Testing Illiquidity and Momentum Factors with Asset Pricing: Evidence from Emerging Capital Markets of South Asia

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Abstract

This paper explores the asset pricing factors which pose aggregate risk to the portfolio returns in the Pakistan Stock Exchange (PSX). The purpose is to test the illiquidity and momentum factors along with the well-documented three factors in asset pricing model using Fama and French (2015) and Lam and Tam (2011) for one of the emerging markets of South Asia, i.e., Pakistan, using 20-year monthly data from January 2001 to December 2020. This paper adopts the methodology of Fama and French (2015) as used in the developed market and Lam and Tam (2011) for the emerging market phenomenon, to formulate the portfolio returns based on Size, Book-to-Market(BM), and the Liquidity, and test these returns against the factors causing the return variations. The results based on the 3-factor model, liquidity-adjusted model, and the momentum-based model validate factors of excess market return (CAPM), size, value, liquidity, and momentum as significant risk factors in explaining the variations in portfolio returns of PSX stocks. The portfolio access returns for PSX stocks are adjusted for risk factors with mixed significant response holding average explanatory power. Our results are robust to the GRS F-test.

Keywords: Asset Pricing, Fama and French, Illiquidity, Momentum.

Introduction

Asset pricing factors which cause variations in the returns of the stock or portfolio have been tested and established over the decades. Studies show that the factors of size, market returns, and the value are significant in the developed and the less volatile markets (Fama &French, 1993, 2015) and the liquidity in the emerging markets (Lam & Tam, 2011). The investor's preference for investing in securities is based on the choice of the firm's size, i.e., the market capitalization, returns corresponding to the change in the market returns, and the change in the book value as a ratio of the price. Since these three factors have not fully captured the variation in the returns for pricing assets, the additional factors are used to improve the performance of asset pricing models (Acharya & Pedersen, 2005; Lee, 2011). Illiquidity has been considered one of the factors affecting asset pricing and is being studied as the risk proxy besides three prominently determined factors, i.e., access market returns, size, and value (Fama & French, 1992; 1993; 2015). The multifactor models explain the variation in portfolio returns which offer a rational foundation for estimating intrinsic value.

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The factor of liquidity is one of the significant risk considerations, and an important issue for emerging and developing markets. This rises due to the turnover volume sensitivity and high volatility in returns which turns the realization of the value difficult at the time of transfer of ownership. Amihud (2002) finds that the changes in the returns have an inverse relationship with liquidity. Such findings have also been substantiated in later empirical studies (Keene & Peterson, 2007; Nguyen et al., 2007; Amihud & Mendelson, 1986).

The investors tempt to seek more returns on illiquid securities. These factors have been tested in different markets, which may vary in characteristics: the volume of business, number of investors, number of companies listed, stock turnover, volatility in returns, and market integration. The developed stock markets are significantly different in such characteristics than those of the emerging markets. These risk factors are tested in multiple markets for the returns and investment choices, and the variation in returns caused by the factors have statistical significance (Fama & French 1993; 2015; Lam & Tam 2011). Most of past studies are conducted in the developed and developing markets and the euphoria of the results is much appealing in view of the volatility of the market as ascribed by the Lam and Tam (2011).

The South Asian markets are the least explored for the factors, i.e., excess market returns, size, value, liquidity, and the momentum. Motivated by the above studies, and the scarcity of literature, we test the relevance of these factors in determining returns on the PSX. It is one of the important markets of South Asia with a high market capitalization and high volatility as documented by Chawla and Gajurel (2022). Our objective is to enhance the understanding of asset pricing models employing illiquidity and momentum factors along with Fama and French 3-factor with special reference to an emerging and relatively volatile market, Pakistan. By doing so, we seek the answer to the question of how the portfolio returns of PSX stocks are adjusted for the given risk factors. The study results suggest that the liquidity and momentum adjusted models are significant in case of PSX stocks. However, the combined model of liquidity and the momentum along with three-factor could not improve the explanation due to redundancy. The results are further validated by the GRS F-test for the panels of portfolio returns.

The paper's structure includes previous literature foundations in section 2 for return liquidity, and the momentum relations; section 3 incorporates data and methodologies. Section 4 displays and discusses the models' analytical results, and section 5 presents the conclusion and recommendations.

Literature Review

The behavioral explanation of the returns is rooted in the pioneer model of CAPM, which led to beta being a risk proxy in explaining the returns (Sharpe, 1964; Lintner, 1965). Fama and MacBeth (1973) performed the standard test of the CAPM, which could not explain the returns with the beta due to lower predictive value, leading the researchers to seek additional factors that explain variations. The theoretical development of multifactor models like ICAPM by Merton (1973) and Arbitrage price theory (APT) by Stephen Ross (1976) sought to include the macroeconomic factors in asset pricing. However, the macroeconomic variations are dynamically different from the variation patterns of stock returns and the market-specific factors. Therefore, diversity in factors affecting the returns emerged from factors like the earnings-price (E/P) ratio (Basu, 1977), yield surrogates (Ball, 1978), firm size (Banz, 1981), and leverage (Bhandari, 1988).

Fama and French (1992) employed the price/earnings ratio and leverage to explain the cross-sectional variations in the returns and found that the BM and size explain the cross-sectional variation in the expected returns. Fama and French (1993) revealed that the size and the book-to-market explain much of the cross-sectional variations in return. There are other anomalies that the three-factor model does not explain. The pioneering work of bid and ask spread used as a proxy for liquidity factor by Amihud and Mendelson (1986) investigated the illiquidity towards returns and determined a positive relation between expected returns and illiquidity. With an updated period, Eleswarapu and Reinganum (1993) re-examined the illiquidity and found a positive return-illiquidity relationship, which was restrained to the January effect. Brennan and Subrahmanyam (1996) examined the liquidity premium using Fama and French's (1993) three factors, beta, size, and value and explained similar conclusions. The results followed Amihud and Mendelson's findings but refuted the January effect.

Peterson and Fialkowski (1994) raised the concerns over the bid-ask spread a poor proxy for liquidity measure as it stands to be a stock specific risk as compared to the aggregate measure of liquidity effects which was then followed in other studies (Brennan & Subrahmanyam, 1996). Therefore, alternatives proxies for liquidity were tested in later studies. These include trading volume (Brennan et al., 1998), the turnover ratio (Datar et al., 1998; Chan & Faff, 2005), the standard deviations and the coefficients of the turnover ratio and trading volume (Chordia et al., 2001), the liquidity measure as by Pastor and Stambaugh (2003).

