The Risk-Free Rate and Its Ripple Effect: Unveiling the Impact on Stock Prices in Pakistan

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ABSTRACT

Purpose
This study examined the effect of the risk-free rate of return and other macroeconomic variables on the stock prices of firms listed on the Pakistan Stock Exchange-100 (PSX).

Methodology
The data from 2013 to 2023 was collected from the Karachi Stock Exchange website, Yahoo Finance, and the State Bank of Pakistan's website. The main techniques for data analysis were Johansen-Juselius (J.J.) cointegration and the Vector Error Correction Model (VECM).

Findings
The findings show that a risk-free rate significantly impacts stock returns in the long run. Further, foreign direct investment (FDI) has a significant positive impact on the stock return of listed companies. The cointegration result indicates a long-run association among all the selected variables. Moreover, the results of the VECM show that the error correction term (ECT) in VECM (-1) is negative (-0.150) and significant. The negative coefficient of 0.150 indicates that deviations from the long-run equilibrium will be corrected at a speed of 15% per period, approximately within 7 months.

Conclusion
The study concludes that stock prices and macroeconomic indicators have long-run associations. Conversely, changes in the risk-free rate of return by the government or the banking sector have the opposite effect on stock prices. This study assists government officials, stock market participants, and policymakers in determining the profitability of the National Savings Scheme and Banks.

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1. Introduction

The equity market plays an imperative role in economic development. Without stock exchanges, it is impossible to imagine economic growth, as a significant portion of the economy depends on the growth of the financial sector. This sector plays a vital role in mobilizing domestic resources, so keeping a close watch on macroeconomic factors is essential for predicting changes in the stock market index. Various factors, including internal management practices at the firm, macro and microeconomic conditions at home, as well as social, political, and internal policy considerations, influence how the stock index moves (Asaolu & Ogunmuyiwa, 2010; Chinoda & Kapingura, 2024).

Investors invest money in the capital market to earn better returns on investment (ROI), which depends on several factors. However, the actual number of these market-influencing elements is difficult to determine. The scholarly literature has a wealth of prior research on the variables influencing stock prices. Available literature suggests that different macroeconomic factors significantly impact stock prices. Recurrent fluctuations in macroeconomic factors impede the seamless operation of the financial sector and have a detrimental effect on economic growth. Examples of such events are the Wall Street Crash of 1929 and Black Monday on October 19, 1987. The Global Financial Crisis of 2008 and the Asian Disaster of 1997 are two other instances. All these events impact the stock market and affect local and international economies. Therefore, understanding changes in the enactment of the equity market is essential knowledge for financial analysts, economists, investors, and policymakers. Investors and financial analysts have a keen interest in understanding the frequent change in the prices of financial assets and also have an interest in knowing what kind of event will become the cause of an increase/decrease in the prices of securities over time (Alfiana et al., 2024; Malik et al., 2013).

Pakistan’s economy is one of the emerging economies among developing economies worldwide, in terms of progression, since the last decade. Many factors have contributed to this rapid change in economic forces and the growth of security market returns. The combination of foreign and domestic forces has brought about a remarkable transformation in Pakistan's national economy. Internal factors include the government's incentives, such as a strong regulatory framework, provided to domestic and foreign investors. One external element that helped Pakistan secure financial aid and foreign direct investment was its advantageous location following the 9/11 attacks. Developing nations are forced to accelerate economic development due to widening economic gaps and expanding capital needs. An essential component of economic stability is foreign direct investment (FDI). In Pakistan, foreign direct investment (FDI) is crucial to maintaining economic stability. The Pakistani government has implemented the most free and welcoming economic policies during the past ten years in an attempt to draw in foreign investment, making Pakistani markets seem appealing to outside investors. Foreign direct investment strengthens human resources, introduces new technology, and forges intimate ties between Pakistan's domestic and international markets.

