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Testing Liquidity Augmented Fama-French Five-Factor Model in Pakistan Stock Exchange

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Abstract *This study examines the empirical evaluation of the six-factor asset pricing model that augments the Fama-French (2015) five-factor asset pricing model with liquidity factor. Using data from July 2010 to June 2017 of non-financial firms listed on PSX, a 2x3 sort approach is used to construct six left-hand side portfolios, and a 2x2 approach is used to construct right-hand side factors namely, SMB, HML, RMW, CMA, and IML. Time series regression is used to analyze the data to obtained results. The empirical evidence illustrates that in PSX the six-factor model has efficient and better outcomes. Furthermore, the liquidity factor has a strong role in improving the performance of the asset pricing model.*

Key Words: PSX, LHS Portfolios, RHS Factors, Liquidity.

JEL Classification: F65, O16, P33

Introduction

The exclusive emphasis of contemporary finance on capital markets can be considered as the foremost trait which differentiates it from economic theory. The comprehension into the atmosphere where decisions concerning finance are constructed on the models which are suggested by finance theory. The core components of modern finance comprise of an efficient market hypothesis (EMH) and various other theories, for instance, irrelevance theory, capital asset pricing model (henceforth CAPM). According to Dimson (1999), the concept of contemporary finance is established on three indispensable hypotheses; investors are logical in the decisiveness; capital markets are assumed as efficient, and arbitrage opportunities are exploited by the investors.

The fundamental suggestion of financial philosophies is that higher retunes can be attained by higher risk. In this regard, in most of finance models and concepts, it is assumed that risk-averse attitude is adopted by the investors and risk premia rationalizes the risk and return nexus. The idea of risk premia is pioneered by Sharpe (1964) and suggested CAPM's single factor. In today's established equity markets, to comprehend Excess Returns (ER) can be a test for the investors. The traditional finance concepts ascertain that markets are efficient in which realistic financial decisions are made by individual investors. For projecting the expected returns, investors and analysts mostly employ CAPM, since it has simple structure and straightforwardness. Nevertheless, with the inception of multifactor asset pricing models, CAPM begun losing

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its significance and prominence; however, to investigate new anomalies which can affect the expected returns of the securities, CAPM offered the solid grounds for other researchers. In this regard, Harry Markowitz (1952) initiated the portfolio selection techniques in the domain of the asset pricing model. Hence, for investigating the risk factors attached to assets, numerous researchers and investors employed these models for determining risk.

The literature on the pricing of the assets shows that the contribution of Sharpe (1964) is indispensable to comprehend the determination of risk premia on financial assets. Later on, Black, Jensen, and Scholes (1972), Linter (1965), and Mossin (1966) also worked on asset pricing and made a vital contribution to asset pricing literature. The key concept of this paper is that the risk premium can rely on structural risks like a beta market or other systematic risk controls. Empirical evidence shows that the FF5F model does remarkably well in describing the disparity in returns and beats the FF3F model immediately. As demonstrated by Chiah, Chai, Zhong, and Li (2016) This model has added capacity to explain stock return differences relative to the spectrum of competitive asset valuation models on global equity markets.

Recently, Jiao (2017) found in china the applicability of the FF5F model, the model outperforms, on the other hand, Kubota and Takehara, (2018) found the FF5F model was insufficient in describing variance to the previous literature of the asset returns. This evidence leads to the conclusion that the effect of some anomalies remains unexplained. As the FF5F model is developed on US data, nevertheless, the sources and pricing of risk in emerging and developed markets are different. In the study of Such as Lee (2011), emerging stocks have been reported to be more highly leveraged than mature capital markets. Accordingly, liquidity effects in asset-pricing models must be taken into consideration. Moreover, when investors transfer ownership of their assets, they face liquidity risk. Hence, when investors are making investment decisions, they consider liquidity to be a vital factor. In this regard, a significant positive relationship amid returns and illiquidity has been founded by Amihud and Mendelson (1986). Since that study, the return-illiquidity relationship is continued to examine by many other researchers. But the proof has usually been incoherent and inconsistent over the last two decades. Later, Amihud (2002) found that liquidity is significantly and negatively associated with expected returns, even size, beta and momentum anomalies are present. This motivated us to test a multifactor asset pricing model that includes liquidity factors along with the FF5F model. The current study examines the role of liquidity in Pakistan Stock Exchange (PSX) and investigate that how liquidity can determine the deviations in ER. The findings from this analysis suggest that liquidity is a major element in Pakistan's stock price. In specific, illiquid stocks have positive loads, and liquid stocks have negative liquidity loads. The remaining paper is sorted accordingly. Section 2 summarizes the literature on the relationship between return and liquidity. The details of data and methodologies are outlined in Section 3 and 4. The analytical findings are in Section 5 are examined and Section 6 concluded the findings of this study.

