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LONG-RUN RELATIONSHIP OF MACROECONOMIC VARIABLES AND STOCK RETURNS: EVIDENCE FROM KARACHI STOCK EXCHANGE (KSE) 100 INDEX

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Abstract

The purpose of this study is to share in the existing literature by investigating long-run effect of macroeconomic variables on the movement of Karachi Stock Exchange (KSE) return. The monthly data of inflation, exchange rate, Treasury bill and Stock return is taken from the period of January 2000 to December 2010. The result of descriptive statistics revealed that KSE return provides highest return. Co-integration is used for the purpose to explore the long run co-movement between different series. The result showed that there is no co-movement exists between variables and KSE return. The data was not stationary at ADF & PP level but at first difference data become stationary. The result of correlation shows that there is no significant positive correlation among these variables. There is insignificant positive correlation between T-Bill and inflation and T-bill & X-Rate. In order to investigate the direction of flow of information Granger causality test is used. The result shows that X-Rate granger causes the RM. Similarly inflation granger causes the T-Bill. The result of impulse function response showed that changes in stock prices of KSE are due to by itself. T-bill exerts pressure on inflation. Variance decomposition is used for the purpose to show the decomposition of variance. The result shows that that most of the changes in inflation are explained by itself and other variables have no or very little effect on it. So inflation is found exogenous among these variables because .97 percent change in inflation in comes from itself.

Key Words: Stock return, Inflation rate, X-rate, T-bill, Descriptive Statistics, unit root test co-integration, Granger Causality, impulse response function, decomposition of variance

INTRODUCTION

Stock market of any country acts as the mirror of economy. From the earlier few decades the importance of stock market around the world opened a new road of research into the economic growth and stock market development. It is evidenced that share prices are determined on the basis of macroeconomic factors such as industrial production, interest rate, consumer index price, inflation rate, exchange rate etc. Investors generally believe that economic events have large influence on stock market prices. The result revealed that macroeconomics variables have impact on the investor's decision of investment and motivate many researches to investigate the relationship between macroeconomic variables and stock prices.

Several studies indicate that macroeconomic variables have impact on the stock market prices. For example Arbitrage Pricing Theory (APT) introduced by Chen and Ross in (1976) used few macroeconomic factors to explore the stock returns in US stock market. Result of the study indicates that industrial production, change in risk premium and change in term structure have positive effect on stock returns and inflation has negative impact on stock returns. Many researchers explore the dynamic co-movements between stock return and macroeconomic factors.

This paper focused on the long run co-movements between macroeconomic factors (Inflation, Exchange rate & Treasury bill) and KSE return. The purpose of this study is to share

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in existing literature by finding the effect of macroeconomic variables identified on the movement of Karachi stock Exchange (KSE) 100 Index.

Dependent variable

The equity market return is calculated by applying the following model

Return = Rt = ln (Pt / Pt- 1)

Where

Rt = Return for Given Period't'

Pt = Price at closing time

Pt-1 = Price at the opening time

ln = Natural Log

Independent variables

T-bill

T-bill is used as proxy of interest rate. . Change in value of T-bill rate is measured by taking log differences i.e.

T-bill rate = ln(T-Bt/T-Bt)

Exchange Rate

In this study foreign exchange rate is taken as end of month US$/Rs exchange rate. Change in value of exchange rate is measured by taking log differences i.e.

Change in Foreign Exchange Rate = ln (FERt / FERt-1)

Inflation

For inflation consumer price index (CPI) is used as a proxy. PCI is used to measure the average price of services and goods for a specific period.