Amihud (2002) highlights the illiquidity factor on stock returns and examines the effect of stock liquidity on stock returns over time and across the market, stating that "the expected return on the stock increases for the expected illiquidity of the market." Acharya and Pederson (2005) measure the liquidity risk while explaining how asset prices are affected by the liquidity risk and commonality in liquidity by decomposing Jacoby et al.'s (2000) liquidity-adjusted beta into four components and finding that the traditional CAPM's performance is improved. Liu (2006) develops a new proxy measure for liquidity and states that the market and liquidity factor model explains the cross-sectional returns after controlling for well-documented stock determinants. In addition, the model accounts for the B/M effect left unexplained by the Fama–French three-factor. The return and liquidity relation were investigated with updated data by Keene and Peterson (2007), and the results of Amihud and Mendelson (1986) were validated.

Nguyen et al. (2007), considering the effects of three-moment CAPM, Fama and French (1993), and Pastor and Stambaugh (2003), examined the role of liquidity on returns and showed that market-wide liquidity-sensitive stocks yield higher returns as compared to the low sensitive stocks. Chan and Faff (2005) and Limkriangkrai et al. (2008) investigated the liquidity factor in Australian stock markets and found that the changes in liquidity do not explain stock returns. Lam and Tam (2011) adopted nine measures of liquidity to examine the return-liquidity relation in the Hong Kong stock market and found liquidity as a priced factor. Fama and French (2015) extended the 3-factor model to five factors with improved performance in asset pricing for data from 1963 onward.

For emerging and Asian markets, Bekaert et al. (2007) tested 18 stock markets and found that liquidity is priced in the emerging markets. Siddiqui and Shoaib (2017) tested the South Asian emerging markets for factors of size, value, momentum, and growth premium to adjust returns in extended return. Wahal (2019), using data older than the FF-05 factor model, showed that the value and profitability factors improved the explanation of the portfolio returns.

Chawla and Gajurel (2022) maintained that South Asian markets are volatile compared to the US market, as the rapidity of price evolution is higher in South Asian markets. Moreover, South Asian markets are the least explored emerging markets in terms of asset pricing models. Therefore, considering the paucity of empirical studies on the South Asian markets, we examine the three-factor model following Fama and French (2015) and the factors of liquidity and momentum following Lam and Tam (2011) for the PSX stocks for the South Asian region.

Data and Methodology

Data

We have extracted the data of financial variables from the Thompson Reuters database. The data comprise 370 active companies listed on the PSX from January 2001 to December 2020. Monthly data were employed for the non-financial companies following the extant literature (Lam and Tam, 2011). The value-weighed market returns with cash dividends reinvested, and the monthly KIBOR rate has been used as a proxy for the risk-free rate to calculate the excess returns.

Methodology

In this research, we employ a multivariate regression for a panel of returns to investigate the relationship between returns of the portfolio, formed on the basis of size, BM, and liquidity, and the explanatory factors including three factors (market returns, size, value), the liquidity factor, and the momentum factors for the PSX stocks. We examine the models' performance and determine the efficacy of the models in explaining PSX stocks return variation. If the factors in any model capture all the time series variations in the returns, the intercept will not be significantly different from zero. We also apply the Gibbons-Ross and Shanken (GRS-F) test to ascertain how the overall variation in returns is explained and whether the intercept is statistically significant.

Table 1: Two sets of Average monthly percent Excess returns for portfolios formed on Size, Book-to-Market, and Liquidity for Pakistan Stock Exchange listed companies for the period January 2001 to December 2020, 240 months.

	Low	2	3	4	High	Low	2	3	4	High
Panel A for Size - B/M Portfolio						Panel B for Size –LiQ				
Small	0.02	0.09	0.08	0.07	0.00	0.04	0.01	0.07	0.11	0.12
2	0.01	0.08	0.06	0.05	0.01	0.05	0.01	0.06	0.09	0.10
3	0.05	0.12	0.11	0.09	0.03	0.01	0.03	0.10	0.13	0.15
4	0.04	0.11	0.10	0.08	0.02	0.02	0.03	0.09	0.12	0.14
Big	0.17	0.11	0.12	0.13	0.20	0.24	0.19	0.13	0.09	0.08

Note: Portfolio returns are taken by the intersection of 5 size groups and 5 BM groups to produce 25 value-weighted portfolios. Stock data are allocated independently with reference to PSX market capitalization break points, at the end of June each year. Simultaneous allocation to five BM groups (low to high) where B is the book equity at the end of the fiscal year ending in year t-1 and M is market cap at the end of December of year t-1, followed by Fama French (2015) for adjustment in outstanding shares and measurement of B and M. For portfolios of Size-Liquidity and Size-Investment are formed similarly. At the end of June each year, stock allocated to the share turnover by volume as proxy to liquidity following by Lam and Tam (2011) and five groups (less liquid and most liquid) are formed.

Table 1 presents the two panels of value-weighted portfolio returns for a month, formed for size-BM and size-LiQ. Monthly returns for each year from January 2001 to December 2020, using PSX stock for 240 months. Following Fama and French (2015) and Lam and Tam (2011) the value-weighted monthly average portfolio returns are calculated each year of 5x5 sorts: (1) size and book-to-market, and (2) size and liquidity as presented in Table 1. For average returns on size, at the end of June each year, the return data has been allocated to market capitalization from small to big and divided into five equally weighted average returns portfolios. For returns on book-to-market, at the end of June each year, the return data has been allocated independently to the BM ratio from low to high and divided into 5 equally weighted returns portfolio. The difference of 5x5 sorts produce 25 monthly value weighted portfolio returns for size and BM each year for 20 years. Similarly, for average returns on liquidity; at the end of June each year, the returns data is allocated to turnover volume for the least liquid to the most liquid, and divide into 5 equally weighted returns portfolios. The difference of 5x5 sorts forms 25 value weighted portfolio returns for monthly returns for 20 years.

We test the model of size and value with the CAPM, the liquidity-adjusted model, the momentum factor after controlling the effects of three factors, and the combined effect of the liquidity and momentum factors on return variations. We then apply the GRS F-test to ascertain whether the consolidated effect of the model significantly captures all the variation in the returns.

