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Modeling Sentiment, Temporal Volatility and Excess Returns: Empirical Evidence From Segmented Stock Market

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Abstract

This study examines the ability of investor sentiment to predict conditional volatility and excess returns at both aggregate market and industry level in Pakistani stock market. Following the top-down-approach, a broad band investor sentiment index for Pakistan has been developed to empirically test this issue. A significantly positive contemporaneous as well as negatively lagged effect of investor sentiment is found on excess returns at aggregate market and industry level. It has also been confirmed that bullish (bearish) sentiment increases (decreases) volatility which in-turn affect the mean variance relationship. However, the commonality of the effect of investor sentiment via conditional volatility has not been uniform across industries.

Keywords: Sentiment; volatility; emerging stock market; principal component

1. Introduction

If markets are informationally efficient then why asset prices are not aligned with their fundamental value? Is there any significant role of noise trader's theory in decomposing asset returns and its deviations? These problems grasped the attention of both the practitioners and academicians

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from the past three decades. From practitioners' view point, it seems to have been apparent that markets are not efficient and therefore, asset prices follow noise trader theory (Gebka, 2014). However, in financial economics, most academicians assume that noise traders do not offer any source of systematic risk. Therefore, it is not priced and markets are efficient (Malkiel & Fama, 1970). Efficient Market Hypothesis (EMH hereafter) implies that if an investor holds an asset then the contemporaneous price P of that asset is equal to the projected value of all cash streams to be received in the future (Baker & Nofsinger, 2010).

$$P = E(P^*) \tag{1}$$

$$E(P^*) = \frac{\sum_{t=1}^{\infty} E[CF_t]}{(1+E[R])^t} \tag{2}$$

In equation (1), P denotes the contemporaneous price of an asset $E(P^*)$ is the fun- damental value and in equation (2), $E[CF_t]$ is the projected cash stream to the investor at time t and $E[R]$) denotes the stochastic discount factor. Fundamentalists provide several arguments in favor of efficient market theory. Firstly, investors use all information accurately to determine the fundamental value of assets (i.e. $E(P^*)$). If $P < E(P^*)$, then demand for that asset increases to the point where $P = E(P^*)$ and vice versa.

Secondly, noise traders incur losses due to error prone investment decisions which lead them to disappear from the market (Friedman, 1953). Thirdly, Investors biases are uncorrelated. Optimistic investors biases who believe that $P < E(P^*)$ are washed out by the pessimistic investors' perceptions who think $P > E(P^*)$. So, $P = E(P^*)$ remain unchanged. Fourthly, if $P \neq E(P^*)$, then arbitragers come in to play their role and lead the prices to fundamental value, hence markets are efficient (Malkiel & Fama, 1970).

However, continuing evidence of market anomalies, for example, excess volatility, over and under reaction of asset prices and mutual funds puzzle; question the EMH doctrine (Kumari & Mahakud, 2015). As a response, behavioral finance has surfaced as a new paradigm allowing for market inefficiency due to investors psycho- logical biases or sentiments (Barberis & Thaler, 2003). Lease, Lewellen, & Schlarbaum (1974) believe that many traders trade against the economist's advice which results in suboptimal investment decisions. Moreover, Black (1986) claims that noise traders exist in the market as investors who inaccurately assume to have more information regarding the expected price of risky assets.

De Long, Shleifer, Summers & Waldmann (1990) show that two types of traders are present in the financial markets i.e. sophisticated investors who act rationally and noise traders who have irrational behavior. De Long et al. (1990) theoretically prove the direct and indirect impact of noise trading on asset pricing and document four different channels through which noise traders can affect equilibrium prices. These four channels are depicted in Figure1 and are defined as below:

The "Price Pressure" is the phenomenon which affirms that when irrational traders are optimistic they tend to invest in risky assets. As a result, the demand for risky assets increase their prices shoot upwards. An upward movement in prices imply lower expected returns. The "Hold More" effect states, the more bullish the irrational investors are, the more they invest in risky assets. Resultantly the risk for that asset increases which leads to higher expected returns. The "Friedman" effect describes a situation where irrational investors make the worst possible investment decisions over time. They tend to buy (sell) high (low) and follow the herding behavior which leads to possible capital losses. The more they are irrational the more they are affected by their poor timing decisions. The "Create space" is a situation when the sentiments of noise traders increase about the asset's risk; it increases price uncertainty and reduces risk averse rational investors' desire to hold risky assets. Consequently, noise traders benefit more when rational traders disappear from the market. In brief, price pressure and hold more

effect directly affect expected returns whereas Friedman effect and Create Space indirectly affect expected returns through conditional volatility. Further- more, hold more and create space works in favor of noise traders while price pressure and Friedman effect works against noise traders.

Many researchers (for example Lee, Jiang, & Indro (2002) and Tourani-Rad et al. (2008)) empirically test DSSW theory at aggregate market level. Furthermore, Sayim, Morris, & Rahman (2013) and Huang, Yang, Yang, & Sheng (2014) investigate the relationship between investor sentiment, equity returns and volatility using industry data. However, few of these studies are based on the data set of emerging markets. The lack of evidence on emerging markets motivate authors to test De Long et al. (1990) phenomenon on an emerging stock market. Pakistani stock market is selected because (1) Pakistani stock market share typical characteristic of an emerging economy (Khwaja & Mian, 2005) (2) modeling risky assets is more problematic in emerging markets such as Pakistan (Iqbal, Brooks, & Galagedera, 2010) (3) Pakistani stock market is a segmented market as compared to other emerging markets (Bae & Zhang, 2015). The goal of this paper is to empirically investigate the influence of noise traders' sentiments on returns and temporal volatility at (1) aggregate market level and (2) industry level via these four channels.