Inflation Rate = ln (CPIt / CPIt-1)

THEORETICAL BACKGROUND

The co-movement between stock price and macroeconomic factors has become very important over the past few decades, the stock price is determined on the basis of macroeconomic variables. Several studies and researches are conducted in order to find out the impact of macroeconomic variables on the stock price. A number of studies have been published in many advanced countries like U.S, Japan and Europe. Many researches argue that stock prices are depends on macroeconomic factors such as oil price, inflation, industrial production, exchange rate, market capitalization, price earnings ratio, money supply, employment rate, risk premium, consumer price index and the market rate of interest etc. Many investors believed that fluctuation in these factors have positive or negative impact on the stock price and they make decisions for investment on the basis of these factors. These factors strongly affect the investors and also influence the researchers to find out the relationship between stock price and macroeconomic factors. Several techniques, methods and models are used by the researches in order to see the relationship between stock market and macroeconomic variables such as (APT) theory that was introduced by Rose (1976), development of co integration test, granger causality tests , innovation Accounting, Unit Root test and a number of other methods.

Rodolfo Q. Aquino (2000) find out the determinants of cross sectional stock returns variations. The data is taken from the period 1988 to 2000. The study focus on macroeconomic fluctuations as risk factor and for this purpose multifactor asset pricing framework is applied. Regression result indicates that all macroeconomic factors have significant influence on stock returns. All findings of multifactor asset pricing model fail to price the macroeconomic risk factors. There are two reasons of poor results. The first is the lack of market efficiency that leads to the high profitability and second is the presence of large idiosyncratic risks that is not fully diversified. In the context of asset pricing risk is defined as volatility of stock return that is measured by variance and standard deviation. Systematic risk is induced by unanticipated fluctuations in macroeconomic factors and can't be diversified. On the basis of investment theory risk can be diversified and can be ignored for pricing purpose.

Ahmed and Mustafa (2002) investigate the impact of inflation on stock return for this purpose annual data is taken from 1972 to 2002. The Full Information Maximum Likelihood (FIML) is employed to calculate the casual relationship between the inflation rate and stock return. Inflation is calculated on the basis of price indices such as GDP producer price index and consumer price index. The relationship is calculated by using Fama (1981) methodology. The result shows that if there is real growth rate

is controlled then negative relationship between real return is disappeared while the relationship between real return unexpected growth and unexpected inflation is negative and significantly important.

L.M.C.S. Menike (2002) used monthly data from the period of 1991 to 2002 of Sri Lankan Stock Exchange merket. Miltivariate regression model was applied. The null hypothesis indicates that inflation rate, exchange rate, interest rate and money supply have no effect on stock market prices. The stock prices have an opposite impact on T-bill, inflation and exchange rate in the CSE. The evidence tells that stock prices react by rising interest rate. Exchange rate, Inflation rate, and interest rate exert pressure to increase stock prices. Exchange rate and inflation rate and money supply cause the stock prices movements.

Dubravka Benaković (2003) investigates impact of macroeconomic factors on share prices for this purpose multifactor model was applied. Factor model is based on (APT) theory developed by Ross (1976) that is used to estimate the systematic risk. The result revealed that index of market has significance for all stocks prices and has positive relationship with stock return. Interest rate, industrial production and oil prices have also positive relation with stock return but inflation has negative influence. Furthermore cross-sectional regression result of time series of risk premium of each sector. The important variable which affects the stock return is the CROBEX index which has a positive risk premium. Stock prices are mostly affected by the investor's expectations because they response quickly to the announced information such as economic and political news.

Nishat and Shaheen (2005) analyze the long-run co-movement between macroeconomic factors and Karachi Stock market index. Vector Error Model was implemented to explore such relationship during 1973 to 2004. The result indicates that there is a "casual" co-movement between the economy and the stock market and reverse causality between industrial production and stock prices. Industrial production has largest positive impact on stock price and inflation has largest negative impact on Karachi Stock Market (KSE) Prices. The result also shows that stock prices are not predict on the basis of past economy trends. The variance decomposition result shows that one of factors explains a substantial variance in stock prices over both in short and medium-run.

Gann and Lee (2006) investigated the relationship between the New Zealand stock market index and macroeconomic factors from January 1990 to January 2003 and employed the monthly data. They used co integration test, Granger-causality test, Accounting Innovation test, and they also used the co-integration test to see long run relationship between New Zealand stock market prices and macroeconomic factors. This study showed that CPI has negative impact on the NZSE40. Johansen Multivariate Co integration Test revealed that there is a long-term relationship exists between New Zealand and macroeconomic factors. The result of granger causality test indicates that NZSE40 factor doesn't affect because New Zealand stock market is very small as compare to other developed countries.

