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## **A study on the impact of macroeconomic indicators on the stock price by relaxing the assumptions of stationarity in time series data in a general linear model**

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**Abstract:** A model has been evolved by keeping the stock index as dependable variable and gross domestic product, consumption and consumer price index as independent variables. The assumptions to arrive the model are tested. The behaviour of the model is studied by including and relaxing the important assumption of stationarity in the economic data. It was finally found that the model becomes significant if we violate the stationary assumption for both dependent variable stock price and independent variable consumer price index, consumption and gross domestic product. This is evidenced by demonstrating the model by using the data related to the macroeconomic variables of developed countries (USA, UK), emerging countries (India, Brazil), and frontier countries (Latvia, Estonia).

**Keywords:** consumer price index; consumption; gross domestic product; stock prices; stationarity.

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## **1 Introduction**

Focus on stock market as an engine of economic growth is a new phenomenon in financial literature. Stock market is one of the most dominant sectors that play a crucial role in contributing to the wealth of an economy. The stock market serves in the mobilisation and allocation of savings among competing uses which are critical to the growth and efficiency of the economy. The determination of the overall growth of an economy depends on how efficiently the stock market performs its allocation functions of capital.

Generally, the stock prices tend to oscillate according to the economic news. Many observations prove that many macroeconomic variables are powerful in explaining the fluctuations in stock market. Many studies have concentrated on the effect of macroeconomic variables on stock returns and they include; Campbell and Shiller (1988), Bulmash and Trivoli (1991), Cheung and Lai (1994) and Cheung and Ng (1998). Various variables like money supply (Barnor, 2015), interest rate (Abdullah and Hayworth, 1993; Dhakal et al., 1993), bank credit (Ibrahim, 2001), and exports (Ahmed, 2008) have been studied to know their impact on stock market.

The variables like consumer price index, consumption and gross domestic product indicated different effect on stock prices. Gan et al. (2006), and Gunasekarage et al. (2004) studied the impact of consumer price index on stock price which had negative impact, whereas Sohail and Hussain (2012) and Santos et al. (2013) found a positive impact of consumer price index on stock prices. Gan et al. (2006), Attari and Saffar (2013), Hunjra et al. (2014) and Chaudhuri and Smiles (2004) analysed gross domestic product to know its influence on stock market. He proved that the GDP had positive effect on stock prices. Chaudhuri and Smiles (2004) analysed consumption and found that it had positive relationship with stock prices.

The authors mentioned above have analysed the impact of variables namely CPI, GDP and consumption individually on stock market. No one has used these variables collectively to analyse their impact on stock market. In this paper, we have attempted to find the combined effect of these variables on Stock market. For this purpose, we formulated a model with stock index as dependable variable and CPI, GDP and consumption as independent variable and tried to find the impact of variables on stock index.

This is done by converting the non-stationary data of Stock index, CPI, GDP and consumption into stationary data to satisfy the assumption that the data should be stationary. The special feature of this study is that the study is carried out with four combinations of dependent and independent variable with stationary and non-stationary data. The impact of CPI, GDP, and consumption on stock market under these combinations is analysed

- both independent and dependent variable are stationary
- independent variables are stationary and dependent variable is non-stationary
- dependent variable is stationary and independent variables are non-stationary data
- both dependent and independent variables are non-stationary.

To know the role of these selected variables on stock market of various economies, we selected few countries for study and classified those countries as developed countries, emerging countries and frontier countries.

The countries selected under developed countries are USA and under emerging countries, we have selected India and Brazil and for frontier countries we preferred Estonia and Latvia. To fulfil the purpose of finding the effect of CPI, GDP and consumption on stock index, we collected data from 2000 to 2017.

The remainder of the paper is organised as follows: Section 2 deals with a literature review, Section 3 with the present study, and Section 4 with methodology. Finally, Section 5 describes the results, and Section 6 summarises the paper with a conclusion.