This study is important from many perspectives. Firstly, risk-return tradeoff principle postulates that, there should be positive relationship between risk (uncertainty) and returns (reward). Therefore, it is important to accurately model the temporal deviations of the conditional volatility. Secondly, it is valuable in finding the fair prices of many financial instruments such as bonds, stocks and derivatives. Thirdly, temporal risk plays decisive role in the construction of optimal portfolio strategies. If investor sentiment significantly explains the temporal deviations of conditional volatility, leaving investor sentiment out is likely to lead to inaccurate forecasts of asset prices and suboptimal portfolio decisions. Fourthly, from diversification perspective, this study is helpful for international investors in understanding the dynamics of risk-returns in a

segmented market.

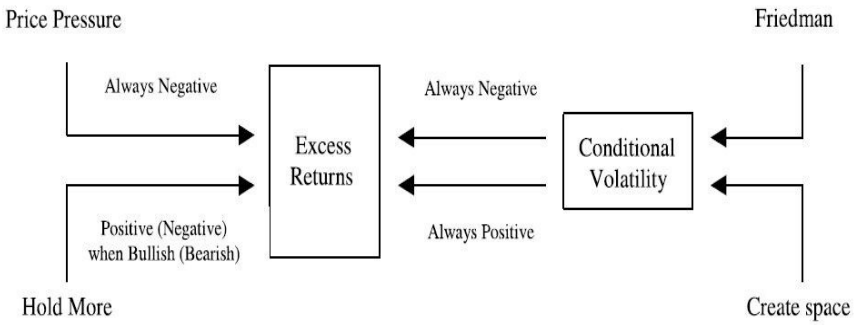


Fig. 1 Effect of Investors' sentiment on temporal volatility and excess returns Source: Lee et al. (2002)

This study reports that contemporaneous investor sentiment has a positive effect on stock returns and lagged investor sentiment has a negative effect on stock returns. Moreover, this study provides evidence in favor of holding more effect via direct channel and creates space effect through an indirect channel. Across industries, the sentiment effect via direct channel is consistent. However, the feedback from conditional variance to conditional mean is inconsistent. Furthermore, the non-trading period effect is evident in Pakistani stock market. This study also confirms that Price pressure is followed by Hold More effect.

2. Testable Hypotheses

The fundamental problem in the literature over market efficiency is whether irrational traders significantly influence asset returns. Three things are required for this to occur. First, irrational investors must value available information incorrectly or transact for sub-optimal reasons. Second, there must be limits to the ability of sophisticated traders, that is, sophisticated traders fail to bring asset prices to fundamental value through arbitrage. Third, irrational traders must be systematically interconnected, that is, irrational investors must be net buyers (sellers) of the identical asset. If contrarily, irrational investors buy (sell) arbitrarily, their transactions will, on

average, cancel, rather than reinforce, each other. If these circumstances are existent, irrational traders will distort asset prices and this distortion is non-diversifiable risk that is priced in equilibrium.

De Long'S et al. (1990) theoretical model is tested empirically that result from the four effects of investor sentiment on aggregate market and industry returns and temporal volatility. The hold more effect is related to the hypothesis that irrational investors invest more in the risky assets than a sophisticated investor. As a result, irrational investors bear more risk therefore they also expect higher returns and hence a positive relationship between expected returns and investor sentiment. The Price Pressure effect is related to the hypothesis that irrational investors increase demand for risky assets when they are optimistic on average. As a result, the price of risky assets goes up and expected returns decrease. In that case there is a negative relationship between investor sentiment and excess returns.

H0: Investor sentiment has no ability to influence excess returns.
H1a: Investor sentiment positively affects excess returns when Hold

More effect dominates Price Pressure effect.

H1b: Investor sentiment negatively affects excess returns when Price Pressure effect dominates Hold More effect.

In Friedman's effect, noise traders transact at worst possible time which increases uncertainty in the market and result in capital loss. Therefore, there exists a negative relationship between expected returns and noise trader's volatility. The last effect "Create Space" hypothesizes that irrational investors are rewarded for their trading. Due to high uncertainty, sophisticated investors leave the market as a result expected returns to the noise trader increases. Therefore, volatility of noise traders positively affects expected returns of risky assets.

H0: Conditional variance has no ability to influence excess returns.

H1a: Conditional variance positively affects excess returns when Create Space effect dominates Friedman effect.

H1b: Conditional Variance negatively affects excess returns when Friedman effect dominates Create Space effect.

3. Data and Methodology

3.1 Data

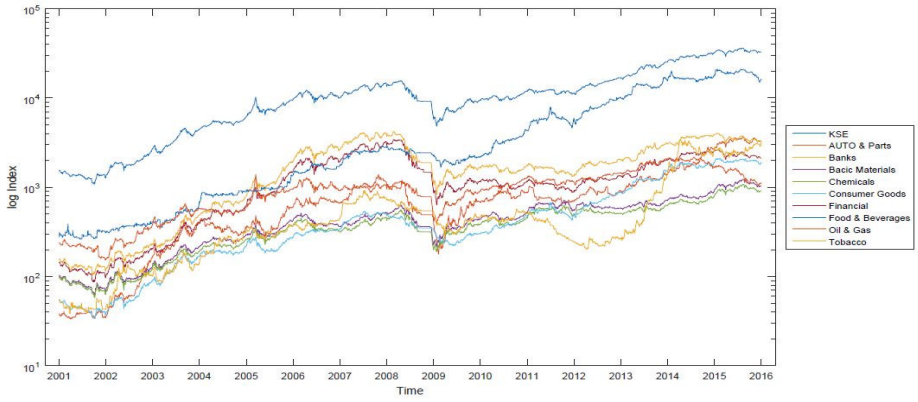
KSE 100 Index is chosen as market Index[1] for this study. To quantify the effect of investor sentiment on industry level, nine sectors are selected. They are: Oil & Gas (OG), Basic Materials (BM), Consumer Goods (CG), Chemicals (CH), Automobile & Parts (Auto), Food & Beverages (FG), Tobacco (TOB), Financial Services(FIN) and Banks (BAN). The sample covers 3,572 trading days, from January, 2001 to December, 2015. DataStream is used to retrieve all the data unless otherwise mentioned. The relative daily returns for KSE 100 Index and each industry are calculated as:

$$R_{it} = \frac{P_{i\,t}}{P_{it} - P_{it-1}} \tag{3}$$

6-month T-bill rates are used as risk free rate to get excess returns.