The novel COVID-19 coronavirus initially spread in China. The World Health Organization (WHO) declared a pandemic on March 12, 2020, after it had spread to most of the earth. The virus has inevitably affected commercial and social surroundings worldwide. COVID-19 significantly impacted national economies, and cultural activities were almost entirely restricted. It is difficult to predict how the epidemic will develop in the future because of the scarcity of accessible data. More comprehensive data will provide clearer insights into the potential effects of the pandemic on financial markets

and the economy. The lack of daily measurements for macroeconomic variables like GDP, trade openness, and unemployment makes it difficult for empirical research to show how these factors relate to COVID-19.

The Karachi stock exchange, which peaked in April 2008 at 15,125 points, began to decrease and ended the month of June 2008 at 12,221 points (an unanticipated 20 percent decline in just two months). The Karachi Stock Exchange ceased trading in August 2008 to halt further declines. December 2008 had a 62 percent decline in the KSE index. on December 15, the KSE resumed trading following the lifting of the price floor. The KSE's survival period ran from 2009 to 2012, during which time it saw impressive performance, emerging as one of the best stock markets and ranking among the top 10 global markets. Its yardstick index showed an annual return of 49.4 percent, or 37 percent in terms of dollar returns. The KSE, LSE, and ISE stock exchanges were combined to form PSX on January 11, 2016. The development of PSX following this merger is summarized below:

Table.1.Last sixty Years market summary of PSX Index (1950-2020)

PSX-Summery	1950	1960	1970	1980	1990	2000	2010	2020
Number of Listed Companies	15.00	81.00	291.00	314.00	487.00	702.00	644.00	531
Paid up equity capital (Rs. Billion)	0.12	1.00	3.90	7.60	28.00	236.50	919.10	1421
Free Float Market Capitalization (Rs. Billion)	Data not available	1.90	5.70	9.80	61.70	382.70	3268.90	8035

Source: Author's own elaboration

Table.2.Last half decade market summary of PSX index (2019-2023)

PSX-Summery	2019	2020	2021	2022	2023
Number of Listed companies	534	531	533	531	524
Paid up equity capital (Rs. Billions)	1386.60	1421.09	1485.10	1552.73	1665.48
Free Float Market Capitalization (Rs. Billions)	7811.81	8035.36	7684.64	6500.82	9062.90

Source: Author's own elaboration

The study of macroeconomic indicators that impact securities exchange efficiency is also valuable for economists and policymakers. It helps them devise unique strategies to expand economic principles, improve security market performance, and achieve economic stability. According to empirical research on this topic, a country's overall stability and monetary advancement may be inferred from a stable and emerging security exchange. Any change in the economic situation might lead to a revolution in the security market. Pakistan's economy has progressed admirably over the past ten years, and its security markets have performed quite well. In the current period, when economic conditions are not showing signs of improvement and the stock market is moving downward, research is being done to identify macroeconomic variables and specific economic issues that can be used to predict changes in the share prices of the Karachi Stock Exchange 100-index. In particular, to address questions like is the multifactor model appropriate for representing fluctuations in Pakistani share prices? and "Which economic variable and economic issue significantly influences stock prices and contributes to strengthening the association with stock prices?

2. Literature Review

The current economic and monetary literature presents many theories that explain the relationship between macroeconomic determents and stock exchanges. Among all these theories, the most prominent are the Efficient Market Hypothesis (EMH) and Capital Assets Pricing model (CAPM). EMH theory recommends that stock prices contain fully and rationally incorporated all the appropriate information. Hence, previous information is useless in forecasting the future prices of an asset. Only for this reason, information which is latest and related is employed to explicate share market performance (Fama, 1965). CAPM theory, for instance APT, and PVM, illustrated association-ship among share prices variation with economic activity. To examine the relationship between macroeconomic variables and return on share prices many research studies were completed before this study like the study of Blanchard & Kahn (1980)and Fitriani & Simon, (2024) which established a linkage between return on share prices and the interest rate. The study argued that amendment in the policy of rising and declining the MS in the market has affected the share prices of the PSX 100 Index. BILSON et al. (1991) & NDLOVU (2024) argued that interest rates had a negative effect on stock returns. A high interest rate attracts new investors in unconventional manners (Bohl et al., 2008; Hagström & Runesson, 2024). According to Bohl et al. (2008), there was a significant correlation between interest rates and stock prices. This relationship is based on heteroskedasticity, and covariance turns positive during times of high volatility brought on by changes in interest rates. This highlights the influence of interest rate fluctuations on the dynamics of the equity market. Further, this highlights the significance of heteroskedasticity in comprehending the correlation between interest rates and share prices.