## **2 Literature review**

Various literatures that had dealt with the impact of macroeconomic variables on stock market was referred for the present study and submitted below.

Irandoost (2017) focused on the relationship between the metal price index and share price index of ten European countries. The bootstrap panel Granger causality accounting for both cross-sectional dependence and heterogeneity across countries is used to detect the direction of causality. The results showed that the stock price index and metal price index are not related and changes in metal prices cannot predict stock market prices in the European economies.

Barnor (2015) considered the macroeconomic variables like interest rate, inflation rate, exchange rate and money supply to find out the impact of these variables on stock return of government sponsored enterprise (GSE) of Ghana. He had used ADF test, normality test, Johansen co-integration test, vector error correction (VEC) model, vector impulse function, E GARCH, and X GARCH, Breuch Godfrey serial correlation test to test normality of data, serial correlation, multicollinearity of data and converted data into stationary data. He found that the macroeconomic variables like inflation, interest rate, exchange rate and money supply influenced stock return

Hunjra et al. (2014) examined the impact of macroeconomic variables namely; exchange rate, inflation rate, GDP, and interest rate on Stock price in Pakistan. They have applied co-integration and Granger causality test to examine the impact of these variables. The findings revealed that in the short-run, there is no relationship between the stock price and the macroeconomic variables. But in the long-run, the findings have shown a strong relationship between the stock prices and the macroeconomic variables.

Santos et al. (2013) investigated the relation between the Brazilian stock market and macroeconomic variables exchange rate, interest rate, industrial production, and consumer price index by using a VEC model. They revealed that IBOVESPA responds negatively to the interest rate, the exchange rate, and positively to the price index.

Attari and Saffar (2013) have investigated the relationship between economic factors like gross domestic product, inflation, and interest rate on the stock market by applying the exponential generalised autoregressive conditional heteroskedasticity (EGARCH). They found that macroeconomic variables have significant influence on the stock prices. The stock prices are regarded as the greatest indicators for future forecast of the market and economy as well.

Berk and Aydogan (2012) examined the shocks of crude oil price variations on the Turkish stock market returns. They have employed vector auto regression (VAR) model

on daily observations of Istanbul Stock Exchange National Index (ISE-100) returns and Brent crude oil prices. The Variance decomposition test results proposed that crude oil price shocks were found to influence the stock market returns

Sohail and Hussain (2012) have examined the response of stock prices to macroeconomic variables i.e., consumer price index, money supply, industrial production index, treasury bills rate, and exchange rate on three stock indices of Lahore Stock Exchange, Islamabad Stock Exchange, and Karachi Stock Exchange employing Johansen co-integration technique. They showed that Industrial production, exchange rate is positively affecting stock prices in all the three market. The M2 and CPI affect stock return negatively while Treasury Bill Rate had a mixed effect.

Hasan and Javed (2009) employed Johansen co-integration test, causality test, impulse response function (IRF) analysis, and forecast error variance decomposition (FEVD) analysis on money supply, treasury bill rates, consumer price index, foreign exchange rates. – This study provided evidence for the long run relationship between the equity market and monetary variables. IRFs indicated that both the interest rate and the exchange rates had a negative impact on equity returns, whereas the money supply has had a positive impact on the equity market of Pakistan.

Humpe and Macmillan (2009) employed Johansen co-integration test, causality tests, IRF analysis, and FEVD analysis on money supply, long-term interest rate, inflation, and industrial production. – With respect to the US stock market, this study has suggested that US stock price was influenced positively by IP and negatively by inflation and the long-term interest rate. The money supply did not have a significant influence over the US stock price.

Ahmed (2008) applied Johansen co-integration test, causality test, IRF analysis, and FEVD analysis on money supply, interest rates, exchange rates, exports, foreign direct investments, IP. And the study revealed that a long run relationship between stock prices and money supply existed. There is no relationship between the interest rate and stock prices.