Literature Review

The ease with which the agents can exchange or convert stocks into cash is known as liquidity. Illiquid stocks are those who are hard to exchange (buy or sell), and liquid stocks are those who are easily exchangeable (Bali, Engle, & Murray, 2016). The illiquid stocks contain liquidity risk, and the investors usually avoid purchasing illiquid stocks

because of the liquidity risk. Nevertheless, Liquidity is a dynamic phenomenon observed (Amihud, Mendelson, & Pedersen, 2005) in the market place. In this regard, the very first attempt to test the role of illiquidity by Amihud and Mendelson (1986) and uncovered its significant role while in the description of stock returns variation. Later, their study has been re-examined by Eleswarapu and Reinganum (1993) Using a revised time; the beneficial relationship was found to be primarily limited to January. In the same line, Brennan and Subrahmanyam (1996), a study has been carried out to study liquidity premiums and ascertained positive link between liquidity and return on stocks. The outcomes of the research generally support the results of Amihud and Mendelson (1986). However, these results refute the results of Eleswarapu and Reinganum (1993).

The recent liquidity literature indicates that previous research found liquidity to be a special function that affects asset prices. While recent work changes away to considered liquidity as a common factor of risk such as Pástor and Stambaugh (2003) reported that the stock with relatively high compassion to the market-wide liquidness aspect outcome much high return as compared to stocks with lower compassion. In the same way, the role of liquidity in the movement of stock prices with updated data is investigated by Keene and Peterson (2007). The empirical evidence of the study support Amihud and Mendelson (1986) Findings and the analysis concluded that even after managing the impact of business, size, volume, and momentum, uncertainty remains a major factor.

Moreover, for emerging and Asian economies, Bekaert, Harvey, and Lundblad (2007) examine the equity markets of 18 developing economies, and empirical results suggest that liquidity has priced in the markets of these economies. Similarly, Chung and Wei (2005) find empirical evidence regarding the significant relationship amid liquidity and stock returns. It is concluded from the above literature that there a significant relationship amid stock returns and liquidity.

Sources of Data

For this study, we gathered the data from the State bank of Pakistan (SBP), business recorder, and yahoo finance. Following the prior research studies, the data set only contains the monthly returns on non-financial stocks listed on PSX for the period 2010-2017. For the calculation of risk-free rate, we used the T-Bills rate for the last 6 months, as they are annual rates; therefore, the rates are divided by 1200 to convert them into monthly rates. Market capitalization, profitability, B/M ratio, and investment growth in asset factor is calculated for each firm for each year as outstanding shares*market value/share, annual revenue minus CGS, administrative and interest expense, and divide them by book equity for the last financial year, the book value of equity ratio and equity of market at the end of each year and total assets at time t minus previous year (t-1) total assets divided by previous year total assets, respectively. For the proxy of liquidity, we used the turnover ratio. 2x3 approach has been used to construct six left-hand sides (LHS) portfolios; the excess return of these portfolios is treated as a dependent variable. The whole sample stocks are divided into two parts grounded on the size of the stock using the median of market capitalization. The stocks have market capitalization more than the median is termed as big stock, and the stock has market capitalizations less than the median is termed as small stocks. Then each size group is further allocated into three B/M, investment, liquidity and OP groups. The 2x2 approach is used as an exploratory factor to construct the right side (RHS) factors. The entire

sample stock is split into two classes of sizes. Then each size group was further split into two B/M, investment, profitability, or liquidity groups. The exploratory factors HML, CMA, RMW, and IML are described as the difference between average returns on low and high B / M portfolios, conservative and aggressive portfolios, robust and weak portfolios, and low liquidity and high liquidity portfolios.

Methodology

This study tests the six-factor asset pricing model that augment liquidity factor to the FF5F model which includes market excess factor (MKT), value (HML), size (SMB), investment (CMA), profitability (RMW), and liquidity (IML) factor. Following is the model related to research.

$$R_{pt} - R_f = \alpha + b_i\,(R_{mt} - R_f) + s_i\,SMB_t + h_i\,HML_t + r_i\,RMW_t + c_i\,CMA_t + l_i\,IML_t + e_{it}$$

Results and Discussion

Table 1 exhibits the summary statistics for factor return in A-Panel and correlation matrix in B Panel. The mean of market ER is 0.908 % with the standard deviation of 7.866% in the period under consideration ranging from July 2010 to June 2017. The positive premium of size, value, profitability, investment, and liquidity illustrate the existence of the effect of these factors for sample stocks of the PSX; however, the observed t-statistics show the insignificance of the value, size, investment premium, and profitability. In contrast, only the liquidity premium is significant.

