

## Impact of Macroeconomic Variables on Stock Markets: Evidence from Frontier Markets like Pakistan Stock Exchange (PSX)

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### Abstract

*The macroeconomic version of the APT is of great significance in examining the return on assets. It analyzes the estimated security return with reference to various macroeconomic variables. Despite availability of research studies related to the developed and emerging stock markets of the world, still a research gap exists for exploring the frontier markets like equity market of Pakistan. The study examines the long and short term impact of macroeconomic variables on the KSE 100 index for the period of July 1996 - June 2015. Cointegration technique and VECM models have been applied. Among these variables, GDP, inflation, exchange rate, unemployment rate, labor force cost and stock market of US were found significant for explanation of effects on return of stock market of Pakistan. The study findings have potential implications for both policymakers and investors pertaining to macroeconomic factors and stock market volatility.*

### Key Words:

Macroeconomic factors, Arbitrage pricing theory, Stock Returns, KSE 100 index, Exchange, ADF, Cointegration technique, Vector Error Correction Model, CPI

### Introduction

An important topic of finance is to study the expected asset return having systematic risk involved through the macroeconomic variables. The theory of portfolio by Markowitz (1952) brought a tremendous change in the field of financial economics. This theory discussed the choices/ alternate investment decisions of the investor and the associated risk elements. The second stage was to

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set market equilibrium status and prices of the assets containing risk. In this regard the famous scholar Sharpe (1964) presented the CAPM stands for Capital Asset Pricing Model and that model was further modified by (Lintner 1965, Mossin 1966). Association of systematic risk with security is shown through variation in the asset with respect to market portfolio in the CAPM. However, it was criticized by various researchers (Harrington 1987, Fama and French 1992). Ross (1976) presented a more generalized form of the CAPM known as the Arbitrage Pricing Theory (APT) based on a few restraining and realistic assumptions. The APT propagates that expected rate of return on an asset relies on the variation in the macroeconomic factors containing systematic risks that cannot be fully controlled. On other hand, unsystematic risk related to firm can be controlled. The CAPM is a special case of the APT. Within the framework of APT several multifactor models have been used employing macroeconomic variables. Findings of these studies revealed that several macroeconomics indicators affected the aggregate stock market index.

## **Pakistan Stock Market and the Economy of the Country**

After its establishment in 1947, the equity market of Karachi started its operation with KSE 50 index. Being a benchmark KSE 100 index represents the maximum market capitalization of the enlisted companies of the Stock Exchange. In the year 1992 Security Exchange Commission of Pakistan was established in order to ensure liberalization, facilitation and modernization of the operations of the stock market. Companies enlisted with the equity market have been divided in 36 categories. Out of these, 32 companies fully contributes to the capitalization value of the market. Karachi stock market has been through many good and bad times. It has been declared among the best markets of the world several times. KSE remained the biggest stock market until in 2016 its merge with Lahore and Islamabad Stock Exchange (ISE). Now it is known as the Pakistan Stock Exchange (PSX) with KSE 100 index still the key index for measuring the stock market performance.

This paper aims to investigate that how macroeconomic variables impact the aggregate stock return of the Pakistan Stock Market i.e. KSE 100 index within the frame of the APT by analyzing the relationship in short and long run. It applied econometric models such as the co-integration technique and the VECM for this purpose.

## **Literature Review**

The literature regarding asset pricing can be traced out from research contributions of several scholars, in which Sharpe (1964), then Lintner (1965) and finally Mossin (1966) presented the asset pricing model like CAMP for establishing market

equilibrium and pricing of the asset containing risk. Later on Roll (1976) presented the APT which was an alternative to the model of CAPM. Later Roll and Ross (1980) and then Huberman (1982) its empirical form gradually and systematically by Roll and Ross (1980) and Huberman (1982).

