Effect of Monetary Variables on Stock Index: Evidence from Pakistan Stock Exchange

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Abstract

This study estimates the effect of monetary variables on share index covering the monthly data over the period of July 2008 to December 2018 by various econometric methodologies i.e Granger causality test, Johansen cointegration, VECM (Vector Error Correction Model), variance decomposition analysis. The authors found that interest rate and money supply are inversely correlated with stock index. The cointegration test indicates that one cointegrated equation exists in the model. Johansen test and the VECM indicate a long-run association amid variables. Where, money supply and interest rate are inversely affecting the index, on the other hand real GDP is effecting directly. The error correction term suggests that the index requires one-month period to respond to these explanatory variables to retain its long-run equilibrium. Furthermore, Granger analysis also endorsed a unidirectional causality streaming from the GDP, interest rate, and money supply to a market index. A variance decomposition analysis reveals that the market index is dominantly forecast by its own variation and interest rate. Overall results assert that the market is inefficient in terms of selected monetary variables.

Key words: Interest rate, Money Supply, Stock Index, Vector Error Correction Model

Introduction

The stock exchange is a considerable yardstick for the assessment of the performance of the economy (Comincioli 1996). Economic growth and development is measured by the stock exchange (Maskay 2007). However, it is among the most volatile financial market in the world. Sirucek (2012) state that the stock indices are the most sensitive aspect of any economy. It can be influenced by various variables that can be split into two broad classes. The first category is comprised of company fundamental like earnings per share as studied by Uddin (2009), dividend per share and its yield, firm size and earnings per share ratio as studied by Iqbal, Ahmed, Zaidi & Raza (2015), corporate governance as studied by Awan and Jamali (2016), etc. The second category incorporates on technical variables i.e. war & terrorism as studied by Nguyen and Enomoto (2009), exchange rate, oil & gold prices as studied by Bhattacharya and Dasa (2014), technological development aspects are investigated by Abadi, Faghani and Tabatabaee (2013), likewise GDP growth rate, inflation, interest rate, and money supply as studied by Muhammad, Hussain, Ali and Jalil (2009), law & order situation and political instability as explored by Shah and Abdullah (2015), etc.

Considerable research has performed on the impact of macroeconomic variables on the stock exchange in the scenario of Pakistan. But very little contribution is available on current data in the context of the relation of the stock exchange and monetary variables. In Pakistan monetary variables like money supply and interest rates are controlled by SBP (State Bank of Pakistan) through monetary policy. Economists considered monetary policy as a core macroeconomic policy (Maskay 2007) because it controls inflation and money supply. In Pakistan, the bi-monthly announcement of monetary policy interrupts the actual money supply and economic activities. Expansion and contraction of the economy partially depend on the fluctuations of the money supply.

Capital market investors modify their investment strategies as per the announcement of monetary policy which eventually influence the adjustments in market indices. In the phenomena of tight monetary policy, central bank increases the interest rate and sells government securities to various schedule banks and the public. The aim is to reduce the money supply, consumption, encourage savings and to control inflation. Although the cost of debt for borrowers also rises, hence future economic growth may reduce. In a loose monetary policy, SBP decreases the interest rate

and repurchase government securities. The aim is to promote investment with low cost of borrowings, promote consumption and economic growth. Although, the actual and expected level of inflation has also risen due to the rise in consumption.

In concise, shocks in the money supply along with GDP growth rate will make a strong impact on the bourse and real economic activities. Gupta (1974) identified an unambiguous association between market index variation & the money supply by employing a probabilistic model. He elaborated that the money supply predicts 65 percent volatility in the stock index in trough phenomena, while money supply predicts 59 percent volatility in the stock index in peak phenomena.

Fama (1970) argues that all price affecting information does not affect the share price in conditions of an efficient market, therefore, investors are incapable to consistently acquire abnormal profits. Although, inefficient market stock prices may be influenced by price affecting information and their own lag values. Conversely, researchers who argued in the presence of their relationship believe that the equilibrium of the market portfolio is disturbed by money supply. Therefore, monetary policy interrupted the stock market and provide abnormal profits. This empirical study explores the effect of monetary variables on share index in Pakistan to contribute to the literature. The findings of the paper are fruitful for financial analysts, individual & institutional investors, portfolio managers and fund hedgers in pursuit of making investment decisions. This is also helped government officials in the formulation of monetary policy.

The further study is divided as follows section 2 and 3 are committed to review of the literature and methodology respectively. Empirical results are explored in Section 5 and Section 6 presents the conclusion.

Literature Review

A pioneer work on money supply and the share prices were conducted by Sprinkle (1964). He found a significant relation between the U.S. stock market and money supply, from 1960 to 1981. Hussain and Mehmood (1999) employed a broad and narrow money supply as an explanatory variable in the scenario of the Karachi Stock Exchange. They used cointegration and the ECM to conclude that long-term integration between money supply & share indices had existed. Though, the ECM indicates that share index is influenced by M2 (broad money supply) in the short-run while no relationship exist in long-run between these variables.

Furthermore, the market looks inefficient, with regard to money supply information. Similar results were also found by Ahmed and Hussain (2006) in scenario of Karachi Stock Exchange of Pakistan. Hanousek and Filer (1999) studied Central European states from 1993 through 1999. Their findings showed significant positive relationships between money supply and stock index.