Table 1. Descriptive Statistics

	$R_m - R_f$	**SMB**	**HML**	**RMW**	**CMA**	**IML**
Mean	0.908	0.497	0.418	0.305	0.073	0.795
Std	7.866	5.284	4.962	4.145	4.992	6.435
t-statistics	1.576	1.136	1.676	1.492	0.984	2.413
Panel B: Correlation Coefficients						
	$R_m - R_f$	SMB	HML	RMW	CMA	IML
$R_m - R_f$	1.00					
SMB	0.125	1.00				
HML	−0.002	−0.689	1.00			
RMW	-0.052	−0.213	-0.023	1.00		
CMA	-0.109	−0.220	0.371	−0.321	1.00	
IML	-0.271	-0.114	0.232	0.032	0.294	1.00

B panel of Table 1 indicates the correlation among explanatory factors to detect the likelihood of multicollinearity. Correlation among exploratory risk factors is negligible; thus, it can be inferred that correlation is within tolerable limits, and it is concluded that the problem of multicollinearity does not exist among explanatory variables.

Table 2. Average Monthly Percent ER for LHS Portfolios

	L	**M**	**H**
A Panel: S-BM Portfolios			
S	0.544	0.415	0.933
B	0.463	0.242	0.629

B Panel: S-OP Portfolios			
S	0.552	0.686	0.751
B	0.476	0.599	0.613
C Panel: S-Inv Portfolios			
S	0.911	0.932	0.893
B	0.527	0.586	0.485
D Panel: S-Liq Portfolios			
S	1.024	0.846	0.684
B	0.577	0.363	0.215

The results in Panel A indicate that monthly average ER falls from small stock portfolios to big stock portfolios (from 0.544% to 0.463% per month) which shows size effect. Further, the average ER increase from low (growth) stock to high (value) stock portfolios indicated the value effect. While results show that value effects are stronger in small stocks portfolios than big stocks portfolios.

Panel B presents the average returns on an excess of risk-free rate on six portfolios formed on profitability and size. The size effect is the same as panel A. The average ER is high for stocks in robust profitability portfolios and low for stocks in weak profitability portfolios.

C Panel of Table 2 displays that ER of six portfolios sort on investment and size are at an average point. Results exhibit a negative link amid average ER and investment as it is observed that average ER fall from conservative to aggressive investment portfolios. The results illustrate that conservative stocks yield a higher return than aggressive stocks.

D Panel of Table 2 showing ER of six portfolios based on liquidity and size factor on average points. The average ER of illiquid stock portfolios are more than liquid stock firms. There exists a negative association amid liquidity factor and average ER as the average ER decrease when liquidity increase.

Table 3. Regression Results of S-BM Portfolios

	L	**M**	**H**	**L**	**M**	**H**
Panel A: Five-Factor Intercepts						
		A			t (a)	
S	-0.138	0.232	0.162	1.876	2.169	1.543
B	-0.172	-0.143	0.054	1.987	0.7653	1.172
Panel B: Six-Factor Intercepts and Slopes						
		A			t (a)	
S	-0.115	-0.210	-0.107	0.093	1.765	0.679
B	-0.127	0.090	0.115	1.753	1.536	1.825
		B			t (b)	
S	0.658	0.798	0.876	4.154	6.764	5.764
B	0.738	0.534	0.728	7.875	8.855	6.768
		S			t (s)	
S	0.993	0.839	1.058	15.51	9.853	8.131
B	0.164	-0.032	0.056	2.073	−1.179	0.615
		H			t (h)	

S	−0.449	0.275	0.364	−5.217	4.409	6.157
B	−0.532	0.301	0.602	−6.64	3.442	8.215
		R			t (r)	
S	0.1596	-0.135	−0.062	2.1264	-1.912	-0.733
B	-0.220	-0.054	-0.115	-3.360	-0.763	-2.907
		C			t (c)	
S	-0.742	-0.126	0.315	-7.616	-1.024	5.358
B	-0.620	0.301	0.0674	6.332	3.591	0.569
		I			t (i)	
S	-0.392	-0.095	0.257	5.654	2.765	6.23
B	-0.154	0.147	-0.065	2.365	2.923	1.987

The result in Panel A shows a reduction in regression intercepts on six S-BM portfolios by augmenting liquidity into the FF5F model. The intercept values of the FF5F model are in the range between -0.138 and 0.232 (Panel A), while the values of the intercept of liquidity augmented model ranges -0.210 and 0.09 (Panel B) which indicates, some portion of the variation in average returns on S-BM portfolios has captured by a proposed model that left unexplained by FF5F model.

