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Stock Price Synchronicity and Information Environment

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Abstract

This study investigates the relationship between Stock Price Synchronicity and information environment variables in Pakistani equity market by using data of 133 stocks for the period of June 2002 to June 2016. The results indicate that liquidity, book to market ratio, percentage of zero volume days and size have significant impact on stock price synchronicity. The findings of the study suggest that low R-squared stocks are smaller, have less turnover rate and infrequent trading, which makes them less profitable. During global financial crisis, the stocks are more synchronized with the market. This study further suggests that low-stock-price synchronicity is a result of firm-specific variables.

Keywords: *Stock price synchronicity, Idiosyncratic volatility, Karachi stock market, Liquidity*

JEL classification: G12, G14

1. Introduction

Does information environment affect stock price synchronicity (SPS)? Whether stocks are more synchronized during global financial crisis? This study aims to answer these questions. Prior literature notes that information plays a critical role in stock market behavior and researchers emphasize on the reduction of information asymmetry by recommending mandatory disclosure, regulation of financial information and corporate governance practices (Frankel & Li, 2004). Informational efficiency is dynamic phenomenon and market reactions are diversified. Most of the work in this domain is focused on the presence of different forms of market efficiency. However, factors determining the quality of information environment have remained less attended in general and this area is specifically ignored in emerging markets like Pakistan. Therefore, no consensus exists about drivers of quality of information environment

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and their influence on SPS at company level.

A lot of debate is still there on the argument that "a firm's stock price reflects all information related to market factors, industry factors and firm specific information". The basic reason behind this argument is that stock prices co-vary with industry returns and market returns (King, 1988). In the presence of information asymmetry investor may have incomplete information about firm specific variables and only rely on market factors while taking investment decisions. In such scenario, stock price discovery will only be dependent on the overall market trend than the firm specific information. Morck, Yeung, and Yu (2000) propose a model on the basis of R-squared from asset pricing regressions as a proxy of SPS to measure firm specific information. They have defined SPS as "the tendency of stock market prices to move in the same direction in a given period of time".

Extensive work has been done on SPS using R-squared obtained from the regression of individual stock return to stock market returns (Morck, Yeung, & Yu, 2000; Durnev, Li, Morck, & Yeung, 2004; Farooq & Ahmed, 2014; Farooq & ElBannan, 2016). The findings of these studies suggest that there is low SPS in developed markets due to strong legal system, well established institutional structure, informed trading, quality of information environment based on firm specific information and stocks are more informational efficient with better price discovery. Whereas, lesser developed countries have greater impediments to firm specific information incorporation into prices and have high SPS. Dasgupta et al. (2010) argue that in an efficient market stock prices only respond to that announcement that is not anticipated in advance. As firm improves the information environment surrounding, that results the availability of firm specific information to all market participants.

Given the evidence on the relationship between SPS and firm's information environment, it is likely that SPS affects firm's exposure to financial crisis. Heleka (2015) argue that SPS and information environment have significant relationship, and SPS affects firm's exposure to financial crisis. They posit that pre-crisis SPS has positive impact on financial crisis up to a certain level. Johnson, Boone, Breach, and Friedman (200) suggest that good corporate governance environment of an organization helps in reduction of exposure to crisis by reducing confiscation by controlling shareholders. Mitton (2002) presents the same evidence about those firms which perform better have good governance and information environment during the crisis.

Theoretically, several researchers argue that interpretation of information efficiency by R-squared is difficult to measure with standard models (West 1988; Campbell, et al., 2001; Peng & Xiong 2006). SPS and information environment quality are negatively related that propose R-squared can be used as an inverse proxy for information

environment quality (Morck, Yeung, & Yu, 2000; Durnev, Morck, Yeung, & Zarowin, 2003; Jin & Myers, 2006; Haggard, Martin & Periera, 2008; Farooq & Ahmed, 2014). Whereas, West (1988) reports that firm specific return volatility is positively related to bubbles, fad and other non-fundamental variables. Although two different conclusions are presented by the literature and these arguments suggest that average R-squared of market model i.e., measured by SPS can be used as a proxy of information environment quality or noise. Literature suggests that R square can be a proxy of information environment quality, despite the fact that totally different opinions hold. Together, these cross-country studies use stock return synchronicity as a proxy for informed prices and document market behavior that jointly validates their interpretation of synchronicity (Farooq and Ahmed, 2014; Farooq and ElBannan, 2016).

It is always a main goal of regulator to reduce information asymmetry through firm specific fundamentals for investor protection. In developed markets like, US, UK, Japan etc., any information is quickly incorporated in the security prices and markets are considered more efficient. The empirical literature states that an established and emergent stock market is an indication of economic growth. Similarly, firm specific variables based model for exploring information environment quality practically does not exist for emerging markets like Pakistan. When social, economic or political condition of any country changes, it affect the performance of stock market. In case of Pakistani stock market, the situation may be different as compare to developed countries. Pakistani market is an emerging market during last decade phenomenal growth is observed, but at the same time market saw number of ups and downs. It is generally considered as high risk and high return market. The market also attracted foreign investment during last decade. But, it is also criticized that foreign investment is a source of volatility in market. So, the questions about the quality of information environment have also been raised. These unique conditions of the market demand that price adjustment dynamics should also be explored in detail, so that investor can get better insight regarding the dynamics of market.

