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Causal Relationship between Inflation Rate, Exchange Rate, Interest Rate and Stock Market Returns

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ABSTRACT

Purpose: The purpose of this study is to provide empirical evidence on the causal relationship between interest rate (INTR), exchange rate (EXR), inflation rate (INFR) and stock prices return (SPR) in Pakistan for twenty years from 1998-2018.

Design and Methodology: The research study first used Augmented Dickey Fuller (ADF) unit root test to check the stationarity of the data at level and at first differences, after determining the stationarity of the data next technique that is Johansen Co-integration Technique was used to determine the long term equilibrium relationship among variables. Finally, Granger Causality Test was used to find the causal relationship among the variables, by using this technique, direction of causality that is unidirectional, bidirectional and no direction causality was investigated.

Findings: The results from Granger Causality have shown a unidirectional causality running from EXR to SPR and from INTR to SPR and no causality was observed between INFR and SPR respectively.

Implications: The overall evidence, however, appears to show that Pakistan equity market efficiently incorporated much of the INTR and EXR information in its SPR. The study have important implications for investors.

Keywords: Augmented Dickey Fuller, Co-integration, Stock prices return, Granger causality.

1. Introduction

The stock market is considered as the important segment of the economies in every country (Arestis et al., 2001). The increase in globalization, advancement in technologies, and free and open trade and economic polices encourage investors to invest in stock markets around the global (Morck et al., 2000). Stock market is an important for every country, as indices of the country indicates the health of its economy (Maysami et al., 2000). There are many theories that describes the importance and working of the stock market and these theories were formulated because of the increasing importance of the stock markets in the world. The Karachi stock exchange (KSE) was

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established in 1947 and is called as the Pakistan biggest and most seasoned stock exchange. It was the foremost runny market, there were numerous local and international securities were registered on it. It was pronounced as the Finest Performing security market of the World in 2002 by the Business week. Index is a number that represents some important numbers, KSE also develop its index, and at the beginning it creates 50 share index that represents 50 companies. Later on, there on in 1991 the develop another index which is called as KSE-100 index which represents top 100 performing companies from all sectors listed on KSE, this index was considered as the most effective measure for exchange. This index represent top 100 performing companies and these companies overall represents about 86% of the market capitalization. On January 2016 the three stock exchanges in Pakistan were merged into a one big stock market which is known as Pakistan Stock exchange (PSX). The head office is located in Karachi and its main index is KSE-100 index. This step was taken as to increase number of transactions and meeting the international standards respectively. The trading floors of PSX are located in Karachi, Lahore and Islamabad. The PSX was classified by MSCI as a Frontier Market on September 2021.

There are so many macroeconomic variables that will influence the performance of the stock market. Likewise, INTR, EXR, and INFR are the factors that will influence the SPR. Therefore, the objective of this research study is to investigate the causal relationship between INTR, EXR, and INFR with SPR in Pakistan. The study used quantitative secondary data published on State bank of Pakistan website and PSX web site for the period from 1998-2018. The study have some important implications for investors, brokers and shareholders.

The rest of the paper is organized as follows, section two give detail about relevant past studies, section three provide information about the methodology and the rest of the two sections provide detail about data analysis and conclusion respectively.

2. Literature Review

The previous research studies mainly focused on the relationship between macroeconomic variables and SPR. This research study briefly includes some studies that specifically show the relationship of EXR, INTR and INFR with SPR. The previous studies provide conflicting results on the causal relationship between SPR and the economic variables (INTR, INFR and EXR). Karaduman (2021) determined the post-crisis factors for stock market development in 31 selected emerging economies by using data from 2009-2017. The study develop two models and apply Generalized Method of Moments (GMM) approach on both of the models. The result of the study shows that EXR is the main factor that will affect the stock market capitalization. Mok (1993) determined the causality of EXR, INTR and share prices in Hong Kong for the time period from 1986-1991. The study applied ARIMA approach and Granger causality test in order to check the relationship. The outcome of the study indicate a uni-directional causality between INTR and SPR whereas a bi-directional causality is observed between EXR and SPR. The overall findings of the

research has shown that Hong Kong market effectively incorporate much of the EXR, and INTR information in its SPR. Goh, Henry, and, Albert (2021) examined the relationship of INTR and EXR with stock market index of the Jakarta stock exchange (JKSE) during the COVID-19 pandemic. The study used daily data from JKSE composite index from 15th October 2019 – 15th September 2020. The finding of the study indicates that INTR has a significant positive relationship with stock market index whereas, EXR has a significant negative relationship with stock market index respectively. Nishat and Shaheen (2004) determine the relationship of CPI, INTR, industrial production, and money supply (M1) with Pakistani stock market index. The findings confirmed that industrial production is strongly positively related with SPR whereas CPI act as a negative determinant of stock market index in Pakistan.

