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# Investor sentiment, momentum, and stock returns: an examination for direct and indirect effects

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**ABSTRACT**

This paper aims to analyse the impact of behavioural biases on asset pricing by hypothesising that sentiment and momentum are relevant risk factors in Pakistan equity market. The paper also examines the influence of sentiment and momentum factors on market risk, size, and value premiums by estimating the interacted asset-pricing model. To carry out the empirical analysis, monthly stock returns of firms listed on Pakistan Stock Exchange are used for the period 2000–2013. The empirical results indicate that both investor sentiment and momentum factors have a significant impact on the required rate of returns. Specifically, it is found that the premium for both factors is positive and statistically significant. Further, the estimated results provide evidence that the inclusion of these two factors in the Fama-French three-factor model considerably increases the prediction power of the model. The results also reveal that the inclusion of sentiment factor in the Carhart four-factor model significantly increases the prediction power of the model. Yet, the estimation results indicate that the prediction power of the model further increases when the interaction terms are added to the model in order to examine the indirect effects of sentiment and momentum. The results of the interacted model provide evidence of a significant impact of investor sentiment and momentum factors on market risk, size, and value premiums. Although investor sentiment negatively affects all the three premiums, the effect of momentum is positive for both market risk and size premium, whereas, it is negative for value premium. The findings are helpful in explaining and understanding the effects of behavioural biases on stock returns in Pakistan. The findings of the indirect effects suggest that investor sentiment and momentum factors significantly increase the chance of mispricing in Pakistan equity market.

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## 1. Introduction

The framework of standard finance assumes fair securities valuation in financial markets mainly due to the existence of rational traders and informationally efficient

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working of the markets. Traders are considered rational enough to mitigate the influence of any irrational trading. It is further assumed that all investors have same expectations and do almost similar reactions to new information. Furthermore, according to standard finance, if due to any irrational investment decision stock price deviates from its fundamental value, then arbitrageurs play their role and instantly bring the price back at the equilibrium level. Thus, the rationality of investors and the efficiency of markets both are central and essential for establishing and maintaining equilibrium conditions, which is a main part of classical financial doctrine.

The standard capital asset-pricing models imply that the determination of capital asset prices is an unbiased process, which is primarily based on investors' attitude towards risk and the maximisation of expected utility.[1] However, it has been widely argued that the standard asset-pricing models cannot fully explain stylised patterns of stock returns due to the existence of a huge gap in theory and practice. Principally, these models are based on several unrealistic assumptions. These assumptions include financial markets are efficient and frictionless, investors are rational and risk averse whose utility functions are better approximated by quadratic utility functions (Markowitz, 1959), investors are price takers and have homogeneous expectations about asset returns, informations are costless and simultaneously available to all investors, and investors select risky assets based on the mean-variance approach.

Nevertheless, the empirical results for these theoretically widely accepted models are not very encouraging, reflecting failure of their theoretical basis. Several researches argue that the standard one-factor capital asset-pricing model (hereafter CAPM) is insufficient in explaining cross-sectional variations in expected stock returns (see, for example, among several others, Harvey, 1995; Michailidis, Tsopoglou, & Papanastasiou, 2006; Miller & Bromiley, 1990; Novak & Peter, 2011; Strugnell, Gilbert, & Kruger, 2011; Ward & Muller, 2013).[2]

The empirical failure of these models is largely due to the assumption of rational and unemotional investors. In the real world, investors are distracted due to their judgmental and emotional biases. The advocates of standard finance are unable to explain several historical financial markets' crashes and bubbles in the framework of conventional finance theories. In these uncertain events, asset prices significantly deviate from their fundamental values. However, classical asset pricing models have largely been failed to explain or predict these price deviations. For example, black Monday in 1987, tech bubble crash in 2000, and the 2007–2008 global financial crisis put a question mark on the empirical validity of standard asset-pricing models and the efficient market hypothesis and highlight the role of behavioural biases or investor sentiment in the determination of stock prices.[3]

Irrational trading is one of the possible reasons for price deviation from the fundamental value, particularly in periods of adverse shocks. Due to limited purchasing power, short-sale constraints, and restricted risk-bearing capacities, arbitrageurs often failed to bring prices back to their intrinsic value. Indeed, as stated by Shiller (1987), the one of major reasons of stock price fluctuation is irrational investment decision-making of investors rather than any change in fundamental value of firms. On the other end of the spectrum, according to the proponents of the theory of market efficiency, stock prices are fairly determined by market forces (demand and supply) and it is almost impossible to predict future stock prices by using any kind of historical, publicly available, or private information (Fama, 1965).

Recent empirical evidence indicates that although it is hard to beat the market every time, there are some possibilities to predict excess stock returns. In fact, several recent studies have documented that stock returns can be predicted by using the information on investor sentiment.[4] Therefore, over the decades, practitioners, financial analysts, and academic scholars have put forth a great deal of effort in the area of the predictability of stock returns. Several risk factors such as value factor, size factor, profitability factor, liquidity factor, investor sentiment, momentum factor, etc. have been identified that are significant in explaining cross-sectional variations in stock returns and significantly priced in the equity market over and above the market factor (alias market beta).

Only systematic risk or market risk is taken as a relevant risk factor in the standard CAPM. However, human and emotional biases exert a major influence on asset pricing, which is termed as noise trader risk. Human error has a persistent and prolonged effect on stock pricing. Noise traders are normal investors who are very likely to give more weight to subjective measures or behavioural biases. Researchers relax the rigorous assumptions of the standard finance theory and expand the asset-pricing models by including sentiment biases (e.g., investor sentiment and momentum) for improving the predictability of asset returns.