The APT was examined empirically by Roll and Ross (1980) by applying four factors loading of macroeconomic factors in the context of the US economy. Findings of the study supported this theory and concluded that stock return relies on these factors. It was modified by Chamberlain and Rothschild (1982) who focused on determining the estimating arrangement of the variables. Their findings suggested that principle component could be applied due to approximate unique factor structure result when there exist only  $k$  unbounded Eigen values for covariance matrix. The APT model of Ross was criticized by Humberlain (1982) who concluded that his APT is a bit complicated as it cannot clearly define arbitrage and that the condition for the presence of no arbitrage is not compulsory. He therefore defined the arbitrage more clearly and the insight of the APT was made formal. The impact of asset pricing was analyzed by Chen, Roll et al. (1986) who employed the equity market returns with macroeconomic variables as sources of systematic risk. Late the APT was applied by several researchers like Chen et al. (1980), Fama (1990), Ferson and Harvey (1991) in their studies significant influence has been found between equity return and macroeconomic factors possessing considerable capacity of explanation. By employing VECM and test of Granger Causality Abdullah and Hayworth (1993) analyzed the fluctuations occur in the US stock market i.e. S&P 500 index through variation in the macroeconomic forces such as inflation, trade deficit, industrial production, interest rate, budget deficit and money supply. Empirical results obtained implied that all of the variables Granger cause the equity prices excluding industrial production. The long run association between macroeconomic factors and equity market returns was examined by Cheung and Ng (1998) in the context of US, German, Japanese, Canadian and Italian economies. They employed variables of equity market indices with real consumption, real output, real oil prices, real money supply, real GNP of the respective economies. Findings of the revealed significant linkages among the overall variables ad equity market indices.

A significant association between economic activity and equity market was observed through VECM by Chaudhuri and Smiles (2004) while examining macroeconomic factors like real GNP, real oil prices, real money supply and real private consumption with equity market return for the economy of Australia. Association in the long and short haul between variables like oil prices and money supply with US Stock market index like S&P 500 index was investigated by (Rahman 2008). Relationship in the short run only was observed from empirical findings of the study. The descriptive capacity of the macroeconomic variables with respect to stock market developments for developed economies of the world was shown through the studies discussed above. However, research gap still exists

in literature regarding analyzing the effect of potential macroeconomic factors with respect to stock market developments in the under developed economies. The test of APT in the emerging economies is of more importance as changes in the information and market factors are more frequent as compared to developed economies. Thus the results are also not the same in such research studies. Some of the research for the less developed economies is here under. Ibrahim and Musah (2014) examined the interlinks between stock index of Kuala Lumpur stock exchange and variables like money supply, CPI, credit aggregate and reserves, exchange rate and real production index . He applied the statistical techniques of co-integration and multivariate Granger Causality. He observed long term relationship for variables of credit aggregate and reserves and CPI. Impact of Turkish Stock market with respect to factors like foreign exchange rate, money supply and interest rate was examined by Muradoglu, Taskin et al. (2000) as Co-integration technique applied by him revealed that results were not supportive due to the fact of frequent variations in the market participants.

Gunasekarage, Pisedtasalasai et al. (2004) attempted to exam the variables effect i.e. CPI, money supply and rate of T bill on the equity index market of Colombo, Sri Lanka. He observed significant association (i.e. short & long haul) based on results of the research word.

Adam and Tweneboah (2009) used quarterly time series data to examine the short and long haul for the macroeconomic forces and equity market return in Ghana. Empirical results obtained showed a considerable long haul between inflation and equity return. However, based on results of variance decomposition it was asserted that inflation acted as a hurdle to stock return for attaining a positive effect for variables like exchange rate, FDI and interest rate.

Stock market Performance of Nigeria while restraining in the scaffold of APT by using OLS method was studied by Izedonmi and Abdullahi (2011) who used monthly time series data from 2000-2004 for variables like market capitalization value, inflation and exchange rate. The influence of these variables on performance of the stock market of Nigeria was denied on the basis of the outcome of the statistical analysis.

For the Indian economy, Dasgupta (2012) investigated the linkage among equity market index and set of macroeconomic indicators such as foreign exchange rate, rate of inflation, interest rate ad GDP. Empirical results obtained revealed the presence of long run association conveying that informational inefficiency prevails in the equity market of India. Further, no causality was documented for these variables.

Ahmad and Zhao et al. (2016) applied Johansen Cointegration analysis for investigating the association between monthly inflation rate ad monthly closing values of Dhaka Stock Exchange for the period of 09:2004 to 07:2014. At 5% level of significance a Cointegration equation is shown signifying long term relation

between these variables. Further a short term association between the two variables was also noticed.

Chauque and Rayappan (2018) examined the influence of inflation and exchange rate factors on returns of Malaysian equity market by applying the ADF test, Ganger Causality test and OLS method. Empirical findings revealed a negative effect of inflation and exchange rate on the performance of equity Exchange of Kuala Lumpur. Further, Granger causality test showed the presence of unidirectional linkage from stock return to inflation implying that previous values of the stock market returns could be used for estimating future inflation levels in Malaysia.