Gan, Lee, Young and Zhang (2006) state that the rise in interest rate may create fall in the stock returns because the average investor is risk-averse because of the increase in RRR (Required Rate of Return), they sell their securities and invest in safe havens i.e. bank saving certificates, corporate debentures, and bonds, etc. Furthermore, if the interest rate increases the cost of debt also increase, therefore, firms` future cash flows decrease consequently share prices reduce. Al-Sharkas and Adel (2004) examined the relation between macroeconomic variables and Amman Stock Exchange of Jordan. Their study used the VECM model on quarterly data ranging from 1980 through 2003. Their results summarize that industrial interest rate, industrial production and money supply indicate a direct relationship with the stock index while the consumer price index has a conventional inverse relation to the stock index. Their overall model suggests a long-run equilibrium among variables. Alatiqi and Fazel (2008) employed the Engle-Granger cointegration and Granger causality technique. Their variables are the S&P 500 index of U.S., adjusted narrow money supply, average rates of treasury-bill and treasury-bond. They concluded that in long-run phenomenon money supply is insignificant in the prediction of the index. Rahman and Mustafa (2008) applied Johansen cointegration, the VECM, and variance decomposition method for M2, oil prices and S&P 500. Using monthly data, they found no causality in the long-term, but, the short-term relationship still exists among these variables. They further indicated that fluctuations in the stock index are mostly induced by its`s own shock.

Hussain, Lal and Mubin (2009) used the Johansen cointegration and VECM model in Karachi Stock Exchange. Their monthly data concludes that gross fixed capital formation & M2 are significant, but directly proportional to the stock index. But for the interest rate they get insignificant inverse relation of money supply with stock index. Moreover, the coefficient of ECT (Error Correction Term) is significant and inverse showing a long-run association amid macroeconomic variables and stock index with a higher speed of adjustments. Muhammad et al. (2009) applied

the ARMA (Autoregressive and Moving Average) technique to identify the effect of macroeconomic variables on the stock returns in the Karachi Stock Exchange. The results indicate that the M2 and the interest rate imposed a significant negative effect on the stock returns. Raymond (2009) also investigated money supply and monetary variables. He applied the Granger causality and the VECM models on variables, i.e. inflation rate, interest rate, money supply M2 & M3 and exchange rate, on Jamaica Stock Exchange. They state that the exchange rate and M2 were inversely associated with the Jamaican stock index. In contrast, inflation rate and M3 have a significant direct association with share returns. While, in the long-run cointegrating relationship amid all variables. Wambui (2009) established a relationship between selected variables particularly interest rate, GDP, and money supply with stock returns for Nairobi Stock Exchange of Kenya. Their study found that money supply and stock returns are inversely proportional due to overflow of currency in circulation which causes inflation. Consequently, reduce the purchasing power. Therefore, investors sold their investment to increase their purchasing power. Consequently, a stock supply raise and stock prices fall. Moreover, the interest rate is directly proportional with sotck returns.

Sirucek (2012) examines the effect of money supply on the DJIA (Dow Jones Industrial Average) of U.S. over a long horizon of 1959 to 2011. His Engel-Granger cointegration test identified that the money supply and the stock index are significantly related to long-run. Attari and Safdar (2013) had investigated the long-term association between macroeconomic variables and KSE 100 index on monthly data, ranging from December 1991 through August 2012. They employed the EGARCH (Exponential Generalized Autoregressive Conditional Heteroskedasticity) model. Their study found high volatility in stock index due to macroeconomic variables. Bosupeng (2014) adopted the cointegration test & the VECM model and argued against the relationship between money supply and stock returns in Botswana.

Al-Majali & Al-Assaf (2014) utilized cointegration test, the VECM, impulse response and variance decomposition approach in the investigation of the Amman Stock Exchange of Jordan in terms of macroeconomic variables. For this purpose quarterly data have been used from 1992 to 2014. They found an occurrence significant relationship between a dependent variable of market index and independent variables i.e. in the long-run GDP, loan facility from bank to private sector and

consumer price index. Although, ECT displays a comparatively steady speed of adjustment. Furthermore, the average interest rate and real GDP are positively affecting the share index. Mahzabeen (2016) examines the effect of inflation rate, interest rate, and M2 on the returns of the Dhaka Stock Exchange in Bangladesh from January 2001 to December 2012. Their OLS (Ordinary Least Square) results reveal that the money supply is significantly positive while the interest rate is inversely affecting the market returns. Ismail, Pervaz, Ahmed and Iqbal (2016) have studied the relationship between macroeconomic variables and PSX by utilizing Auto Regressive Distributed Lag Model on monthly data, ranging from 2003 to 2013. They concluded that the interest rate, exchange rate, and money supply are insignificant in predicting market index. While GDP is a sole significant indicator that influencing the stock returns.

Picha (2017) studied the influence of money supply on stock efficiency in the S&P 500 index over a longer horizon of 1952 to 2015. Their findings discover a significant positive relationship, where in the long-run if the money supply increase by one billion it may cause an increase of 0.14 points in the stock index. Gursida (2018) investigated the impact of money supply, interest rate and inflation rate on the stock market of Indonesia. He used the OLS model in the period ranging from 2010 to 2016. He summarized that money supply and share prices are significant and directly proportional. Although inflation and interest rate are insignificant in influencing the index. Umezurike, Echekoba and Ananwnde (2019) assessed the monetary variables and the stock returns in Nigeria. They concluded that the effect of interest rate on stock`s returns is vanishing due to increase in cost of debt ultimately reduced the net cash flows of firms. Akintola & Aroyewun (2022) studied Nigerian economy in terms of monetary policy by simple linear regression model. Their study indicated that decrease in interest rates and increase in money supply may attract local and foreign investments in stock exchange.