According to results in Panel B of Table 3, the coefficient of the market premium is positively and significantly correlated with stock returns which shows that market premium has a significant positive relationship with returns on six portfolios formed on size and profitability and it is consistent with the conventional assets pricing model (i.e., CAPM). The slopes of SMB factor exhibit that on small stock portfolios the factor loadings are large and positive, and on big stock portfolios factor loading are small, and for the big mid portfolio it is negative; however, the t-statistics shows the insignificance of the slopes for big portfolios. The result suggests that the size factor is failed to explain the variations in big stocks. The result is in line with the findings of Ali, He, and Jiang (2018). While the slopes of HML factor indicate large negative factor loadings for growth portfolios, however, the slopes are positive for value portfolios. The RMW factor slopes are negative, but their t-statistics show that most of them are not significantly different from zero, except the portfolio which contains growth stocks with small capitalization for which the slop of RMW is statistically positive.

Table 4. Regression Results

	L	**M**	**H**	**L**	**M**	**H**
Panel A: Five-Factor Intercepts and Adjusted R-Square v						
		A			t (a)	
S	0.137	0.102	-0.047	1.532	0.943	-1.283
B	-0.072	0.157	0.354	-0.423	1.539	2.925
Panel B: Six Factors Intercept and Slops						
		A			t (a)	
S	0.146	0.098	−0.02	1.458	0.452	−1.068
B	−0.097	0.073	0.298	-0.343	1.210	2.120
		B			t (b)	
S	0.546	0.498	0.739	5.798	8.150	11.901
B	0.645	0.765	0.598	6.978	13.309	5.318
		S			t (s)	

S	1.081	0.985	0.868	12.828	5.853	8.976
B	0.050	-0.071	−0.145	-1.175	-1.348	−1.104
		H			t (h)	
S	0.376	-0.330	-0.117	2.805	-3.759	-1.863
B	-0.160	0.450	-0.270	−2.014	5.9019	-2.186
		R			t (r)	
S	−0.419	−0.301	0.732	−5.176	6.641	11.73
B	-0.631	−0.121	0.501	−10.151	1.539	9.500
		C			t (c)	
S	0.271	0.159	0.498	4.442	3.693	-7.385
B	0.472	0.039	0.201	9.953	1.765	5.743
		I			t (i)	
S	-0.226	-0.329	-0.150	4.713	-2.974	-3.575
B	-0.170	-0.022	-0.161	2.423	1.245	1.150

Table 4 shows that the intercept values of the FF5F model are in the range between -0.047and 0.354 (Panel A), while the intercepts of the six-factor model between −0.02 and 0.298 which shows the regression intercepts are reduced slightly and the six-factor model capture a small portion of variations left unexplained by FF5F model.

The results show RMW is significantly and negatively related to portfolio returns of low profitable stocks and significantly and positively related to portfolio returns of high profitable stocks portfolio which indicate that average ER is high for high profitable stocks and low for low profitable stocks. The same results and interpretations are also provided by Fama and French (2015). The HML slopes are negative for robust profitability portfolios which is typical of robust profitability stocks that high profitable stocks are typically growing rapidly. The HML slope is positive for a small weak profitability portfolio, indicating that low profitability is associated with a high B/M ratio.

Table 5. Regression Results of S-Inv Portfolios

	L	**M**	**H**	**L**	**M**	**H**
Panel A: Five-Factor Intercepts and Adjusted R-Square v						
		A			t (a)	
S	0.372	0.128	0.243	2.015	1.116	2.518
B	0.261	0.081	0.141	1.229	0.538	0.907
Panel B: Six-Factor Intercepts and Slops						
		A			t (a)	
S	0.227	0.139	0.216	1.48	0.763	1.155
B	-0.063	0.05	0.074	-0.25	0.024	0.373
		B			t (b)	
S	0.570	0.642	0.679	5.91	8.728	7.346
B	0.64	0.597	0.742	7.96	5.853	7.952
		S			t (s)	
S	1.019	1.211	1.025	4.888	4.975	8.173
B	-0.047	0.036	0.043	1.103	-1.070	-0.907
		H			t (h)	
S	−0.065	0.145	-0.396	−1.183	-3.921	-4.982