Literature pertaining to investigation of association between macroeconomic forces and equity market can be categorized into 3 classes. Important or considerable association for the macroeconomic forces with returns of the equity market was revealed from their studies (Maysami, Loo et al. 2004, Kyereboah-Coleman and Agyire-Tettey 2008, Buyuksalvarci 2010, Ray 2012, Farhi, Gopinath et al. 2014). On the other hand, insignificant association was demonstrated from other studies (Mahdian and Ravikumar). Thirdly mixed results carrying both significant and insignificant factors were documented some studies (Kurihara, 2006; Pal & Mittal, 2011; Ullah et al., 2014).

## **Hypothesis**

1. There is a statistically significant effect of macroeconomics factors on equity returns
2. Karachi Stock market is semi strong efficient

## **Research Strategy**

The study is deductive in nature as the quantitative data has been examined by means of statistical methods in order to check the study's assumptions. Published data of time series nature has been selected in this study. KSE100 index has been used as proxy and for macroeconomic factors inflation (CPI), exchange rate (KIBOR), interest rate (10 years bond yield), GDP, unemployment rate, Labor force cost and S&P 500 index have been selected. The basic purpose of the study has been achieved through econometric tests like unit root test i.e. the ADF analysis.

## **Augmented Dickey Fuller Test**

The following tests with respective tables below have been mentioned with their specific purpose or task.

**Table 1.**

Test	Purpose
ADF	For checking stationary
VARSOC	For lag selection
Johansen Cointegration test	for measuring long run relationship
VECM For measuring	short run behavior with long run behavior

## Result and Analysis

### ADF Test

The characteristic of time series data pertaining to the variables of economics carries with itself problem of unit root. In other words, a researcher first checks for stationary of the data which is time series natured. In order to solve this issue researcher mostly apply ADF test for data sample. Unit Root postulates in the Null hypothesis, whereas an alternate postulate negates it. Always the value of ADF test is illustrated negatively. Chances of turning down the null hypothesis raise if the value of ADF obtains tends to move more towards negative.

### Results from the ADF test For KSE 100 Index

The test statistics and critical values are the two criteria for the making result decision in ADF test are checking. Here at 5% level of significance-2.881 is critical value. Table shows the test statistics value. Then the Philips-perron test value. So it can be concluded that KSE 100 index and other variables are integrated of order 1 or I (1). Initially other variables were not stationary and got stationary at first order after taking the first difference.

**Table 2.** Unit Root Test

ADF (Augmented Dickey Fuller)			Philips- Perron Test	
Probability on level & 1 <sup>st</sup> Difference			Probability on Level & 1 <sup>ST</sup> Difference	
Variables	Level	Difference 1 <sup>st</sup>	Level	Difference 1 <sup>st</sup>
KSE 100index	0.1452	0.0000(*)	0.1084	0.0000(*)
GDP	0.6822	0.0000(*)	0.6557	0.0000(*)
S&P 500	0.9111	0.0000(*)	0.8860	0.0000(*)
Exchange rate	0.3492	0.0000(*)	0.3522	0.0000(*)
Interest Rate	0.4573	0.0000(*)	0.4256	0.0000(*)

Employment rate	0.7854	0.0000(*)	0.7789	0.0000(*)
Labor force	0.3395	0.0000(*)	0.3452	0.0000(*)
Inflation	0.4878	0.0000(*)	0.4987	0.0000(*)

### Lag selection (Varsoc Test)

For the selection of lag, Varsoc command is applied. It mainly helps in setting out the optimal lag level that is going to be applied in the test of Co-integration. Obtained empirical findings of the Varsoc test has been illustrated from the table below in which 236 observations have been used.

### VARSOC

**Table 3.** Lag Selection

Lag	LL	DF	P	FPE	AIC	HQIC	SBIC
0	-5450.78				46.2693	46.3226	46.4014
1	-4446.28	2009	81	0.000	38.443	38.9755	39.764
2	-4380.68	126.84	81	0.001	38.592	39.6037	41.1018
3	-4332.08	101.56	81	0.061	38.8481	40.3391	42.5468
4	-428.53	107.09	81	0.028	39.0808	41.051	43.9683

Endogenous: KSE100 index, GDP, Exchange Rate, S&P 500, interest rate, Unemployment, labor force, Inflation  
Exogenous \_con

### J&J Co-integration Technique

Before conducting the co-integration technique, the data in hand which is of time series in nature is it is ensured to be of 1st order integration. This test recognizes the equations that are co-integrating. Estimation of the vectors of co-integration is done. Now if co-integration is found then it means that in the long run, variables of the study are at equilibrium. Linear combination of the variables can be observed if each are I(1).