Sohail and Hussain (2006) explore the short-run and long-run relationship between Karachi Stock market return and five macroeconomic factors. VECM and Johansen co integration technique was implemented. They used monthly data for analyzing KSE100 index. The result shows that there is a positive effect inflation, GDP growth and exchange rate on KSE100 in long-run while the Treasury bill and money supply have negative impact on stock return. The VECM explore that it takes more than four months of previous period for the adjustment of disequilibrium. The result of variance explore that in macroeconomic variables inflation explain more forecast error. The study also explores that three months treasury bills should be kept low and they have no effect on the stock market returns.

Tweneboah and Adam (2006) study the impact of macroeconomic variables on Ghana Stock market. They investigate the long-run and short-run dynamic relationship between stock prices index and macroeconomics index by taking quarterly data from the period 1991 to 2004. The employed the Johannes's multivariate co-integration tests to find out the long-run relationship and innovation accounting test for short-run relationship. Hypothesis indicates that inflation positively correlated with share prices.

The FEVD result indicates that inflation become small portion of cause in stock price variation as compare to exchange rate, FDI and interest rate.

In January (2008) Rashid and Abdul investigate the relationship between macroeconomic variables and stock prices. The purpose of study was to explore the dynamic interaction stock prices and the four macro-economic variables. They used co-integration test and granger Causality test for structural breaker. The Error-correction model indicates that there is a long-term casual co-movement between said macroeconomic factors and stock prices with the exception of consumer price index that only lead to stock prices. The result is also shows that in short-run stock prices caused by interest rate. The empirical result also indicate that GDP and exchange rate effect the portfolio return but on the other side exchange rate, inflation rate and money supply have negative impact on portfolio return of medium and big companies.

Torso and Rjoub in (2008) used Arbitrage Pricing Theory (APT) to find out the co movement between the macroeconomic variables and Istanbul Stock Market price. Data is taken monthly data from start of 2001 to the end of December 2007. Other studies that are used APT to test financial literature. The result indicates that macroeconomic variables have no significant impact on the ISE. However every portfolio is affected each industry in different manner a macroeconomic variable may have the positive impact in one industry and same variable may have the negative impact in other industry.

Rjoub and Tu¨rsoy (2009) conduct the research in order to find the APT theory's performance in Istanbul stock exchange (ISE). In this study six macroeconomic factors are used to find out the relationship between with index same like used in US by Chen, Roll and Ross (1986). OLS technique was employed to investigate the differences among the market portfolios. The series correlation problem was also discussed. To find out the portfolio return APT model was used. According to the regression result there is high chances that there is no series correlation between the portfolios. Result shows that there is a significant co movement between stock index (ISE) and tested macroeconomic factors. These findings gave the weak explanatory results this mean that there are other factors that have also impact on Istanbul Stock Exchange (ISE) returns.

Mansor and Dinniah (2009) conducted the research in order to investigate the dynamic co-movement between stock prices of six Asian specific countries of Malaysia, Thailand, Korea, Hong Kong, Australia & Japan, and macroeconomic variables. Statistics for the Return Series, Unit Root Tests, Engle-Granger Co integration Test, granger co integration Test, Multivariate Johansen Co integration Test, Estimates of the (ECM) – Multivariate are used to find out the results. The result indicates that the relationship between and among the variables that are exists in only four countries i.e... Korea, Japan, Australia Hong Kong and the short run relationship exist between all countries but not in Thailand and Hong Kong. The Thailand stock return is linked with inflation and exchange rate. The Japanese stock return linked with industrial production and inflation while Hong Kong and Korea stock returns are correlated with inflation.