Humpe & Macmillan (2009) studied the impact of macroeconomic factors on the stock markets of the United States and Japan using co-integration. The money supply, interest rates, consumer prices, and industrial production were used in this study. The findings indicate that for a single co-integrating vector in the USA, the data was constant and that stock prices are negatively correlated with the interest rate and the CPI and positively correlated with IP. In contrast, Chen et al. (2005) examined the ability of macroeconomic factors to influence the stock exchanges in a recession. Results revealed that interest rate spread and inflation rate affect the stock prices in the recession period. Ali (2012) investigated the impact of macro and microeconomic variables on the stock prices of Bangladesh's Dhaka Security Market. The Dhaka Stock Markets were explained variables, while the industrial production index (IPI), foreign remittances, inflation, market price/earnings, and average monthly growth in the capital market were explanatory variables. Eight years of data, spanning from July 2002 to December 2009, were collected for analysis through official Dhaka Stock Market monthly releases. Multiple Regression Models calculated using OLS standards were used to assess the data. The study concluded that the industrial production index (IPI), market price/earnings, and average monthly growth in the capital have a significant positive impact. Inflation and foreign remittances had a negative impact on stock returns. Further, Elahi (2017) studied the short and long-term relationship between macroeconomic indicators and stock prices in Germany and the UK. The researcher used the Johnson Co-integration procedure and ECM to analyze each case individually. In the case of Germany, the findings indicated a short-term causality from stock prices to money supply, industrial production, and inflation. Moreover, in long run, there is a casualty from stock prices to inflation and exchange rates. The outcomes also indicate that IP has both short and long run casualty among share prices. In the United Kingdom case, short-run casualty runs from stock prices to exchange rate and T. bills. Results of long-run casualty show that there runs

long run casualty from stock prices to inflation. In contrast, Shahzadi & Chohan (2012) studied the impact of Gold prices on share prices over 5 years from 2006 to 2010 at the Karachi stock exchange. The research used statistical techniques like Augmented Dickey-Fuller (ADF) and Phillip Perron to explore the relationship between stock returns and Gold prices. Additionally, Johansen's Co Integration and Granger Causality test (GCT) were employed for long-term and causality testing. The study's findings indicated that the exchange rate and gold rate had a negative influence on stock prices. Likewise, Ahmed & Mustafa (2012) conducted a study on the relationship between inflation and real stock return using Full Information Maximum Likelihood (FIML). They analyzed monthly and yearly data from 1972 to 2002. The researchers used KSE-100 index share prices as endogenous variables, and GNP and inflation as independent variables. It was found that the relationship between inflation and return diminishes when the real output growth rate is controlled.

Khan et al. (2021) discussed the causal relationship between the KSE 100 index, exchange rate, interest rate, import & export, and consumer price index. The study used data from 1992 to 2012 for Regression Analysis and Granger causality test. Results showed a two-way relationship between interest rate and the KSE-100 index, but no causal link between the consumer price index, export, and KSE-100 index was found. Hedau (2024) analyzed the Indian Stock Market NIFTY 50 with primary and secondary data. The study found that political stability and economic situation significantly impact NIFTY 50. This study aims to address the gap in the current literature by investigating how macroeconomic variables and the risk-free rate affect stock prices within the Karachi stock exchange.

