and the Carhart annualized alpha estimate is derived from the Carhart four-factor model. T-values are reported under each model alpha. Finally, the last column of the table represents the chi-square statistics obtained through the Wald test testing to the null hypothesis H_0 = The alphas of the 10 portfolios are jointly equal to zero. p-values are reported below the statistic. *,**, and *** indicate significance at 10%, 5% and 1% respectively.

Table 6: Alphas of the Equally Weighted Portfolios Sorted by the Return-to-Turnover (RtoTR) Price Impact Ratio

Results	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P1-P10	Wald
CAPM_alpha (%)	0.095	-0.916	-0.436	-0.192	0.103	-0.042	-0.101	0.026	0.691	1.226	-1.131	26.457
T-value	0.244	-1.477	-0.918	-0.401	0.213	-0.081	-0.162	0.045	0.850	1.531	-1.287	0.003
Fama_French_alpha (%)	0.587	0.058	-0.396	-0.418	-0.455	-0.856	-1.673	-1.167	-0.962	-0.0007	0.658	15.407
T_value	1.217	0.077	-0.663	-0.702	-0.802	-1.482	-2.570***	-1.800*	-1.057	-0.452	1.670*	0.117
Carhart_alpha (%)	0.659	0.173	0.067	0.157	0.049	-0.806	-1.215	-0.691	-0.908	0.069	0.590	10.192
T_value	1.172	0.198	0.102	0.243	0.081	-1.280	-1.688*	-0.955	-0.836	-0.807	1.980**	0.423

The alpha of the equal-weighted portfolios arranged on the basis of the return-to-turnover (RtoTR) price impact ratio. The table illustrates the abnormal performance of the 10 equal-weighted portfolios. Among the 10 portfolios, P1 comprises the stocks with the lowest RtoTR ratio and P10 contains those with the highest RtoTR price impact ratio. The spread between the portfolios is represented as (P1 – P10). The CAPM alpha is determined as the annualized alpha estimate resulting from the capital asset-pricing model (CAPM). In addition, the Fama–French alpha is calculated as the annualized alpha estimate resulting from the Fama–French three-factor model. Moreover, the final model is based on the Carhart four-factor model and the Carhart annualized alpha estimate is derived from the Carhart four-factor model. T-values are reported under each model alpha. Finally, the last column of the table represents the chi-square statistics obtained through the Wald test testing to the null hypothesis H_0 = The alphas of the 10 portfolios are jointly equal to zero. p-values are reported below the statistics. *,**, and *** indicate significance at 10%, 5% and 1% respectively.