By reviewing the empirical literature, it is observed that multi-factors asset-pricing models such as the Fama-French three- and five-factor model and the Carhart four-factor model are well estimated for developed countries.[5] However, there has been little empirical work done on the validity of these multi-factors models for developing and emerging equity markets such as Pakistan. Yet, empirical evidence from these markets will definitely help us to enhance further our understanding of asset pricing. Therefore, this paper aims to expand the Carhart model by adding investor sentiment in order to better explain stock returns in Pakistan. The paper also examines the influence of sentiment and momentum factors on market risk, size, and value premiums by estimating the interacted asset-pricing model. To carry out the empirical analysis, monthly stock returns of a large sample of non-financial firms listed on Pakistan Stock Exchange (hereafter PSX) are used for the period 2000–2013. To the best of our knowledge, this paper provides first-hand empirical evidence on asset pricing for Pakistan by adding investor sentiment factor to the Carhart four-factor model and by interacting both momentum and sentiment factors to market, size, and value factors.

The empirical results indicate that both investor sentiment and momentum factors have a significant impact on the required rate of return. Specifically, it is found that the premium for both factors is positive and statistically significant. Further, the estimated results provide evidence that the inclusion of these two factors in the Fama-French three-factor model considerably increases the prediction power of the model. The results of the interacted model provide evidence of a significant impact of investor sentiment and momentum factors on market risk, size, and value premiums. Although investor sentiment negatively affects all the three premiums, the effect of momentum is positive for both market risk and size premium, whereas, it is negative for value premium.

Excess volatility of stock returns indicates the existence of high investor sentiment in stock markets, which may cause deviation of market prices of stocks from their intrinsic value. Theoretically, it is expected that investor sentiment has a strong, significant impact on asset prices and can result in substantial deviations of stock prices from the fundamental value. Another possible channel is that investor sentiment affects trading activity, which, in turn, influences stock prices (Wu, Liu, & Chen, 2016). Furthermore, some scholars argue that investor sentiment significantly affects investment and financing decisions of individuals, affecting their buying, selling, and holding decisions, which ultimately affects stock prices (McLean & Zhao, 2014)

This paper contributes to the literature of asset pricing in many ways. Review of the existent literature reveals limited evidence on the influence of sentiment and momentum effect on asset pricing for PSX. It also proposes a novel approach to inspect whether these factors have a tendency to influence the other risk factors, namely, risk premium, value premium, and size premium. Research on how behavioural biases play a role in determining asset prices is at the very early stage in most of developing countries, like Pakistan. Yet, in principle, investment decisions in developing and emerging markets are more likely to suffer from behavioural biases. In this context, Pakistan's equity market provides us an interesting laboratory for empirical analysis of the role of investor sentiment and momentum in stock price determination.

The rest of the paper is structured as follows. Section 2 presents a brief literature review. Section 3 presents the empirical framework. Section 4 presents the empirical results. Finally, Section 5 concludes the paper.

## 2. Literature review

Traditional asset pricing requires stock markets to be efficient based upon the assumption that all economic agents have homogenous expectations. However, the accuracy of CAPM in return prediction is doubtful (Berk & Van Binsbergen, 2016). Normal investors are not always in a position to follow rational strategies of profit maximisation due to the effect of personal choices and emotions (Statman, 2014). Cooper and Priestley (2013) considered the role of behavioural factors in asset pricing. They argued that sentiment factor has a significant prediction power. Therefore, the incorporation of behavioural biases into asset pricing models will certainly enhance the prediction ability of the model. In the standard CAPM, a single risk factor termed as beta (β) is considered to accommodate all kind of risk factors. However, Fama and French (1992) presented a three-factor model, which includes a risk premium, size, and value factor. Nevertheless, according to Statman (2014), behavioural asset pricing model (henceforth BAPM) takes these three-risk-factors as a reflection of human biases.

Fama and French (1992) interpreted size and value as common risk factors that can explain the return differential in stock returns. Small stocks are too risky. Therefore, they need compensation for risk. Normal investors increase demand for stocks of big firms with the expectation of higher future returns and these stocks become high-priced in the stock market. Higher prices of stocks result in lower returns along with higher-risk factor involved. Thus, size factor negatively relates to stock returns. Investors become excessively optimistic and confident for shares those have high market capitalisation (Finter & Ruenzi, 2012; Statman, 2014). Fama and French (1993) confirmed that both size and value factor explain cross-section variations in expected returns.

From a behavioural perspective, the low return of a small stock is interpreted quite differently. Stocks with low book to equity ratio are termed as glamour stocks because investors perceive them as a good opportunity to invest. Investors formulate beliefs about future returns by extrapolating past return series (Barberis, Greenwood, Jin, & Shleifer, 2015). However, these overvalued stocks earn less return in comparison to undervalue stocks (Statman, 2014). Excess return accumulated by value firms is high enough to be just explained by the market risk factor (Fama & French, 1992). Irrational traders drive up market prices of high book-to-market equity stocks by increasing their demand for such stocks. Investors' wrong expectations result in higher earning of value stocks and lower earning for glamour stocks. Greater information asymmetry among investors generates a conservative response to new information and delays the price adjustment mechanism (Chen, Lee, & Shih, 2016).