3. Methodology

Pakistan Stock Exchange (PSX) previously known as KSE is a growing stock exchange in Pakistan and was ranked as the 33rd best market globally. The shares traded in PSX are considered a benchmark for other markets by investors. PSX has 36 listed sectors that make up the 100 Index, with one sector, mutual funds, excluded. The market's performance is influenced by various macroeconomic factors such as inflation, interest rates, unemployment, current account deficit, gold prices, exchange rates, government spending, and money supply. Among these factors, foreign direct investment exchange rate, National Saving Schemes' profit rate, interest rates, and gold prices are deemed most crucial. Investors focus on interest rates and profit from National Saving Centers in Pakistan for risk-free investments, affecting decisions. Changes in rates impact investment value and decisions, as well as exchange rates affecting investor profits. Gold rate changes also influence investor decisions, along with stock market returns, exchange rates, interest rates, gold rates, and FDI. A diagram illustrating the conceptual framework is provided in Figure 1.

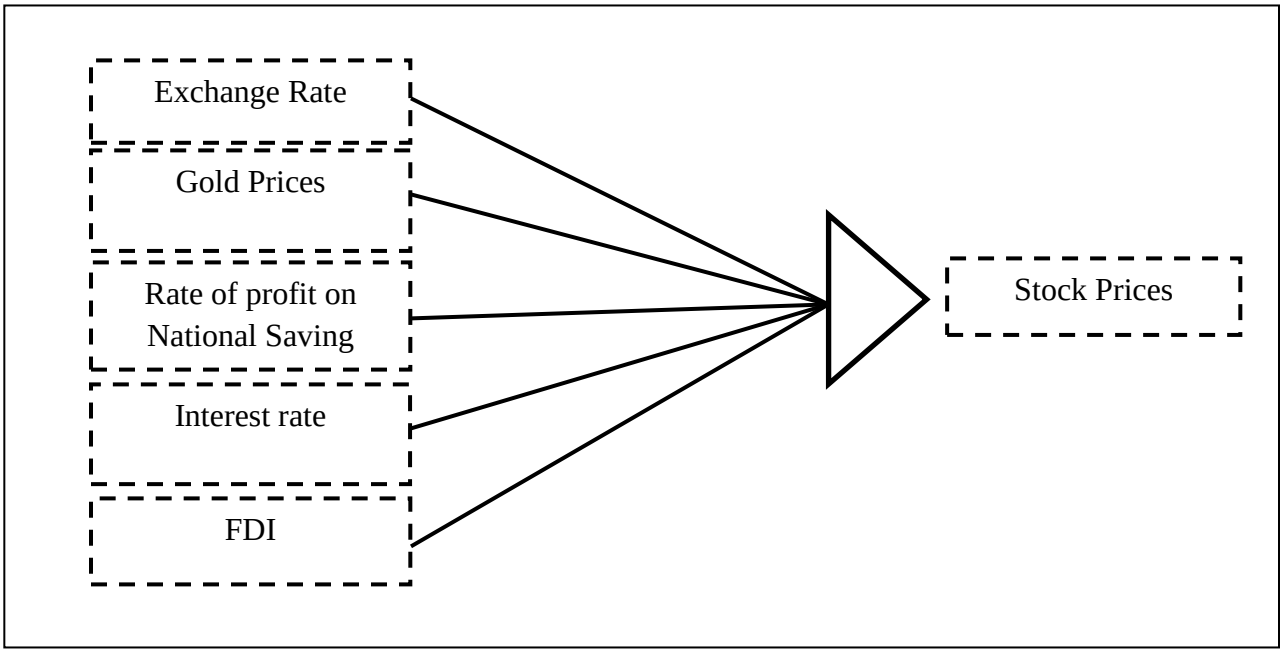

Figure.1.Conceptual Framework
Source: Author's own elaboration

3.1. Data and Methodology

For the study, secondary data was used to investigate the relationship between exogenous and endogenous variables. Data was collected from published sources over the past 20 years. Information on interest rates, foreign direct investment, and gold prices was obtained from the State Bank of Pakistan (SBP) and National Saving Center websites, respectively. To examine the long-run association the J.J. cointegration and to examine the variation from the long-run equilibrium the VECM model was used.