Sheikh et al. (2020) investigate the association between selected macroeconomic variables with stock market index. The study specifically used non-liner autoregressive distribution lag models on a data from 2004-2018. The findings of the research study revealed that INTR and EXR have a significant positive relationship with SPR. Al-Sharkas (2004) has studied the impact of INTR, INFR and money supply on stock returns of the companies listed on Amman stock exchange. The findings from the VECM appeared that money supply, INTR and INFR have a long term equilibrium relationship with SPR. Banerjee and Adhikary (2009) explore the long run equilibrium relationship between stock returns with INTR and EXR by using co-integration approach. The finding of the study showed significant relationship between selected variables. Ahmad, Rehman, and Raoof (2010) inspected the relationship between stock return, INTR and EXR in Pakistani economy. The study used annual data of the selected variables like INTR, EXR (Rs/US $) and stock market returns (KSE-100) had been utilized. The findings from the multiple regression revealed that both INTR and EXR have a significant relationship with stock market returns. Hsing (2008) utilized a basic VAR model and found that there's an inverse association between INTR and SPR. Jaradat et al. (2010) finds a positive association between INTR and stock market returns in Jordan. Mahmudul and Gazi (2009) inspected a significant negative relationship between INTR and SPR. Hashemzadeh and Taylor (1988) finds a one way causality running from INTR to SPR.

The relationship of SPR with EXR was firstly inspected by Franck and Young (1972) and later on the findings of this research study revealed a significant association between SPR and EXR. Aggarwal (1981) used simple regression analysis in order to find the relationship between EXR and SPR and find a positive relationship between these two variables. Solnik (1987) found a frail positive connection between real stock return and EXR. Soenen and Hanniger (1988) found a strong negative affiliation between EXR and SPR. Likewise, Ajayi and Mougoue (1996) determine a negative relationship between EXR and SPR in short run and a positive association between EXR and SPR in the long run respectively. For South Asian countries, Muhammad, Rasheed, and Husain, (2002) try to find the short run and the long run association between EXR

and SPR. The study used Vector Error Correction (VEC) and Granger Causality Test. The finding shows that there is no short term and long term association between EXR and SPR for all selected countries including India, Bangladesh, Pakistan, and Sri Lanka. A bi-directional causality was observed only for Bangladesh and Sri Lanka between EXR and SPR.

Prior literature on INFR and SPR indicates a negative relationship in several economies during different period of time by using various techniques. Asravor and Fonu (2021) used ARDL approach in order to determine the long run and the short run association between INFR and SPR in Ghana. Findings revealed a significant negative relationship between INFR and SPR. Alam (2020) determined the relationship between various macroeconomic variables with SPR by using annual data of five South Asian countries from 1993-2019. The findings from regression analysis revealed significant relationship between INFR and SPR in selected economies respectively. The significant relationship between INFR and SPR are in line with some prior studies Tarza, Iorember, and Usar (2017), Adrangi, Chatrath, and Shank (1999), Lintner (1975), Fama (1981), and Thornton (1993) respectively.

3. Data Collection, Equation, Hypothesis and Methodology

3.1 Data Collection

The research study used quantitative secondary data published on Pakistan stock exchange (PSX) website and State Bank of Pakistan (SBP). The dependent variable used in the study is stock market return as is named as SPR and data for this variable is collected from PSX website whereas, the independent variables used in the study are EXR, INTR and INFR and data for these variables are collected from SBP website. The time period of the study is 1998 to 2018.

3.2 Equation

The equation for this research study is as follow:

$$\mathbf{SPR_{it} = \alpha + \beta_{1it}\, EXR + \beta_{2it}\, INFR + \beta_{3it}\, INTR + \mathcal{E}}$$

In the above equation SPR is the dependent variable and is called as stock prices return, α is the intercept and it represent average value of dependent variable when all the other variables (EXR = exchange rate, INFR = inflation rate, INTR = interest rate) are equal to zero. β1 to β3 are the slope of the line of all selected independent variables, it indicates average change in the value of dependent variables due to per unit change in the value of each of the independent variables used in this study respectively. Ɛ is the error term and this term shows that there are so many other factors that may influence the value of SPR.