Summary statistics, time series properties and correlation matrix among KSE and industry excess returns are presented in Table 1. In Panel A of Table 1, the overall daily excess returns over the sample period are 0.09 percent for the KSE (22.68 percent annually) with daily standard deviation of 1.37 percent (21.74 percent annually). Among industries, AUTO and TOB have the highest daily returns which are 0.14 percent (35.28 percent annually) for both industries but these high returns come with higher daily

[1]There are three stock exchanges in Pakistan. KSE 100 Index is selected which is widely used in empirical research and capture about 85 percent of the total market turnover. The other two exchanges are Lahore stock exchange (LSE) and Islamabad stock exchange (ISE) with market turnover of 14 percent and 1 percent respectively. For further details, see Iqbal (2012)



standard deviation of 2.20 percent (34.92 percent annually) and 2.29 percent (36.35 percent annually) respectively. While OG industry has the lowest daily excess returns of 0.06 percent (15.12 percent annually) with daily standard deviation of 1.8 percent (28.57 percent annually). Overall, all industries produce positive excess returns over the sample period and returns for all industries including KSE are statistically different from zero. In column 8 of Table 1, Jarque-Bera (JB) statistics shows that returns are not normally distributed having excess kurtosis for KSE and all industries. Augmented Dicky Fuller test (ADF) is conducted to check for stationarity in the series. The significant ADF statistics confirm that all return series are stationary and therefore, GARCH models are appropriate for data. The existence of autocorrelation is also tested in the data. In column 10, it is shown that all the return series have autocorrelation up to lag 3. Panel B shows the cross correlations. All the industries are significantly positively correlated with KSE. Only Food industry has low positive correlation with KSE and all other industries. Figure 2 depicts the index values over time. All the series are moving in the same direction confirming the positive correlation. Pakistani stock market has performed remarkably well during the period 2002 to 2007. During this period the annual growth of the market was about 136 percent. This growth has been associated towards the liberalization policies adopted by the government[2]. However, in 2008 and 2009 there is a substantial decrease due to domestic political uncertainty, inadequate

[2] For details see: Economic Survey of Pakistan 2008-09

Table 1
Statistical Properties of Excess Returns

	Mean	SD	SK	KUR	MAX	MIN	JBE	ADF	AC			t-stat
									Lag1	Lag 2	Lag 3	
Panel A: Daily Excess Returns												
KSE	0.0009	0.0137	-0.1818	6.3699	0.0888	-0.0745	1709.851	-53.36886***	0.112***	0.024***	0.040***	3.8978***
AUT	0.0014	0.0220	0.1875	5.0836	0.1091	-0.1459	667.0996	-51.3193***	0.1510***	0.0180***	0.0220***	3.7467***
BAN	0.0009	0.0179	0.0230	5.3680	0.1019	-0.0856	834.8997	-50.7478***	0.1620***	0.0420***	0.0440***	3.1397***
BM	0.0008	0.0166	0.2918	9.8808	0.1813	-0.1180	7097.197	-54.8539***	0.0850***	-0.0320***	0.0140***	2.7225***
CG	0.0010	0.0135	0.2348	6.9956	0.0988	-0.0860	2408.876	-53.1702***	0.1160***	0.0190***	0.0290***	4.4393***
CH	0.0007	0.0169	0.3619	10.3917	0.1882	-0.1195	8209.811	-55.1384***	0.0800***	-0.0300***	0.0130***	2.6113***
FIN	0.0008	0.0175	-0.0456	5.2607	0.0962	-0.0932	761.8782	-50.0913***	0.1740***	0.0480***	0.0450***	2.858***
FOO	0.0012	0.0164	0.4318	17.3261	0.1494	-0.1553	30657.10	-59.0962***	0.0110	0.0150	-0.0230	4.2173***
OG	0.0006	0.0180	-0.2548	8.7792	0.0983	-0.1925	5009.484	-54.5210***	0.0910***	0.0390***	0.0450***	1.8585**
TOB	0.0014	0.0229	0.5458	9.6220	0.1946	-0.1980	6703.887	-51.0032***	0.1560***	0.0540***	0.0400***	3.5863***
Panel B: Correlation Analysis												
	KSE	AUTO	BAN	BM	CG	CH	FIN	FOOD	OG	TOB		
KSE	1											
BAN	0.8541*	0.3750*	1									
CG	0.6203*	0.4908*	0.5163*	0.5599*	1							
CH	0.8127*	0.4031*	0.6897*	0.9958*	0.5556*	1						
FIN	0.8692*	0.3878*	0.9876*	0.7106*	0.5313*	0.7032*	1					
FOO	0.1792*	0.0793*	0.1060*	0.1144*	0.3937*	0.1124*	0.1074**	1				
OG	0.8629*	0.3549*	0.6673*	0.6535*	0.4789*	0.6483*	0.6796**	0.1072***	1			
TOB	0.2588*	0.1087*	0.2069*	0.2216*	0.3078*	0.2188*	0.2146**	0.0493***	0.1852***	1		