The econometric models are stated as follows;

$$R_{pt} - R_{ft} = \alpha_p + b_pERM_t + s_pSMB_t + h_pHML_t + €_{pt} \quad \text{(Base Model)} \quad (1)$$
$$R_{pt} - R_{ft} = \alpha_p + b_pERM_t + s_pSMB_t + h_pHML_t + l_pLIQ_t + €_{pt} \quad (2)$$
$$R_{pt} - R_{ft} = \alpha_p + b_pERM_t + s_pSMB_t + h_pHML_t + l_pLIQ_t + w_pWML_t + €_{pt} \quad (3)$$
$$R_{pt} - R_{ft} = \alpha_p + b_pERM_t + s_pSMB_t + h_pHML_t + l_pLIQ_t + w_pWML_t + €_{pt} \quad (4)$$

"R_{pt} - R_{ft}" is the monthly excess average return of portfolio or risk premium in excess of the risk-free rate 'R_{ft}'. 'ERM_t' is the excess market return, 'SMB_t' *is the size factor*, 'HML_t' is the value factor, 'LIQ_t is the liquidity factor and 'WML_t' is the factor of momentum. The value of factors has been taken at t time per period where '$€_{pt}$' is the error term, assumed to be uncorrelated with the factors explaining the variation in the returns in the models. The b_p, s_p, h_p, l_p, *and* w_p are the factors coefficients and slopes in the time series regressions capture the variation in the monthly average access returns of portfolios.

Table 2: The factor construction for PSX stock for Size, Value, Liquidity, and momentum; the explanatory risk factors for returns, i.e. the right side of the equations of the testing models for the period Jan 31, 2001 to December 31, 2020.

Sorts	Breakpoints	Factors
2x3 sorts on	Excess Market Returns	ERM = nlog($Mcap_t$/$Mcap_{t-1}$)
Size and B/M, or	Size: Median of PSX stock capitalization	SMB = (SL+SN+SH)/3 - (BL + BN + BH)/3
Size and LiQ, or	B/M: 30th and 70th percentiles of PSX	HML = (SH+BH)/2 - (SL + BL)/2 = {(SH - SL) + (BH - BL)}/2
	T/over: 30th and 70th percentiles of PSX	LiQ = (SL1+BL1)/2 - (SL3+BL3)/2 = {(SL1-SL3) + (BL1-BL3)}/2
	BV/S: Median of PSX percentiles	WML = (SW + BW)/2 - (SL + BL)/2 = {(SW - SL) + (BW - BL)}/2

Note: We use stock data independently to allocate returns for market capitalization and take 2 sorts of median groups; 'S' small cap and 'B' big cap, for each year ended June 30 and Three groups as 30th percentile, and, 70^{th} percentile of returns data allocated for B/M; as 'L' Low, 'M' medium, and 'H' high value factors. For Liquidity (LiQ), the return data allocated for turnover by volume and divided as percentiles for 'L1' most illiquid, 'L2' liquid and 'L3' Most liquid, and for Momentum; the returns data allocated for performance and median of 'W' Winners, and 'L' Loosers. The VW portfolios of factors are formed by the intersection of the groups.

Table 2 presents the procedure of the construction of factors like ERM, SMB, HML, LiQ, and WML which cause variation in the portfolio returns. The factors construction has been adopted from combination of the two studies (Fama and French, 2015; Lam and Tam, 2011) in asset pricing explaining the results for developed and emerging markets. Following the Fama and French (2015) five factor model, the construction of the factors are based on size, whereas liquidity and momentum factors are followed with Lam and Tam (2011). Our motivation is to assess whether liquidity and momentum factors are priced for the asset pricing in PSX.

Final Results

Descriptive Statistics

Table 3 presents the descriptive statistics of the factors which are explanatory variables in the time series regression. The excess monthly average returns of the PSX are lower than those reported in the Fama and French (2015) and Lam and Tam (2011). The mean returns for ERM, HML, LiQ and WML are found significant. The average return effect of the Excess market returns (ERM) is -.07%, which is much lower than FF-03 factor (i.e. 0.49%) and Lam & Tam-05 factor (i.e. 1.19%). The mean return for SMB is 0.00187% as compared to 0.28% of Lam and Tam (2011). The mean return for HML is 0.05449% which is much lower to 0.83% of Lam and Tam (2011) and, same is the case for momentum and liquidity. This indicates that the PSX price evolution is much higher and the changes in returns as compared to the Lam and Tam (2011) are higher.

Table 3: The following figures are the descriptive statistics of the factors explaining the returns of the Pakistan Stock Exchange (PSX); Jan 2001 to December 2020. The factors are the Excess Market Return, Size, Value, Liquidity, Investment and momentum derived to explain the variation in the return

Variables	Mean	Std. dev.	t-stat.	Min	Max
ERM	-0.0707461	0.0910021	-12.04	-0.6037455	0.2659481
SMB	0.0000187	0.0049227	-0.06	-0.0464775	0.0207166
HML	0.0005449	0.0038629	2.19	-0.0146755	0.0234726
LiQ	-0.0029132	0.0087103	-5.18	-0.0836412	0.0171016
WML	-0.0011815	0.0036274	-5.05	-0.0292997	0.0139795

Table 4 reports pairwise correlations between the factors. The relationship of these factors is significant for ERM, SMB, HML, LiQ, and WML. The excess market returns have the positive relationship with the size, value, liquidity and the momentum factors i.e. 0.1769, 1.1441, 0.1966, and 0.2331, respectively. The relationship of HML, LiQ, and WML are positively correlated with the size 0.3639, 0.7535, and 0.2427, respectively.

Table 4: Pair wise correlation of the factors; Excess market returns, Size, Value, Liquidity, and Momentum affecting average monthly returns of the portfolios excess of the risk-free rate (KIBOR) The correlation of the factors of ERM, SMB, HML, LiQ and WML for the PSX stocks.

	ERM	SMB	HML	LiQ	WML
ERM	1.0000				
SMB	0.1769	1.0000			
	(0.0060)				
HML	1.1441	0.3639	1.0000		
	(0.0256)	(0.0000)			
LiQ	0.1966	0.7535	0.2215	1.0000	
	(0.0022)	(0.0000)	(0.0005)		
WML	0.2331	0.2427	0.1169	0.6816	1.0000
	(0.0003)	(0.0001)	(0.0706)	(0.0000)	

Note: The values in brackets are p-values.