3.3 Hypothesis

In order to determine the relationship between two variables, study needs to develop the testable statements. Therefore, the testable statements that shows a logical conjectured relationship between two or more variables is called as hypothesis. There are two types of hypothesis statements. The null hypothesis statement indicates no relationship between two variables whereas, alternative hypothesis shows exact or 100 percent relationship between two variables. Likewise, in this research study there are three independent variables so, there are three hypothesis statements which are given as;

H01: There is a relationship between EXR and SPR
H02: There is a relationship between INTR and SPR
H03: There is a relationship between INFR and SPR

3.4 Methodology

3.4.1 Co-integration Approach

In order to determine the long term causal relationship between selected dependent and independent variables, the study applied the co-integration approach. Further, the study also applied Granger causality test in order to determine the uni-directional or bi-directional causality between selected variables. Before applying co-integration approach, it is necessary to check the order of integration in the given data set. For determining the order of integration the study applied Unit Root Test.

3.4.1.1 Unit Root Test

The study select Augmented Dickey-Fuller (ADF) unit root test, this test has been used in order to find out the stationarity of the data at level or at the 1st differences.

3.4.1.2 Cointegration Test

Cointegration approach is the most appropriate method for investigating the linear combination of time series variables. By using unit root test if the data is stationarity at level or at 1st difference then we will be able to apply cointegration test. stationarity means that cointegration is present between given time series variables and there may be a long run relationship between dependent and independent variables.

3.4.1.3 Granger Causality Test

Granger causality developed by Engle and Granger (1987) has been used to determine the uni-directional and bi-directional causal relationship between two variables. If we find a long term co-integration relationship between two variables by using co-integration approach, then the next step is to determine the causality between selected variables. We proceed to determine whether SPR Granger cause INTR and other variables (EXR, INFR) and vice-versa.

4. Empirical Results

4.1 Unit root tests

For this research study, Table 1 shows the result of unit root test. The outcome of the unit root test obtained from software E-views indicate that all the selected variables are non-stationarity at level and all are become stationary at first difference. The lag length used is only 0 and 1 and the order of integration for all the variables is 1. The ADF test results will reject the null hypothesis of the unit root is the 1st difference for INFR, INTR, and SPR at 1 percent level of significance and for EXR it is satisfied at 5 percent level of significance. Finally the value of the DW test is also acceptable for all the selected variables.

Table 1: ADF Unit Root Test

Variables	Lag	ADF test Statistics at Level	ADF test Statistics at 1^{st} Δ	DW Statistics	Order of Integration
Stock Prices Return (SPR)	1	-5.663282	-5.819029*	1.745501 1.750079	I(1)
Exchange Rate (EXR)	0	0.495197	-3.144622**	1.440633 1.795742	I(1)
Inflation Rate (INFR)	0	-1.657294	-5.329669*	1.879979 1.644227	I(1)
Interest Rate (INTR)	0	-0.954730	-4.703526*	1.913494 1.675964	I(1)

4.2 Cointegration Analysis

We continue to apply cointegration tests between the factors to determine long run equilibrium relationship between the series. The null of no cointegrating vector can be rejected for all the factors utilized within the think about (see Table 2) and the observational discoveries strengthen the conclusions almost the nearness of long run relationship between SPR, exchange rate and INTR. Agreeing to given criteria's ideal lag 1 has been chosen. The comes about from

this test demonstrate that the null hypothesis is rejected since the value of both Trace statistics and Max-Eigen statistic is more prominent than the critical value at 5% level of significance. This shows that the yearly information for this study from 1998 to 2018 indicate that in Pakistan there exist a long run equilibrium relationship between EXR, INFR, INTR and SPR.

Table 2: Johansen Cointegration Test

VAR Lag Order Statistics for Pakistan

Lag	FPE	AIC	SC	HQ
0	1079.684*	9.8175*	10.0165*	9.8607*
1	1139.541	9.8669	10.1156	9.9209

VAR Cointegration test Statistics

(1) Trace Test

Hypothesized Number of CE(s)	Eigenvalue	Trace Statistics	5 % Critical Value (CV)
r =0*	0.8616	70.9267	47.8561
r< 1*	0.6795	31.3616	29.7970
r< 2	0.3366	8.5979	15.4947
r< 3	0.0192	0.3894	3.8414

(2) Max-Eigenvalue Test

Hypothesized Number of CE(s)	Eigenvalue	Max-Eigen Statistics	5 % Critical Value (CV)
r =0*	0.8616	39.5650	27.5843
r< 1*	0.6795	22.7636	21.1316
r< 2	0.3366	8.2085	14.2646
r< 3	0.0192	0.3894	3.8414