Emrah Ozbay (2009) explores the causal relationship between macroeconomic variables and stock return. Granger causality test is applied to find out this relationship and apply monthly data from 1998 to 2008 from Turkey. The result indicates that GDP, inflation, interest rate, foreign sale cause the stock prices. Industrial production did not become the cause of stock price movement. Result also gives the evidence that interest rate negatively affects the stock price and foreign investment has positive impact in determinant of Turkey stock market prices. For time series data unit root test is also applied. The result is also indicates that interest rate and inflation rate directly affect the stock prices and industrial production & exchange rate have no impact on the movement of stock prices in Turkey.

Mohammad and Hussain (2009) explore the co-movement between macroeconomic variables and Karachi stock market (KSE) prices. Study considers the quarterly data from 1986 to 2008 and Asset valuation model, unit root tests are applied for this purpose. The result of Auto Regression and Moving Average concluded that past information of macroeconomic factors has

effect on the stock prices. The result shows that exchange rate highly affected the stock prices. The empirical result indicates that money and interest rate are negatively affects the stock prices. Variables like GFCF and IPI have no impact on stock market prices. Result is also suggesting that increase in information about capital and industrial production have no influence on the stock market prices. The change in information about the economy doesn't affect the investor's decisions.

Rodolfo Q. Adam (2009) investigates the co-movement between share prices and bond return. He takes the data of G7 countries in order to find out the relationship between share prices and bond return. For correlation Asset Pricing Model was applied. Empirical result indicates that a major trend in stock-bond correlation is determined by uncertainty of expected inflation. Unexpected inflation and interest rate are lesser significant to the degree. Forecast of this stock-bond correlation help the investors to invest more because stock-bond correlation is positively correlated.

Butt and Rehman (2010) examine stock return variation from macroeconomic by applying multi-factor model and they analyze firm and industry level. Model of GARCH is employed to find out the return and risk relationship. The impact of variation in economic factor on stock return is more strong and significant at industry level then firm level. It is also concluded that stock return of financial sectors like industry and banking are more sensitive then manufacturing industries. According to the result of conditional standard deviation there is a statistical relationship between risk and return of the firms. The rising inflation in the country has negatively affected the return of the firms. Increase in interest rate also adversely affect stock return but has positive effect on financial sector. It is also concluded that stock return of different industries are different in different economic conditions that give the investors an opportunity of risk diversification. ARCH and GARCH result indicates that stock return volatility of textile industry is the function of both lag of square residual and lag of variance.

Ahmet Büyükşalvarcı (2010) explored the effect of macroeconomic factors on Turkey stock Market. Arbitrage Pricing Theory was applied and monthly data is taken from January of 2003 to March of 2010 for this purpose. Public information about economic factors has impact in the prediction of stock prices. In order to calculate the relationship between economic factors and stock prices multi-factor regression model is used. The outcome of this study indicates that macroeconomic variables can lead to the stock market return. The result of the study indicates that industrial production, exchange rate and interest rate negatively effect on TSE-100 Index. On the other hand inflation rate and gold prices have no impact on prices of ISE-100 index.

Singh and Mehta (2011) investigate the relationship between Taiwan stock market price and macroeconomic factors. The aim of paper was to find the casual relationship between stock market index and macroeconomic factors including money supply, inflation, GDP, exchange rate and employment rate. Leaner regression was employed. Empirical result shows that GDP and exchange rate effect on all portfolio returns but not small company's portfolio. Inflation rate have significant effect on PBR portfolio return of small companies. On other side money supply and employment rate have no significant impact on stock market returns. Furthermore that internal financing and high financing are highly related with growth of the firms. The net effect of equity financing on basic industries is significantly positive. All findings have significant impact for both the companies and the investors.

Hasan and Nasir finds the co movement between macroeconomic factors and stock prices and implements the ARDL approach for investigation. They also employed the bound testing procedure proposed by Pesaran (2001). Data is tested to find the problems of econometric such as series correlation, normality, functional form and unit root by applying LM test. Findings revealed that inflation is not significant in determine stock price in long-run but money supply, exchange rate, interest rate significantly determine the equity prices in long-run. Foreign investment has significant effect in short-run while it has no effect in long-run. Auto regression lag approach has applied as yield estimate of long-run

coefficient in order to know whether the regresses is I(1) or I(0).