Bondt and Thaler (1985) examined long-term reversal, supporting the overreaction hypothesis. They stated that investors are likely to overreact to unexpected and dramatic news events. Their findings help us to understand why prior 'winners' and 'losers' earned return in the month of January. One possible explanation of momentum effect in stock returns is an overreaction (Byun, Lim, & Yun, 2016). Winner stocks continue to earn more than loser stocks (Jegadeesh & Titman, 1993, 2001). Momentum strategy provides an opportunity to informed investors for accumulating excess returns by taking a long position on winner stocks. Momentum effect exists due to the overconfident behaviour of individuals (Barberis, Shleifer, & Vishny, 1998; Daniel, Hirshleifer, & Subrahmanyam, 1998). Momentum profits can be accumulated in liquid markets. Higher market liquidity or higher trade indicates the prevalence of investors' behavioral biases in the market (Chan, Hameed, & Tong, 2000; Hong & Stein, 2007).

Chen et al. (2014) have provided strong evidence on the persistent momentum effect in sock earnings. Furthermore, it is evident that the persistent momentum effect remains robust even after adjustment for risk factors (Chen, Chou, & Hsieh, 2016). Several scholars are of the view that investor sentiment not only explains the reasons for the existence of other risk factors like size, value, and momentum. It also directly affects the stock returns and is one of the basic determinants in explaining the risk-return relationship. Statman (2014) ascertained that investors classify stocks as stocks of good (big and growth) and bad (small and value) companies. They depress the market price of bad stocks and follow the social contagion (Statman, Fisher, & Anginer, 2008). Uhl (2014) also established that behavioural biases could disguise the process of market adjustment. The sentimental wave can disvalue the stocks in the market; so the stocks are not necessarily always, contemporaneously, and fully reflecting the all publicly available informations (Shefrin, 2015; Uhl, 2014; Zhang, 2008). Along with limited rationality, investors suffer from overconfidence problem. These cognitive biases cause different types of anomalies in financial markets.

Verardo (2009) argued that heterogeneous beliefs of investors lead to strong momentum effect. To identify the money making opportunities, it is necessary to have a pricing mechanism, which incorporates investor sentiment (Schaul, 2013).

Fluctuation in sentiment can cause mispricing and it brings an inverse effect on returns in a subsequent period. The sentiment-return relationship varies across safe and risky stocks. Stock returns for risky stocks are more likely to be dependent on sentimental shocks (Watanabe, Xu, Yao, & Yu, 2013).

# 3. Empirical framework

## 3.1. Data and empirical models

Monthly stock return data for non-financial firms of Pakistan Stock Exchange covering the period 2000–2013 are used in this paper to carry out the empirical analysis. The main data sources are Pakistan Stock Exchange (PSX) and State Bank of Pakistan (SBP).

### 3.1.1. Fama-French three-factor model

First of all, the Fama and French 3-factor model has been estimated.

$$R_{it} = R_f + \beta_1(RP_t) + \beta_2(SMB_t) + \beta_3(HML_t) + \varepsilon_t \tag{1}$$

where 'i' represents non-financial firms and 't' denotes time period. $R_f$ and $RP_{it}$ symbolise the risk-free rate and risk premium, respectively. Monthly T-bill rates are used as a proxy for the risk-free rate ( $R_f$). $RP_{it}$ is a premium for taking extra risk by investing in risky stocks. Risk premium is measured by subtracting risk free rate from the market rate of return ($R_m - R_f$). SMB symbolises the difference in return of small-portfolios (stocks of less capitalised firms) and big-portfolios (stocks of firms having large market capitalisation). HML shows the value premium, which is the extra return attributed to the difference of the book to market ratio, stock return for high book to market (hereafter B-M) stocks minus stock return for low B-M stocks. For measurement of size effect, portfolios are built by using the market capitalisation of firms and stocks are further divided into big and small stocks. For measurement of value effect, the book to market ratio has been used. SMB is calculated by subtracting big stocks' monthly average return from average monthly returns of small stocks. Similarly, three classes of stocks are introduced according to the book to market ratio. Stocks with higher B-M ratio are termed as value stocks (Highest 30%). Those firms' stocks that have 30% lowest of B-M ratio are supposed to hold glamour stocks. Remaining 40% are termed as middle stocks. Factors are calculated by using both value weights and equal weights.

### 3.1.2. Carhart four-factor model

After having estimated the Fama-French model, the model proposed by Carhart (1997) is estimated. He introduces four-factor model by adding a new factor, namely momentum factor in the Fama-French three-factor model. The model is expressed as follows.

$$R_{it} = R_f + \beta_1(RP_t) + \beta_2(SMB_t) + \beta_3(HML_t) + \varphi\ (\mathrm{WML_t}) + \varepsilon_{it} \tag{2}$$

In this model, new factor WML is introduced. It denotes winner minus loser, which signifies the higher return due to the presence of momentum effect. For the creation of momentum factor, all stocks included in the sample are first classified into winner and loser stocks. Excess returns for each stock in every month are defined as $(R_i - R_m)$. Cumulative excess returns for past 11 months are then arranged in order to formulate three portfolios: winner (Top 30% firms), loser (Lowest 30% firms), and neutral (Mid 40% firms).

### 3.1.3. Augmented asset-pricing model

To examine the effect of investor sentiment and momentum on stock return determination we expand the Carhart model by including sentiment as an additional risk factor. The model takes the following form.

$$R_{it} = R_f + \beta_1(RP_t) + \beta_2(SMB_t) + \beta_3(HML_t) + \gamma(\mathrm{HSMLS_t}) + \varphi(\mathrm{WLM_t}) + \varepsilon_{it} \tag{3}$$

where H$SMLS$ indicates the difference in more sentiment-sensitive stocks and less sentiment-sensitive stocks. Stocks based on national sentiment index are also divided into three classes: high-sentiment stocks, mild-sentiment stocks, and low-sentiment stocks.