In august 2008, PSX has faced the great crash and thousands of small investors have lost billions of rupees during the 2008. The market crashed, this crash leads towards the cancellation of five largest brokers' membership, the PSX has offered just 6.7 per cent compensation against the investors claim on the condition that they surrender their right to challenge the partial settlement in any court of law. The 'floor' remained in place for 110 days, which virtually closed the exit door of the market. So, the questions about the quality of information environment have also been raised. These unique conditions of the market demand that price adjustment dynamics should also be explored in detail, so that investor can get better insight regarding the dynamics of market. Development of such model is helpful in raising

the confidence of investor in estimation of market behavior.

The rest of the paper is organized as follows: Section II critically covers the literature on the subject. Section III provides data description and discusses the econometric model. Section IV reports and analyses the results. Section V concludes the study.

2. Literature Review

The concept of "Synchronicity" is introduced in psychology literature by Carl Jung in 1920's, that events are "meaningful coincidences". He gave full statement regarding synchronicity in 1951, while presenting a lecture in Eranos. Then this concept is formally discussed in a published paper in 1952 "Synchronizität als ein Prinzip akausaler Zusammenhänge" (An Acausal Connecting Principle), is define by Jung "Synchronicity" as an "*acausal connecting principle in which events, both large and small, in the external world might align to the experience of the individual, perhaps mirroring or echoing personal concerns or thoughts*". In accounting and finance literature synchronicity is used in capital markets, to measure co-movement between stock prices and market in same or opposite direction.

Roll (1988) reports that stock price variations are not fully captured by market level information and the residual movements in stock price variations are captured by firm specific variables. He suggests firm specific information is uncorrelated with market returns and behaves differently from public information. This firm specific information cannot be priced into stocks the moment it is generated, but can be incorporate in prices by using informed trading (French & Roll, 1986). Whereas, lower SPS interprets that the value of R-squared is lower, which reflects more idiosyncratic return volatility and less market wide information (Morck et al., 2000). Those firms are not informationally efficient will impounds trading activity, as a result it reduces R square. Some studies suggest that behavioral factors i.e., herding, bubbles and other non-fundamental factors also affect stock return volatility (Shleifer, 2000) and eventually SPS is useful to measure the firm specific information (Ashbaugh, Gassen, & LaFond, 2006).

Jin and Myers (2006) examine the relationship between corporate transparency and SPS. Their analysis shows less transparency between insiders and outsiders thus making the prediction about those stocks with high SPS are more likely to have large negative returns. Whereas, more transparent environment provides more firm specific information to the investor and that reduce future variations in price. Chan and Hameed (2006) assume that SPS is positively related to the extent of analyst coverage, firm size, and trading volume. In subsequent study, these findings are supported by Kelly (2014), who argues that the SPS is inconsistent to firm specific fundamentals.

This study suggests that R-squared is direct proxy of information environment quality. The study also suggests that R-squared should be higher with high liquidity, greater analyst coverage, large size, greater age, large institutional holding, lower transaction cost, and large information events. Because all these attributes disseminate the information into market.

Roll (1988) finds the effect of public news on the volatility of returns, but this impact is relatively small. Due to this reason, microstructure variables should be used for information incorporation (Kelly, 2014). In this study, firm specific attributes are used to examine the quality of information for Pakistani equity market. These attributes include liquidity, percentage of zero volume days, firm size, BTM ratio and idiosyncratic volatility. Datar, Naik, and Radcliffe (1998) document the role of liquidity in the stock prices using the proxy of turnover rate. Liquidity is generally related to characteristics of asset that it can immediately be sold after purchase without any discount. Liquidity in financial markets is defined as "ease of trading" (Amihud, 2002). Datar, Naik and Radcliffe (1998) use the framework proposed by Amihud and Mendelson (1986) to examine individual stocks. The findings of this study support the argument that stocks which are less liquid should yield higher returns in order to cover the illiquidity risk. Hence, it can be concluded that a stock which has low turnover should earn a higher premium.

French and Roll (1986) report a key difference between public and private news. Public information is incorporated into prices the moment it becomes known, whereas private information is revealed into prices through trading. Furthermore, the study suggests that the activity of information based traders brings greater return volatility and the volatility in prices is different during trading and non-trading hours. In an information environment based analysis, trading activity should have to increase stock return variation and reduce SPS. The association between trading activities and SPS would be negative. However, Chan and Hameed (2006) argue that frequently traded stocks timely react to any market information so that these price movements to individual stocks are more synchronize with the market. Conversely, irregular traded stocks do not react instantly against market news and face greater delay in price reactions. These infrequently traded stocks have lower synchronization with market.