This suggests that the size has direct relationship with HML as the small stocks have more value as compared to the big stocks. Also, the liquidity is of much significance in the developing markets which is positively correlated with the size. i.e. 0.1535. Liquidity of the stock increases for big size stock and decreases for small stock. The excess market returns have a positive and significant correlation with liquidity i.e. 0.1966, indicating a higher market return for the liquid stocks.

Three Factors Regressions

The empirical results of the regression are displayed in the Table 5, where the coefficients and constants are described to measure the performance of the factors explaining the variation in returns. Panel A of Table 5 depicts the results of the 25-value weighted monthly portfolio returns formed for Size and B/M, while Panel B represents 25 portfolios for Size and LiQ of PSX stocks from January 31, 2000 to December 31, 2020.

Table 5: The intercepts and coefficients using FF-03 factor equation model are taken for the 25 value weighted portfolios returns in each Panel A, B & C; Jan 2001 to Dec 2020, 240 months.

BM Quintile	Size Quintile									
RSB01-25	α					t(α)				
	1	2	3	4	5	1	2	3	4	5
Panel A										
1	0.034	0.040	0.044	0.038	0.042	5.42	6.05	5.79	5.99	7.74
2	0.031	0.039	0.011	0.004	-0.004	5.54	8.39	1.67	0.58	-0.54
3	0.019	0.015	0.011	0.004	-0.004	3.09	2.28	1.77	0.53	-0.50
4	-0.001	-0.005	-0.009	-0.016	-0.024	-0.09	-0.89	-1.46	-2.62	-2.71
5	0.010	0.014	0.018	0.025	0.033	1.28	2.32	3.08	3.49	3.43
	β					t(β)				
1	0.017	0.016	0.081	0.028	0.062	0.52	0.46	2.07	0.83	2.19
2	-0.010	0.000	-0.213	-0.149	-0.106	-0.33	0.00	-5.99	-4.43	-2.75
3	-0.017	-0.063	-0.093	-0.029	0.014	-0.51	-1.86	-2.80	-0.80	0.32

4	0.174	0.128	0.097	0.116	0.205	5.40	4.24	3.16	4.98	4.41
5	-0.258	-0.211	-0.181	-0.245	-0.288	-6.64	-6.62	-6.05	-6.48	-5.73
	s					t(*s*)				
1	0.207	-0.135	-1.600	-0.663	-0.362	0.38	-0.24	-2.46	-1.21	-0.78
2	-0.926	-1.258	0.939	0.023	-1.155	-1.89	-3.10	1.59	0.04	-1.81
3	-0.193	-0.217	1.158	0.241	-0.936	-0.35	-0.39	2.09	0.41	-1.32
4	-1.030	-1.055	0.320	-0.596	-1.773	-1.93	-2.11	0.63	-1.11	-2.31
5	1.409	1.434	0.059	0.975	2.152	2.19	2.72	0.12	1.56	2.59
	ɦ					t(ɦ)				
1	2.553	2.282	2.749	2.351	1.559	3.70	3.17	3.35	3.41	2.67
2	1.445	1.148	2.116	1.439	-1.227	2.34	2.25	2.85	2.06	-1.53
3	1.507	2.434	1.092	0.415	-2.251	2.20	3.44	1.57	0.55	-2.52
4	-0.269	0.658	-0.684	-1.361	-4.027	-0.40	1.05	-1.06	-2.01	-4.17
5	1.247	0.320	1.661	2.338	5.005	1.54	0.48	2.66	2.96	4.78
	R^2									
1	0.072	0.051	0.076	0.054	0.093					
2	0.030	0.061	0.161	0.089	0.083					
3	0.045	0.071	0.068	0.007	0.049					
4	0.115	0.081	0.050	0.116	0.168					
5	0.170	0.171	0.160	0.189	0.225					
RSL01-25										
Panel B	α					t(α)				
1	0.002	-0.005	-0.010	-0.015	-0.037	0.24	-0.63	-1.24	-1.62	-3.46
2	-0.006	0.001	0.007	0.011	0.034	-0.76	0.16	1.00	1.65	4.21
3	-0.006	0.001	0.006	0.011	0.034	-0.73	0.15	0.98	1.59	4.57
4	-0.026	-0.019	-0.014	-0.009	0.014	-3.24	-2.27	-2.10	-1.63	2.08
5	0.035	0.028	0.023	0.080	-0.005	4.33	3.15	2.89	2.42	-0.79
	β					t(β)				
1	-0.178	-0.102	0.199	0.367	0.638	-3.81	-2.69	4.77	7.86	11.41
2	0.204	0.129	-0.173	-0.340	-0.611	5.35	3.38	-5.08	-9.67	-14.63
3	0.324	0.249	-0.053	-0.220	-0.491	8.03	6.41	-1.55	-6.10	-12.80
4	0.515	0.440	0.138	-0.029	-0.300	12.48	10.12	4.11	-1.02	-8.80
5	-0.598	-0.523	-0.222	-0.054	0.217	-14.35	-11.32	-5.43	-1.40	7.18
	s					t(s)				
1	-1.783	-1.374	-2.375	-1.691	-3.145	-2.31	-2.18	-3.43	-2.19	-3.40
2	-0.449	-0.857	0.143	-0.541	0.913	-0.71	-1.36	0.25	-0.93	1.32
3	-0.230	-0.639	0.361	-0.322	1.132	-0.34	-0.99	0.64	-0.54	1.78
4	-1.067	-1.476	-0.476	-1.160	0.294	-1.56	-2.05	-0.86	-2.44	0.52
5	1.446	1.855	0.855	1.539	0.085	2.10	2.43	1.27	2.40	0.17
	ɦ					t(ɦ)				
1	0.355	-1.396	-0.809	-1.032	-2.055	0.37	-1.76	-0.93	-1.06	-1.76
2	0.279	2.031	1.443	1.667	2.689	0.35	2.55	2.04	2.27	3.09
3	-0.745	1.007	0.419	0.642	1.665	-0.89	1.24	0.59	0.85	2.08
4	-2.521	-0.769	-1.357	-1.133	-0.111	-2.93	-0.85	-1.94	-1.90	-0.16
5	3.498	1.747	2.334	2.111	1.088	4.02	1.81	2.74	2.61	1.73