According to the different opinion of researchers, a literature review of empirical studies can be divided into two aspects, the first aspect argues in support of a significant association between stock index and money supply. These particular results obtained by Sprinkle (1964), Hanousek and Filer (2000), Al-Sharkas and Adel (2004), Muhammad et al. (2009), Gursida (2018). and Sumaryoto et al. (2021). The second aspect predicts no causal relationship is Black (1987), Kraft and Kraft (1997), Alatiqi and Fazel (2008), and Bosupeng (2014).

Methodology

Data Collection

We employ monthly data which is obtained from published sources of the Economic Survey of Pakistan, data portal of Pakistan Stock Exchange and the State Bank of Pakistan. The sample data covered a total 504 observations for the period of July 2008 to December 2018.

Description of Variables Used in the Model

KSE 100 Index*:*

It is a benchmark index that represents approximately 85 percent market capitalization in PSX (Pakistan Stock Exchange). Therefore the study in hand used KSE 100 index as a proxy for measurement of stock performance. For this purpose, index points on a closing working day of the month are selected. This variable is transformed into a natural log and denoted by SI.

Money Supply:

Generally, refers to money used in an exchange of goods and services. It can be defined as i) M1 narrow money defines as money prevails in an economy and use for transactions which consist of coin and notes in circulation, demand deposits, and travelers cheque. It is the most liquid form of money ii) M2 refers to broad money. It consists of M1, plus near money items like saving and time deposit accounts, money market instruments, mutual funds and other time deposits. Here, M2 is considered with a natural log to transform the data and this variable is also denoted by M2.

Cornell (1983) holds a view on the risk premium hypothesis that the unpredicted rise in the money supply may raise the risk premium required by investors. Therefore, this risk premium increases in the RRR. Hence, securities prices decrease. In contrast, the real activity hypothesis proposes that the measures take to increase the money supply will boost potential productivity and cash flows of firms. Hence securities prices will rise in the future.

Interest Rate:

It is a policy rate set by the central bank to grant loan to schedule banks. The direction of monetary policy is derived from this rate. Here, increase refers to tight monetary policy, conversely; a decrease refers to loose

monetary policy. Sellin (2001) states that rise in this rate may cause a reduction in economic activities and conclusively reduce the share prices. While real activity economist holds the view that the money supply and interest rate are directly proportional. They assume that an increment in the money supply may cause an increase in economic activities which further increase the firm`s cash flows & security prices. In the context of Pakistan, it may explain in two ways: firstly, a positive relationship may occur by the contribution of the financial sector in the PSX because this sector takes approximately 25 percent share in terms of market capitalization. This increase in interest rate provides benefits the financial sector e.g. banks, insurance companies, mutual funds, modaraba companies, and brokerage houses. Secondly, it is a conventional relationship where an increase in interest rates may fall, bond prices, therefore investors sell their bonds and park their investment in the stock exchange to boost their yields. It is denoted by INTR.

Log of Real Gross Domestic Product:

The accumulated amount of whole completed goods and services produced by a nation during a specific year and discount by GDP deflator is called real GDP. Merely, yearly data of GDP is available in the Economic Survey of Pakistan. Therefore, we convert the yearly frequency into monthly using constant-match average method of low to high. Because all other variables are monthly bases. The long-term increase in GDP may increase in a firm's cash flow, living standards of people and investment opportunities which is further increasing the stock index. It is denoted by GDP.

Research Methodology

Research methodology based on the following steps:

1. Explain the descriptive analysis by their coefficient of skewness, Jarque-Bera, kurtosis, mean, median, standard deviation, maximum and minimum value.
2. Determination of lags to avoid serial correlation in error terms.
3. This step deals with stationary analysis. To investigate the unit root in time series data we employed the Augmented Dickey-Fuller and Phillips-Peron model.
4. Long-run integration is addressed by through the Johansen cointegration test. Further forecasting models based on results on this test.

5. VECM model is employed in the case of long-term integration amid variables, otherwise, the VAR (Vector Autoregressive Model) is applicable in case of the short-run dynamics of the model. Asari et al. (2011) and Binh (2013) argues that in the case of cointegrated variables, error correction term must be added in the VAR. Hence it becomes the VECM model, also called restricted VAR. In case of no cointegration VAR model will be appropriate for further analysis.
6. Granger (1969) proposes that if cointegration exists amid the variables, the direction of causality also exist either unidirectional or bidirectional. Therefore, the Granger causality test is utilized.
7. The variance decomposition technique is employed to distribute variance as a component of variability over different periods. It will explore which variable contain an explanatory power to contribute to the variation of the stock index.

Results and Findings

Descriptive Analysis

Table 1 depicts the descriptive analysis without their logs. The average of the main policy rate reveals that 9.84 percent interest rate prevailing in the country from July 2008 to December 2018 with a variation of 3.10 percent. Pakistan Stock Exchange depicts the monthly average of 24,519.49 points with a high standard deviation of 13,696.13 points. Broad money supply M2 has a monthly average of 9,260,203 million rupees. There is huge volatility in terms of M2 from a minimum of 4,431,502 to a maximum of 16,352,719. GDP has the highest mean value of 21,722,872 million rupees. The coefficient of skewness of all variables is slightly positive skewed along with a kurtosis value of less than 3 portrays a platykurtic shape. Standard deviation is the highest for GDP, M2, and stock index respectively. The results of the Jarque-Bera coefficients are significant at the 5 percent level, endorse that all variables are not normally distributed.