### 3.1.4. The interacted asset-pricing model

Market risk premium, size premium, and value premium are likely to be influenced by sentiment and momentum factors. Specifically, to examine the impact of sentiment and momentum on these premiums, $\beta_1, \beta_2$, and $\beta_3$ are regressed on a measure of national sentiment ($HSMLS_t$) and momentum ($\mathrm{WLM_t}$).

$$\beta_1 = \alpha_1 + \gamma_1 \mathrm{H}SMLS_t + \varphi_1 \mathrm{WML}_t + \varepsilon_t$$

$$\beta_2 = \alpha_2 + \gamma_2 \mathrm{H}SMLS_t + \varphi_2 \mathrm{WML}_t + \varepsilon_t$$

$$\beta_3 = \alpha_3 + \gamma_3 \mathrm{H}SMLS_t + \varphi_3 \mathrm{WML}_t + \varepsilon_t$$

By putting value on $\beta_1$, $\beta_2$, *and* $\beta_3$ in Equation (3), the indirect impact of sentiment and momentum on asset pricing is estimated. Accordingly, the interacted model takes the following form.

$$\begin{aligned} R_{it} = R_f + \alpha_1 RP_t + \alpha_2 SMB_t + \alpha_3 HML_t + \gamma \mathrm{H}SMLS_t + \varphi WML_t + \gamma_1 \mathrm{H}SMLS_t \\ \times RP_t + \gamma_2 \mathrm{H}SMLS_t \times SMB_t + \gamma_3 \mathrm{H}SMLS_t \times HML_t + \varphi_1 WML_t \times RP_t \\ + \varphi_2 WML_t \times SMB_t + \varphi_3 WML_t \times HML_t + \varepsilon_{it} \end{aligned} \tag{4}$$

In above-mentioned models, decomposed factors are used by intersecting portfolios of size and value, size and momentum, and last size and momentum. This procedure results in six portfolios for each combination and then these are used to construct the factors as follows.

$$\mathrm{SMB} = \frac{(\mathrm{SL} + \mathrm{SM} + \mathrm{SH})}{3} - \frac{(\mathrm{BL} + \mathrm{BM} + \mathrm{BH})}{3}$$

$$\text{HML} = \frac{\text{SH} + \text{BH}}{2} - \frac{\text{SL} + \text{BL}}{2}$$

$$\text{HSMLS} = \frac{S_{opt} + B_{opt}}{2} - \frac{S_{pess} + B_{pess}}{2}$$

$$\text{WML} = \frac{\text{SW} + \text{BW}}{2} - \frac{\text{SL} + \text{BL}}{2}$$

### 3.2. Sentiment proxies

The investor sentiment is not straightforward to measure due to diversity in concepts about the sentiment and so about the measures. Reviewing the literature we find that there are various tools to measure the impact of sentiment. Researchers have used different instruments, which can be broadly classified as the direct and indirect measures. Direct measures are those who can directly measure the investor mood and beliefs about the market, for example, investor surveys and mood proxies. Indirect proxies measure the behaviour of economic agents with the analysis of fluctuations in the equity market. These proxies have the following pros and cons.

a. Different researchers such as Brown and Cliff (2004) have used Investor Survey. The survey is a direct response from individuals and it represents their attitude. Individuals tend to conceal their actual views. Thus, they respond differently to questions from their actual behaviour. Burghardt (2011) mentioned various sources of potential error in survey findings, which can be due to the interviewer, interviewee, and the questionnaire. Sometimes respondent cannot fully understand the question or cannot assess their own behaviour that is necessary for accurate answering. People do not have accurate and precise expectations about the future trend of the market. Hence, they are not able to give a precise and accurate answer.

Furthermore, response biases and measurement errors might cause a sentiment index to be biased, which is only partially related to real-sentiment level (Zhang, 2008). Another mostly used direct sentiment proxy is mood proxy. Mood effect can be measured by seasonal, game results, and mega-events in an economy. Drakos (2010) used terrorism activity as a good proxy to measure sentiment. However, it is hard to get such indicator at firm or industry level.

b. In behavioral finance literature, indirect proxies like liquidity (Baker & Stein, 2004) and volatility premium (Baker, Wurgler, & Yuan, 2012) are considered a very good way to measure the prevalence of psychological impact in the stock market. Several market-level variables from firm-level data and economic indicators are used to quantify stock market mania. Some of them are trades by retail investors, mutual fund flow, trading volume, dividend premium, discount on closed-end funds, option implied volatility, initial public offering (IPO) volume, return on the first day of IPO, equity issuance, and trade volume by insiders.

The previous literature has provided evidence that the all of these proxies have a systematic investor sentiment component. Indirect proxies capture investors' expectations about future price variations. These proxies have ability to exhibit market reactions, which are due to high level of expressiveness in market data (Burghardt, 2011). Sentiment is considered as a tool, which generates mispricing. Following the previous literature, this paper uses indirect proxies for investor sentiment measurement using firm-level data.

#### 3.2.1. Measurement of sentiment

Business cycle fluctuations have tendency to affect sentiment proxies (McLean & Zhao, 2014). According to Finter, Niessen-Ruenzi, and Ruenzi (2012), financial sentiment proxies already include a component related to the business cycle movements. To remove these macro-related variations from the underlying sentiment indicators, the sentiment proxies are orthogonalised on five macroeconomic variables. These variables are growth in industrial production, the exchange rate, the inflation rate, the short-term interest rate, and the term premium. Regressing the sentiment proxies on these macro indicators eliminates the sentiment component that relates to business cycle fluctuations. Each industry's total sentiment index is calculated by applying the principal component approach. After construction of industry-wise indices, we construct national index by using the sentiment values of these industries.

#### 3.2.2. Construction of sentiment indices

We use three firm-level proxies, viz. volatility premium, turnover, and equity share to measure investor sentiment.