	R^2				
1	0.096	0.099	0.125	0.213	0.366
2	0.111	0.078	0.111	0.302	0.483
3	0.221	0.167	0.023	0.145	0.417
4	0.407	0.304	0.082	0.090	0.254
5	0.482	0.359	0.141	0.095	0.213

Note: At the end of June each year, stocks are allocated to five size groups using PSX market cap quintiles (small to big). Same stocks allocated to five B/M groups of quintile returns of small BM to high BM. The difference of two sorts produces 25 portfolios for Size-BM. For Size-LiQ, the stocks are allocated independently to five liquidity groups, proxy to turnover, (low to high liquid) at the end of June each year. The difference of size and liquidity quintiles produce 25 sorts (Panel B). The LHS represents the returns of the value weighted portfolios of Size-BM, Size-LiQ and Size-Inv from July 2001 to December 2020, and RHS represents the explanatory risk elements of fama French 3-factor model including excess market returns, size and value.
$R_{pt} - R_{ft} = \alpha_t + \beta_t(ERM) + S_t(SMB) + \hbar_t(HML) + \varepsilon_{pt}$

The statistical insignificance (significance) of alpha '$\boldsymbol{\alpha_t}$' i.e. coefficient constant, shows whether the model is effective (ineffective) in explaining the return variations. Fifteen values of alpha in Panel A, and eleven in Panel B are significant, indicating that not all the return variations are captured by three-factor model. The mixed findings of the alpha represents that the model does not fully explain the variation for asset pricing in PSX. The positive intercepts suggest the outperformance of the model which is much dominant in panel A for the value stock. Thus, the model has rejected the null hypothesis ($H \neq 0$) of three factors towards excess returns in three sets of portfolio returns. It is also observed that there is a positive relationship of the risk proxies with small size stock returns and negative relationship with the big size stock returns in the PSX. The above results are in correspondence with the Fama-French five-factor (2015) model and the Lam and Tam (2011) four-factor model.
The value of beta '$\boldsymbol{\beta_t}$' is highly explanatory in the model as the 15 out of 25 portfolio regressions are significant in Panel A and 22 out of 25 in Panel B are significant. This suggests that CAPM has the significance to explain the variation in the portfolio returns where small size portfolio returns are negatively related and big size returns are positively related to market returns. There is positive relation of ERM with big size and high BM portfolio returns and negative to the small size and low BM and rest of others are found mixed in response in Panel A. Contrary to this, Panel B indicates a positive relationship of extreme small size and the most liquid stocks and the negative relationship with big size and most illiquid stock returns. This describes that there may be other factors affecting returns of PSX market.
The size factor '$\boldsymbol{S_t}$' is weakly explaining the relation with the returns of the portfolios for 9/25 in Panel A and 10/25 in B are significant. The SMB is positively related to small size and low BM stock and negatively related to big size and high BM stock in Panel A and B. Though a few of the responses are mixed in nature, yet the proximity is found significant in the said terms. Size has low significance in explaining the variation in monthly returns in PSX which is contrary to the Fama and French (2015) and Lam and Tam (2011).
The coefficients of HML **'$\boldsymbol{\hbar_t}$'** factor is significant as 15/25 and 8/24 are significant in Panel A and B, respectively. Value factor is positive in the extreme small-size and low-value stocks, and negative in the extreme big-size and high-value stocks of Panel A and B and the rest are of mixed results. The results of 'R^2' in Panel A and B appears as 7/25 and 12/25 respectively explaining the variation with some average values of 16-49%. Thus, we conclude the model adopted in PSX

security returns has low explanatory power. However, it can't be ignored as the factors affecting the returns are significant as indicated by the F-test.

Liquidity Adjusted Factors Regressions

The results in Table 6 exhibit the value of regression intercepts and the coefficients of the liquidity adjusted model for each of the 25 value-weighted monthly portfolios returns formed on size and B/M in Panel A, and size and LiQ in Panel B for the PSX stock from January 31, 2000 to December 31, 2020. 16 of 25 coefficients in Panel A, and 11 of 25 in Panel B are found significant.

The results indicate that the four factors, ERM, SMB, HML, and LiQ, significantly affect the returns. Thus, the model improves the explanation as compared to the three-factor model. The relationship of small and big stock portfolio returns with risk factors is explained positively, whereas, the low BM has positive relationship and high BM is negative in the PSX. The results correspond to those of the Lam & Tam (2014) four factor model. The value of beta '$\boldsymbol{\beta_t}$' is explanatory in this model with 16/25, and 22/25 of the coefficients are significant in Panel A, and B, respectively. There is positive relation of ERM with value stock and negative to the growth stock. However, the variations are in mixed response for Panel A and B.

Table 6: The intercepts and coefficients using FF-03 factor adjusted for liquidity model are taken for the 25 value weighted portfolios returns in each Panel A, B & C; Jan 2001 to Dec 2020

BM Quintile	Size Quintile									
RSB01-25	α					t(α)				
	1	2	3	4	5	1	2	3	4	5
Panel A										
1	0.035	0.037	0.038	0.036	0.041	5.41	5.45	4.97	5.50	7.34
2	0.032	0.037	0.010	0.001	-0.006	5.50	7.69	1.40	0.22	-0.77
3	0.020	0.016	0.014	0.006	-0.002	3.15	2.35	2.15	0.81	-0.19
4	-0.002	-0.007	-0.009	-0.017	-0.024	-0.38	-1.19	-1.43	-2.66	-2.67
5	0.009	0.014	0.016	0.024	0.031	1.23	2.24	2.68	3.23	3.17
	β					t(β)				
1	0.015	0.026	0.100	0.034	0.065	0.44	0.75	2.58	1.04	2.29
2	-0.012	0.008	-0.208	-0.142	-0.100	-0.39	0.34	-5.80	-4.20	-2.58
3	-0.020	-0.066	-0.102	-0.035	0.006	-0.59	-1.92	-3.04	-0.98	0.14
4	0.180	0.133	0.098	0.164	0.206	5.54	4.40	3.13	4.99	4.39
5	-0.257	-0.211	-0.175	-0.242	-0.283	-6.55	-6.54	-5.81	-6.31	-5.58
	s					t(s)				
1	-0.138	1.181	0.813	0.239	0.079	-0.17	1.42	0.87	0.30	0.12
2	-1.199	-0.184	1.573	0.921	-0.412	-1.67	-0.31	1.82	1.13	-0.44
3	-0.566	-0.565	0.059	-0.593	-1.926	-0.71	-0.69	0.07	-0.68	-1.86
4	-0.285	-0.285	0.340	-0.313	-1.645	-0.37	-0.39	0.45	-0.40	-1.46
5	1.460	1.460	0.835	1.488	2.820	1.55	1.88	1.15	1.62	2.31
	ɦ					t(ɦ)				
1	2.590	2.138	2.485	2.252	1.511	3.73	2.98	3.09	3.26	2.57
2	1.475	1.030	2.047	1.341	-1.309	2.38	2.03	2.74	1.91	-1.62
3	1.547	2.472	1.212	0.506	-2.143	2.24	3.47	1.74	0.68	-2.40