H1: There exists a significant relationship between SPS and liquidity

Idiosyncratic volatility is firm specific risk. It is unique to a specific firm and independent to the movements of market. As, Roll (1988) argues that lower market model R-squared is due to greater idiosyncratic volatility. Jiang, Xu, and Yao (2009) suggests that high idiosyncratic volatility is due to lack of information disclosure of firms. Those firms having poor information disclosure do have high idiosyncratic

volatility it reduces market model R square. Wei and Zhang (2006) explain the possible causes for increased idiosyncratic return volatility overtime in the U.S. and find that the volatility in firm specific variables has increased overtime. However, they further suggest that the relationship between variations of firm specific information and idiosyncratic return volatility that casts doubt on information based explanation for decreasing values of SPS. Prior studies report a positive relationship between idiosyncratic return volatility, information risk, and analyst forecast dispersion (Rajgopal & Venkatachalam, 2005; Pastor & Veronesi, 2003)

H2: There exists a significant relationship between SPS and Idiosyncratic risk

Cost of information is a major portion which is allocated by traders for collecting information, so they optimally allocate recourses and get the important information only (Grossman, 1976). Size is used to capture the attention of traders in this study. Large and old firms are more efficient and less costly than small firms in acquisition of information, so, investors optimally choose and learn more about large firms (Ho & Michaely, 1988). Big firms have generally richer information environment and should have to increase stock return variation and reduce SPS. So, the association between size and SPS would be negative. However, to some extent large firms reveal trends of macro-economic information and the price behavior of these firms induce similar market movements and resulted in high SPS (Dasgupta, Gan, & Gao, 2010). These firms also have more diversified operations and have more synchronize trading with market resulting positive association between size and SPS (Piotroski & Roulston, 2004; Chan & Hameed, 2006 and Ashbaugh-Skaife et al., 2006). Kelly (2014) argues that analysts prepare their reports in light of maximum information available to them. This detailed analysis helps investor to get the information and lower the cost of accessibility. The acquisition of information is relatively costly for small and younger firms.

H3: There exists a meaningful relationship between SPS and firm size

BTM ratio is measure of valuation and is used to differentiate between value and growth stock. Dahlquist and Robertsson (2001) suggest that investors prefer to invest in growth firms. Whereas, Ferreira and Matos (2008) suggest that foreign investors prefer to invest in growth firms and local investor prefer to invest in value firms. Stattman (1980) and Rosenberg, Reid, and Lanstein (1985) are the pioneer researchers who document the relationship between expected returns and book-to-market ratio. Growth firms are those firms that have low BTM ratio and value firms are those that have high BTM ratio. The BTM ratio refers to book value of equity divided by market value of equity (Rosenberg et al., 1985). Dasgupta et al. (2010) use reverse proxy of BTM ratio i.e., market to book ratio and results of this study report

negative relationship between market to book ratio and SPS.

H4: There exists a significant relationship between SPS and BTM ratio

Given the evidence on the basis of prior literature that there exists significance relationship between SPS and information environment. There is a likelihood that firm's exposure to global financial crisis may be different. Heleka (2015) documents that during crisis those firms performed better, which have good information environment and better governance. Consistent with prior literature that good governance helps in reduction of exposure to crisis (Johnson et al., 2000; Mitton, 2002; Jhonson & Mitton, 2003). Rajan and Zingales (1998) argue that firms do not follow governance practices, but as the crisis vents investors take actions to and pull out their capital. It has been argued that monitoring of managerial discretion is difficult for those firms have inadequate governance mechanism and managers of these firms do not disclose true information. Poor disclosure increases the information asymmetries for the investors. Prior literature suggests that investors show more reaction towards negative news for poor governance mechanism firms than higher governance mechanism firms. Therefore, investors react more severely to the negative shocks during crisis in those firms having higher information asymmetries than firms have better governance mechanisms (Mitton, 2002).

H4: There exists a significant difference in SPS during global financial crisis.

Numerous studies have found that capital investment in companies or countries is more responsive to variation in stock returns and low R-squared (Wurgler, 2000; Durnev, Morck, & Yeung, 2004; Chen, Goldstein, & Jiang, 2006). In contrast, several studies have found inconsistent relationship between R-squared and information incorporation (Chan & Hameed, 2006; Ashbaugh, Gassen & LaFond, 2006; Griffin, Kelly, & Nadari, 2006; Kelly, 2014). Theoretically, several researchers argue that interpretation of information efficiency by R-squared is difficult to measure with standard models (West 1988; Campbell, et al., 2001; Peng & Xiong, 2006). West (1988) presents a theoretical model, which says that firm specific return variations are more linked with noise in returns than with information of firm specific variable and reports that idiosyncratic return volatility is positively related to bubbles, fad and other non-fundamental variables.

3. Data Description and Methodology

3.1 Data description

Information environment quality is captured by using firm specific variables for 133 Pakistani firms listed at PSX for the period of June 2002 to June 2016. The

variables include turnover rate, Idiosyncratic risk, percentage of zero volume days, size and book to market ratio. Firm level data is employed to observe the impact of information environment quality variables on SPS. The data are collected from Pakistan Stock Exchange (PSX) and The State Bank of Pakistan's websites.