Ratanapakorn and Sharma (2007) has applied Johansen co-integration test, causality test, and FEVD analysis on US money supply, short-term of interest rate, long-term interest rate, inflation, and exchange rate. The study observed that the stock prices were negatively related to the long-term interest rate, and positively to the money supply, Industrial Production, inflation, the exchange rate, and the short-term interest rate.

Gan et al. (2006) has suggested that M1, short term and long term interest rate, inflation rate, CPI, exchange rate, domestic retail oil price and GDP have long term relationship with New Zealand Stock index. The Granger causality test indicated the New Zealand stock was not influencing the economy of that country.

Ibrahim (2001) used VAR model, IRF analysis on bank loans, interest rates, exchange rate, price level, and output. The results revealed that bank loans reacted positively to the increase in stock prices.

Gunasekarage et al. (2004) applied Johansen co-integration test, IRF analysis, and FEVD analysis money supply, treasury bills rate, consumer price index, and exchange rate and suggested that the money supply and the treasury bill rate had a significant influence on the stock market in Sri Lanka.

Chaudhuri and Smiles (2004) has found that a long term relationship existed between variables like M3, world oil prices, GDP, private personal consumption expenditure on stock market by applying Johansen co-integration test, IRF analysis and FEVD analysis.

The IRF and variance decomposition analysis revealed weak evidences for relationship between Australian Stock Price Index and all the above said variables.

Hondroyannis and Papapetrou (2001) applied multivariate vector auto regressive (VAR) model on industrial production, interest rates, the exchange rates, real oil price, and S&P 500. The foreign stock market changes partially explained stock market movements. – Oil price changes influenced stock price movements and had a negative impact on macroeconomic activity of Greece.

Muradoglu et al. (2000) causality test interest rates, inflation, exchange rate, IP. The results have revealed that the relationship between stock returns and the macroeconomic variables are mainly influenced by the size of the stock markets and their integration with world markets.

Sadorsky (1999) applied VAR model, and FEVD analysis on interest rate, oil price and industrial production. This study found stock returns have a positive impact on interest rates and IP.

Errunza and Hogan (1998) used GARCH Model, VAR model, and ordinary least squares method (OLS) on money supply, inflation, and industrial production. This study has found that the time variation in the seven European stock markets was significantly affected by the past variability of monetary and real macroeconomic factors.

Abdullah and Hayworth (1993) focused on M1, short term interest rates, inflation, budget deficits, trade deficits and industrial production by employing VAR model, Granger causality test, FEVD analysis and indicated that US Stock market is positively related to inflation and money growth and negatively related budget deficit, trade deficit, long term and short term interest rates.

Dhakal et al. (1993) applied VAR model to variables like money supply, short term interest rate, the price level, real output and indicated that money supply had direct impact on stock prices and interest rate and inflation had indirect influence on stock return. The result has suggested that share price volatility cause output fluctuations.

Najand and Noronha (1991) applied GARCH model monetary base, on interest rate, inflation and real output. This study has provided support for existing relationships between volatility of stock returns and volatility of the tested macroeconomic variables of US, Germany, and Canada.

### **3 Present study**

#### *3.1 Research gap*

From the previous literature, we could find that many studies had used variables like money supply – Urich and Wachtel (1981), Rogalski and Vinso (1977) and Chaudhuri and Smiles (2004) treasury bill rate, foreign exchange rates – Issahaku et al. (2013), Noura and Sekkat (2012), Kuwornu and Owusu-Nantwi (2012), and Okoli (2012) interest rates, exports, foreign direct investment – Mukherjee and Naka (1995) and Maysami and Koh (2000) foreign reserves, bank credits – Ibrahim and Shah (2012) oil prices – Berk and Aydogan (2012) to know how they affect stock market.

The variables like consumer price index, consumption and gross domestic product are crucial variables that play a dominant role in the economy of any country. Very few studies were carried out using variables like CPI, GDP and consumption to find out the impact of these variables on stock index. In this paper, we have considered the variables

like CPI, GDP and consumption collectively to study the influence of these variables on stock market.