Normalized Co integrating Coefficients

Stock Prices Return	Exchange Rate (EXR)	Inflation Rate (INFR)	Interest Rate (INTR)	C
1	-0.0186	0.0415	-0.0581	150.0029
	(0.3378)**	(1.4033)*	(2.6115)***	

The co-integrating equation for this research study is given as:

$SPR = \alpha + \beta_1 \ EXR - \beta_2 INFR + \beta 3 \ INTR + \varepsilon$ ---------- *(1)*

$SPR = -150.0029 + 0.0168EXR - 0.0415INFR + 0.0581INTR$

The outcome of this research study shows that there is a significant positive relationship of INTR, and exchange rate with SPR and a significant negative relationship is observed between INFR and SPR in a given selected time period from 1998-2018. Equation 1 shows that for EXR 1percent increase in EXR cause to increase SPR by 0.0186 percent as shown in the equation 1, for INTR a 1 percent increase in INTR causes to increase SPR by 0.0581 percent as shown in the equation 1. For INFR 1 percent increase in INFR will leads to decrease SPR by 0.0415 % and there is a negative relationship between INFR and SPR and this relationship is supported by some prior studies (Adrangi et al., 1999; Wahlroos & Berglund, 1986; Raghutla, Sampath, & Vadivel, 2020; Yaghi, 2020). EXR and INTR has a significant positive relationship with SPR and this relationship is supported by these prior studies (Aggarwal, 1981; Abdalla & Murinde, 1997; Goh et al., 2021; Jaradat et al., 2010; Sheikh et al., 2020).

4.3 Granger Causality Approach

The Granger causality test has been used to check the causal relationship between variables. The direction of causality may be uni-directional causality and bi-directional causality between two variable. The pairwise causality between the selected variables for this research study is presented in Table 3. The six null hypothesis are formed and the findings are presented in the table.

Table 3: Granger Causality Test

Pairwise Granger Causality Tests			
Null Hypothesis:	Obs	F-Statistic	Prob.
Exchange Rate (EXR) does not Granger Cause Stock prices return (SP)	20	3.17727	0.0707***
Stock prices return (SP) does not Granger Cause Exchange Rate (EXR)		0.05260	0.9489
Inflation Rate (INFR) does not Granger Cause Stock prices return (SP)	20	1.86023	0.1898
Stock prices return (SP) does not Granger Cause Inflation Rate (INFR)		0.49582	0.6187
Interest Rate (INTR) does not Granger Cause Stock prices return (SP)	20	4.65369	0.0268**
Stock prices return (SP) does not Granger Cause Interest Rate (INTR)		0.44253	0.6505

The outcome of the table 3 shows that there are two significant causal relationship out of eight hypothesis. One uni-directional causality is observed funning from EXR to SPR and the

other one is from INTR to SPR. These causality also justify our previous co-integrating positive relationship for this study between EXR and SPR and INTR and SPR respectively.

5. Conclusion

It may be a well-established truth that macroeconomic factors such as EXR, INTR, GDP, M1, INFR affects the SPR or stock return. In this investigate, we attempt to examine the impact of EXR, INFR, INTR on SPR in Pakistani equity market. The study utilizes yearly information on four factors for Pakistan: the KSE-100 index, EXR, INTR, INFR for the period from 1998 to 2018. First, this study used to apply unit root test in order to check the stationary of the selected data set, Secondly, apply co-integration technique in order to determine the long run equilibrium relationship between variables. Finally, this study apply Granger causality test in order to check uni-directional or bi-directional causality.

Findings for the Pakistan in this research study revealed a long term positive causal relationship of EXR and INTR with SPR and a negative relationship was detected between INFR and SPR. The positive relationship for EXR and INTR with SPR is supported from the work of Abdalla and Murinde (1997), Goh et al. (2021, Sheikh et al. (2020), and Jaradat et al. (2010). For INFR the negative relationship of INFR with SPR is supported by Fama and Schwert (1977), Geske and Roll (1983), Raghutla et al. (2020), and Yaghi (2020). These results suggested that macroeconomic factors are important determinants for SPR in any country.

In conclusion, the investigation recommends that care ought to be taken in planning government approaches (financial liberalization, privatization, and monetary policy development and EXR policies). The findings suggested that EXR, INTR, and INFR are the important determinants for determining the SPR in Pakistan. The Security and Exchange Commissions of Pakistan ought to begin a capital market modification program at need premise towards the advancement of a modern and proficient corporate segment and capital market, based on sound administrative standards that give momentum for high and steady economic growth.

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