Notes: Panel A summarizes the distributional and time series properties of KSE and 9 industry excess returns. The 9 industries are: Automobile and Parts (AUTO), Banks (BAN), Basic Materials (BM), Consumer Goods (CG), Chemicals (CH), Financial Industry (FIN), Food and Beverages (FOOD), Oil and Gas (OG) and Tobacco(TOB). Panel B shows the correlation among industries. Mean = Time series average of excess returns, SD = Standard Deviation of excess returns, SK = Skewness, KUR = Kurtosis' MAX = Maximum, MIN = Minimum, ADF = Augmented Dicky Fuller Test, AC = Autocorrelation at Lag 1, 2 and 3, t-Stat = t-statistics of excess returns. ***, **, * denotes significance at 1%, 5% and 10% respectively.

corporate governance measures and global financial crisis.

3.2 Investor Sentiment Index

3.2.1 Measuring Investor Sentiment

Baker & Wurgler (2007) argue that quantification of investor sentiment is a daunting task. According to (M. Baker & Wurgler, 2006, p.1655) "... there are no definitive and uncontroversial measures ...." Brown & Cliff (2004) document a number of proxies to measure investor sentiment. Prior literature suggests two different approaches to measure investors' behavior in financial markets. First is bottom-up (Direct) approach which is the outcome of individual investors anticipated views about the overall economy (Schmeling, 2009). The second approach is the top-down (Indirect) approach in which investors' sentiments are measured through market indicators (M. Baker & Wurgler, 2006). The first approach is subjective while the second approach is objective in nature Hudson & Green (2015). The bottom-up approach is more suitable for markets which are dominated by individual and retail investors (Kumari & Mahakud, 2015). However, like other emerging markets, Pakistani stock market is also dominated by institutional investors. Therefore, the second approach is followed to measure investor sentiment in Pakistani stock market. In behavioral finance literature, there is no evidence regarding the exact number of proxies to be used to construct investor sentiment index (Kumari & Mahakud, 2015). Baker & Wurgler (2006) document that data limitation problem limits the list of sentiment measures significantly. On the basis of data availability, 6 market related variables are used to construct sentiment index for the Pakistani market.

The 6 proxies are elaborated below:

ARMS Index

ARMS Index is the ratio of the number of advancing stocks divided by their volume to the number of declining stocks divided by their volume. A

value greater (lesser) than one implies that market is oversold (over bought) and indicates the market is in a bearish(bullish) state. Hence a negative relationship is expected between ARMS Index and sentiment Index. Brown & Cliff (2004), Wang, Keswani, & Taylor (2006) and Blasco, Corredor, & Ferreruela (2012) use this proxy to measure investor sentiment. It is calculated as:

$$ARMS_t = \frac{\frac{\#Adv_t}{AdvVol_t}}{\frac{\#Dec_t}{DecVol_t}} \quad (4)$$

where $\#Adv$ denotes number of advancing issues, $Adv\ Vol$ denotes advancing volume, $\#Dec$ denotes number of declining issues, $Dec\ Vol$ denotes declining volume.

Money Flow Index

Chen, Chong, & Duan (2010) adopt the Money flow index (MFI) to develop aggregate investor sentiment index in the Chinese market. Hudson & Green (2015) employ the similar measure in UK stock market. MFI is a volume weighted measure which shows whether the market is overbought or oversold. Therefore, there is positive association between MFI and Sentiment Index. A value greater (lesser) than 80 (20) implies market is overbought (oversold). MFI is computed in 4 steps. In the first step "Typical Price" is calculated as:

$$TP_t = \frac{Ph_t + Pl_t + Pc_t}{3} \quad (5)$$

Where TP_t (Typical price) at time t is the average of Ph_t (highest price), Pl_t (lowest price) and Pc_t (closing price). In the second step Money Flow is calculated which is the product of typical price (computed in step 1) and its turnover.

$$Money\ Flow_t = TP_t * Turnover_t \quad (6)$$

In the third step the $Money\ Ratio_t$ is computed which is the ratio of the $Positive\ Money\ Flow_t$ to $Negative\ Money\ Flow_t$. Money flow is positive if $TP_t \geq TP_{t-1}$ and vice versa.

$$Money\ Ratio_t = \frac{Positive\ Money\ Flow_t}{Negative\ Money\ Flow_t} \tag{7}$$

In the last step the MFI is estimated as:

$$MFI_t = 100 - \frac{100}{1 + Money\ Ratio_t} \tag{8}$$

Relative Strength Index

Relative Strength Index (RSI) measures the swiftness and variations in price movements. It ranges between 0 and 100. Wilder (1978), the creator of RSI states that the market is overbought when the value of RSI is above 70 and oversold when its value is below 30. A positive relationship is expected among RSI and Sentiment Index. Chen et al. (2010), Hudson & Green (2015) and Yang & Zhou (2015) employ this variable to construct a composite investor sentiment index. It is calculated as:

$$RSI_t = 100 * \frac{\sum_{i=1}^{14} (P_{t-i} - P_{t-i-1})+}{\sum_{i=1}^{14} |P_{t-i} - P_{t-i-1}|} \tag{9}$$

14 days are used to calculate RSI. P denotes the closing price and $(P_{t-i} - P_{t-i-1})+ = P_{t-i} - P_{t-i-1}\ if\ P_{t-i} - P_{t-i-1} > 0$.