The countries considered for the study were categorised as developed country, emerging country and frontier country. Under the developed Country, USA is selected as these countries are highly developed and market oriented. They largely influence the economy of other countries. India and Brazil are selected under emerging country as they are fast growing major economy. Baltic countries like Estonia and Latvia are considered as they possess advanced economy and exhibit a tremendous growth in economy within shorter period since transition of economy in the year 1991. There are no adequate studies on the stock market of these region but these countries are highly industrialised and attract huge investment.

### 3.2 Objective of the study

- To find the impact of Consumer Price Index, Gross Domestic Product and consumption on stock Prices.

## 4 Research methodology

To satisfy the objective of finding the impact of CPI, GDP and consumption on stock index, few assumptions have been made like

- The data should be stationary with mean = 0, Variance is constant, covariance is time independent, error term is random and it follows homoscedasticity.
- The data is then tested under four combinations to find the impact of independent variables on dependable variable stock index. For this purpose, variables like the consumer price index, consumption and GDP of the USA, India, Brazil, Estonia, and Latvia on stock index of the respective countries. The countries selected for the study were classified as developed countries, emerging countries, or frontier countries.

**Table 1** List of countries selected and variables for the study

				<i>Economic indicators</i>
Countries	Developed countries	USA	UK	Consumer price index gross domestic product consumption and stock index
	Emerging countries	India	Brazil	
	Frontier countries	Latvia	Estonia	

### 4.1 Sources of data

The annual observations of the consumer price index, Gross Domestic Product and consumption of all selected countries were collected from the World Bank data. The observations of the stock index of all countries were taken from the stock exchange of the respective countries. The stock index observations of the USA were collected from NASDAQ, UK from FTSE, India from BSE, Brazil from the IBOVESPA Brazil Sao Paulo Stock Exchange Index, Latvia from OMX Riga, and Estonia from OMX Tallinn. The observations of the consumer price index, stock index, GDP and consumption were

collected from January 2000 to December 2017. The data collected were converted to stationary data for further analysis.

#### 4.2 Application

The variables like CPI, GDP and consumption are time series data. These data contain noise and has to be preprocessed to remove the noise by making it stationary for further application.

In order to make the data stationary, we have followed a sequential procedure. We applied the data collected to various models like pure random walk model, random walk model with drift, random walk model with drift and trend to find the presence of unit root by checking the beta coefficient with tau ( $\tau$ ) statistic and applied Durbin-Watson test to check the randomness of error term and LM test to check the homoscedasticity of error term. The data is considered stationary only when it does not have unit root and the error term is random and follows homoscedasticity. If the data has unit root in all these models or error term are not random or follows heteroscedasticity, then we difference the data once or twice and repeat the procedure to get model in which the unit root is not present and error term is random and follows homoscedasticity. We select the model that is free from unit root and with error randomness and homoscedasticity for model building.

The macroeconomic variables namely gross domestic product, consumption and consumer price index of the USA, India, Brazil, Latvia, and Estonia became stationary with various models subject to unit root test, Dickey-Fuller test. This is shown in Table 2.

**Table 2** Stationarity model of variables

Variable	Countries			Model
	Developed countries	Emerging countries	Frontier countries	
CPI	USA, UK	India, Brazil	Estonia, Latvia	$\Delta^2 y_t = \beta_0 + \rho \Delta y_{t-1} + \beta_2 t + u_t$ $\Delta^2 y_t = \beta_0 + \rho \Delta y_{t-1} + u_t$
SI	USA, UK	India, Brazil	Estonia, Latvia	$\Delta^2 y_t = \beta_0 + \rho \Delta y_{t-1} + \beta_2 t + u_t$ $\Delta^2 y_t = \beta_0 + \rho \Delta y_{t-1} + u_t$
Consumption	USA, UK	India, Brazil	Estonia, Latvia	$\Delta^2 y_t = \beta_0 + \rho \Delta y_{t-1} + \beta_2 t + u_t$ $\Delta^2 y_t = \beta_0 + \rho \Delta y_{t-1} + u_t$
GDP	USA, UK	India, Brazil	Estonia, Latvia	$\Delta^2 y_t = \beta_0 + \rho \Delta y_{t-1} + \beta_2 t + u_t$ $\Delta^2 y_t = \beta_0 + \rho \Delta y_{t-1} + u_t$