B	0.229	0.039	0.162	2.892	0.888	6.985
		R			t (r)	
S	−0.179	−0.081	0.192	−3.99	−1.983	2.598
B	0.139	−0.129	0.02	2.031	0.673	2.632
		C			t (c)	
S	0.653	−0.0209	−0.747	1.21	−2.200	−1.813
B	0.765	0.0395	−0.643	0.943	0.754	-2.087
		I			t (i)	
S	-0.305	-0.066	-0.097	2.433	-1.625	-1.724
B	-0.449	0.043	0.126	-4.518	0.578	0.633

Table 5 report the values of intercepts and coefficients of six factors and their t-statistics formed on size and investment portfolios. As same to the result obtained from size-value and Size-OP portfolios the regression intercepts are reduced in the six-factor model. Panel B indicates a negative relationship amid average returns of portfolios and investment.

Table 6. Regression Results of S-Liq Portfolios

	L	**M**	**H**	**L**	**M**	**H**
Panel A: five-factor intercepts						
		A			t (a)	
S	-0.093	0.244	0.371	-1.279	1.929	2.098
B	0.373	-0.189	0.042	2.752	1.376	0.298
Panel B: six-factor intercept and slopes						
		A			t (a)	
S	0.124	0.012	0.081	1.065	0.7547	1.091
B	0.19	0.104	0.108	1.98	1.765	1.086
		B			t (b)	
S	0.900	0.934	0.914	13.64	11.617	9.804
B	0.758	0.613	0.794	7.91	6.457	8.897
		S			t (s)	
S	0.890	0.901	0.849	8.69	9.450	8.942
B	−0.151	−0.115	0.092	−1.393	−1.266	1.101
		H			t (h)	
S	−0.059	0.182	0.0240	-1.363	-3.408	1.724
B	−0.031	0.059	0.071	-1.585	2.654	2.482
		R			t (r)	
S	−0.432	0.203	−0.316	−6.056	3.375	5.174
B	−0.0271	0.371	−0.002	−0.950	4.208	0.959
		C			t (c)	
S	0.041	0.127	−0.0043	1.326	2.182	−1.272
B	0.056	0.172	−0.61	0.152	1.924	−2.941
		I			t (i)	
S	0.721	0.313	-0.480	12.90	-4.97	-8.30
B	0.675	-0.063	-0.817	10.06	-1.22	13.26

Table 6 reports the values of intercepts and their t-statistics formed on size and liquidity portfolios for the FF5F model. As same to the result obtained from previous sets of portfolios, the regression intercepts are reduced in the six-factor model.

Conclusion

The research explores the nexus between average excess portfolio returns and risk factors (market, size, value, profitability, investment, and liquidity). The main objective of this study is to propose a six-factor model that extends FF5F by adding a liquidity factor to understand time-series changes in portfolio ER on the PSX. Data from July 2010 to June 2017 of non-financial firms listed on PSX has been collected for portfolios construction. To test the five and six-factor model, the 2x3 approach is used to construct four sets of six LHS portfolios (S-BM, S-OP, S-Inv, S-Liq), whereas the 2x2 approach is used to construct RHS factors such as value, size, profitability, investment, and liquidity. Moreover, time series regression is used to analyze the data to obtained results.

The descriptive statistics of ER on double sorted portfolios showed that return typically falls from small to big, conservative to aggressive and less liquidity to high liquidity stocks, whereas return rise from low to high B/M and weak profitability to high profitability stocks. The result of the summary statistics of average return evident the presence of size, profitability, value, investment, and liquidity effect in the PSX. Besides, the study found positive size, liquidity, profitability, value and investment premium which indicate that on average the small, low liquidity, highly profitable, high B/M, low investment and stocks earn high return than big, high liquidity, low profitable, high B/M and aggressive investment firms. Furthermore, the regression results empirically evident that the six-factor has superior performance than FF5F since the regression intercepts decrease with the addition of the liquidity factor into the FF5F model. The study finds strong evidence that the liquidity factor has a strong role in improving the performance of the asset pricing model. Furthermore, the average ER has a significant negative relationship with size, liquidity, and investment, while a positive and significant relationship with market premium, value, and profitability of the firm. The value stocks typically invest conservatively and are less profitable firms. While growth stocks are those firms that invest aggressively and are more profitable. The only exception is the portfolio consists of big growth firms whose returns behave like less profitable firms that have grown rapidly. Whereas the growth firms are more liquid than the value firms. Overall, empirical evidence shows that the model with six-factor improves the FF5F's explanatory power. Besides, our findings go a step further in the asset pricing literature with vital implications in guiding risk control and portfolio management analyzes for practitioners.

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