Psychological Line Index

Yang & Gao (2014) and Yang & Zhou (2015) employ Psychological line index (PLI) to proxy the behavior of investors. It shows the short term reversals in the market. PLI is defined by (Yang & Zhou, 2015, p.45) “a

sentiment indicator to look behind the obvious sentiment of the market and to detect undertones for a trend change". PLI is used with two limits i.e. upper limit and lower limit. Approaching the upper (lower) limit is an indication that the market is overbought(oversold). Therefore, a positive relationship is expected between PLI and Sentiment Index. It is calculated as:

$$PLI_t = \frac{T^u}{T} * 100 \tag{10}$$

where T^u is the number of periods when the previous price of asset is less than the current price and T is the number of periods.

Parkinson Volatility

Brown & Cliff (2004) use volatility measure to develop a sentiment index. Following Parkinson (1980) methodology, the extreme value method is used to estimate volatility. It is calculated on the daily maximum and daily minimum prices of market index. Hudson & Green (2015) use the similar measure to compute volatility. Low (high) values of Parkinson volatility (PV) imply bullish (bearish) investor sentiment. PV is negatively associated with Sentiment Index.

$$PV_t = \sqrt{\frac{\frac{1}{4\ln(2)} \sum_{i=1}^{N} \left(\ln\left(\frac{h_i}{l_i}\right)\right)^2}{N}} \tag{11}$$

where ln is the natural logarithm of the ratio of daily maximum prices to daily minimum prices, N is the number of periods, h is the maximum price and l the minimum price.

KSE Share Turnover

Scheinkman & Xiong (2003) argue that trading volume accounts for the

Table 2
Regression Results

Var	KSE	AUTO	BAN	BM	CG	CH	FIN	FOOD	OG	TOB
Panel A: Investor Sentiment Proxy Variables										
C	-0.0158***	-0.0154***	-0.0197***	-0.0140***	-0.0085***	-0.0142***	-0.0206***	-0.0083***	-0.0166***	-0.0077***
Arms	-0.0011***	-0.0007***	-0.0012***	-0.0012***	-0.0008***	-0.0013***	-0.0012***	0.0001**	-0.0013**	-0.0004***
MFI	-0.0002***	-0.0001***	-0.0002***	-0.0002***	-0.0001***	-0.0002***	-0.0002***	0.0000	-0.0002***	-0.0001***
PLI	0.0000**	0.0000	0.0001*	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001**	0.0000
PV	0.4503***	0.3087***	0.5882***	0.4799***	0.2215***	0.4849***	0.5921***	0.1431***	0.4984***	0.1791**
RSI	0.0005***	0.0005***	0.0006***	0.0004***	0.0003***	0.0004***	0.0006***	0.0003***	0.0005***	0.0003***
TR	-0.0040***	-0.0038***	-0.0047***	-0.0033***	-0.0037***	-0.0033***	-0.0051***	-0.0025***	-0.0041***	-0.0033***
Panel B: Diagnostic Tests										
R-Sqr	0.3030	0.0802	0.2320	0.2187	0.1694	0.2148	0.2508	0.0194	0.2256	0.0266
F-Stat	257.9410***	52.5427***	179.5514***	166.4476***	121.5469***	162.6977***	198.8925***	12.7073***	173.1356***	17.1799***

Notes: Panel A shows the regression results KSE and all industries on 6 investor sentiment variables. Panel B shows the diagnostics test statistics for each regression model. AUTO = Automobile and Parts, BAN = Banks, BM = Basic Materials, CG = Consumer Goods, CH = Chemicals, FIN = Financial Industry, FOOD = Food and Beverages, OG = Oil and Gas, TOB = Tobacco industry. ARMS = ARMS INDEX, MFI = Money Flow Index, PLI = Psychological Line Index, PV = Parkinson Volatility, RSI = Relative Strength Index, TR = Turnover. ***, **, * denotes significance at 1%, 5% and 10% respectively.

underlying differences of opinions among market participants. Furthermore, Brown & Cliff (2004) explain that noise traders are more likely to transact in the presence of short sales constraints thus adding liquidity to the market. Since high (low) liquidity imply stocks are overvalued (undervalued), therefore, turnover reveal investors behavior in the market and is associated positively with the Sentiment Index. Scheinkman & Xiong (2003), Brown & Cliff (2004) and Baker & Wurgler (2006) also employ turnover to measure investor sentiment.

$$TR_t = \frac{\sum_{i=1}^{50} TR}{\sum_{i=1}^{100} TR} * 100 \qquad (12)$$

Construction of Sentiment Index

Baker & Wurgler (2006) and Brown & Cliff (2004) use principle component analysis (PCA) and develop a sentiment index to isolate the common element in the six sentiment indicators. This study develops Sentiment Index for Pakistan using similar methodology. KSE and Industry returns are at first regressed on six sentiment indicators to analyze the relation among them. Table 2 shows that all the sentiment indicators have some explanatory power over KSE and Industry returns (except PV which has limited ability). Overall, the results suggest that these sentiment variables may be used to measure aggregated sentiment index in Pakistani stock market. PCA methodology is then applied on these 6 sentiment proxies in 3 stages.