Table 2 shows that the model of  $\Delta y_{t-1}$  of CPI,  $\Delta y_{t-1}$  of stock index,  $\Delta y_{t-1}$  of GDP and  $\Delta y_{t-1}$  of consumption data of the developed countries (USA, UK) emerging countries (India, and Brazil) and frontier countries (Latvia and Estonia) were stationary at the model specified above.

#### 4.3 Identification of mathematical model at which the data became stationary

It has been observed from the previous literature that there exists a relationship among the variables like CPI, GDP, consumption and stock index. In many research, this relationship is viewed with stock index as dependent variable and CPI, GDP and consumption as independent variable. First we tried to find whether any nonlinear

relationship exists among the variables CPI, GDP consumption and stock index. This resulted in minimal  $R^2$  values, insignificant t values and failed to pass ANNOVA test for the nonlinear models. Later we have evolved the linear multiple regression model.

$$\text{Stock Index} = \beta_0 + \beta_1 \text{CPI} + \beta_2 \text{GDP} + \beta_3 \text{Consumption} + \varepsilon_i \quad (1)$$

And this model has been tested for its significance.

#### *4.4 Application of multiple regression to find the significance of data*

There are few assumptions which are to be followed while applying the linear regression models and they are

- linearity
- independence of error term
- normality of error terms  $\varepsilon_i$
- stationary variance of  $\varepsilon_i$
- explanatory variables must be independent of error term
- explanatory variables must be stationary, often not true in finance and economics.

Most of the works are carried out without satisfying the assumptions of linear models. One of the assumptions of linear models is the stationarity of variables. In this paper, we have applied a framework for converting the variables into stationary variables and analysed how the model behaves for different combination which is not tested usually.

To satisfy this purpose, the annual data of consumer price index, consumption and GDP of USA, India, Brazil, Estonia and Latvia were regressed on Stock price of respective countries following four different Combinations namely:

- both dependent variable (stock index) and independent variable (CPI, GDP, and consumption) are stationary
- dependent variable (stock index) is stationary and independent variable (CPI, GDP, consumption) are non-stationary
- dependent variable (stock index) is non-stationary and independent variable (CPI, GDP, consumption) are stationary
- both dependent variable (stock index) and Independent variable (CPI, GDP, and consumption) are non-stationary.

## **5 Result and analysis**

The data collected from selected countries were converted to stationary data. The analysis is carried out with four combinations of dependent and independent variable with stationary and non-stationary data. The impact of CPI, GDP, and consumption on stock market under these combinations is analysed.



### 5.1 Both dependent variable (stock index) and independent variable (CPI, GDP, and consumption) are stationary

The independent variables of  $\Delta y_{t-1}$  of CPI,  $\Delta y_{t-1}$  of GDP, and  $\Delta y_{t-1}$  of consumption were regressed on dependable variable  $\Delta y_{t-1}$  of stock index and the impact of these independent variables on stock index is analysed. The significance is analysed by checking the partial regression coefficient. The result is shown in Table 3.

**Table 3** Result of significance when both dependent variable and independent variable are stationary

Country	Coefficient of variables		
	Consumption	Consumer price index	Gross domestic product
USA	6.85E-09	-82.4679	1.04E-08
UK	9.04E-08	-130.739	8.07E-08
India	3.02E-07(*)	-113.05	3.99E-09
Brazil	-53,286.7 (*)	-1,166.44	12,490.92(*)
Estonia	2.94E-07	-16.4087	-151.695
Latvia	2.77E-07(**)	-32.8664(*)	5.72E-08

Notes: (\*) 5% level of significance, (\*\*) 1% level of significance.