*3.2.2.1. Volatility premium.* Volatility in stock returns exists due to errors of noise traders (Statman, 1995). Volatility premium is the relative value assessment of high volatile stocks. It identifies the time when valuation on risky stocks is high or low relative to valuation on less risky stocks. It can also be interpreted as the measure of market makers' response to more volatile stocks.

Baker and Wurgler (2007) measured volatility by dividend premium and find that it can explain well the major historical trend in a firm's propensity to pay dividends. Another study by the same authors (Baker & Wurgler, 2006) asserted that the relative premium on dividend paying stock is inversely related to investor sentiment. The motivation to use this variable is based on the theoretical prediction that sentiment has its strongest effect on volatile stocks. Volatility attracts day traders and thus, the proportion of individual ownership increases in periods of high volatility. Volatile stocks are subject to noise trader, arbitrage, and fundamental risk. Volatility premium is defined as the natural log of the ratio of the value-weighted average market-to-book value of high volatile stocks to that of less volatile stocks. Volatility arises from daily trading activities. High volatility in stock prices shows high dispersion in stock returns.

$$\mathrm{VOLP}_{jt} = \ln\left[\frac{\mathrm{Market{-}to{-}book}_{\mathrm{HVSt}}}{\mathrm{Market{-}to{-}book}_{\mathrm{LVSt}}}\right]$$

where 'j' indicates the number of industries and 't' represents years.

High Volatile Stocks (HVS) are stocks those have high volatility in return, whereas, Less Volatile Stocks (LVS) are the stocks that have less standard deviation for the return series. Volatility premium can be analysed as the compensation of risky stocks. This paper follows the approach of Baker, Wurgler, and Yuan (2012) to calculate the volatility premium. All stocks are sorted on the base of the standard deviation of the monthly return series in the previous year. Stocks on the top are named as highly volatile stocks and lower stocks are named as the low volatile stocks. The book value of the *i*th share is calculated by using the formula:

$$BV_{it} = \frac{\left(\text{Total Shareholder's Equity}_{it} - \text{Preferred Equity}_{it}\right)}{\left(\text{Total Outstanding Share}_{it}\right)}$$

The market value of shares is calculated by multiplying the number of issued shares with the market price. Volatile stocks are generally considered hard to value and more prone to sentimental shocks.

*3.2.2.2. Market turnover.* Our second sentiment proxy is turnover in the stock market. It is defined as the value of trade took place during any specified time period. Specifically, it can be defined as the volume of trade for stocks in the stock exchange. High turnover shows the surge in trading volume, which is an indicator of the optimistic behaviour of investors. Ogunmuyia (2010) considered turnover as a measure of liquidity and relates it to investor sentiment.

Baker and Wurgler (2007) postulated that turnover exposes the difference of opinion among investors at the different time. High (low) turnover indicates the positivity (negativity) of investors' behaviour. Investor's pessimistic and optimistic behaviours affect the liquidity of stocks. In the literature, high market liquidity or trading volume has been considered to be a symptom of overvaluation of stocks (Baker & Stein, 2004). In a market with short-sale constraints, retail investors will only participate if they are optimistic. This increases trading volume. Thus, liquidity should increase when traders are optimistic and increase demand for overvalued stocks. In this context, only an optimistic investor will invest in a market with short sale constraints (Finter, Niessen-Ruenzi, & Ruenzi, 2012). Turnover can be referred as a measure of irrational exuberance. Higher liquidity indicates overreaction of investors and as a result, overvaluation of stocks (Baker & Wurgler, 2006). Baker, Wurgler, and Yuan (2012) used turnover as a sentiment proxy and quantify it by taking the natural log of the ratio of volume to capitalisation.

$$\text{TURN}_{jt} = \ln\left[\frac{\sum_{i}^{N}(\text{Volume}_{\text{ijt}})}{\sum_{i}^{N}(\text{Capitalisation}_{\text{ijt}})}\right]$$

where 'i' is representing the number of firms in *j* industry and 't' is indicating years.

Volume is the number of shares traded in a security market during a specified period of time. It is simply the measure of activity or liquidity and calculates the number of shares traded. High trading volume is the indication of the overreaction of traders. Hong and Stein (2007) indicated high volume as a sign of the existence of biases and emotions that are playing a role in investors' decisions to trade. Price movements and trading volume cater the extent and direction of fluctuation in the stock market. Higher volume shows the high interest of market makers. Market capitalisation demonstrates the valuation of securities. Valuation in marketplace directly depends upon the level of psychological biases. If security is overvalued, then it shows the optimistic behaviour of investors and vice versa.

*3.2.2.3. Equity share.* Equity share is the proportion of financing provided by the owners of a firm. This is a broader measure of equity financing that quantifies all equity instruments, not just IPOs. Equity share is defined as gross equity issuance divided by gross equity plus gross long-term debt issuance. Overvalued firms are more likely to finance their new projects with equity financing. The trade-off theory of capital structure states that if a firm is using less equity and high leverage, then it is a sign of negative growth prospect. Equity share has a positive impact on investor sentiment. The magnitude of undervaluation or overvaluation indicates investor behaviour as overvaluation results in an increase equity share of the firm. Indeed, some scholars are of the view that equity issuance decisions have an important impact on stock prices (Baker & Wurgler, 2006) .