In the first stage, all the sentiment variables[3] are standardized and raw sentiment index (SIraw) is constructed using the first principal component from 12 sentiment variables: The 6 sentiment variables and their lags (Brown & Cliff, 2004; Baker & Wurgler, 2006) provide the rational for using contemporaneous and lag variables due to the fact that some proxies take longer to incorporate sentiment information. The first stage equation of SIraw is given as below:

[3] Zero mean and unit variance

$$SI\,Raw_t = -0.0853ARMS_t - 0.1057ARMS_{t-1} + 0.3730MFI_t + 0.3698MFI_{t-1} + 0.3588PLI_t + 0.3604PLI_{t-1} - 0.1277PV_t - 0.1241PV_{t-1} + 0.3767RSI_t + 0.3798RSI_{t-1} + 0.2574TR_t + 0.2508TR_{t-1} \quad (13)$$

In the 2nd stage, the correlation between the SIraw and 12 variables is calculated. Each sentiment variable is selected with current or lag on the basis of higher correlation with SIraw. These results are summarized in panel C of Table 3 which shows that M F I, PV, RSI and T R are to be selected at levels while lag values of ARM S and P LI are to be used. Finally, Sentiment Index (SI) is developed which is the first principal component of these selected variables. The final SI is expressed as:

$$SI_t = -0.1803ARMS_{t-1} + 0.5184MFI_t + 0.50434PLI_{t-1} - 0.1799PV_t + 0.5331RSI_{t-1} + 0.3576TR_t \quad (14)$$

The correlation between SIraw and SI is 0.99, shows that little information is lost in dropping the 6 variables with different time notations[4]. SI which is the first principle component explains about 38 percent of the sample variations. Therefore, it is inferred that one factor explains a significant portion of the common variance.

3.3 Empirical Methodology

De Long et al documents (1990) four channels through which irrational trading influences return of risky assets (as discussed in Section 1). The Price Pressure and Hold More directly affect asset returns while the Friedman and Create Space indirectly influence asset returns via conditional volatility. De Long et al. (1990) summarizes that Friedman effect and Price pressure effect negatively affect asset returns while Hold More and Create Space Effect positively affect asset returns. Lee et al. (2002) provides the base model to empirically test these four effects. They use a sentiment augmented GARCH-in-Mean framework in their study. Later on, researchers adopted

[4] Results can be provided upon request

Table 3
Properties of Investor Sentiment

	Mean	SD	SK	KUR	MAX	MIN	JB	ADF	AC		
									Lag 1	Lag 2	Lag 3
Panel A: Investor Sentiment Proxy Variables											
ARMS	1.8706	4.8844	5.4965	35.6485	36.7316	0.0102	175394.7000***	-7.658138***	0.138***	0.104***	0.141***
MFI	61.5603	18.0395	-0.3451	2.4539	94.6126	16.7654	114.4898***	-6.910562***	0.955***	0.893***	0.83***
PLI	55.0646	15.9601	-0.1487	2.7096	92.8571	14.2857	25.5249***	-6.385049***	0.95***	0.893***	0.839***
PV	0.0105	0.0050	1.1309	4.0520	0.0261	0.0003	919.5889***	-5.724729***	0.991***	0.975***	0.955***
RSI	56.3273	15.3327	-0.1644	2.4071	88.1044	18.1981	67.9249***	-9.375815***	0.957***	0.91**	0.864***
TR	1.0233	0.5410	1.3124	5.2042	3.0330	0.0068	1736.2440***	-8.003441***	0.982***	0.947***	0.902***
Panel B: Correlation Analysis											
	ARMS	MFI	PLI	PV	RSI	TR					
ARMS	1										
MFI	-0.1634***	1									
PLI	-0.1630***	0.8007***	1								
PV	0.1380***	-0.2276***	-0.1798***	1							
RSI	-0.2517***	0.8305***	0.7803	-0.3197***	1						
TR	-0.804***	0.4627***	0.4423***	0.1053***	0.4945***	1					
Panel C: Correlation between Sentiment Index and Sentiment Variables											
	SI	ARMS-L	NFI	PLI-L	PV	RSI-L	TR				
SI	1										
ARMS-L	-0.3177***	1									
MFI	0.9105***	-0.1945***	1								
PLI-L	0.8852***	-0.1627***	0.7890***	1							
PV	-0.3154***	0.1554***	-0.2263***	-0.1828***	1						
RSI-L	0.9361***	-0.2515***	0.8269***	0.7795***	-0.3259***	1					
TR	0.6261***	-0.0881***	0.4624***	0.4559***	0.1054***	0.5175***	1				

their models and modified according to their data set requirements as in case of Tourani-Rad et al. (2008) and Uygur & Tas (2014). This study borrowed the model from Lee et al. (2002), Tourani-Rad et al. (2008) and Uygur & Tas (2014) to test the hypothesis. The model takes the following form:

$$r_{it} - r_f = \alpha_0 + \alpha_1 \log(\sigma_{it})^2 + \alpha_2 MD_t + \alpha_3 SI_t + \alpha_4 SI_{t-1} + \theta_i \sum_{i=1}^{n} r_{it-1} - r_{f-1} + \varepsilon_{it} \quad (11)$$

$$\varepsilon_{it} = \vartheta_t \sigma_t \qquad \vartheta_t \sim N(0,1) \quad (12)$$

$$\sigma_{it}^2 = \beta_0 + \lambda_i \sum_{j=1}^{p} \varepsilon_{t-1}^2 + \omega_i \varepsilon_{it-i}^2 I_{t-1} + \gamma_i \sum_{k=1}^{q} \sigma_{it-1}^2 + \beta_1 SI_{t-1} * D_{t-1} + \beta_2 SI_{t-1} * (1 - D_{t-1}) \quad (13)$$

rit is the daily returns of market and respective industries. rft it he risk free rate. σit denotes the conditional variance of the KSE and all industries returns. SIt and SIt−1 measures current and one period lagged investor sentiment. M D is a Monday dummy to check for the non-trading period and used as control variable. It is equal to 1 if the current day is a Monday and zero otherwise. Dt−1 is an indicator variable for capturing bullish/optimistic behavior of traders which is equal to 1 if the previous period sentiment index is positive. α0, α1, α2, α3, α4, θi, β0, λi, ωi, γi, β1, and β2 are parameters to be estimated. To test the direct impact of sentiment on excess returns, α3 is observed. If this coefficient is significant and positive (negative) then there is evidence of Hold More (Price Pressure) effect. On the other side, if α2 is positive (Negative) and significant, it provides evidence in favor of Create Space (Friedman) effect. To test whether Price pressure effect follow Hold more effect, the sign of α4 is observed. It is judged by the negative sign and its significance level.