The result showed that when the stationary data of  $\Delta y_{t-1}$  of CPI,  $\Delta y_{t-1}$  of GDP, and  $\Delta y_{t-1}$  of consumption were regressed on dependable variable  $\Delta y_{t-1}$  of stock index. The consumer price index, consumption and GDP of developed countries failed to influence stock index. GDP of emerging countries also did not have impact on stock index. The consumption of frontier countries also did not influence stock index.

The CPI of India, Brazil and Latvia, consumption of Brazil and GDP of Estonia had significant influence on stock index of respective countries.

### 5.2 Dependent variable (stock index) is stationary and independent variables (CPI, GDP, and consumption) are non-stationary

We have taken stock index which is dependent variable as stationary and independent variables like CPI, GDP and consumption non-stationary. Here the  $\Delta y_{t-1}$  of stock index is regressed on non-stationary CPI, GDP and consumption.

**Table 4** Result of significance when dependent variable (stock index) is stationary and independent variables (CPI, GDP, consumption) are non-stationary

Country	Coefficient of variables		
	Consumption	Consumer price index	Gross domestic product
USA	1.22E-07	-524.874	-3.4E-08
UK	-5.7E-07	-1,166.33	8.93E-07
India	-8.2E-07	5,521.564(*)	6.63E-08(*)
Brazil	76,786.54	6,409.911	-35,863.5
Estonia	-1.6E-07	-18.5503	-514.177
Latvia	-4E-07	15.52268	4.75E-07

Notes: (\*) 5% level of significance, (\*\*) 1% level of significance.

The analysis showed that except the consumption and GDP of India, CPI, GDP and consumption of all other selected countries failed to influence the stock index when the independent variables are non-stationary and dependent variable stock index is stationary.

**5.3 Both Dependent variable (stock index) and Independent variable (CPI, GDP, and consumption) are non-stationary**

Under this combination, the CPI, GDP, consumption and stock index data are taken in raw form without converting these variables into stationary data.

**Table 5** Result of significance when dependent variable (stock index) and independent variables (CPI, GDP, consumption) are non-stationary

Country	Coefficient of variables		
	Consumption	Consumer price index	Gross domestic product
USA	3,680.853(*)	-4,477.06(*)	2.63E-09(**)
UK	2,481.834(*)	229.3848	2.51E-08(**)
India	-1439.88	-4,973.58	1.61E-07(**)
Brazil	1,1193.76	1,043.699	3.07E-07(**)
Estonia	208.6935(*)	-283.147(*)	4.1E-07(**)
Latvia	218.0635(**)	40.91864	1.96E-07(**)

Notes: (\*) 5% level of significance, (\*\*) 1% level of significance.

The result showed that the consumption of UK, Estonia and Latvia significantly influence stock index. Similarly, the CPI of USA and Estonia have impact on stock index of the respective countries. The GDP of USA, UK, India, Brazil, Estonia and Latvia have significant impact of stock index of respective countries. Meanwhile the consumption of USA, India and Brazil, CPI of UK, India, Brazil and Latvia failed to influence stock index.

**5.4 Dependent variable (stock index) is non-stationary and Independent variable (CPI, GDP, consumption) are stationary.**

Under this combination, the stationary data of  $\Delta y_{t-1}$  of CPI,  $\Delta y_{t-1}$  of GDP, and  $\Delta y_{t-1}$  of consumption are regressed on non-stationary dependent variable stock index.