4	-0.351	0.574	-0.686	-1.392	-4.041	-0.52	0.91	-1.06	-2.04	-4.15
5	1.241	0.317	1.576	2.282	4.932	1.52	0.47	2.52	2.87	4.68
	l					t(l)				
1	0.256	-0.980	-1.797	-0.672	-0.328	0.58	-2.16	-3.54	-1.54	-0.89
2	0.203	-0.800	-0.472	-0.669	-0.553	0.52	-2.50	-1.00	-1.51	-1.09
3	0.278	0.260	0.819	0.622	0.738	0.64	0.58	1.86	1.31	1.31
4	-0.555	-0.573	-0.014	-0.211	-0.095	-1.31	-1.44	-0.03	-0.49	-0.16
5	-0.038	-0.020	-0.579	-0.382	-0.498	-0.07	-0.05	-1.47	-0.76	-0.75
	R^2									
1	0.073	0.069	0.123	0.064	0.096					
2	0.031	0.085	0.164	0.098	0.085					
3	0.046	0.072	0.082	0.014	0.056					
4	0.12	0.09	0.05	0.12	0.17					
5	0.17	0.17	0.17	0.19	0.23					
RSL01-25	α					t(α)				
	1	2	3	4	5	1	2	3	4	5
Panel B										
1	0.004	-0.001	-0.011	-0.015	-0.041	0.39	-0.19	-1.32	-1.65	-3.69
2	-0.009	-0.005	0.005	0.009	0.035	-1.27	-0.62	0.74	1.34	4.20
3	-0.005	-0.003	0.009	0.014	0.039	-0.66	-0.04	1.38	1.91	5.24
4	-0.028	-0.023	-0.014	-0.009	0.016	-3.45	-2.72	-2.05	-1.64	2.40
5	0.035	0.030	0.021	0.016	-0.009	4.26	3.31	2.57	2.14	-1.55
	β					t(β)				
1	-0.182	-0.112	0.202	0.369	0.648	-3.87	-2.93	4.79	7.82	11.51
2	0.216	0.146	-0.168	-0.334	-0.614	5.66	3.89	-4.89	-9.43	-14.54
3	0.323	0.253	-0.061	-0.228	-0.507	7.91	6.45	-1.79	-6.28	-13.33
4	0.522	0.452	0.138	-0.028	-0.308	12.56	10.40	4.07	-0.98	-8.96
5	-0.600	-0.530	-0.216	-0.049	0.230	-14.22	-11.36	-5.24	-1.25	7.72
	s					t(s)				
1	-2.346	-2.643	-2.000	-1.422	-1.794	-2.07	-2.88	-1.97	-1.25	-1.32
2	1.116	1.414	0.770	0.193	0.565	1.22	1.56	0.93	2.16	0.56
3	-0.398	-0.100	-0.744	-1.321	-0.949	-0.41	-0.11	-0.91	-1.51	-1.04
4	-0.117	0.180	-0.463	-1.041	-0.669	-0.12	0.17	-0.57	-1.49	-0.81
5	1.292	0.995	1.638	2.216	1.844	1.27	0.89	1.66	2.35	2.57
	ɦ					t(ɦ)				
1	0.417	-1.258	-0.850	-1.06	-2.20	0.43	-1.59	-0.97	-1.08	-1.88
2	0.108	1.782	1.374	1.586	2.727	0.14	2.28	1.93	2.16	3.11
3	-0.727	0.948	0.540	0.752	1.893	-0.86	1.16	0.76	1.00	2.40
4	-2.625	-0.950	-1.358	-1.146	-0.006	-3.04	-1.05	-1.93	-1.91	-0.01
5	3.515	1.841	2.638	2.037	0.896	4.02	1.90	2.63	2.51	1.45
	l					t(l)				
1	0.419	0.945	-0.279	-0.200	-1.006	0.68	1.89	-0.50	-0.32	-1.36
2	-1.166	-1.692	-0.468	-0.546	0.259	-2.33	-3.43	-1.04	-1.18	0.47
3	0.125	-0.401	0.823	0.744	1.550	0.23	-0.78	1.84	1.57	3.11
4	-0.708	-1.234	-0.010	-0.088	0.717	-1.30	-2.17	-0.02	-0.23	1.60

5	0.115	0.641	-0.583	-0.504	-1.310	0.21	1.05	-1.08	-0.98	-3.35
	R^2									
1	0.098	0.112	0.126	0.213	0.371					
2	0.131	0.122	0.115	0.306	0.484					
3	0.222	0.169	0.036	0.154	0.440					
4	0.41	0.32	0.08	0.09	0.26					
5	0.47	0.36	0.14	0.10	0.25					

Note: The LHS represents the monthly returns of the value weighted portfolios of Size-BM, Size-LiQ and Size-Inv from January 2001 to December 2020, and RHS represents the explanatory risk elements of fama French 3-factor model including Excess market returns, Size, value and liquidity as following in Lam and Tam Four factor model i.e. $R_{pt} - R_{ft} = \alpha_t + \beta_t(ERM) + S_t(SMB) + ɦ_t(HML) + l_t(LiQ) + \varepsilon_p$

In the liquidity-adjusted model, the size factor exhibits a distinguished characteristic by showing the minimal relationship with the portfolio returns. Panel A and B of Table 6, show that 1/25, and 6/25 respectively are significant exhibiting weak explanation of the factor. In comparison to the previous three-factor model, the SMB factor is least adjusted. Results for the HML factor are consistent in both sets of the portfolio returns as the coefficients of '***ɦ***' showing significance in 16/25 and 8/24 in Panel A and B respectively. The HML factor is positive in small size and low value stock, and negative in the big size and high value stock shown in Panel A and B. Rest of the results pertaining to HML are mixed. The liquidity coefficient '***l***', reported in Table 6, represents the variation in returns due to liquidity risk. The values for the coefficient are significant but the model performance is relatively weak in comparison to Lam and Tam (2011). This is substantiated by the results shown in Panel A and B where 3/25 and 5/25 of the coefficients are significant. The big stocks are more liquid than the small stocks. The value of 'R^2' exhibit the results fluctuate between 16% and 49% in Panel A and B. This is evident that the aggregate risk factor towards return is least priced, yet significant, and the big size portfolios returns are better explained in comparison to small size returns.