DATA AND METHODOLOGY

This study includes monthly data of stock prices of KSE 100 index (Karachi Stock Exchange) from the period of January 2000 to 2010 December. The continuous compounded rate of return is calculated by applying the following model

Return = Rt = ln (Pt / Pt- 1)
Where
Rt = Return for Given Period't'
Pt = Price at closing time
Pt-1 = Price at the opening time
ln = Natural Log

Following hypothesis are concluded by applying the above explained methodologies.

HYPOTHESIS:

H1: There exists long run relationship among stock price and macroeconomic variables in Pakistan.

Ho: There exists no long run relationship among stock price and macroeconomic variables in Pakistan.

RESULTS

Descriptive statistics

Insert table-1 here

Descriptive statistics is used in order to check the behavior of stock return. The result of descriptive statistics showed that inflation has an average return of 1.08 percent with standard deviation of 15.13 percent. KSE return provides highest return among these four variables with standard deviation of 9.03 percent. T-Bill and X-Rate offers .31 and .38 percent with standard deviation of 9.4 and 1.11 percent respectively. KSE return found as high return with high risk among these four variables.

Correlation Matrix

Insert table-2 here

The result of correlation shows that there is no significant positive correlation among these variables. There is insignificant positive correlation between T-Bill and inflation and T-bill & X-Rate. The inflation is partially negatively correlated with market return X-Rate. RM is partially negatively correlated T-Bill and X-Rate. X-Rate partially negatively correlated with inflation and RM.

VAR Statistics

Insert table-3 here

Lag selection a pre-requisite in order to run co integration test. In order for the estimation of Johansen and Julius (1991) unrestricted VAR is estimated. Both Akaike information criterion and Schwarz criterion are found at minimum two lag. So two month lag is suitable lag length.

Unit Root Test Statistics

Insert table-4 here

For co-integration test it is necessary that the data should be stationary/random form. . The data was not stationary at ADF & PP level but at first difference data becomes stationary. Stationary is employed through Augmented Dicky Fuller and Phillip Perron Tests both tests give same results. Data is stationery of same order so we can run co-integration among these variables.

Co-integration: Unrestricted Co integration Rank Test (Trace)

Insert table-5 here

Co-integration is used to analyze the long run co movement between different series. Results of Table 5 show that no long run relationship exists between KSE share prices and variables.

Insert table-5.1 here

Co-integration is used for the purpose to analyze the long run relationship between different series. Table 5.1 showed that the result of multivariate co integration analysis and no co-integration was found between these series. It is possible that different series are not found integrated in multivariate analysis but shows different results with a Bi-variate analysis.

Bi-variate Co-integration

Insert table-6 here

Bi-variate test is used to analyze the co-integration between variables and index. Table 6 shows that there is no Bi-variate co-integration exist between index and variables but co-integration exist between index and inflation.

Insert table-6.1 here

In Table 6.1 we run Bi-variate at Max-eigenvalue that also provide the same result as

unrestricted rank test (Trace). The results of Bi-variate co-integration test prove only the co-integration between index and variables but not the direction the flow of information. For this purpose we employ the Granger causality test.

Granger Causality Tests

Insert table-7 here

Granger causality test is used determining whether one time series is useful in forecasting for another. Granger causality test shows that X-Rate granger causes the RM. Similarly inflation granger causes the T-Bill. It shows that flow of information or relationship exists between X-Rate and KSE (Karachi stock Exchange) return and between inflation & T-Bill.

Impulse Response Function

Insert figure-1 here

Impulse response function is employed for the purpose that one standard deviation change in one variable brings standard deviation change in another variable. The above diagrams show that most of the variables are affected or exert pressure by itself but T-Bill exert pressure on X-Rate and as well as on inflation.