3.2. Model Specification

$PSX=\beta_0+\beta_1(ER) +\beta_2 (FDI) +\beta_3 (GR) +\beta_4 (IR) +\beta_5 (RPNS) +\mu_t$

Whereas:

PSX= Pakistan Stock Exchange Share Prices

ER= Exchange Rate

FDI= Foreign Direct Investment

GR= Gold Prices

IR= Interest Rate

RPNS= Rate of Profit offered by National Saving Schemes proxy of T-bill

μ_t= Error Term

Pakistan Stock Exchange prices were calculated as:

$PSP = (P1 – P0) /P0$

3.3. Exchange Rate and Stock Prices

The study examines the impact of US Dollar appreciation on Pakistan's stock exchange prices due to exchange rate variations. Investors convert profits from overseas to domestic currency, affecting their profits. Examining the relationship between exchange rates and stock prices is crucial. Previous studies like Ahmad et al. (2012) found a positive association, while Kralik (2012) and Jawaid & Ul Haq (2012) found a negative association. Mok (1993) and Ryan & Worthington, (2004) argued there is no significant impact between exchange rates and stock prices. Other researchers also tested this variable.

(Akash et al., 2011; Amjad, 2024; Baloch & Rehman, 2019; Fahnayu et al., 2024; Saeed & Jamil, 2023).

3.4. Interest Rate and Stock Prices

Many studies have examined the impact of interest rates on stock returns, showing a negative relationship. An increase in interest rates raises the discount rate for investment analysis, resulting in a negative correlation. This negative relationship is confirmed for the KSE (Nordin et al., 2014; Quayyoum et al., n.d.; Rana & Akhter, 2015; Saeed & Ali, 2024).

3.5. Rate of Profit offered on National Saving Scheme and Stock Prices

The National Savings Centers in Pakistan, established in 1873, evolved to encourage small savings and cover budget deficits through various schemes. Initially managed under British rule, it became the Central Directorate of National Savings in 1953, responsible for policy and implementation of savings schemes. With a workforce of 3,377, it operates in major cities like Islamabad and Karachi. The organization offers risk-free investment products, including Savings Certificates and Prize Bonds. Higher profit rates from these schemes attract investors, leading to reduced stock market returns and influencing portfolio managers' strategies for better cash inflows. Dunyo et al., 2024; and Ochieng et al., (2012) examined the data gathered from the stock market in Kenya from 2008 to 2012 including 91 days T. bills rate.

3.6. Foreign Direct Investment and Stock Prices

Foreign direct investment (FDI) contributes significantly to economic progress and growth by reducing the impact of low local savings and investments (Adam & Tweneboah, 2008). Various studies Rasool et al. (2024), Khan et al. (2021),T. Ahmed & Ullah (2012), Kabir et al. (2014), Shahbaz et al. (2008), Hanif (2020); and Arčabić et al. (2013) have shown that an increase in FDI leads to growth in the stock market.

3.7. Gold Prices and Stock Prices

Gold is seen as a stable asset during economic uncertainty. Shahzadi & Chohan, (2012) found that global investors turn to gold in recessions. In times of financial crises, countries like the USA, China, and India are major gold consumers, while the USA, China, South Africa, and Australia are top producers (Mpofu, 2010). In Pakistan, political instability and economic decline led to increased gold demand causing prices to reach 2,41,200 per Tola by June 2024. This has attracted more investors to gold, prompting a study on its impact on the Pakistani stock market. Previous research, such as that by Lawrence (2003), found no significant link between gold returns and macroeconomic variables or equity market returns.

4. Results and Discussions

Table.3. Correlation Analysis

Variables	PSP	ER	IR	GR	FDI	RPNS
KSP	1					
ER	0.612	1				
IR	0.030	0.518	1			
GR	0.608	0.938	0.522	1		
FDI	0.618	0.951	0.491	0.945	1	
RPNS	-0.651	-0.940	-0.449	-0.933	-0.926	1

Source: Author's own elaboration

Table-3 displays stock prices' relationship with FDI, exchange rate, gold prices, interest rate, and rate of profit on national saving schemes. A strong positive correlation with stock prices is shown by the exchange rate (0.612) and foreign direct investment and gold prices also have strong positive associations (0.618 and 0.608). The interest rate has a weak positive correlation (0.030) while the rate of profit from National Saving Schemes has a strong negative correlation (-0.651). Although all variables are correlated, constraints of Correlation limit the ability to classify movement magnitude in terms of percentage and assess cause-and-effect relationships. A co-integration procedure is being carried out to capture the presentation of co-movements of endogenous predictors.