Based on the approach of Johansen & Juselius (1990) the proposed equation is as follow:

$$\log KSE\ 100 = \alpha + \beta_1 \log GDP + \beta_2 \log E\ growth + \beta_3 \log\ exch\ rate + \beta_4 \log\ S\&P + \beta_5 \log\ interest\ rate + \beta_6 \log\ Unemployment + \beta_7 \log\ labor + \beta_8 \log\ Inflation + e$$

Result of co-integration method has been illustrated through table give as under. The total of 239 observations signifies that 1 lag has been utilized. Actually

this table comprises of two components. The first part shows 5% levels of significance is compared with test statics values. For the maximum ranks 0 the trace statistics is 8.22.50 implying being higher from 192.89 as critical value. Trace statistics value is 5.8719 implying being higher from 156.00 value. In table rank of the test arises where the trace statistics appear to below form the critical value. At rank 7 of the co integration test, the trace statistics is 11.23 in comparison with 15.41 which is noteworthy. Referring to the below output table, based on Trace statistics it can be said that there are seven co integrating equations. The second part is the maximum Eigen values criteria which also serve the same purpose. It also uses the rank for the identification of cointegration equations. In this way we have seven cointegrating vectors present in our model. So we can say that these variables have long run relationship with each other.

### Results from co Integration Test

Vecrank KSE 100 Index GDP Eco growth Exchange rate unemployment rate  
 Labor force inflation trend(constant) lags(1) Cointegration  
 Johenson test for cointegration  
 Nos. of observation: 239  
 Sample: 2-240

### Vector Error Correction Model

Table 4.

Maximum Rank	Parms	LL	Eigen Value	Trace Statistic	5% Critical Value
0	9	-4907.5208		822.89	192.89
1	26	-4785.3654	0.64020	378.1987	136.00
2	41	-4712.1237	0.43821	431.7193	124.24
3	54	-4647.6774	0.41685	302.8227	94.15
4	65	-4596.9269	0.34603	201.32165	68.32
5	74	-4360.1498	0.26491	127.7675	47.21
6	81	-4560.1498	0.23887	62.5324	29.68
7	86	-4527.5323	0.19316	11.2371	15.41
8	89	-4497.6936	.03445	2.8391	3.76
9	90	-4496.2661	0.01189		
Maximum Rank	Parms	LL	Eigen Value	Trace Statistic	5% Critical Value
0	9	-4907.5208		244.3107	57.12
1	26	-4785.3654	0.64020	146.4794	31.42
2	41	-4712.1237	0.43821	128.8966	45.12



3	54	-4647.6774	0.41685	101.5311	39.37
4	65	-4596.9269	0.34603	73.5542	33.46
5	74	-4360.1498	0.26491	65.2351	27.07
6	81	-4560.1498	0.23887	51.2953	20.97
7	86	-4527.5323	0.19316	8.3780	14.07
8	89	-4497.6936	.03445	2.8591	3.76
9	90	-4496.2661	0.01189		

The stage of VECM reaches after identification of the co-integration equation on the basis of J&J approach (1990). VAR test would have been used if there was not co-integration. Identification of optimum lag level is mandatory before proceeding for the VECM. The Varsoc test was conducted in this regard. The said test forwarded 4 important criteria i.e. FPE, AIC, HQIC, SBIC that recommend 1 lag. Hence in the VECM one lag selection has been followed. In the long deviation exists between variables and for this purpose VECM is applied. Equations of the co-integration identified ensured that despite the arbitrary movement in the short run between variables, equilibrium status has been achieved in the long run. Further VECM explains the speed of variables for attaining equilibrium when they lying scattered. In fact, the short term between variables in the short term is rectified by VECM over the long term association through the co-integration.

### **Results from VECM test**

Vector error correction model

Sample:2-240

No. of obs.= 239

AIC = 40.26247

Log likelihood =-4785.365

HQIC = 40.41487

Det (Sigma-ml) = 1990717

SBIC = 40.64066

**Table 5.**

Equation	Parms	RMSE	R- Sq	Chi 2	P>Chi 2
1	2	890.384	0.0045	1.05944	0.5888
2	2	2.39486	0.0039	.919744	0.6315
3	2	.467259	0.0216	5.235084	0.0730
4	2	3.48327	0.0007	.1588761	0.9236
5	2	41.4384	0.0212	5.14389	0.0764
6	2	.002705	0.6148	346.5128	0.0000
7	2	1.07057	0.0079	1.893915	0.3879

8	2	1.89028	0.0002	.045414	0.9775
9	2	2.42635	0.0044	1.0566	0.5896

The table comprises of 3 parts. The above table demonstrates the 1st part. First part of the table presents the command testing VECM. Total 239 observations have been used in the table with one lag value confirmation. The value of AIC is 40.26; of HQIC is 40.41 and SBIC shows 40.64.