Baker and Wurgler (2007) also describe equity share as a measure of total financing activity. A change in financing decisions reflects sentiment variation. Equity share is a market level factor due to its usage in investment decisions by institutional investors. It is a comprehensive measure of financing and also includes the impact of IPOs. In corporate finance literature, the market-timing theory of capital structure infers that firm managers will issue more equity when market participants are overvaluing equity shares in the stock market. We define equity share as follows.

$$ES_{jt} = \frac{\sum_{i}^{N}(\text{Gross Equity Issuance}_{ijt})}{\sum_{i}^{N}(\text{Gross Equity Issuance}_{ijt} + \text{Long Term Debt}_{ijt})}$$

where 'i' indicates firms in $j$ industry and 't' denotes years. Gross equity share is the total value of common shareholder's equity in a firm. Long-term debt indicates the debt obligations of a firm other than its current liabilities.

### 3.2.3. Orthogonalising sentiment proxies and constructing index

Macro-related fluctuations are removed from the underlying sentiment proxies by estimating following regression equation.

$$\text{Sent}_{\text{Proxies}_{jt}} = \alpha_i + \beta_1 GIP_t + \beta_2 SIR_t + \beta_3 TP_t + \beta_4 ER_t + \beta_5 IR_t + \varepsilon_{jt} \quad (5)$$

where, $\text{Sent}_{\text{Proxies}}$ denotes the underlying sentiment variable, i.e., volatility premium (VOLP), turnover (TURN), and equity share (ES). Explanatory variables GIP, SIR, TP, ER, and IR are growth in industrial production, the short-term interest rate, term premium, the exchange rate, and the inflation rate, respectively. Next, the estimated residuals are first obtained from this regression and then are used for further analysis. Specifically, the industry-level investor sentiment index is constructed as follows.

**Table 1.** Summary statistics for portfolio returns

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Small | −0.08 | 0.19 | −2.53 | 0.03 |
| Big | 0.08 | 0.22 | 0.00 | 5.18 |
| High | −0.01 | 0.12 | −0.95 | 3.14 |
| Medium | 0.00 | 0.14 | −0.42 | 4.42 |
| Low | 0.01 | 0.12 | −3.37 | 1.13 |
| Winner | −0.06 | 0.18 | −2.46 | 1.02 |
| Loser | 0.05 | 0.17 | −0.22 | 2.97 |
| Neutral | −0.06 | 2.92 | −10.14 | 3.94 |
| Pessimistic | 0.09 | 0.88 | −0.27 | 3.30 |
| Mild | −0.05 | 0.13 | −0.78 | 3.93 |
| Optimistic | 0.03 | 1.64 | −5.07 | 0.90 |
| HML | 0.14 | 0.55 | −3.02 | 5.07 |
| SMB | −0.16 | 0.38 | −5.42 | 0.02 |
| WML | 0.03 | 3.18 | −1.80 | 1.81 |
| HSMLS | −0.11 | 1.05 | −1.18 | 0.66 |

$$Sent_t^{total} = \beta_1 VOLP_{jt} + \beta_2 TURN_{jt} + \beta_3 ES_{jt} \tag{6}$$

Sentiment index for 13 industries is constructed by using the firm-level data. Index coefficients/weight ($\beta_1$, $\beta_2$, *and* $\beta_3$) are estimated by using principal component approach. The constructed annual industrial indices are finally used to form the composite national index as follows.

$$Sent_t^{National} = \beta_1 Sent_{1t}^{total} + \beta_2 Sent_{2t}^{total} + \ldots + \beta_{13} Sent_{13t}^{total} \tag{7}$$

National (market) sentiment index is formed by the total industrial indices and 't' is presenting time variable. The weight of each industry index ($\beta_1, \beta_2, \ldots, \beta_{13}$) is determined based on the principle component analysis.

## 4. Empirical results

### *4.1. Summary statistics*

Table 1 reports the summary statistics for value weighted monthly returns of common risk factors. Average return on small stocks is negative and it is less in comparison to big stocks. On average, growth, and medium stocks are attaining almost same returns across all three classifications. Loser stocks are able to earn higher average returns as compared to their winner counterparts. HML, SMB, WML, and HSMLS exhibit the average return for decomposed value, size, momentum, and sentiment portfolios. Value premium and mean returns from momentum strategy are positive. Both size and sentiment premiums are negative for monthly returns. Stocks with high sentiment value underperform the low-sentiment stocks. Table 2 shows the descriptive statistics for the intersecting portfolios. Value, momentum, and sentiment have different effects for small and big stocks. For small stocks, all value-intersecting groups are showing negative returns. However, this negativity is decreasing with the higher value of book to market ratio. These negative returns decrease as the book equity-to-market ratio increases. It implies that undervalued stocks are earning more in comparison to their overvalued counterparts.

**Table 2.** Summary statistics for intersecting portfolios

| | | small | | | | Big | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | S.D. | Min. | Max. | Mean | S.D. | Min. | Max. |
| Value | Low | −0.12 | 0.32 | −5.07 | 0.06 | 0.12 | 0.29 | 0.00 | 2.33 |
| | Medium | −0.07 | 0.19 | −1.51 | 0.97 | 0.08 | 0.25 | 0.00 | 6.14 |
| | High | −0.06 | 0.26 | −3.03 | 0.01 | 0.04 | 0.18 | 0.00 | 6.67 |
| Momentum | Loser | −0.05 | 0.16 | −1.17 | 0.03 | 0.10 | 0.26 | 0.01 | 2.97 |
| | Neutral | −0.06 | 0.28 | −10.14 | 0.49 | 0.05 | 0.23 | 0.00 | 7.31 |
| | Winner | −0.10 | 0.28 | −2.46 | 0.00 | 0.04 | 0.18 | 0.00 | 1.81 |
| Sentiment | Optimistic | −0.17 | 0.42 | −5.07 | −0.01 | 0.16 | 0.37 | 0.00 | 3.25 |
| | Pessimistic | −0.02 | 0.45 | −0.41 | 0.06 | 0.34 | 0.15 | 0.00 | 4.95 |
| | Mild | −0.63 | 0.22 | −1.59 | 0.97 | 0.58 | 0.20 | 0.00 | 5.42 |

Table 2 shows the descriptive statistics separately for small and big firms on the left and right side, respectively. Big firms, in all groups, are able to earn higher returns on average as compared to their smaller counterparts. Value stocks accumulate higher average return in comparison to their counterparts. The statistics suggest that the momentum profit is positive for big size firms in all three categories (loser, neutral, and winner) and negative for small firms. It could be inferred that sentiment factor is exerting different impacts across all six categories. Big and pessimistic stocks are getting the highest average return. On the other side, small stocks having a high value of sentiment are earning the lowest average return. It implies that the size effect is more prominent for extreme sentiment situations.