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Table 1. Descriptive Statistics

Variables	SI	M2	INTR	GDP
Mean	24519.49	9260203.00	9.85	21722872.00
Median	23118.70	8783359.00	10.00	21506865.00
Maximum	49455.86	16352719.00	15.00	34771613.00
Minimum	5139.93	4431502.00	5.75	8274975.00
Std. Dev.	13696.13	3548028.00	3.10	7726089.00
Skewness	0.25	0.38	0.01	-0.07
Kurtosis	1.61	1.92	1.61	1.80
Jarque-Bera	11.46	9.13	10.21	7.63
Probability	0.00	0.01	0.01	0.02
Observations	126.00	126.00	126.00	126.00

Optimal Lag Selection

The forecasting of the causality between macroeconomic variables is highly affected by lag periods employed in the analysis. Johansen cointegration and VECM model also based on optimum lag. Thus, it is necessary to find an optimum lag used in the model. For detection of a suitable number of lags we employed unrestricted VAR model based on different lag, there is four selection criteria's e.g. the AIC (Akaike information criterion), FPE (Final prediction error), HQ (Hannan–Quin information criterion), and SC (Schwarz's information criterion), *Table below* depicts only the value of HQ and SC criteria at different lags where the value of lag 1 is the lowest. Therefore, lag 1 is used for further proceedings.

Table 2. Lag Selection Criteria

Lag Length	0	1	2	3	4	5	6
SC	-0.542	-13.73	-13.36	-13.06	-12.59	-12.31	-12.11
HQ	-0.599	-14.01	-13.87	-13.80	-13.56	-13.51	-13.54

* denotes the lowest value of SC & HQ

Stationary Analysis

Granger and Newbold (1974) summarized econometric analysis should be conducted on stationary data. For this purpose, stationarity analysis is applied to time series data. Alatiqi and Fazel (2008) argue that if the indigenous series is stationary at first difference known as first-order integration. If the series is stationary at the second difference known as second-order integration. Gujrati (1999) identified numerous methods to detect the stationarity of the data e.g. graphical way, correlogram test, and

unit root analysis. Here, presence of unit root is identified by Augmented Dickey-Fuller (1979) and Phillips and Peron (1988) test are utilized where the null hypothesis based on the presence of a unit root around a deterministic trend. It will be tested contrary to the alternative hypothesis of stationarity.

Conventionally it can be tested through three equations:

$\Delta Y_t = \propto Y_{t-1} + \mu_t$ (Excluding constant and trend)

$\Delta Y_t = \beta_1 + \propto Y_{t-1} + \mu_t$ (Including constant)

$\Delta Y_t = \beta_1 + \beta_{2trend} + \propto Y_{t-1} + \mu_t$ (Including constant and trend)

Table 3 depicts the outcomes of the ADF test. The null hypothesis is rejected at an original series because the statistical value falls in the critical region except for two variables in one condition. While the alternative hypothesis is conclusively accepted at first difference because the statistical values fall in the critical region indicating stationarity of the data.

Table 4 deals with Phillips-Perron test outcomes where the presence of unit root is found in the original series. Although at the first difference level the presence of the unit is rejected for all variables, it reveals that data is integrated at order one.

Table 4. Phillips-Perron Test

Variables	Original Series			First Difference		
	Equation I	Equation II	Equationn III	Equation I	Equation II	Equationn III
	None	Constant	Trend & Constant	None	Constant	Trend & Constant
SI	1.49	-0.71	-2.41	-9.16*	-9.31*	-9.28*
M2	9.05	-0.39	-4.75*	-9.18*	-14.16*	-14.11*
INTR	-0.94	-1.09	0.14	-10.36*	-10.35*	-10.43*
GDP	9.36	-5.29*	-2.37	-5.15*	-8.75*	-10.38*
Critical Value 0.05	-1.94	-2.88	-3.45	-1.94	-2.88	-3.45

Null Hyp: data has a unit root/ data is not staionary, Alt Hyp: data is staionary.

* denotes significance level at 5 per cent.

In conclusion, the results of both methods endorse that variables have a unit root at the series because mean, covariance, and the variance of the dataset are not constant throughout the period. Conversely, in both tests, all variables are stationary at first difference. These results are in line with the results Attari and Safdar (2013). Consequently, the probability of a long-run relationship may exist.

Cointegration Analysis

A cointegration check is used to identify the long-run association because the data is stationary in the same order. There is a various test like Augmented Engle-Granger, Engle-Granger, and Johansen cointegration test. Lee and Tse (1996) endorsed that Johansen cointegration test is more efficient beside the Dickey-Fuller test. The econometric equation of this method is:

$$\Delta Y_t = (\sum_{i-1}^{p} A_i - 1)Y_{t-1} + \sum_{i-1}^{p-1}(-\sum_{j-t+1}^{p} A_j)\Delta Y_{t-1} + \beta X_t + \mu_t$$

Here, ΔY_t describe a vector of observation in a p-element form in each variable at a specific time. The $\sum_{i-1}^{p-1}(-\sum_{j-t+1}^{p} A_j)\Delta Y_{t-1}$compute variations in stationarity to a prior trend of variables and $\sum_{i-1}^{p} A_i - 1$ explain co-integrated associations. Number of cointegrated equations can be obtained by λ_{trace} test and $\lambda_{Max-Eigenvalue}$ test:

λ_{Trace} (r|n) = -T $\sum_{i=r+1}^{n}$ log (1- λ_i)

$\lambda_{\text{Max-Eigenvalue}}$ (r|r+1) = -T log (1- λ_{r+1})

When a uniform level of stationary is obtained for all variables, then a long-run association is addressed by cointegration analysis (Johansen 1988). Masih and Masih (1995) also state that the cointegration test is essential before use causality tests. The test is a yardstick for the selection of a suitable test.