4.1. Unit Root Test

It is essential to check the stationarity of the data before running the time series model. To test the stationarity the Augmented Dickey Fuller (ADF-1979) was used in this study.

The equation of ADF can be expressed as:

$$\Delta y_t = ß_1 + \delta y_{t-1} + y_{t-i} + \mu_t$$
$$\Delta y_t = \beta_{l+} \beta_{2\,t} + \delta y_{t-1} + y_{t-i} + \mu t$$

In the case of time series, the stationary of the data consistently depends on the coefficient (δ) of the repressor i.e. Yt- 1. The coefficient of the regression is always equal to P-1. But if the value of P=1 then coefficient (δ) will be zero. As a result, the null hypothesis cannot be rejected in the position where the coefficient is equal to zero (δ=0). The reason is that the calculated value of t statistics will remain lower than the tabulated critical value. On the other side, if the coefficient (δ) is negative or less than one, the null hypothesis is liable to be rejected, because the computed value will be greater than the tabulated critical value of ADF. The data is now made stationary and have the same order of integration that is I (1), the residuals of all the variables are stationary at level i.e., I (0). The results of the stationary can be viewed in Table -04 below:

Table.4.Unit Root Test

Name of Variable	Results of Test at Level		Results of Test at 1st order Difference		Conclusion
	T. Value	P. Value	T. Value	P. Value	
KSP	-0.109	0.9449	-12.248	0.000*	I(1)
ER	1.215	0.9981	-13.059	0.000*	I(1)
FDI	-0.3541	0.9121	-6.1603	0.000*	I(1)
RPNS	-1.773	0.3922	-91.532	0.0001*	I(1)
IR	-1.566746	0.4964	-8.6282	0.000*	I(1)
Residual	-9.3580	0.0000			I(O)

Note: a. Significant at 1 percent * b. Significant at 5 percent C. Significant at 10 percent

Source: Author's own elaboration

4.2. Lag order Selection Criteria

The optimal lag length selection criteria was used to select the optimal lag. There are six criteria in E-Views software including Bayesian Schwartz (BSC), The Hannan-Quinn Criterion (HQ), and the Akaike Information Criterion (AIC). Results are shown in the table-3 as:

Table.5.Lag order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3340.9	NA	3.64	59.77	59.912	59.825
1	-2324.94	1904.907	9.16	42.27	43.286*	42.681*
2	-2276.96	84.828	7.43	42.053	43.946	42.821
3	-2242.04	57.993	7.68	42.072	44.839	43.195
4	-2211.94	46.759	8.76	42.178	45.818	43.655
5	-2180.3	45.772	9.89	42.255	46.770	44.087
6	-2139.7	54.373	9.72	42.1732	47.562	44.359
7	-2099.4	49.659	9.89	42.096	48.3586	44.6371
8	-2052.37	52.906*	9.26	41.899*	49.0355	44.795

Note: * Indicates lag order selected by the criterion
LR: Sequential modified LR test statistic (each test at 5 percent level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Author's own elaboration

According to SC criteria lag one is optimal as the asterisk value and highlighted values are optimal. The FPE and AIC criteria indicated that the 2nd lag is an optimal lag, while LR criteria show that 5th Lag is an optimal Lag. So, it was decided to use AIC, LR, and SC criteria Lag for further tests.

4.3. Co-integration Test

There are many techniques to examine the long-run equilibrium relation including Engle-Granger (1987), Johanson and Juselius (1990), and ARDL Pesaran and Shin (1995). This study applied the Johanson and Juselius (1990) cointegration technique.