Three Factor with Momentum

The results of intercepts and the coefficients of regressions for the momentum-based model are given in Table 7. The value of alpha 'α_t' varies in number of responses significantly as compared to three-factor, and liquidity-adjusted models. The fifteen intercepts in panel A and ten in panel B, are significant. This model also significantly explains the risk factors. There is a significant positive relationship of the risk factors with big-size stock returns in the PSX. The coefficient of beta 'β_t' is highly explanatory as 16/25, and 21/25 in Panel A and B, respectively are significant. This shows that the market returns have the strong influence on the portfolio returns. The ERM has a positive relation with the returns of high-value and high-growth stocks and a positive relation with stock size. The results for SMB 'S_t' contained in Panel A, and B reveal notable significance of 23/25 and 20/25 coefficients, respectively. Compared to other models, the SMB has shown greater strength in relationship with the returns. It shows a positive relation with the big-size stock returns and low relationship with small stock in the PSX. Findings about HML suggest that the coefficient of HML '$ɦ_t$' is consistent in all the sets of the portfolio returns as 17/25 and 9/24 are significant in Panel A and B, respectively. The value factor shows a positive relationship with extreme high value stock returns and negative with extreme growth stock returns whereas the rest of the effects are mixed. Next, we report the coefficient of momentum '***w***' in Table 7. The results for Panel A and B show 6/25 and 4/25 coefficients significant, respectively. The number of outcomes suggests a weak but significant factor. The relationship of momentum is inverse with big size stock portfolio returns. The results for the small stock, however, turn least explanatory. The 'R^2' values exhibit that the momentum-adjusted model weakly, yet significantly, capture the variation. The values vary from 17% to 24% for panel A and from 16 to 50% in panel B. The momentum-adjusted model has improved performance in all the factors as compared to the three-factor and liquidity-adjusted models.

Table 7: The intercepts and coefficients using FF-03 factor with Investment factor are taken for the 25 value weighted portfolios returns in each Panel A, B & C for PSX stocks; Jan 2001 to Dec 2020.

BM Quintile	Size Quintile									
RSB01-25	α					t(α)				
	1	2	3	4	5	1	2	3	4	5
Panel A										
1	0.036	0.039	0.041	0.036	0.041	5.54	5.79	5.43	5.70	7.61
2	0.032	0.037	0.010	0.003	-0.004	5.66	7.99	1.38	0.40	-0.59
3	0.021	0.015	0.011	0.004	-0.003	3.30	2.21	1.67	0.57	-0.37
4	0.000	-0.006	-0.010	-0.017	-0.024	0.01	-1.08	-1.69	-2.68	-2.67
5	0.006	0.012	0.016	0.023	0.030	0.81	2.01	2.79	3.15	3.10
	β					t(β)				
1	0.009	0.026	0.102	0.039	0.063	0.26	0.74	2.55	1.17	2.20
2	-0.017	0.016	-0.199	-0.140	-0.103	-0.57	0.64	-5.48	-4.09	-2.59
3	-0.028	-0.061	-0.090	-0.031	0.006	-0.85	-1.76	-2.62	-0.86	0.14
4	0.169	0.137	0.108	0.166	0.204	5.14	4.44	3.44	4.99	4.29
5	-0.230	-0.197	-0.169	-0.227	-0.265	-5.91	-6.08	-5.54	-5.90	-5.19
	s					t(s)				
1	0.088	0.010	-1.316	-0.497	-0.339	0.16	0.02	-2.01	-0.90	-0.72
2	-1.035	-1.034	1.148	0.142	-1.105	-2.08	-2.55	1.92	0.25	-1.70
3	-0.357	-0.188	1.210	0.205	-1.043	-0.65	-0.33	2.15	0.34	-1.45
4	-1.095	-0.926	0.473	-0.533	-1.780	-2.02	-1.83	0.91	-0.97	-2.28
5	1.800	1.631	0.233	1.238	2.486	2.81	3.06	0.46	1.96	2.96
	ɦ					t(ɦ)				
1	2.538	2.300	2.783	2.371	1.562	3.68	3.20	3.43	3.45	2.66
2	1.432	1.175	2.141	1.453	-1.221	2.32	2.34	2.90	2.08	-1.51
3	1.487	2.437	1.098	0.410	-2.264	2.18	3.43	1.57	0.55	-2.54
4	-0.277	0.673	-0.665	-1.353	-4.028	-0.41	1.07	-1.04	-1.99	-4.16
5	1.294	0.344	1.682	2.370	5.045	1.63	0.52	2.71	3.03	4.85
	w					t(w)				
1	0.837	-1.023	-2.001	-1.175	-0.158	1.16	-1.36	-2.36	-1.64	-0.26
2	0.764	-1.576	-1.469	-0.843	-0.349	1.19	-3.01	-1.91	-1.16	-0.41
3	1.163	-0.202	-0.368	0.259	0.753	1.63	-0.27	-0.51	0.33	0.81
4	0.455	-0.910	-1.076	-0.449	0.045	0.65	-1.39	-1.61	-0.63	0.04
5	-2.760	-1.396	-1.230	-1.856	-2.350	-3.34	-2.03	-1.90	-2.27	-2.17
	R^2									
1	0.077	0.058	0.097	0.065	0.094					
2	0.036	0.096	0.173	0.094	0.082					