### 4.2. Regression analysis

Table 3 presents the empirical results of asset-pricing equations. Equation (1) is the Fama-French 3-factor model. The results suggest the significant role of risk, size, and value premiums in explaining stock returns. Particularly, the estimated coefficients infer that a one-unit rise of risk premium results in an increase of 44% in stock return. Size factor has a negative and significant effect, whereas, the coefficient of HML is positive and significant. The negative coefficient of SMB implies that large-cap stocks perform better than small stocks. These outcomes differ from the findings of the previous studies that have reported the positive premium for size factor. One possible explanation is that in Pakistan, investors prefer to buy stocks of big companies as they may consider big firms are relatively less risky and thus, they overvalue these stocks.[6]

The results indicate that all the factors are statistically significant, suggesting that sentiment-based asset-pricing model is a coherent way to explain the excess returns. One can see from the table that the value premium is positive and significant. Thus, value stocks are able to earn more, which is against normal investors' perceptions. The CAPM claims to explain returns by a single risk factor (β) but these results indicate that the size and value factors are also significant for explaining variations in stock returns.

The estimation results of Equation (2) suggest that the momentum premium is positive and statistically significant. This infers that past winners continue to earn higher returns in upcoming periods. Equation (3) articulates the sentiment effect in asset-pricing mechanism. The estimate of this factor suggests that high sentiment stocks accumulate more

**Table 3.** Regression Results.

| | Eq.1 | Eq.2 | Eq.3 | Eq.4 | Eq. 5 |
|---|---|---|---|---|---|
| $R_m - R_f$ | 0.44*** | 0.26*** | 0.43*** | 0.28*** | 0.16** |
| (S.E) | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| SMB | −0.09*** | −0.07*** | −0.1*** | −0.09*** | −0.03*** |
| (S.E) | 0.01 | 0.01 | 0.01 | 0.01 | 0.12 |
| HML | 0.28*** | 0.18*** | 0.27*** | 0.19*** | 0.65** |
| (S.E) | 0.02 | 0.02 | 0.02 | 0.02 | 0.31 |
| WML | | 0.26*** | | 0.22*** | 4.63*** |
| (S.E) | | 0.03 | | 0.03 | 0.18 |
| SMN | | | 0.13*** | 0.04*** | 0.44*** |
| (S.E) | | | 0.01 | 0.14 | 0.10 |
| RP × SMN | | | | | −0.39*** |
| (S.E) | | | | | 0.12 |
| HML × SMN | | | | | −0.07*** |
| (S.E) | | | | | 0.29 |
| SMB × SMN | | | | | −0.35*** |
| (S.E) | | | | | 0.22 |
| RP × Mom | | | | | 27.45*** |
| (S.E) | | | | | 5.29 |
| HML × Mom | | | | | −0.23* |
| (S.E) | | | | | 0.45 |
| SMB × Mom | | | | | 1.39*** |
| (S.E) | | | | | 0.15 |
| Intercept | 0.51*** | 0.35 | 0.48*** | 0.36*** | 0.02*** |
| (S.E) | 0.07 | 0.04 | 0.07 | 0.07 | 0.01 |
| Adj.$R^2$ | 2.34% | 2.93% | 2.89% | 3.27% | 9.27% |

*Note:* ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

returns than low sentiment stocks. When investors foresee better growth and payoff options for any firm they increase trading of their stocks. Demand goes up and so do the stock prices and stock returns. This accomplishes that investor sentiment is an essential and a relevant risk factor for improving the predictability of stock returns.

Equation (4) is the five-factor model formed by the inclusion of sentiment in the Carhart four-factor model. All the factors are showing a significant relationship with the excess return. The value of R-square has increased, which implies that the sentiment of investors is a relevant risk factor for the determination of stock returns in Pakistan's equity market. Only size premium is negative, while all the remaining factors have a positive risk premium.

Equation (5) is the interacted asset-pricing model, which estimates the marginal effect of sentiment and momentum on the other risk factors included in the model. The coefficient for the conditional effect of sentiment on risk premium is significant and negative, suggesting that investor sentiment factor has a significant role to play in determining the market risk premium. The estimated value of the coefficient suggests that a one-unit increase in the level of investor sentiment decreases the market risk premium by 0.39 units.

The results suggest that investor sentiment factor has a significant and negative effect on value premium. This finding implies that at the time of sentiment shocks, returns on value stocks are less than the glamour stocks. The results also reveal that sentiment shocks have a negative and significant effect on size premium. Specifically, the estimated value of the interaction term implies that the optimism of investors can decrease average returns for small stocks by 35%. It is due to the fact that optimistic and overconfident investors perceive a big stock as a good investment opportunity.

Hence, they tend to hold more big stocks, which, in turn, results in overvaluation of big stocks.