Table 06 shows that all model variables are integrated at the same order, i.e. I (1). Therefore, the Johansen and Juselius (1990) (JJ) procedure was applied to examine the long-run relationship between the variables. The Trace and Max Eige-values were used to select the co-integrating vectors. The Johnson co-integration test is a data analysis technique used to test the co-integration of time series datasets with the same integrated lag order. Johnson's co-integration methodology originates from vector autoregression. The formula for the Johnson co-integration can be expressed as follows:

$$\Delta xt = A0 + A1\Delta xt-1 + A2\Delta xt-2 + \cdots + Ak-1\Delta xt-(k-1) + \Pi xt-k + \mu t$$

The first step is the lag order selection of integrated variables of data set using the lag length criteria. The next step is the application of co-integration. The co-integration function outlines two likelihood ratio tests, first, one is known as the "Trace Test" and the other is the "Maximum Eigen Value Test"

$$\lambda \text{ trace } (r) = - T (1-\lambda i)$$

The null hypothesis in the above equation shows that the number of co-integrations is less than or equal to r against the alternate hypothesis, which shows that "r" is 1 or more than 1 co-integration as "r" is greater than 0.

$$\lambda \max (r, r+1) = - T \, 1n(1-\lambda r+1)$$

The null hypothesis is Π (rank) = r against the alternative hypothesis Π = r+1. The null hypothesis shows there is a co-integration relationship equal to r against the alternate hypothesis, shows that there is one or more than r co-integration relationship. The results of the Trace statistic and Maximal Eigen statistic are shown in Tables 06 and 07 respectively.

Table.6.Johansen Co-integration Analysis

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.444	189.452	95.754	0
At most 1 *	0.3569	124.320	69.819	0
At most 2 *	0.3112	75.325	47.856	0
At most 3 *	0.1879	33.945	29.798	0.0157
At most 4	0.0784	10.843	15.495	0.2213
At most 5	0.0160	1.785	3.8415	0.1816

Note: Trace test indicates 4 cointegrating eqn(s) at the 0.05 level

*** denotes rejection of the hypothesis at the 0.05 level**

****MacKinnon-Haug-Michelis (1999) p-values**

Source: Author's own elaboration

Table.07.Johansen Co-integration Analysis)

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE (s)	**Eigen value**	**Max-Eigen statistic**	**Critical Value**	**Prob.****
None *	0.444	65.132	40.078	0
At most 1 *	0.357	48.9952	33.877	0.0004
At most 2 *	0.3112	41.380	27.584	0.0005
At most 3 *	0.1879	23.102	21.132	0.0261
At most 4	0.0784	9.0588	14.265	0.2813
At most 5	0.0160	1.785	3.8415	0.1816

Note: Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level

*** denotes rejection of the hypothesis at the 0.05 level**

****MacKinnon-Haug-Michelis (1999) p-values**

Source: Author's own elaboration

Therefore, based on the results it is suggested that there is a long-run relationship between all exogenous variables and Indigenous variables i.e. stock prices. Since the normalized cointegration equation can easily be used to test for positive and negative relationships among all variables under study, the results of this equation can be revealed as follows:

Table.8.Normalized Co-integrating Equation

Variables	**KSP**	**ER**	**IR**	**GR**	**FDI**	**RPNS**
Coefficient	1	879.688	760.398	0.08680	-355.517	4781.499
S.E.		-90.468	-289.267	-0.0360	-67.4144	-1427.07
t- value		-9.724	-2.6287	-2.412	5.2736	3.35057

Source: Author's own elaboration

The 1st normalized co-integration can be written as

$PSP = \beta_0 - \beta_{1(ER)} + \beta_{2(IR)} + \beta_{3(GR)} - \beta_{4(FDI)} - \beta_{5(RPNS)}$

$PSP = \beta o - 879.6882 - 760.3984 - 0.086794 + 355.517 - 4781.499$

As we establish the presence of a single co-integrating equation, we can conclude a stable long-term equilibrium relationship. The results are normalized on stock returns of the KSE-100 Index. Due to the normalization process, the signs were reversed to enable proper interpretation. As per the normalized co-integration equation, negative and significant linkage among exchange rate, interest rate, and rate of profit on the National Saving Scheme. While the foreign direct investment result reveals a significant positive association, the gold rate shows a positive but weak association-ship.