3.2 Model specification for stock price synchronicity

To estimate the effect of information environment variables on SPS this study uses panel data analysis. Common coefficient model assumes that all firms are homogenous and coefficient is common across all companies. However, data may vary and there could be difference in intercept in a specific group in terms of different cross sectional unit's. The results under such conditions provide biased results. This problem is addressed by using fixed effect model. Fixed effect model creates company specific dummies for the data set, which assumes different intercepts of each cross sectional units. Another situation may exist, when each company differs in terms of error term. In such condition random effect model is used. This study has employed redundant fixed effect test and Hausman test to select appropriate model for estimation. The following models is used to estimate common cross section regression, random effect regression and fixed effect regression:

$$SYNCH_{i,t} = \alpha_i + \beta_1 ln(Liquidity)_{it} + \beta_2 ln(Illiquidity)_{it} + \beta_3 ln(IdyVol)_{it} + \beta_4 ln(Size)_{it} + \beta_5 ln(BTM)_{it} + \beta_6 D_t + \delta_{it} \quad (1)$$

$$SYNCH_{i,t} = (\alpha_i + V_i) + \beta_1 ln(Liquidity)_{it} + \beta_2 ln(Illiquidity)_{it} + \beta_3 ln(IdyVol)_{it} + \beta_4 ln(Size)_{it} + \beta_5 ln(BTM)_{it} + \delta_{it} \quad (2)$$

$$SYNCH_{i,t} = \alpha_i + \beta_1 ln(Liquidity)_{it} + \beta_2 ln(Illiquidity)_{it} + \beta_3 ln(IdyVol)_{it} + \beta_4 ln(Size)_{it} + \beta_5 ln(BTM)_{it} + \delta_{it} \quad (3)$$

where SYNCH is the stock price synchronicity for the firm *i* for time *t*, Liquidity is the Liquidity of stock for the firm *i* for time *t*, Liquidity is the Liquidity of stock for the firm *i* for time *t*, Illiquidity is the Illiquidity of stock for the firm *i* for time *t*, Idy vol is the Idiosyncratic risk of stock for the firm *i* for time *t*, Size is the size of the firm *i* for time *t*, BTM is the Book to market ratio of the firm *i* for time *t*, D_t is Dummy of Global financial crisis for time *t*, α_i is constant, β is coefficient, δ is error term and V is company specific intercept.

3.2.1 Stock price synchronicity

Market model R-squared is used as a proxy of SPS which is calculated by using basic asset pricing model. The study uses weekly market return and weekly individual firm stock return proposed by various studies (Morck et al., 2000; Dasgupta et al., 2010; Li et al., 2014; Zhang et al., 2016). The following model is used.

$$R_{i,t} = \alpha_i + \beta_{Mkt,i,t} R_{Mkt\,i,t} + e_{i,t} \quad (4)$$

$R_{i,t}$ is return of individual firm stock return, $R_{Mkt\ i,t}$ is value weighed market returns. For each firm R-squared measure of (Durnev, Morck, & Yeung, 2004; Farooq & Ahmed, 2014; Farooq & ElBannan, 2016) is applied:

$$SYNCH_{i,t} = ln\left(\frac{R^2}{1-R^2}\right) \tag{5}$$

This log transformation is equal to the ratio of explain versus unexplained variance.

3.2.2 Liquidity

Liquidity of financial market measures the smooth trading of stocks. In this study liquidity of stock market is measured by using turnover rate as a proxy of trading activity. Liquidity measure by using turnover rate is introduced by Datar, Naik, and Radcliffe (1998) i.e., the number of shares traded in a given day divided by the number of shares outstanding that day or percentage of outstanding shares traded in a day. Then it will be averaged for the year to provide yearly measure. This is an intuitive measure, as it simply states how many times the outstanding equity switched hands during a period. To measure turnover rate, the measure of (Chan, Hameed, & Kang, 2013) is applied

$$Turnover\ rate = \frac{number\ of\ shares\ traded\ in\ a\ given\ day}{the\ number\ of\ shares\ outstanding} \tag{6}$$

Illiquidity is used as a second measure of liquidity i.e., percentage of zero volume days as used by Dasgupta et al. (2010), which is the ratio of the days with non-missing price data to the total trading days of market. To measure Illiquidity, the measure of (Dasgupta et al., 2010; Lee, 2011) is applied

$$Percentage\ of\ zero\ volume\ days = \frac{zero\ volume\ days}{total\ number\ of\ days\ trading} \tag{7}$$

3.2.3 Idiosyncratic volatility

To measure Idiosyncratic risk, standard deviation of the individual stock is calculated. The measure of Lewellen (2014) for idiosyncratic risk is used in this study.

$$Idiosyncratic\ Volatility = \sqrt{\frac{\sum(r_i - \overline{r_i})^2}{n}} \tag{8}$$

3.2.4 Attention and cost of information (Size)

As earlier discussed, cost of information is a major portion which traders allocate for collecting information. So, they optimally allocate recourses and get the important information only. Merton (1987) states that more investors follow large firms than small and young firms. Hence, size is used to capture the attention of analyst coverage and calculated by multiplying the market price per share with the number of shares

outstanding on June 30 every year, which is used by (Banz, 1981; Imran, Usman, & Nishat, 2013). Analyst coverage and firm size is strongly correlated as stated by Bhushan (1989).

$$Size = (market\ price\ per\ share)\ X\ (number\ of\ shares\ outstanding) \quad (9)$$

3.2.5 Book to market

The valuation measure of book to market ratio of a firm is used, which is proposed by Fama and French (1996). Book to market ratio of every sample security is computed at June 30, by dividing book value of equity with market value of equity. This is a valuation measure of the firm.

$$Book\ to\ market\ ratio = \frac{Book\ value\ of\ equity}{Market\ value\ of\ equity} \quad (10)$$

3.2.6 Global financial crisis

This study introduces a time dummy of crisis period of 2008 to test the difference of SPS during crisis period. In 2008 Global credit crisis hits the financial markets across the globe. This crisis results in bankruptcy of number of financial institutions in various parts of the world. As world markets are interconnected so the problem of one part of the world can affects other parts of the globe.