Variance Decomposition of Inflation, RM, T Bills and X Rates

Insert table-8, 9, 10 and 11 here

Variance decomposition is used for the purpose to show the decomposition of variance. The result shows that that most the changes in inflation are explained by itself and other variables have no or very little effect on it. So inflation is found exogenous among these four variables because .97 percent change in inflation in comes from itself. Variance Decomposition of RM shows that variance in returns are caused by itself and due to changes in X-Rate. Similar results are found in granger causality test. Variance Decomposition of X-Rate shows that variance in returns are caused by itself and due to changes in RM.

CONCLUSION

This study analyzes the long-run co movement between macroeconomic factors and Karachi Stock market index. The result of descriptive statistics employed on return showed that highest return is provided by the KSE. All series used in this analysis were found that at level data was non-stationary but stationary at first difference. The result of correlation shows that there is no significant correlation among the variables. The result of VAR statistics showed that two month lag is suitable lag length. The result of co-integration evidenced no long run relationship exists between variables and KSE share prices. Impulse response function showed that most of the variables are affected or exert pressure by itself but T-Bill exert pressure on X-Rate and as well as on inflation. The result of Variance Decomposition of RM shows that variance in returns are caused by itself and due to changes in X-Rate. Similar results are found in granger causality test. All results shows that variables and shares prices has no long term relationship but impact on each other in Pakistan focusing on the data of KSE (Karachi Stock Exchange).

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Table 1: Descriptive Statistics

	INFLATION	RM	TBILL	XRATE
Mean	0.0108	0.014612	0.003077	0.003799
Median	-0.003008	0.019073	0.001255	0.000902
Maximum	0.476291	0.241106	0.316197	0.053169
Minimum	-0.466175	-0.448796	-0.422857	-0.030671
Std. Dev.	0.151309	0.090317	0.094869	0.011133
Skewness	-0.113998	-1.113822	-0.7636	1.49474
Kurtosis	3.71437	7.669444	8.348533	7.47578
Jarque-Bera	3.069256	146.0983	168.8762	158.1257
Probability	0.215536	0	0	0
Sum	1.414796	1.914199	0.40309	0.497653
Sum Sq. Dev.	2.976292	1.060436	1.170025	0.016113
Observations	131	131	131	131

Table 2: Correlation

	INFLATION	RM	TBILL	XRATE
INFLATION	1	-0.063439	0.267581	-0.001345
RM	-0.063439	1	-0.139549	-0.168272
TBILL	0.267581	-0.139549	1	0.261729
XRATE	-0.001345	-0.168272	0.261729	1

Table 3: VAR statistics

Lag	0	1	2	3	4	5	6	7	8	9	10	11	12
AIC	3.41	-11.73	-12.15	-12.06	-12.14	-12.32	-12.21	-12.07	-12.0	-12.01	-12.01	-11.92	-12.01
SC	3.50	-11.26	-11.31*	-10.85	-10.56	-10.36	-9.89	-9.38	-8.93	-8.57	-10.47	-7.74	-7.47

Table 4: Unit root test statistics

	ADF Level	ADF First Diff	PP Level	PP First Diff
Index	-0.792376	-6.576085	-0.90602	-10.2919
Inflation	-1.33804	-5.59106	-1.34055	-10.2256
TBill	-1.23956	-3.99454	-0.89271	-7.7381
XRate	-0.51037	-3.90853	0.153388	-5.44433
Critical Values				
1%	-3.481623	-3.482035	-3.48082	-3.48122
5%	-2.88393	-2.884109	-2.88358	-2.88375
10%	-2.578788	-2.578884	-2.5786	-2.57869

Table 5: Co-integration: Unrestricted Co integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistics	5% Critical Value	Prob.**	
None	0.201044	41.98599	47.85613	0.1591	No Co-integration
At most 1	0.070864	13.03207	29.79707	0.8901	No Co-integration
At most 2	0.026155	3.550599	15.49471	0.9364	No Co-integration
At most 3	0.001021	0.13175	3.841466	0.7166	No Co-integration

Table 5.1: Unrestricted Co integration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	5% Critical Value	Prob.**	
None	0.201044	28.95392	27.58434	0.0332	Co-integration
At most 1	0.070864	9.481474	21.13162	0.7918	No Co-integration
At most 2	0.026155	3.418849	14.2646	0.915	No Co-integration
At most 3	0.001021	0.13175	3.841466	0.7166	No Co-integration