Table 3 and Table 4 shows that variables are integrated at first difference level. Now, we investigate whether any long-term association exists amid variables or not through the cointegration test. If the long-term relationship exists study follows VECM, otherwise, VAR is utilized.

Table 5 presents the Trace and Max-Eigenvalue values. The existence of one cointegrated equation is found in both tests. Because the null hypothesis of at most one cointegrated equation is accepted, indicating at most one cointegrated equation. Johansen`s test, demonstrate the presence of a heteroscedastic cointegrated association amid index & monetary variables in the long-run. Hence, it confirms that one cointegrated vector exists in the model and this supports the application of the VECM. Now, we normalized our cointegrated equation on the bases of SI drive from the results of VECM.

Table 5. Johansen Cointegration Test

Panel A: Trace Test:					
Hypothesis of Cointegrated Eq.	Null Hyp.	Alt. Hyp.	Trace Statistics	Critical value 95%	Prob.**
i) None	r = 0	r ≥ 1	65.96	47.86	0.00*
ii) At most 1	r ≤ 1	r ≥ 2	25.90	29.80	0.13
iii) At most 2	r ≤ 2	r ≥ 3	10.68	15.49	0.23
Panel B: Max-Eigenvalue Test:					
Hypothesis of Cointegrated Eq.	Null Hyp.	Alt. Hyp.	Max-Eigenvalue Statistics	Critical value 95%	Prob.**
i) None	r = 0	r ≥ 1	40.06	27.58	0.01*
ii) At most 1	r ≤ 1	r ≥ 2	15.22	21.13	0.27
iii) At most 2	r ≤ 2	r ≥ 3	10.51	14.26	0.18

Trace test & Max-eigenvalue test both indicate one cointegration at the 0.05 level.

* denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values.

Table 6. Normalized Cointegrating Coefficients (1 Cointegrating Eq.)

SI	M2	INTR	GDP
1.000	7.24	0.31	-7.71
S.E	-1.72	-0.09	-1.45
t-value	-4.21	-3.34	5.30

The above table shows the normalized cointegrated coefficients derived by Johansen and Juselius (1990) indicate long-run causality running from monetary variables. Their linear relationship can be demonstrated in equation form as:

SI + 7.236 M2 +0.307 INTR -7.713 GDP

When we equate the above equation to zero, we get:

SI = -7.236 M2 - 0.307 INTR + 7.713 GDP

According to above equation M2 has a negative relation with an index indicating a 1 percent rise in M2 may cause -7.236 percent fall in the stock index. This response may be induced by increases in time deposit accounts. Wongbangpo and Sharma (2002) also established negative relationship between money supply and stock returns in Indonesia and Philippines in the presence of higher inflation persist in long-run. The outcomes of M2 are matched with the risk premium hypothesis and previous studies of Muhammad et al. (2009) and Raymond (2009).

The stock index and interest rate are also indirectly proportional. It depicts that if the interest rate rise by 1 percent, it may cause 0.307 percent negative to fall in the stock market. Sellin (2001), Muhammad (2009),

Isamil et al. (2016), and Mahzabeen (2016) also found similar results. GDP and stock index are also direct proportional where1 percent rise in GDP may cause a 7.713 percent increase in share index. As defined in the empirical findings of Maskay (2007) and Al-Majali and Al-Assaf (2014).

Vector Error Correction Model

In this section, due research expresses short-run dynamics and speed of adjustment of the model. It can be achieved by the following equation:

$$\Delta SI_t = \propto_1 + \psi_t(SI_{-1} - \beta_1 M2_{-1} - \beta_2 INTR_{-1} - \beta_3 GDP_{-1}) + \gamma_1 \Delta M2_{-1} + \gamma_2 \Delta INTR_{-1} + \gamma_3 \Delta GDP_{-1} + \mu_t$$

In the above equation $\propto$ is a constant, Δ use as a lag operator for the first difference, μ represent a sequence of white noise vector`s zero-mean. ψ_t is a coefficient of ECT, which explains the short-run dynamics of the model of an adjacent parameter. It is derived from cointegrating vectors express as β. The ECT expresses the percentage of the last period's deviation dissipate from the long-term equilibrium that ΔSI_t reacts to. The statistically negative and significant term of ψ_t depicts the disequilibrium state and existence of convergence from short-run adjustment towards its long-run equilibrium. While γ depicts the short-run dynamics of the vector of variables.

Table 7. Vector Error Correction Model

Variables	Coefficients	Prob.	
ECT (Ψ)	-0.01	0.09**	
Dlog(SI)	0.15	0.07**	
Dlog(M2)	0.76	0.04*	
Dlog(intr)	-0.05	0.00*	
Dlog(GDP)	0.48	0.320	
Adjusted R-squared	0.17	Sum squared resid	0.44
S.E. of regression	0.06	Schwarz criterion	-2.56
F-statistic	6.11	Hannan-Quinn crite	-2.64
Prob(F-statistic)	0.00	Durbin-Watson stat	1.87

*, ** denotes signficance level at 5 per cent and 10 per cent respectively.