4. Results and Discussion

This section reports the results of SPS and information variable for sample period from the year 2002 to 2016. To understand the nature of information environment and how it is associated with SPS, analysis starts with descriptive statistics.

4.1 Descriptive statistics

To explore the statistical behavior of data descriptive statics is presented in Table 1. Descriptive statistics include mean, standard deviation, skewness, kurtosis, minimum and maximum values of all variables. Mean and median shows the central value of data while standard deviation shows the volatility. Maximum and minimum values provide information about range.

The averages across all 15-years are presented in the Table 1. Avg R^2 is average R-squared of the firms. To calculate R-square, the following regression is estimated for each stocks in each year: $R_{i,t} = \alpha_i + R_{MKTi,t}$, where $R_{MKTi,t}$ is the value weighted market return. Each year non-financial, non-utility stocks which are ordinary shares and listed on PSX with 52 weeks of weekly returns. For each data item from 2002 through 2016 averages are calculated for each year t. Turnover rate is the year t average

Table 1: Descriptive Statistics for the Period of 2002-2016

	Avg. R2	Turnover rate	Percentage of zero volume days	Idy. Vol	Size (x10^6)	BTM
Mean	0.092	0.004	0.316	0.071	10401.586	0.707
Standard Error	0.003	0.000	0.007	0.001	706.723	0.069
Median	0.035	0.001	0.223	0.061	1157.739	0.760
Std. Deviation	0.134	0.018	0.305	0.043	31566.103	3.086
Kurtosis	5.636	439.881	-0.958	35.036	64.606	23.454
Skewness	2.287	18.182	0.622	4.334	7.052	-1.735
Min	0.000	0.000	0.000	0.004	3.545	-23.545
Max	0.800	0.536	0.996	0.630	462565.920	30.560

turnover rate of the year which is defined as the percentage of total volume to shares outstanding traded on a given day, percentage of zero volume days is the percentage of the trading days with non-missing volume to total trading days in year t, Idy Vol is measure by standard deviation of 52 weeks of weekly returns for year, Size is the market capitalization at the end of June in each year and BTM is Book to market ratio at the end of June in each year

The average R-squared is 0.092 and market model explains 9.2% variation in stock returns and the highest R-squared for any firm's market model is 0.80 or 80% approximately and the lowest R-squared is 0.000 with a standard deviation of 13.4%. That low average R-squared shows market model's predictability power is low and it is a possibility that firm specific variables may contribute more or increase in idiosyncratic volatility (Campbell et al., 2001; Kelly, 2014).

Average daily turnover rate is 0.004 and the highest turnover rate of 53.6% and lowest turnover rate is 0.000% with a standard deviation of 1.8%. The percentage of zero volume days' mean value reports that are no trades for 31.6 % of trading days in the year with a standard deviation of 30.5% by any firm. The highest no trade days are 99.6% days and lowest no trade days are 0%. The average idiosyncratic volatility is 7.1% with a standard deviation of 4.3%. The average firm size is Rs.10.4 billion and Nestle Pakistan Ltd has been reported highest market capitalization i.e., Rs. 462.565 billion in 2015 and Khyber Tobacco Co. Ltd has been reported lowest market capitalization is Rs. 3.5 million in 2002. Mostly the values in the Table 1 are indicating the leptokurtic behavior that is greater than 3 with the maximum value of 439.8 and minimum value of -0.958. Furthermore, kurtosis shows the mixed behavior.

4.3 Correlation of information environment variables & average r-square

The Pearson correlation between R-square and the information environment of stocks is calculated. Results are presented in Table 2.

Table 2: Correlation of Information Environment Variables & R-squared

	Avg. R2	Turnover rate	Size	BTM	Percentage of zero volume	Idy. Vol
Avg. R2	1.000					
Turnover rate	0.137	1.000				
Size	0.203	0.071	1.000			
BTM	0.006	-0.003	0.071	1.000		
Percentage of zero volume	-0.354	-0.131	-0.523	0.059	1.000	
Idy. Vol	-0.021	0.008	-0.385	-0.069	0.077	1.000

* All variables are same as define in Table 1

The correlation between R-squared and each of the information environment characteristics are indicating that R-squared is positively correlated with turnover rate, firm size, BTM ratio and negatively correlated with percentage of zero volume days and idiosyncratic volatility. Consistent with the findings of Kelly (2014) and Roll (1988) strong correlation of variables (turnover rate, percentage of zero volume days and firm size) is found with R-squared.

4.4 Regression of SPS on information environment variables

In order to control for the fact that the dependent variable, R-squared, is bounded, in this study same methodology is followed as earlier used by Durnev, Morck, and Yeung (2004) and Kelly (2014). Hence, instead of using R-square this study has used log transformation ratio of the explained variance to unexplained variance SPS i.e. $\ln(R^2/1\text{-}R^2)$ to create continuous variable that has more normal distribution than distribution of R^2 values that are bounded by 0 and 1 (Piotroski & Roulstone, 2004; Ashbaugh-Skaife et al., 2006; Kelly, 2014).