Engle & Ng (1993) have developed size and sign bias test to check for asymmetric impact of positive and negative news on conditional volatility. Authors also apply a similar test on residuals from symmetric GARCH (1,1) model to check for any asymmetric effect. Table 4 report the results of size

Table 4
Symmetric Garch-in-mean Model Results

	KSE	AUTO	BAN	BM	CG	CH	FIN	FOOD	OG	TOB
Panel A: Mean Equation (values multiplied by 100)										
C	0.9168***	-0.1186	1.292***	0.2555	0.3823	0.2258	1.3150***	1.1602**	0.2433	2.1710***
LOG (GARCH)	0.816***	-0.0317	0.1288***	0.0129	0.0273	0.0096	0.1326***	0.1207**	0.0144	0.2564***
SI	0.9825***	0.5790***	1.2309***	0.7779***	0.4531***	0.7753***	1.2432***	0.3504***	0.8802***	0.6419***
SI-L	-0.8817***	-0.4133***	-1.1093***	-0.7296***	-0.3860***	-0.7257***	-1.0923***	-0.2783***	-0.8206***	-0.6239***
MD	-0.1845***	-0.0427	-0.2536***	-0.1248***	-0.1612***	-0.1321***	-0.2538***	-0.1571***	-0.2539***	-0.1951***
Panel B: Variance Equation (values multiplied by 100)										
C	0.0006***	0.0006***	0.0003***	0.0009***	0.0002***	0.0008***	0.0003***	0.0003***	0.0005***	0.0002***
RESID(-1)^2	17.7809***	8.8249***	13.2682***	20.9656***	10.6594***	20.9634***	13.0370***	3.6587***	15.3390***	4.7790***
GARCH(-1)	77.6958***	89.6891***	83.3348***	77.2929***	88.5335***	77.6141***	82.1971***	95.3763***	81.7927***	94.7405***
SI-L*DUM	0.0003***	0.0009***	0.0009***	0.0005***	0.0002**	0.0005***	0.0010***	0.0000	0.0005***	0.0003***
SI-L*(1-DUM)	-0.0004***	-0.0001	-0.0009	0.0004***	0.0000	0.0004***	-0.0015***	0.0000	-0.0007***	0.0000**
Panel C: Diagnostic Tests										
LL Ratio	10939.9400	8926.2700	9904.363	10158.6800	10750.5800	10113.8000	9953.9560	9860.9160	9906.9420	8731.2040
SSB Test	493.1854***	222.1076***	432.8755***	187.6774***	248.3268****	180.7383***	399.3621***	179.6372***	247.1521***	109.8550***

Notes: Panel A summarizes the mean equation for KSE and all Industries. The 9 industries are: Automobile and parts (AUTO), Banks (BAN), Basic materials (BM), Consumer goods (CG), Chemicals (CH), Financial industry (FIN), Food and beverages (FOOD), Oil and gas (OG) and Tobacco(TOB). Panel B shows the variance equation. Panel C shows diagnostic tests of the model. ***, **, * denotes significance at 1%, 5% and 10% respectively.

and sign bias test which shows that negative shocks have a different impact on conditional volatility than positive shocks. On the basis of this evidence, asymmetric term is included in equation: 13 to model conditional variance. In equation 13, ω captures the asymmetric impact. I_{t-1} is an indicator variable and equal to 1 if ε_{t-1} is negative and zero otherwise. The conditional variance equation assumes that $\beta_0 > 0$, $\lambda_i > 0$ and $\omega_i > 0$. If $\omega > 0$ it indicates the existence of leverage effect.

4. Empirical Results and Discussion

Symmetric GARCH-in-mean (1,1) and GJR GARCH-in-mean models is estimated for KSE and Industry excess returns to test hypothesis. The results of GARCH-in- mean model are presented in Table 4 and results of GJR GARCH-in-mean model are depicted in Table 5. The Sign and Size Bias test is run at first to ascertain if there is need for asymmetric GARCH model. Lagrange Multiplier (LM) test is computed for this purpose. The result show that for all return series the LM statistics are significant at 1 percent level meaning that symmetric GARCH model is inappropriate for conditional variance modeling. To account for asymmetric effect, GJR GARCH-in-mean model is estimated for all series.

Results in Panel A of Table 5 show that α_3 is positive and significant for all return series at 1 percent significance level. For a specific example, consider the excess returns series of KSE. A one-standard deviation increase in IS leads to an increase in excess returns of 1.55 percent for the current month. It leads to rejection of first hypothesis which assumes that there is no significant effect of IS on excess returns. Furthermore, Hold More effect is witnessed in Pakistani stock market. α_4 test the phenomenon whether Price Pressure is followed by Hold More effect. Again all the coefficients are significant and negative. For a specific example, consider the excess returns series of KSE. A one-standard deviation increase in IS leads to a decrease in excess returns of 1.41 percent for the next month. It implies that Price Pressure effect is followed by Hold More effect. These results are in line with the results of (Tourani-Rad et al., 2008).

