Co-integration in Pakistan Between Karachi Stock Market and Inflation:

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ABSTRACT

The purpose of this paper is to establish the long run relationship between stock market and inflation in Pakistan. Various studies have been conducted on the relationship of macro economic variables on stock markets. These studies give theoretical support of doing work in such direction. This paper checks the co-integration between Karachi Stock Exchange index (KSE) and inflation. Based on Engle Granger test of co-integration it is found that KSE Index and Inflation time series are co-integrated.

Key Words: Co-integration, Inflation, Macro Variables and Stock Market Movement.

INTRODUCTION

Great deal of research has been done on the effect of macro-economic variables on stock market movement. There are literatures available which establish that there is co-integration between macro-economic variables and stock prices in Ghana indicating long run relationship (Adam & Tweneboah, 2008). There have been a number of studies on different stock indices over a range of different time horizon. For example, Modigliani & Cohn (1979) have shown that expected stock returns should equal the current earnings yield on stocks (defined as earnings over price) plus an inflation premium.

Mayasami and Koh (2000) examined the dynamic relations between macro-economic variables and Singapore stock market and report the sensitivity of Singapore stock market to interest rate and exchange rate. US stock prices were influenced negatively by inflation (Humpe & Macmillan, 2007). This kind of study not only establishes a strong theoretical background for the interrelationship of macro-economic variables and the stock prices but also exposes market inefficiencies in reflecting all the publically available information.

The objective of the present study is to establish and validate similar relationship in Pakistani context; by using inflation and stock index. This is one of the most frequently used technique in this paper.

METHODOLOGY

Among different macro-economic variables considered to be affecting stock indices of Pakistan, Inflation is selected to check the relationship.

Karachi Stock Exchange (KSE) is selected as stock index and Inflation to dig out the relationship between them. The KSE monthly closing index was taken into consideration, whereas the Inflation values were available on monthly basis.

According to (Hharris & Sollis, 2003) there exist two distinct requirements to establish a long term relationship between two series through co-integration.

- Both series are integrated of the same order d
- A linear combination of the two series is integrated to the order b (b<d)

In order to fulfill the two requisites the following course of action can be taken:

I. First, to check out the order of integration of the two univariate series and check for the similarity, in the absence of which it will be difficult to establish the presence of co-integration.

II. Second, bivariate regression is performed, here the response variable being Stock Index and the explanatory variable is inflation. As a result of the regression equation, we will get values for the residuals, which is a linear combination of the two variables in the regression

$$Y_t = \alpha + \beta X_t + u_t \qquad (\textit{Bivariate Regression Equation})$$

$$u_t = Y_t - \alpha - \beta X_t \qquad (\textit{Derived linear relationship})$$

Where Y_t is the stock market index, X_t is inflation and u_t is the error term.

III. At the end I will test the residuals for White Noise, if the hypothesis of absence of White Noise is rejected then it is concluded that the two series producing that residuals are co-integrated.

EMPIRICAL RESULT AND ANALYSIS

In order to identify the order of integration, ADF test has been used and which gives the conclusion that both Stock Index and Inflation time series are I(1), that is; both are of same order. Regression results are as follows;

Augmented Dickey-Fuller test for KSE_Index including one lag of (1-L)KSE_Index
Sample size 76
Unit-root null hypothesis: a = 1

Test without constant

model: (1-L)y = (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.007
estimated value of (a - 1): 0.0188162
test statistic: tau_nc(1) = 2.21287
asymptotic p-value 0.994

Test with constant

model: (1-L)y = b0 + (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.004
estimated value of (a - 1): 0.00193343
test statistic: tau_c(1) = 0.124406
asymptotic p-value 0.9676

With constant and trend

model: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.021
estimated value of (a - 1): -0.278462
test statistic: tau_ct(1) = -3.59295
asymptotic p-value 0.03035

Based on ADF test of KSE Index time series, it is proved that in level form the said series is non-stationary. In order to make it stationary first difference has been taken,