In addition to this, all dependent variables (turnover rate, size, BTM, percentage of zero volume days and idiosyncratic volatility) of information environment are log transformation. So, all interpretations of regression coefficients are to be interpreted as elasticity. Some variables have legitimate zero values, to overcome this issue a constant is added in such variables (turnover rate, size, BTM, percentage of zero volume days

and idiosyncratic volatility) and adding a constant alters the interpretation marginally, but it does not change the sign of the coefficients (Kelly, 2014). A constant is added in all dependent variables that is one plus maximum negative value, prior to taking the log. Table 3 presents the time series coefficients, the model fit statistics (adjusted R-square), variable significance statistics (p-values) and t-statistics.

Table 3: Regression of SPS on Information Environment Variables

	Common effect model			**Fixed effect model**			**Random effect model**		
Variable	**Coef.**	**t-Stat**	**Prob.**	**Coef.**	**t-Stat**	**Prob.**	**Coef.**	**t-Stat**	**Prob.**
Constant	-4.258	-4.552	0.000	-4.468	-3.142	0.002	-4.603	-4.727	0.000
Turnover rate	13.624	4.465	0.000	9.213	2.925	0.004	13.042	4.422	0.000
Size	0.029	0.999	0.318	-0.444	-7.982	0.000	0.001	0.024	0.981
BTM	0.333	1.183	0.237	1.341	3.230	0.001	0.483	1.652	0.099
%age of zero volume days	-3.468	-13.220	0.000	-2.033	-5.708	0.000	-3.210	-11.940	0.000
Volatility	1.120	0.791	0.429	1.360	0.873	0.383	1.150	0.827	0.408
Global financial crisis	0.984	5.047	0.000	1.068	5.809	0.000	0.989	5.385	0.000
Adj. R2	0.143								
F-stat	56.446			5.538			0.105 39.969		
F-value	0.000			0.000			0.000		

Redundant Fixed Effects Tests				**Hausman Test**			
	Statistic	**d.f.**	**Prob.**		**Chi-Sq. Statistic**	**Chi-Sq. d.f.**	**Prob.**
Cross-section Fix	2.900	-1321856	0.000	Cross-section random	172.465	5	0.000
Cross-section Chi-square	374.087	132	0.000				

In case of common effect model, results report adjusted R-squared is 0.143, which indicates that information environment variables have approximately 14.3 % explanatory power of the model. The results of table 3 report that size, BTM ratio and idiosyncratic volatility are not statistically different from zero as estimated in model. Turnover rate is statistically significant and positive in model and percentage of zero volume is statistically significant and negative in model.

In case of the data set used in this study appropriate model is fixed effect model. Fixed effect model has reported the value of adjusted R-squared i.e., 0.239 which indicates that information environment variables have approximately 24% explanatory power of the model. So, these models based on information environment variables can explain a significant portion of SPS. The results of table 3 indicate that idiosyncratic volatility is not statistically different from zero. Whereas, the turnover rate, size, BTM ratio, percentage of zero volume and dummy of global financial crisis are statistically significant. The beta coefficient of turnover rate has the value of 9.213. That indicates 1% increase in turnover rate can increase SPS by 9.213%. Grossman and Stiglitz (1980) suggest that high liquidity facilitate informed based trading. Likewise, the regular traded stocks in PSX are more synchronize with the market. The frequent traded stocks are informationally efficient and able to react instantly to any market information so that their price movement is linked with the market.

Size has statistically significant and negative relationship with SPS, which captures the attention of traders i.e., informed parties trading. The beta coefficient of size is -0.444, which means 1% increase in size can decrease SPS by 0.444 percent. Large firms have richer information environment and show a negative relationship between size and SPS (Piotroski and Roulstone, 2004). Large firms have strong informational environment and improves information surroundings on anticipation of the news. That will bring return variation and reduces R square. Percentage of zero volume days has statistically significant and negative beta value in the model. The beta coefficient of percentage of zero volume days is -2.033 which indicates that 1% increase in percentage of zero volume days can decreases SPS by -2.033 percent. Infrequent traded stocks are not informationally efficient and face delay in reaction. They do not timely respond to market news and such delays resulting low synchronicity with the market (Chan & Hameed, 2006). Similarly, Ashbaugh-Skaife et al. (2006) also suggest infrequent trading with small amounts and non-information based trading slightly immaterial trades. That will result in unrelated firm specific information and lower SPS.

The beta coefficient of BTM ratio has the value of 1.341. That indicates that 1% increase in BTM ratio can increase SPS by 1.341 percent. Which suggests that information incorporation into prices of value stocks is less and are synchronize with the market. Time dummy for global financial crisis have significant and positive sign,

which indicates during crisis stocks are more synchronize with the market. Prior studies suggest a positive relationship between corporate governance and SPS (Farooq & Ahmed, 2014). High SPS firms are linked with good corporate governance mechanism, such firms less affected by crisis (Heleka, 2015). The results of this study are in lined with the findings of Kelly (2014) that in a higher quality of information environment, attention of more informed trader, lower trading cost, large size, value stocks, high liquidity and large information events. The findings of this study Contradicts to the study of Alves, Peasnell, and Taylor (2006) that Pakistan below the average for the implementation of corporate governance and investor protection regimes. It is concluded that the difference in R-squared is due to quality of information environment, i.e. firm specific information or due to informed based trading in Pakistani equity market.