The estimation results indicate that sentiment factor can severely affect the risky stocks, causing erroneous valuation of small and value stocks. This mispricing continues to exist and provides logic for the prevalence of momentum effect. The estimates given in the table also show that the momentum factor has a positive and significant effect on the size and risk premium and a negative effect on the value premium. The results of the interacted asset-pricing model are consistent with the constructed hypothesis that investor sentiment and momentum factors not only affect the required stock returns directly but also affect returns indirectly through their effects on market risk, size, and value premiums. The findings suggest that investors perceive large-cap stocks as a good opportunity to invest as they have a higher earning history. Therefore, demand for big stocks is high in the market, which, in turn, results in the overvaluation of past winner stocks. The continuous overvaluation of the past winner stocks is one of the major causes for higher profit at the current time.

## 5. Conclusions

This paper examines the impact of behavioural biases on asset pricing by hypothesising that sentiment and momentum are relevant risk factors in the equity market of Pakistan. The paper also examines the influence of sentiment and momentum factors on the market risk, size, and value premiums by estimating the interacted asset-pricing model. To carry out the empirical analysis, monthly stock return data for a large sample of non-financial firms listed on Pakistan Stock Exchange are used. The analysis covers the period 2000–2013. To examine the effect of sentiment and momentum on asset pricing, we augment the Carhart four-factor model by considering investor sentiment as an additional risk factor. Finally, to examine the indirect effect of both sentiment and momentum on asset pricing, both the factors are interacted with market risk, size, and value factor. It is hypothesised that both investor sentiment and momentum factors not only affect the required returns directly but also affect the returns indirectly through affecting the market risk, size, and value premiums.

The empirical results indicate that both investor sentiment and momentum factors have a significant impact on the required rate of returns. Specifically, it is found that the premium for both factors is positive and significant. Further, the estimated results provide evidence that the inclusion of these two factors in the Fama-French three-factor model considerably increases the prediction power of the model. The results also reveal that the inclusion of sentiment factor in the Carhart four-factor model significantly increases the prediction power of the model. Yet, the estimation results indicate that the prediction power of the model further increases when the interaction terms are added to the model in order to examine the indirect effects of sentiment and momentum. The results of the interacted model provide evidence of a significant impact of investor sentiment and momentum factors on the market risk, size, and value premiums. Although investor sentiment negatively affects all the three premiums, the effect of momentum is positive for both market risk and size premiums, whereas, it is negative for the value premium. Particularly, the estimates suggest that investor sentiment significantly decreases the premium not only for market risk but also for size and value factors. This implies that investor sentiment increases the chance of mispricing in Pakistani equity market. These results also suggest that the momentum factor, too, significantly affects the marginal effect of market risk, size, and value factor. However, unlike the negative effect of investor sentiment on all three premiums, the effect of momentum is positive for both market risk premium and size premium, whereas, it is negative for the value premium.

The results suggest that past winners continue to earn more than the past losers do. The results also indicate that sentiment-sensitive stocks earn higher returns than the pessimistic stocks. This finding implies that investors opt to hold shares of a firm when they become optimistic about the future prospect of the firm.

The findings of the paper are helpful in explaining and understanding the effects of behavioural biases on stock returns in Pakistan. The findings of the indirect effects suggest that investor sentiment and momentum factors significantly increase the chance of mispricing in Pakistan's equity market. Our analysis also suggests that investor sentiment and momentum factors both have the aptitude to have considerable effects on the risk and return of stocks. These findings have special significance for corporate investors and money managers who quantify risks and assess the required rate of returns for building their portfolios. The findings also suggest that researchers and academics should consider the investor sentiment and momentum factors and their interactions with other risk factors over and above the market risk premium, size, and value factors while modelling asset prices, particularly in developing and emerging economies like Pakistan.

In spite of presenting strong and robust evidence on the role of investor sentiment and momentum in the determination of asset pricing in Pakistan, there are some limitations of our study. We use indirect measures (market indicators) to proxy investor sentiment. However, any empirical analysis based on the direct measures of sentiment may provide more significant information. Another limitation of our study is that we classify the stocks in broad categories using 30% and 70% cut-off points. Nevertheless, this classification could be narrow down based on quintiles to perform a more in-depth and comprehensive analysis. Finally, for future research, it would be worthwhile to perform industry-wise analysis to examine whether the sensitivity of stock returns to both investor sentiment and momentum factors differs across different industries.

## Notes

1. See, for example, Black (1972), Lintner (1965, 1969), Mossin (1966), Sharp (1963, 1964), and Treynor (1961) for the seminal work on standard asset-pricing models.
2. In context of Pakistan, the results for CAPM are also unsatisfactory. Several empirical studies including Al Refai (2009), Bhatti and Hanif (2010), Husain and Uppal (1998), Hameed and Ashraf (2009), Iqbal and Brooks (2007), Javaid and Ahmad (2009), Rashid and Hamid (2015), Rashid, Chughtai, and Fayyaz (2017), and Rashid and Mehmood (2018) also rejected the standard one-factor CAPM.
3. Baker and Wurgler (2007) defined investment sentiment as "Belief about future cash flows and investment risks which is not defined by the facts at hand".

4. See, for example, Cohen and Frazzini (2008), Glushkov and Bardos (2012), Lutz (2015), Rashid, Chughtai, and Fayyaz (2017), and Schmeling (2009).
5. The standard one-factor CAPM first expanded by Fama-French three-factor model (market risk, size, and value factor) and then the Carhart four-factor model added the model one additional factor (momentum) in order to better explain stock returns.
6. One should note that size premium infers a positive effect on average returns in US equity market and negative in the UK (Fama & French, 2012). Fama and French (2012) also reported a negative average size premium for Japan for the period 1991–2010.

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