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 6: Bi-variate Co-integration
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)		Eigen value	Trace Statistics	5% critical value	Prob.**	
Index-Inflation	None	0.126623	18.492910	15.494712	0.017124	Co-integration
	At most 1	0.007936	1.027850	3.841465	0.310663	No co-integration
Index-XRate	None	0.017366	2.270495	15.49471	0.9905	No co-integration
	At most 1	8.17E-05	0.010536	3.841466	0.918	No co-integration
Index-TBill	None	0.048728	8.058156	15.49471	0.4592	No co-integration
	At most 1	0.012433	1.613886	3.841466	0.2039	No co-integration

Table 6.1: Bi-variate Co-integration
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)		Eigen value	Eigen value	5% critical value	Prob.**	
Index-Inflation	None	0.126623	17.465060	14.264600	0.015073	Co-integration
	At most 1	0.007936	1.027850	3.841465	0.310663	No co-integration

Index-XRate	None	0.017366	2.259959	14.2646	0.9835	No co-integration
	At most 1	8.17E-05	0.010536	3.841466	0.918	No co-integration
Index-TBill	None	0.048728	6.44427	14.2646	0.5569	No co-integration
	At most 1	0.012433	1.613886	3.841466	0.2039	No co-integration

Table 7: Granger Causality Tests

Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**
RM does not Granger Cause INFLATION	129	0.99131	0.374
INFLATION does not Granger Cause RM		1.33007	0.2682
TBILL does not Granger Cause INFLATION	129	0.36425	0.6955
INFLATION does not Granger Cause TBILL		4.94051	0.0086
XRATE does not Granger Cause INFLATION	129	0.57475	0.5643
INFLATION does not Granger Cause XRATE		2.02201	0.1367
TBILL does not Granger Cause RM	129	2.99251	0.0538
RM does not Granger Cause TBILL		0.92177	0.4005
XRATE does not Granger Cause RM	129	5.83191	0.0038
RM does not Granger Cause XRATE		2.03018	0.1357
XRATE does not Granger Cause TBILL	129	3.45657	0.0346
TBILL does not Granger Cause XRATE		3.03265	0.0518