5. Conclusion

This study had been done to answer these two questions that SPS play a significant role in information environment quality and to test the synchronization process of stocks during crisis. For these purpose, this study examines the relationship between SPS and information environment variables in Pakistani equity market by using 133 stocks for the period of 2002 to 2016. Our results indicate that Low SPS is resulted due to firm specific variables information incorporation in to stock prices. This study document that movement of prices in large companies affect the synchronization with market so investor can use this information at the time of allocation of funds. Liquidity and SPS are positively correlated so it indicates that market environment plays significant role in price movement and liquidity trends can be used to foresee the behavior of stock with reference to market. Lack of trading is indication of infrequent trading. So, it should be considered while making investment decision. Consistent with prior studies, in a higher quality of information environment, market model R-squared should be higher with value stocks, size, low illiquidity, high liquidity and large information events (Kelly, 2014). Furthermore, this study focuses only on the Pakistani equity market it would be useful to examine the same information environment attributes for other emerging markets, this would enable investors to distinguish unique changes for each country and general emerging market trend.

REFERENCES

Alves, P., Peasnell, K., & Taylor, P. (2010). The use of the r2 as a measure of firm-specific information: a cross-country critique. *Journal of Business Finance & Accounting*, *37*(1-2), 1-26.

Amihud, Y. (2002). Illiquidity and stock returns: Cross-section and time-series effects. *Journal of Financial Markets*, *5*(1), 31-56.

Amihud, Y., & Mendelson, H. (1986). Liquidity and stock returns. *Financial Analysts Journal*, *42*(3), 43-48.

Ashbaugh-Skaife, H., Gassen, J., & LaFond, R. (2006). *Does stock price synchronicity represent firm-specific information? The international evidence*. MIT Sloan Research Paper 4551-05.

Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics*, *9*(1), 3-18.

Bhushan, R. (1989). Firm characteristics and analyst following. *Journal of Accounting and Economics*, *11*(2-3), 255-274.

Campbell, J. Y., Lettau, M., Malkiel, B. G., & Xu, Y. (2001). Have individual stocks become more volatile? an empirical exploration of idiosyncratic risk. *The Journal of Finance*, *56*(1), 1-43.

Chan, K., & Hameed, A. (2006). Stock price synchronicity and analyst coverage in emerging markets. *Journal of Financial Economics*, *80*(1), 115-147.

Chan, K., Hameed, A., & Kang, W. (2013). Stock price synchronicity and liquidity. *Journal of Financial Markets*, *16*(3), 414-438.

Chen, Q., Goldstein, I., & Jiang, W. (2007). Price informativeness and investment sensitivity to stock price. *Review of Financial Studies*, *20*(3), 619-650.

Dahlquist, M., & Robertsson, G. (2001). Direct foreign ownership, institutional investors, and firm characteristics. *Journal of Financial Economics*, *59*(3), 413-440.

Dasgupta, S., Gan, J., & Gao, N. (2010). Transparency, price informativeness, and stock return synchronicity: theory and evidence. *Journal of Financial and Quantitative Analysis*, *45*(5), 1189-1220.

Datar, V. T., Naik, N. Y., & Radcliffe, R. (1998). Liquidity and stock returns: An alternative test. *Journal of Financial Markets*, *1*(2), 203-219.

Durnev, A., Morck, R., Yeung, B., & Zarowin, P. (2003). Does greater firm-specific return variation mean more or less informed stock pricing? *Journal of Accounting Research*, *41*(5), 797-836.

Durnev, A., Li, K., Morck, R., & Yeung, B. (2004). Capital markets and capital allocation: Implications for economies in transition. *Economics of Transition*, *12*(4), 593-634.

Durnev, A., Morck, R., & Yeung, B. (2004). Value‐enhancing capital budgeting and firm-specific stock return variation. *The Journal of Finance*, *59*(1), 65-105.

Fama, E. F., & French, K. R. (1996). Multifactor explanations of asset pricing anomalies. *The Journal of Finance*, *51*(1), 55-84.

Farooq, O. M., & ElBannan, M. A. (2016). Simultaneous determination of stock price synchronicity and dividend payout ratios: evidence from the MENA region. *Journal of Applied Business Research (JABR)*, *32*(4), 1025-1032.

Farooq, O., & Ahmed, S. (2014). Stock price synchronicity and corporate governance mechanisms: evidence from an emerging market. *International Journal of Accounting, Auditing and Performance*

Evaluation, *10*(4), 395-409.

Ferreira, M. A., & Matos, P. (2008). The colors of investors' money: The role of institutional investors around the world. *Journal of Financial Economics*, *88*(3), 499-533.

Frankel, R., & Li, X. (2004). Characteristics of a firm's information environment and the information asymmetry between insiders and outsiders. *Journal of Accounting and Economics*, *37*(2), 229-259.

French, K. R., & Roll, R. (1986). Stock return variances: The arrival of information and the reaction of traders. *Journal of Financial Economics*, *17*(1), 5-26.