3	0.055	0.071	0.069	0.007	0.051					
4	0.12	0.09	0.06	0.12	0.17					
5	0.21	0.18	0.17	0.21	0.24					
RSL01-25	α					t(α)				
	1	2	3	4	5	1	2	3	4	5
Panel B										
1	0.004	-0.002	-0.009	-0.012	-3.300	0.40	-0.27	-1.16	-1.36	-0.04
2	-0.006	-0.001	0.007	0.009	0.033	-0.86	-0.11	1.00	1.39	4.08
3	-0.005	0.001	0.008	0.011	0.034	-0.64	0.07	1.21	1.54	4.62
4	-0.026	-0.020	-0.013	-0.010	0.013	-3.24	-2.42	-1.99	-1.82	2.03
5	0.032	0.026	0.019	0.016	-0.007	3.99	2.95	2.44	2.15	-1.30
	β					t(β)				
1	-0.189	-0.123	0.195	0.349	0.628	-3.97	-3.18	4.55	7.35	10.96
2	0.211	3.710	-0.173	-0.328	-0.606	5.39	0.14	-4.97	-9.13	-14.16
3	0.320	0.253	-0.064	-0.219	-0.497	7.73	6.36	-1.85	-5.92	-12.64
4	0.517	0.451	0.134	-0.021	-0.299	12.23	10.16	3.88	-0.72	-8.55
5	-0.578	-0.511	-0.194	-0.040	0.024	-13.66	-10.83	-4.74	-1.00	7.89
	S					t(s)				
1	-1.945	-1.662	-2.437	-1.937	-3.288	-2.48	-2.62	-3.46	-2.48	-3.49
2	-0.357	-0.640	0.135	-0.366	0.986	-0.55	-1.00	0.24	-0.62	1.40
3	-0.294	-0.578	0.197	-0.303	1.049	-0.43	-0.88	0.35	-0.50	1.62
4	-1.032	-1.315	-0.540	-1.040	0.311	-1.48	-1.80	-0.95	-2.16	0.54
5	1.737	2.021	1.246	1.746	0.394	2.50	2.60	1.85	2.69	0.79
	ɦ					t(ɦ)				
1	0.336	-1.431	-0.816	-1.062	-2.072	0.35	-1.82	-0.93	-1.10	-1.78
2	0.290	2.057	1.442	1.688	2.698	0.36	2.60	2.03	2.31	3.09
3	-0.753	1.014	0.399	0.645	1.655	-0.89	1.25	0.56	0.85	2.06
4	-2.517	-0.750	-1.365	-1.119	-0.109	-2.92	-0.83	-1.94	-1.87	-0.15
5	3.533	1.767	2.382	2.136	1.126	4.10	1.83	2.85	2.65	1.83
	w					t(w)				
1	1.144	2.031	0.441	1.732	1.013	1.13	2.48	0.48	1.71	0.83
2	-0.647	-1.534	0.057	-1.235	-0.515	-0.78	-1.86	0.08	-1.62	-0.57
3	0.455	-0.432	1.159	-0.133	0.587	0.52	-0.51	1.57	-0.17	0.70
4	-0.253	-1.140	0.451	-0.841	-0.121	-0.28	-1.21	0.62	-1.35	-0.16
5	-2.052	-1.166	-2.756	-1.464	-2.184	-2.28	-1.16	-3.16	-1.74	-3.40
	R^2									
1	0.101	0.122	0.126	0.223	0.368					
2	0.113	0.091	0.111	0.310	0.484					
3	0.222	0.168	0.033	0.145	0.418					
4	0.408	0.309	0.083	0.097	0.254					
5	0.494	0.362	0.176	0.107	0.250					

Note: The LHS represents the monthly returns of the value weighted portfolios of Size-BM, Size-LiQ and Size-Inv for PSX, and the RHS represents the explanatory risk elements of fama French 3-factor model including Excess market returns, Size, Value and Momentum i.e.

$R_{pt} - R_{ft} = \alpha_t + \beta_t(ERM) + S_t(SMB) + ɦ_t(HML) + w_t(WML) + \varepsilon_{pt}$

Liquidity and Momentum Adjusted with Three Factor

Finally, we report our findings for the five-factor model based on ERM, SMB, HML, LiQ, and WML. This model could not improve the explanation for the variation in portfolio returns as the redundance of HML factor rises which restricts the overall performance of the model. The results of the liquidity adjusted three-factor model and the momentum-adjusted model remained more relevant in the case of PSX. It is safe to conclude that the returns adjusted for excess market returns, size, illiquidity and the momentum are significant factors for explaining portfolio returns of PSX stocks. The redundance of the value factor, restricting the explanation of the five-factor model, corresponds to the findings of Fama-French (2015). For the sake of brevity, therefore, the results of the model are not presented.

GRS F-Test Results

To test the overall performance of the models, we applied the GRS F-test on all the value-weighted returns formation, i.e. Panel A and B. This tests whether the value of the alpha ‘α’ is jointly and significantly equals to zero. The results for the three-factor model, liquidity-adjusted model, and the momentum-based models are found significant, which enhances the validity of the explanatory power of these models. These results correspond to Lam and Tam (2011) and contrast the Fama and French (2015) five factor model.

Conclusion

The objective of the study is to assess the causal relationship between portfolio returns and the factors of the excess market returns, size, value, liquidity and momentum for one of the emerging South Asian markets, i.e. Pakistan. The study employs monthly data of non-financial firms of PSX extracted from the Thompson Reuters database for the period of January 2001 to December 2020. The returns data has been employed to formulate two panels of 25 value-weighted average portfolio returns on the basis of the size-BM and size-liquidity each for each month. These returns are then assessed for adjusting returns on beta, size, value, liquidity and momentum following Fama French (2015) and Lam and Tam (2011).

The three-factor model validates the exposure of the well documented risk factors of Fama and French (1993) as these factors are priced in PSX with an average explanatory power. The ERM and HML factors are more relevant in capturing the variations, whereas the impact of SMB is significantly low for PSX stocks. GRS F-test validates the results as significant for both of the return panels. The results of liquidity-adjusted model are also significant but size remain a weak factor to adjust variation in the returns in size-BM panel. However, the GRS F-test results still remain significant. This suggests that the model performance improves compared to the three-factor model. The findings for the momentum-based model have been found significant. The results of the GRS F-test are found valid for the first panel of returns and insignificant for the other. Finally, combining liquidity and momentum factors along with three factors could not improve the overall performance of the model. The redundancy in the value factor has been observed for higher influence of the factor which lowers the explanatory power of the factors which are priced.

Since the PSX is a volatile market, this leads to inconsistent pattern in terms of significance of the various asset pricing models applied in this study. The results are limited to the availability of the data of the PSX. The returns variation in monthly set up could not explain much of the time series variations. The alternate return frequency for fortnightly, weekly, or daily may produce more robust results.

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