The above table depicts the results of the VECM model and their probabilities when SI is used as the dependent variable with lag 1. The value ECT is significant and negative, illustrates the convergence of short-run dynamics to long-run equilibrium. Ahmad and Hussain (2006) and Hussain et al. (2009) also found similar results. The value of ECT is 0.014 depicts that 1.4 percent of disequilibrium is dissipated before the next period and 98.6 percent remains.

Speed of adjustment can be determined by this formula:

$$= \quad 1/(1- ECT) = 1/(1-0.014)) \cong 1$$

The speed of adjustment suggests that after the short-run shock market required 1 month to retain its long-run equilibrium. Likewise, coefficients of GDP and interest rate are positive and negative respectively. These signs are consistent with the normalized cointegrated coefficients of the long-term. On the contrary behaviour of M2 is quite negatively significant in short-run dynamics, opposite from its behaviour in the long term normalized coefficient. Because in a short-run raise in M2 may cause a fall in interest rate, therefore an investor becomes more attractive towards stock returns rather than small and constant returns on bank savings. However, the long-run rise in M2 may dilute in the form of inflation, it will reduce the purchasing power. Therefore, people sell their financial wealth. This selling pressure decreases the stock returns in the long-term.

The Durbin-Watson value is nearer to two signifying no issue of serial correlation. Adjusted R-square is 20.6 percent represents the explanatory accuracy of the said model. Moreover, the significance of F-statistics representing the fitness of the model.

Granger Causality Test

Correlation analysis quantifies the relationship between variables, but cannot surmise the tendency of the relationship between two variables. This section deals with the second research question of the study. The direction of causality can be specified by the Granger causality test in the VECM conditions, based on optimal lag estimated by Schwarz and Hanna-Quin Criteria. The equation of the Granger causality method consists of an estimation of pairwise regression:

$$\Delta X_t = \alpha_0 + \sum_{i=1}^{n} \propto_i \Delta Y_{t-i} + \sum_{j=1}^{m} \beta_j \Delta X_{t-j} + \mu_{1t}$$

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{n} \psi_i \Delta X_{t-i} + \sum_{j=1}^{m} \beta_j \Delta Y_{t-j} + \mu_{2t}$$

In the above equations ΔX_t and ΔY_t are dependent variables, i represent the no. of lag, μ_{1t} and μ_{2t} present white noise terms. If the null hypothesis of $\propto_i = 0$ and $\psi_i = 0$ is rejected, it means Y granger causes X and X granger cause Y respectively. In case of rejection of both null hypothesis bi-directional causality exists between variables.

According to Table 8 unidirectional causality exists from the money supply, interest rate, and GDP towards index because the null hypothesis of

X does not Granger cause Y is rejected. These results indicate that the KSE 100 index is highly effective by these variables. While the null hypothesis for all other Granger tests is not rejected, it implies that no causality exists from the stock index. Similar results were found by Ahmad and Hussain (2006). Jawaid and Haq (2012) also observe unidirectional short-run causality running from interest rates to stock index in the banking sector of Pakistan Stock Exchange. Results of GDP are in accordance with the study of Kibria et al. (2014) who explore that GDP Granger caused stock returns.

Table 8. Pairwise Granger Causality Tests (at lag 1)

Null Hypothesis:	F-Statistic	Prob.
M2 ---------- SI	6.15	0.02*
SI ---------- M2	1.05	0.31
INTR---------- SI	5.23	0.02*
SI ---------- INTR	0.08	0.78
GDP ---------- SI	17.79	0.00*
SI ---------- GDP	0.00	0.99

* denotes signficance level at 5 per cent.

Variance Decomposition Analysis

It describes the data of every individual variable`s contribution to the other variables in an autoregressive process. It can be computed by the percentage of forecasted error variance of each of the variables. Table 9 represents the decomposition values of monetary variables and own shock of SI on the horizon of a different period.

Table 9. Variance Decomposition of SI

Period	S.E.	SI	M2	INTR	GDP
1.00	0.06	100.00	0.00	0.00	0.00
2.00	0.10	92.88	0.81	5.89	0.41
3.00	0.12	89.13	0.60	8.68	1.58
4.00	0.15	86.03	0.49	11.03	2.46
5.00	0.17	83.64	0.38	12.76	3.22
9.00	0.25	77.03	0.20	17.38	5.39
10.00	0.27	75.75	0.19	18.24	5.82

According to the above table 1st period reveals that the share index represents 100 percent of the adjustments of its own shock, during this shorter span of the period selected monetary variables have no effect on the

fluctuation of the share index. In the 2nd-period result state that its own shock of SI account for 92.88 percent in SI fluctuations and interest rate account for 5.89 percent, while the effect of the M2 and GDP is negligible in this period. Likewise, in the 3rd, 4TH and 5TH period percentage of SI`s own shock has consistently diminished and shock to the interest rate and real GDP is also increasing period by period. During the last period, the contribution of SI decreases to 75.75 percent. Besides, the shock of interest rate account for 18.24 percent and shock of GDP accounts for 5.82 percent, while the shock of the M2 is still negligible to 0.19 percent. Other than SI's own shock, interest rate creates a major contribution in the fluctuation of SI, its share increase from 5.90 percent in the 2nd period to 18.24 percent in the 10th period. Therefore Interest rate may be termed as an important determinant of Pakistan Stock Exchange`s index.