Table 5
GJR GARCH-in-mean Model Results

	KSE	AUTO	BAN	BM	CG	CH	FIN	FOOD	OG	TOB
Panel A: Mean Equation (values multiplied by 100)										
C	0.8915**	0.1067	0.7927**	0.0338	0.1620	0.0103	0.9744***	1.9377***	0.1429	1.6977***
LOG (GARCH)	0.0802**	-0.0019	0.0758**	-0.0072	0.0061	-0.0098	0.0981**	0.2077***	0.0043	0.1984***
SI	1.5562***	0.4556***	1.3060***	0.8436***	0.2949***	0.8409***	1.3361***	0.3032***	1.0761***	0.4967***
SLL	-1.4192***	-0.3157***	-1.1912***	-0.7797***	-0.2388***	-0.7761***	-1.1798***	-0.2354***	-1.0081***	-0.4779***
MD	-0.1779***	-0.0237	-0.2514***	-0.1273***	-0.1589***	-0.1359***	-0.2484***	-0.1453***	-0.2500***	-0.2097***
AR(1)	-18.3795***	8.0247***	-0.7913		9.0528**		-0.4894		-6.9567***	11.8899***
AR(2)	2.5199	-0.5820	3.7254**		1.1089		3.9306**		2.3023	2.9188*
Panel B: Variance Equation (values multiplied by 100)										
C	0.0006***	0.0010***	0.0003***	0.0009***	0.0002**	0.0008***	0.0003***	0.0010***	0.0005***	0.0002*
RESID(-1)^2* (RESID(-1)<0)	9.0522***	15.1047***	6.1305***	13.1342***	10.9640***	13.5481***	4.8627***	13.5768***	12.9541***	3.4297***
B_3	16.8106***	-2.4262	13.8663***	19.2926***	6.4084***	18.5736***	14.5220***	-9.4896***	5.0450***	1.4527***
GARCH (-1)	77.4206***	16.8865***	83.8389***	48.6692***	46.0703***	48.9476***	83.1985***	10.4800***	81.7992***	95.4866***
GARCH(-2)		65.8975***		25.9231***	39.0025***	26.0088***		4.5747***		
GARCH(-3)								72.9560***		
SI-L*(DUM)	0.0004***	0.0013***	0.0011***	0.0009***	0.0004***	0.0010***	0.0013***	-0.0002***	0.0006***	0.0003**
SI-L*(1-DUM)	-0.0003***	-0.0004***	-0.0006***	0.0004***	0.0000	0.0004***	-0.0013***	0.0002***	-0.0006***	0.0000
Panel C: Diagnostic Tests										
LL Ratio	10993.3400	8944.2820	9926.5830	10188.3000	10764.8700	10141.5000	9977.6900	9906.6130	9910.4010	8754.8140
L-Box Q	3.4598	6.1717	14.1720	18.4560	11.0290	19.585*	15.3480	14.8830	16.5670	8.9239
L-Box Q^2	5.8460	6.4961	7.6903	8.3020	23.564**	10.9770	7.6587	36.215***	10.0490	4.1460
ARCH	0.6926	0.5352	0.7888	0.7621	2.262323**	1.0070	0.7485	3.50275***	0.9051	0.3669

Notes: Panel A summarizes the mean equation for KSE and all Industries. The 9 industries are: Automobile and parts (AUTO), Banks (BAN), Basic materials (BM), Consumer goods (CG), Chemicals (CH), Financial industry (FIN), Food and beverages (FOOD), Oil and gas (OG) and Tobacco(TOB). Panel B shows the variance equation. Panel C shows diagnostic tests of the model. ***, **, * denotes significance at 1%, 5% and 10% respectively .

Panel B of Table 5 present the results of conditional volatility. β1 accounts for the bullish investor sentiment. The sign of this coefficient is positive which shows that when investor is optimistic, uncertainty in the market increases. Contrarily, β2 accounts for the effect of bearish investor behavior. As expected the sign of this coefficient is negative which asserts that volatility decreases when investors are pessimistic on average. Turning to the mean equation again, a significant positive coefficient for GARCH-in-mean term is found. It provides evidence for Create Space effect. Interestingly, this coefficient is not consistent across industries. This coefficient is significant for only BAN, FIN, FOOD and TOB industries. Therefore, the feedback of Investor sentiment via conditional volatility is redundant.

Strong evidence in favor of Monday effect is found which account for the non-trading impact on excess returns. Overall, the ARCH and GARCH terms are positive and significant showing that volatility is persistent and volatility clustering does exist. It can also be seen in Table 5 that the coefficient of asymmetric term is significant and positive. It is concluded that leverage effect is present as negative shock increases the conditional variance as compared to positive shock of the same magnitude.

Panel C of Table 5 reports some diagnostic tests. High LLR statistics shows that asymmetric GJR GARCH-in-mean model is superior to symmetric GARCH-in-mean model. The latter model also accounts for the ARCH effect in the data.

5. Conclusion

Following the theoretical framework of De Long (1990), this study explores the effect of Investor Sentiment on KSE and Industry returns and conditional volatility. Principle component analysis has been used to construct a composite Investor sentiment index for Pakistani stock market using the top down approach (Baker & Wurgler, 2007). Six proxy variables are used to develop Investor Sentiment Index. Asymmetric GARCH- in-

mean framework is employed to test De Long's et al. (1990) phenomenon. Furthermore, whether Price Pressure effect is followed by Hold More effect or not is also tested.

Positive and significant contemporaneous coefficient on Sentiment Index show the dominating role of hold more effect over price pressure effect. While Lagged coefficients on Investor sentiment shows negative and significant values which confirms that Price Pressure is followed by Hold More Effect. The effect of conditional volatility on excess returns is somewhat mixed. At aggregate market level Create Space Effect has been found but at industry level, mixed results are found. Furthermore, consistent effect of non-trading period at both the market and industry level is also found.

Overall, this study shows that investor sentiment is a systematic component which is priced in the market. Moreover, results of this study validate the noise traders' phenomenon asserting that markets are informationally not efficient and contradict the classical theory of market efficiency. The outcomes of this study can be used to improve the predictability of expected stock returns by incorporating investor sentiment along with other macroeconomic and company fundamentals.

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