### Second part of VECM Table

Cointegration Equation  
 Johanson Normalization restriction Imposed  
 Identification  
 Beta is exactly identified

**Table 6.**

Beta	Coefficient	Std. Err	Z	P>(Markowitz)
KSE 100 Index	1			
Inflation	7604.89	3607.773	2.11	0.035
GDP	-3758.336	3854.094	-0.98	0.329
Eco Growth	114347.3	27466.82	4.16	0.000
Exchange rate	-13428.42	3850.332	-3.49	0.000
SP 500	-33.93132	39.73202	-0.92	0.356
Interest rate	-7.50e+07	3723986	-20.14	0.0000
Unemployment rate	-13289.96	9572.423	-1.39	0.165
Labor force	-17147.12	6240.266	-2.11	0.006

**Table 7.**

Equation	Parms	chiz	p>chiz
-col	5	471.7951	0.0000

The above table is the prominent part of VECM. It is pertinent to mention that there is a cel value for every variable. They are actually the speed of adjustment for attaining equilibrium or the error correction terms. Coefficient value of the GDP shows -3758.35 signifying the degree for attaining equilibrium. According to the coefficient values of the variables like economic growth, exchange rate, SP 500 index, interest rate, unemployment rate, labor force and inflation are 11432, 13428, -33.93, -7.50e07, -13286, -17147, 7604 implying the speed towards the equilibrium. Independent variables having t values demonstrate their individual significance has been displayed in table mentioned as under. It is actually this significance value implying the influence of independent variable on the core

variable. In this connection, the null hypothesis assumes that the independent variable has no significant effect on core variable whereas alternative hypothesis assumes that significant impact of the independent variable on core variable.

H0:  $\beta = 0$

H1:  $\beta \neq 0$

If the obtained T value is higher than the standard T tabulated or distribution value then it assumed that a significant impact of the independent variables exists on the core variable. Results of the table 5.6 illustrates that on the basis of their T values independent variables like economic growth, exchange rate, interest rate, inflation, labor force have individual significant association with equity market return (i.e. KSE 100 index) in Pakistan.

The p value is another way of analyzing the individual significance of an independent variable, as the p value illustrates the exact probability of committing type 1 error. As a matter fact in regression oriented results the p value is considered more authenticated. This can be settled either at 1%, 5% or 10% level of significance. Same hypothesis applies here. From the table it is demonstrated that the independent variables like economic growth, exchange rate, interest rate, inflation, labor force are significant at 5% level of significance.

## **Conclusion**

First hypothesis of the paper is whether the aggregate equity return is determined through variation in macro-economic factors like GDP, Exchange rate, Interest rate, Cost of Labor Force, Unemployment rate, Inflation and equity market of the US or not? These macroeconomic forces really affect the return of an equity market. Macroeconomic variables including labor force cost, economic growth, exchange rate, and inflation are found to be significant variation with stock return while the rest of the variable such as unemployment rate equity market and GDP founds to be insignificant variation.

Second hypothesis of the paper was to investigate that Pakistan equity market reflects semi strong form of the EMH or not. Findings of the study reveal unclear results and question the validity of the APT and said EMH form. The APT and semi strong form test of the EMH are conducted together through joint hypothesis testing according to efficiency of a market cannot be eliminated. As a result, we can conclude that Pakistan Equity market does not reflect the semi strong form of efficiency.

## **Future Research Direction**

- The paper has taken the benchmark of KSE 100 index as core variable representing Stock Exchange of Pakistan. However, in future other indices

of Pakistan Stock Exchange such KSE 30 index and PSX all market index can be experimented with the same macroeconomic variables.

- The current paper investigated the historical association of equity return and macroeconomic forces under the umbrella of joint hypothesis theory but it may be broadened with perspective of other theories such International APT and life cycle hypothesis etc.
- By bringing changes in the data selection period or frequency pattern i.e. monthly, quarterly or annually, significant results may be achieved.
- Two prominent macroeconomic markets like the commodity market and the natural resource market can be added in the proposed multifactor model in the context of Pakistan subject to the availability of data.

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