Conclusion

The article explores the impact of monetary variables on the KSE 100 Index of PSX. Therefore, approximately nine and a half year data has been compiled. Augmented Dickey-Fuller and Philips Person test confirmed that all variables are stationary at I(1). While the Johansen cointegration model is identified one co-integrated equation. Therefore, the long-run relationship exists amid these variables. Moreover, VECM is used for further detection of short-run dynamics and speed of adjustment. Normalized coefficients of VECM endorse a positive association between GDP and SI while M2 and interest rates are negatively effecting the share index. ECT term endorses that the market requires one month to dissipate from the shocks of selected variables and to retain its long-run equilibrium. Granger causality model endorses a unidirectional causality running from all independent variables e.g. GDP, interest rate and money supply to stock index. Variance decomposition results state that market volatility is largely induced by its shock and influence of interest rate because the it makes an effective impact on the market index than rest of the monetary variables in an economy. There is a negligible contribution of GDP in the fluctuations of the share price during starting periods. The overall study recommends that this inefficiency is prominently caused by M2 & interest rate. Hence, the study suggests that stakeholders will hold the capability to estimate the stock prices by consideration of monetary variables. These results guide the stakeholders to adjust their investment decisions as per the announcement of the monetary policy. This research can be extended by

the increase in sample size, extension of the model, inclusion of further monetary variables and econometric techniques.

References

Abadi, H. R. D., Faghani, F., & Tabatabaee, S. M. (2013). Impact of Information Technology Development on Stock Market development. Empirical Study in the World's Leading Capital Markets. *Int. J. Academic Res. Account. Finance Manage. Sci.*, *3*(1), 382-390.

Ahmad, N., & Husain, F. (2006). The relation between stock prices and money supply in Pakistan: an investigation. Journal of Independent Studies and Research (JISR) Volume, 5.

Alatiqi, S., & Fazel, S. (2008). Can money supply predict stock prices? *Journal for economic educators*, *8*(2), 54-59.

Al-Majali, A. A., & Al-Assaf, G. I. (2014). Long-run and short-run relationship between stock market index and main macroeconomic variables performance in Jordan. *European Scientific Journal*, *10*(10).

Al-Sharkas, A. (2004). The Dynamic Relationship Between Macroeconomic Factors and the Jordanian stock market. *International Journal of Applied Econometrics and Quantitative Studies*, *1*(1), 97-114.

Asari, F. F. A. H., Baharuddin, N. S., Jusoh, N., Mohamad, Z., Shamsudin, N., & Jusoff, K. (2011). A vector error correction model (VECM) approach in explaining the relationship between interest rate and inflation towards exchange rate volatility in Malaysia. *World Applied Sciences Journal*, *12*(3), 49-56.

Akintola, A. F. & Aroyewun, B. O. (2022). Monetary policy and stock market returns in Nigeria. *International Journal of Recent Innovations in Academici Research*, *4*(4), 23-27.

Attari, M. I. J., Safdar, L., & Student, M. B. A. (2013). The relationship between macroeconomic volatility and the stock market volatility: Empirical evidence from Pakistan. *Pakistan Journal of Commerce and Social Sciences*, *7*(2), 309-320.

Awan, A. W., & Jamali, J. A. (2016). Impact of Corporate Governance on Financial Performance: Karachi Stock Exchange, Pakistan. *Business and Economic Research*, *6*(2), 401-411.

Bhattacharya, S. N., & Dasa, J. K. (2014). Macroeconomic Factors and Stock Market Returns: A Study in Indian Context. *Jamb Journal of Accounting-Business & Management*, *21*(2)

Binh, Phung. "Unit Root Tests, Cointegration, ECM, VECM, and Causality Models." *Topics in Time Series Econometrics, Article* 110 (2013).

Black, F. (1987). A gold standard with double feedback and near zero reserves. *Business cycles and equilibrium*, 115-20.

Boonyanam, N. (2014). Relationship of stock price and monetary variables of Asian small open emerging economy: Evidence from Thailand. *International Journal of financial research*, *5*(1), 52.

Bosupeng, (2014). Sensitivity of Stock Prices to Money Supply Dynamics. *International Journal of Novel Research in Marketing Management and Economics*, *1*(1), 58-65.

Comincioli, B. (1996). The stock market as a leading indicator: An application of granger causality. *University avenue undergraduate journal of economics*, *1*(1), 1.

Cornell, B. (1983). The money supply announcements puzzle: Review and interpretation. *The American Economic Review*, *73*(4), 644-657.

Dickey, D.A., & Fuller, W.A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, *74*(366a), 427-431.

Fama, E. F. (1970) "Efficient Capital Markets: A Review of Theory and Empirical Work," Journal of Finance, 25, 383-417.

Gan, C., Lee, M., Yong, H. H. A., & Zhang, J. (2006). Macroeconomic variables and stock market interactions: New Zealand evidence. *Investment management and financial innovations*, 3(4), 89-101.

Government of Pakistan. Economic Survey (Various Issues). Finance Division.Islamabad.

Granger, C. W. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica: Journal of the Econometric Society*, 424-438.

Granger, C. W., & Newbold, P. (1974). Spurious regressions in econometrics. *Journal of econometrics*, *2*(2), 111-120.

Gujarati, D. N., & Porter, D. C. (1999). *Essentials of econometrics*.

Gupta, M. C. (1974). Money Supply and Stock Prices: A Probabilistic Approach. *Journal of Financial and Quantitative Analysis*, *9*(01), 57-68.