Griffin, J., Kelly, P., & Nardari, F. (2006). *Measurement and determinants of international stock market efficiency*. Working paper. University of Texas-Austin.

Grossman, S. (1976). On the efficiency of competitive stock markets where trades have diverse information. *The Journal of Finance*, *31*(2), 573-585.

Grossman, S. J., & Stiglitz, J. E. (1980). On the impossibility of informationally efficient markets. *The American Economic Review*, *70*(3), 393-408.

Haggard, K. S., Martin, X., & Pereira, R. (2008). Does voluntary disclosure improve stock price informativeness? *Financial Management*, *37*(4), 747-768.

Heflin, F., Shaw, K. W., & Wild, J. J. (2000). Disclosure quality and market liquidity. Available at SSRN 251849.

Heleka, A. A. (2015). *Stock price synchronicity and firm's exposure to financial crisis: Evidence from emerging markets*. Master of Science Thesis, The American University in Cairo.

Ho, T. S., & Michaely, R. (1988). Information quality and market efficiency. *Journal of Financial and Quantitative Analysis*, *23*(1), 53-70.

Imran, K., Usman, M., & Nishat, M. (2013). Banks dividend policy: Evidence from Pakistan. *Economic Modelling*, *32*, 88-90.

Jiang, G. J., Xu, D., & Yao, T. (2009). The information content of idiosyncratic volatility. *Journal of Financial and Quantitative Analysis*, *44*(01), 1-28.

Jin, L., & Myers, S. C. (2006). R^2 around the world: New theory and new tests. *Journal of Financial Economics*, *79*(2), 257-292.

Johnson, S., Boone, P., Breach, A., & Friedman, E. (2000). Corporate governance in the Asian financial crisis. *Journal of Financial Economics*, *58*(1), 141-186.

Kelly, P. J. (2007). *Information efficiency and firm-specific return variation*. Working Paper, Arizona State University.

Kelly, P. J. (2014). Information efficiency and firm-specific return variation. *The Quarterly Journal of Finance*, *4*(4), 1450018.

King, W. R. (1988). How effective is your information systems planning? *Long Range Planning*, *21*(5), 103-112.

Lesmond, D. A., Ogden, J. P., & Trzcinka, C. A. (1999). A new estimate of transaction costs. *Review of Financial Studies*, *12*(5), 1113-1141.

Lee, K. H. (2011). The world price of liquidity risk. *Journal of Financial Economics*, *99*(1), 136-161.

Lewellen, J. (2015). The Cross-section of expected stock returns. *Critical Finance Review*, *4*(1), 1-44.

Li, B., Rajgopal, S., & Venkatachalam, M. (2014). R2 and idiosyncratic risk are not interchangeable. *The Accounting Review*, *89*(6), 2261-2295.

Merton, R. C. (1987). A simple model of capital market equilibrium with incomplete information. *The Journal of Finance*, *42*(3), 483-510.

Mitton, T. (2002). A cross-firm analysis of the impact of corporate governance on the East Asian financial crisis. *Journal of Financial Economics*, *64*(2), 215-241.

Morck, R., Yeung, B., & Yu, W. (2000). The information content of stock markets: Why do emerging markets have synchronous stock price movements? *Journal of Financial Economics*, *58*(1), 215-260.

Pastor, L., & Veronesi, P. (2003). *Stock prices and IPO waves* (No. w9858). National Bureau of Economic Research.

Peng, L., & Xiong, W. (2006). Investor attention, overconfidence and category learning. *Journal of Financial Economics*, *80*(3), 563-602.

Piotroski, J. D., & Roulstone, D. T. (2004). The influence of analysts, institutional investors, and insiders on the incorporation of market, industry, and firm-specific information into stock prices. *The Accounting Review*, *79*(4), 1119-1151.

Rajgopal, S., & Venkatachalam, M. (2005). *Information risk and idiosyncratic return volatility over the last four decades*. Working Paper, Duke University.

Roll, R. (1988). The stochastic dependence of security price changes and transaction volumes: Implications for the mixture-of-distributions hypothesis. *The Journal of Finance*, *43*(3), 541-566.

Rosenberg, B., Reid, K., & Lanstein, R. (1985). Persuasive evidence of market inefficiency. *The Journal of Portfolio Management*, *11*(3), 9-16.

Shleifer, A. (2000). *Inefficient Markets: An introduction to behavioral finance*. OUP Oxford.

Stattman, D. (1980). Book values and stock returns. *The Chicago MBA: A Journal of Selected Papers*, *4*(1), 25-45.

Wei, S. X., & Zhang, C. (2006). Why did individual stocks become more volatile? *The Journal of Business*, *79*(1), 259-292.

West, K. D. (1988). Dividend innovations and stock price volatility. *Econometrica, 56*(1), 37-61.

Wang, N. (2003). *Measuring transaction costs: An incomplete survey*. Working Paper, Ronald Coase Institute.

Wurgler, J. (2000). Financial markets and the allocation of capital. *Journal of financial Economics*, *58*(1), 187-214.

Zhang, W., Li, X., Shen, D., & Teglio, A. (2016). R^2 and idiosyncratic volatility: Which captures the firm-specific return variation? *Economic Modelling*, *55*, 298-304.