Augmented Dickey-Fuller test for d_KSE_Index including one lag of (1-L) d_KSE_Index
sample size 75
unit-root null hypothesis: a = 1
Test without constant
model: (1-L)y = (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.035
estimated value of (a - 1): -1.03003
test statistic: tau_nc(1) = -6.70583
asymptotic p-value 9.492e-011
Test with constant
model: (1-L)y = b0 + (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.027
estimated value of (a - 1): -1.24965
test statistic: tau_c(1) = -7.87818
asymptotic p-value 1.133e-012
With constant and trend
model: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.025
estimated value of (a - 1): -1.27409
test statistic: tau_ct(1) = -7.93489
asymptotic p-value 3.195e-012
After taking first difference KSE Index series becomes stationary. Hence KSE Index series is integrated of order 1.
Similarly, for Inflation time series ADF test has been used to check the order of integration.
Augmented Dickey-Fuller test for Inflation including one lag of (1-L)Inflation
sample size 76
unit-root null hypothesis: a = 1
Test without constant
model: (1-L)y = (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.015
estimated value of (a - 1): 0.00517937
test statistic: tau_nc(1) = 5.25839
asymptotic p-value 1
Test with constant
model: (1-L)y = b0 + (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.011
estimated value of (a - 1): 0.016417
test statistic: tau_c(1) = 2.71027
asymptotic p-value 1
With constant and trend
model: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.007
estimated value of (a - 1): -0.0393982
test statistic: tau_ct(1) = -1.38956
asymptotic p-value 0.8643

Based on ADF test of Inflation time series, it is proved that in level form the said series is non-stationary. In order to make it stationary first difference has been taken,
Augmented Dickey-Fuller test for d_Inflation including one lag of (1-L)d_Inflation
sample size 75
unit-root null hypothesis: a = 1
Test without constant
model: (1-L)y = (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: -0.074
estimated value of (a - 1): -0.384178
test statistic: tau_nc(1) = -3.42318
asymptotic p-value 0.0006078
Test with constant
model: (1-L)y = b0 + (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.018
estimated value of (a - 1): -0.893588
test statistic: tau_c(1) = -5.92014
asymptotic p-value 1.86e-007
With constant and trend
model: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.031
estimated value of (a - 1): -1.18327
test statistic: tau_ct(1) = -7.29621
asymptotic p-value 3.307e-010
After taking first difference Inflation series becomes stationary. Hence, inflation series is integrated of order 1.
Based on above results; it is clear that both KSE Index and Inflation time series are integrated of order 1.

Table1. OLS estimates using the 78 observations 2001:07-2007:12
Dependent variable: KSE_Index

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	-24102	670.364	-35.9537	<0.00001	***
Inflation	251.456	5.44757	46.1594	<0.00001	***

Mean dependent var	6583.068	S.D. dependent var	4087.980
Sum squared resid	44318061	S.E. of regression	763.6311
R-squared	0.965559	Adjusted R-squared	0.965106
F(1, 76)	2130.689	P-value(F)	2.38e-57
Log-likelihood	-627.4348	Akaike criterion	1258.870
Schwarz criterion	1263.583	Hannan-Quinn	1260.756
Rho	0.713758	Durbin-Watson	0.575508

Results are significant except that R-Square is greater than Durbin-Watson value, which dictates that results are spurious. The reasons of such results are, the two series were non-stationary in level form and there may be the existence of co-integration of these two different time series.

In order to avoid the problem of spurious regression co-integration test developed by Engle Granger (EG) or Augmented Engle Granger (AEG) has been used. For this purpose residuals from table 1 regression are saved and these residuals are tested for unit root.

Augmented Dickey-Fuller test for Uhat including one lag of (1-L)Uhat
sample size 76
unit-root null hypothesis: a = 1

Test without constant
model: (1-L)y = (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.016
estimated value of (a - 1): -0.349526
test statistic: tau_nc(1) = -4.00821
asymptotic p-value 6.26e-005

Test with constant
model: (1-L)y = b0 + (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.016
estimated value of (a - 1): -0.34958
test statistic: tau_c(1) = -3.98067
asymptotic p-value 0.001521

With constant and trend
model: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e
1st-order autocorrelation coeff. for e: 0.016
estimated value of (a - 1): -0.351185
test statistic: tau_ct(1) = -3.93206
Asymptotic p-value 0.01087

Based on the unit root test of U-hat, it is clear that residuals from table 1 regression are stationary at 1% significance level. So, we can not reject the hypothesis of co-integration of both the time series. Both the time series are co-integrated in long run at 1% significance level.

CONCLUSION

We can easily figure out that after going through such a long process all of the conditions for the existence of co-integration between KSE Index and Inflation have been fulfilled. Hence, there is strong reason to conclude that there exists co-integration between KSE Index and Inflation over the time period taken into study.

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