Gursida, H. (2018). The influence of inflation rate, interest rate, and money supply on share price LQ45. *Sinergi: Jurnal Ilmiah Ilmu Manajemen*, *8*(1).

Hanousek, J., & Filer, R. K. (2000). The relationship between economic factors and equity markets in Central Europe. *Economics of transition*, *8*(3), 623-638.

Husain, F., & Mahmood, T. (1999). Monetary expansion and stock returns in Pakistan.

Hussain, A., Lal, I., & Mubin, M. (2009). Short run and Long-run Dynamics of Macroeconomics Variables and Stock prices: Case Study of KSE (Karachi Stock Exchange). Kashmir Economic Review, 18(1), 43-61.

Iqbal, A., Ahmed, F., Zaidi, S. S. Z., & Raza, H. (2015). Determinants of Share Prices, Evidence from Oil & Gas and Cement Sector of Karachi Stock Exchange (A Panel Data Approach). *Journal of Poverty, Investment and Development*, *8*(1), 14-19.

Ismail, R., Pervaz, A., Ahmed, A., & Iqbal, R. (2016). Macroeconomic Factors and the Pakistani Equity Market: A Relationship Analysis. *International Journal of Innovation and Applied Studies*, *15*(1), 122.

Jawaid, S. T., & Ul Haq, A. (2012). Effects of interest rate, exchange rate and their volatilities on stock prices: evidence from banking industry of Pakistan. Theoretical & Applied Economics, 19(8).

Johansen, S. (1988): Statistical analysis of cointegrating vectors, Journal of Economic Dynamics and Control, 12, 231-254.

Johansen, S. and K. Juselius (1990). "Maximum likelihood estimation and inference on cointegration with applications to the demand for money." Oxford Bulletin of Economics and statistics 52(2): 169-210.

Kibria, U., Mehmood, Y., Kamran, M., Arshad, M. U., Perveen, R., & Sajid, M. (2014). The impact of macroeconomic variables on stock market returns: a case of Pakistan. *Research Journal of Management Sciences*. *ISSN*, *2319*, 1171.

Kraft, J., & Kraft, A. (1977). Determinants of common stock prices: a time series analysis. *The journal of finance*, *32*(2), 417-425.

Lee, T. H., & Tse, Y. (1996). Cointegration tests with conditional heteroskedasticity. *Journal of Econometrics*, *73*(2), 401-410.

Mahzabeen, S. (2016). Impact of Money, Interest Rate and Inflation on Dhaka Stock Exchange (DSE) of Bangladesh. *Journal of Business and Technology (Dhaka)*, 41-54.

Masih, A. M., & Masih, R. (1995). Temporal causality and the dynamic interactions among macroeconomic activity within a multivariate cointegrated system: evidence from Singapore and Korea. *Review of World Economics*, *131*(2), 265-285.

Maskay, B. (2007). Analyzing the effect of change in Money supply on stock prices. The park place economist, 15(1), 72-79.

Muhammad, S. D., Hussain, A., Ali, A., & Jalil, M. A. (2009). Impact of macroeconomics variables on stock prices: Empirical evidence in Case of KSE. *Available at SSRN 1683357*.

Pakistan Stock Exchange`s official data portal. Retrieved from: https://dps.psx.com.pk/

Phillips, P. C., & Perron, P. (1988).Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335-346.

Pícha, V. (2017). Effect of Money Supply on the Stock Market. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, *65*(2), 465-472.

Rahman, M. (2008). Influences of money supply and oil price on US stock market. *North American Journal of Finance and Banking Research*, *2*(2).

Raymond, K. (2009). Is there a long-run relationship between stock prices and monetary variables? Evidence from Jamaica. *Financial Stability Department Bank of Jamaica*.

Sellin, P. (2001). Monetary policy and the stock market: theory and empirical evidence. *Journal of economic surveys*, *15*(4), 491-541.

Shah, S. M. M., & Abdullah, F. (2015). A Study of Day of the Week Effect in Karachi Stock Exchange During Different Political Regimes in Pakistan. *Business & Economic Review*, *7*(1), 41-66.

Sirucek, M. (2012). The impact of money supply on stock prices and stock bubbles. *Working Paper: MPRA Paper No. 40919*.

Sprinkle, B. (1964) Money and Stock Prices. Illinois.

State Bank of Pakistan (Various Issues) Statistical Bulletins.

Sumaryoto, S., Nurfarkhana, A., & Anita, T. (2021). The Impact of Money Supply and the Inflation Rate on Indonesia Composite Index: Case Study in Indonesia Stock Exchange 2008-2017. International Journal of Economics, Business and Accounting Research (IJEBAR), 5(2).

Uddin, M. B. (2009). Determinants of market price of stock: A study on bank leasing and insurance companies of Bangladesh. *Journal of modern Accounting and Auditing*, *5*(7), 1.

Umezurike, C. M., Echekoba, F., & Ananwude, A. (2019). Does Monetary Policy Affect Stock Market Return? Recent Evidence from Nigerian Stock Exchange (1986-2018). *South Asian Journal of Social Studies and Economics*, *5*(3), 1-8.

Wambui, M. C. (2009). The impact of Money Supply and Selected Macro Economic Variables on Stock Market Returns at the Nairobi Stock Exchange (NSE), *(Doctoral dissertation, University of Nairobi)*.

Wongbangpo, P., & Sharma, S. C. (2002). Stock market and macroeconomic fundamental dynamic interactions: ASEAN-5 countries. *Journal of Asian Economics*, *13*(1), 27-51.