4.4. Vector Error Correction Model (VECM)

The Vector Error Correction Model (VECM) was applied to examine the short-term dynamics and long-run equilibrium relationship. The equation of the VAR model can be expressed as:

$xt = A1xt-1 + A2xt-2 + \cdots + Akxt-k + \epsilon t$

In the Vector Error Correction Model (VECM) it can be expressed as:

$\Delta xt = \Gamma 1 \Delta xt-1 + \Gamma 2 \Delta xt-2 + \cdots + \Gamma k-1 \Delta xt-(k-1) + \Pi xt-1$

Where ∏= shows long-run association-ship within the model. However, ∏ = α and β where α is the speed of adjustment to the equilibrium path and β represents the long-run relationship. The result of VECM is presented as:

Table.9.VECM Estimates for PSP

C	D(PSP)	D(ER)	D(IR)	D(GR)	D(FDI)	D(RPNS)
VECM (1-1)	-0.150359	-6.93E-05	2.19E-05	0.442599	3.34E-06	-1.04E-05
S.E.	-0.0378	-5.70E-05	-1.30E-05	-0.14313	-8.80E-05	-2.70E-06
T. Value	[-3.97756]	[-1.22462]	[1.66649]	[3.09233]	[0.03791]	[-3.86485]
VECM (1-2)	-132.498	-0.048014	0.016189	217.0329	0.16006	-0.008889
S.E.	-34.1785	-0.05114	-0.01187	-129.409	-0.07976	-0.00243
T. Value	[-3.87665]	[-0.93895]	[1.36380]	[1.67710]	[2.00676]	[-3.66553]

Note:* Indicate Error Correction term's value
***[ ] indicate T values**

Source: Author's own elaboration

The results of VECM (1&2) are reported in Table-09. Results showed the short-run dynamics and long-run equilibrium relationship between PSP, ER, IR, GR, FDI, and RPNS. The coefficient of ECT in VECM (-1) is negative (-0.150) and significant. The negative coefficient of 15% indicates that the deviation from the long-run equilibrium will be corrected at the speed of 15% per period. The deviation from the equilibrium will be corrected in 7 months (1/0.150359 = 7 months). The coefficient of VECM (-2) is negative and significant coefficient of the ECT (-132.5). This indicates the rapid speed of the correction towards equilibrium. Further, it also shows a short-term association between PSP, FDI, and RPNS.

5. Conclusion

This study examines the effect of the risk-free rate of return and macroeconomic variables on firms listed with Pakistan Stock Exchange-100 (PSX) stock prices. To achieve the objective of the study the monthly data from January 2013 to December was collected. Cointegration and the VECM were used to analyze the data for the long-run association and deviation from the long-run equilibrium association. Results suggested the long-run association between the risk-free rate and the macroeconomic variables. Further, the risk-free return has a significant negative impact on stock prices, while FDI has a positive significant impact on stock prices. The VECM analysis shows the speed of correction to achieve equilibrium. Moreover, the recovery speed of VECM (-1) is more than VECM (-2).

The outcomes of this research offer significant policy implications for various stakeholders such as individuals, finance managers, portfolio managers, and policymakers while formulating strategies to promote the stock market. It is essential to regulate the interest rate and the rate of profit provided by the Government for the efficient operation of the stock market. Any adjustments made to the risk-free rate of return should be carefully analyzed with the current market return. The Government must attract foreign investors by implementing favorable policies to foster the stock market's growth.

Author Contributions

Saifullah and Ahmed Adekunle jointly carried out the conceptualization and formal analysis. Saifullah focused on the results estimation and tabulation of data, while Ahmed Adekunle revised the manuscript and responded to reviewers' comments.

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Conflicts of Interest

No conflict of interest

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