Figure 1: Impulse Response Function

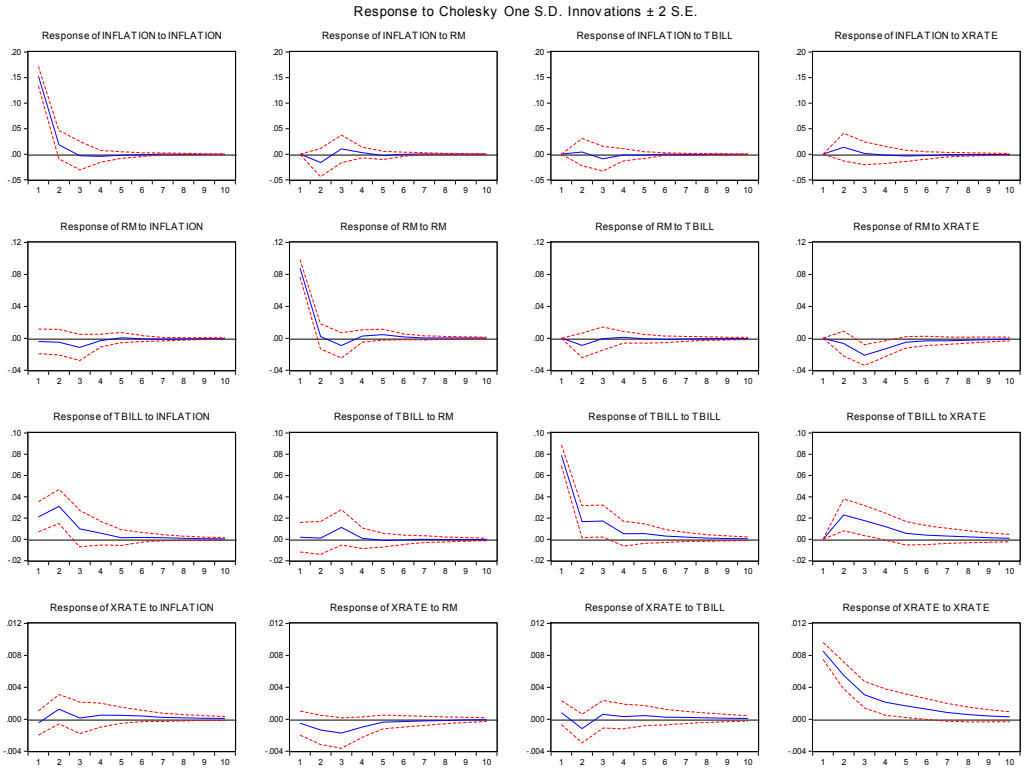

Table 8: **Variance Decomposition of INFLATION:**

Table 9: Variance Decomposition of RM:

Period	S.E.	INFLATION	RM	TBILL	XRATE
1	0.152818	100	0	0	0
2	0.155415	98.06708	1.086374	0.069521	0.777026
3	0.156054	97.3082	1.513439	0.398151	0.780212
4	0.156161	97.2533	1.550044	0.405034	0.791623
5	0.156245	97.16459	1.577418	0.420563	0.837427
6	0.156272	97.13555	1.577113	0.420434	0.866906
7	0.156277	97.12959	1.578465	0.421173	0.870774
8	0.156279	97.12758	1.57888	0.421619	0.871917
9	0.15628	97.12626	1.57886	0.421923	0.872953
10	0.156281	97.12546	1.578849	0.421996	0.873695

Period	S.E.	INFLATION	RM	TBILL	XRATE
1	0.087691	0.206335	99.79366	0	0
2	0.088572	0.525401	97.88165	1.027282	0.565671
3	0.092263	2.066255	91.1778	0.948508	5.807439
4	0.093291	2.124628	89.25988	0.944125	7.671371
5	0.093542	2.118897	89.00512	0.945321	7.930658
6	0.093629	2.118206	88.87285	0.964757	8.044192
7	0.093696	2.132197	88.74793	0.973167	8.146707
8	0.093734	2.138297	88.67853	0.975959	8.207219
9	0.09375	2.13967	88.64917	0.977633	8.233526
10	0.093758	2.140288	88.63564	0.978784	8.245291

Table 10: Variance Decomposition of T Bills

Period	S.E.	INFLATION	RM	TBILL	XRATE
1	0.081816	6.696999	0.053781	93.24922	0
2	0.091928	16.6408	0.062037	77.14161	6.155548
3	0.096373	16.21313	1.430421	73.3859	8.970551
4	0.097434	16.21656	1.410846	72.09258	10.28002
5	0.09776	16.13265	1.40927	71.91718	10.54089
6	0.097907	16.12041	1.407434	71.80099	10.67116
7	0.097992	16.11613	1.405046	71.7227	10.75612
8	0.098033	16.1139	1.403975	71.67657	10.80556
9	0.098051	16.11151	1.403821	71.65681	10.82785
10	0.09806	16.11035	1.403876	71.64756	10.83821

Table 11: Variance Decomposition of X-Rates

Period	S.E.	INFLATION	RM	TBILL	XRATE
1	0.008589	0.318825	0.332789	0.902822	98.44556
2	0.010422	1.629838	1.902439	1.904279	94.56344
3	0.011014	1.477296	4.192394	2.00679	92.32352
4	0.011279	1.612267	4.78687	1.995942	91.60492
5	0.011425	1.748226	4.76566	2.093812	91.3923
6	0.011506	1.838426	4.759749	2.10971	91.29212
7	0.011543	1.864181	4.766137	2.132069	91.23761
8	0.011561	1.878079	4.7695	2.145866	91.20655
9	0.01157	1.886424	4.769038	2.154901	91.18964
10	0.011575	1.891208	4.768362	2.159479	91.18095