**Table 6** Dependent variable (stock index) is non-stationary and Independent variable (CPI, GDP, consumption) are stationary

Country	Coefficient of variables		
	Consumption	Consumer price index	Gross domestic product
USA	-1.7E-09	-34.5937(**)	7.54E-09
UK	-5.7E-07	-1,166.33	8.93E-07
India	-8.2E-07	5,521.564(*)	6.63E-08(*)
Brazil	76,786.54	6,409.911	-35,863.5
Estonia	-1.6E-07	-18.5503	-514.177
Latvia	-4E-07	15.52268	4.75E-07

Notes: (\*) 5% level of significance, (\*\*) 1% level of significance.

The result has showed that consumption of USA and India had impact on stock index whereas the other variables like CPI and GDP fail to influence stock index of USA, India. With respect to other countries like UK, Brazil, Estonia and Latvia the independent variables are insignificant in influencing stock market

### 5.5 Finding and suggestions

The model (1) established is tested for significance with all the four combinations specified in Section 4.4. The analysis showed that the influence of CPI, GDP and consumption on stock index can be better modelled when the data is non-stationary. Under the assumption that both dependent variable and independent are non-stationary, CPI and consumptions data became significant for three countries each and the GDP is significant for all the countries.

When the both dependent variable and independent variable which are stationary is regressed, the CPI is significant for three countries and consumption and GDP becomes significant for one country each. If we regress stationary dependent variable with non-stationary independent variable or vice versa we get consumption and GDP of India alone as significant.

**Table 7** The summary of the result of significance under four combinations for all the selected countries

Country	<i>DV &amp; IV are stationary</i>			<i>DV &amp; IV are non-stationary</i>			<i>DV are stationary and IV are non-stationary</i>			<i>DV are non-stationary and IV are stationary</i>		
	CPI	CONS	GDP	CPI	CONS	GDP	CPI	CONS	GDP	CPI	CONS	GDP
USA				S		S						
UK					S	S						
India	S			S		S	S	S		S	S	
Brazil	S		S			S						
Estonia				S	S	S						
Latvia	S	S			S	S						

Notes: DV – dependent variable; IV – independent variable.

CPI – consumer price index; GDP – gross domestic product; CONS – consumption; S – significant.

Though the assumption is that the data should be made stationary for finding the influence of variables on stock index, the analysis proved that the rules of stationarity should be violated.

The GDP which is a measure of economic health of any country has huge impact on stock market. Any changes in the GDP will have strong effect on the performance of stock market. GDP is more when the economy of the nation prosper and that is reflected in the earning and profit of corporates. When the return is more, people will be interested in investing in stock market expecting higher capital gains and profits. When the stationarity rule is violated, the GDP of USA, UK, India, Brazil, Estonia and Latvia is positively correlated to Stock index

With respect to consumer price index, when prices are high and inflation is huge, people will not have sufficient money to invest. The entire earning will be spent on

consumables. Moreover the price hike in raw materials will result in reduction of profit and fall in stock price. The CPI of USA and India are negatively correlated with stock index when the stationarity rule is violated.

With respect to consumption, when consumption is more, the saving will be less and there will be a negative correlation between stock prices and consumption. The consumption of India and Estonia are negatively correlated with stock index when the data is non-stationary.

## **6 Conclusions**

This paper has used the macroeconomic variables namely Consumer price index, consumption, gross domestic product and stock index of USA, UK (developing country) India, Brazil (emerging countries) Estonia and Latvia (frontier countries) to find the impact of CPI, GDP and consumption on stock index.

To satisfy this purpose, the collected data was converted to stationary data by using pure random walk model, random walk model with drift, random walk model with drift and trend, and also by applying augmented Dickey Fuller test. The data is tested under four combinations of dependent and independent variable with stationary and non-stationary data to find the impact of independent variables like the consumer price index, consumption and GDP on dependable variable stock index.

We found that the impact on independent variables like CPI, GDP and consumption on stock index was more significant when the data is non-stationary.

This paper fulfils assumptions like linearity, independence of error term and the explanatory variables in financial analysis may not be stationary. From the findings one could conclude that there is no harm in violating one of the rules of stationarity in case of developing a model by considering stock index as dependent variable and CPI, GDP and consumption as independent variable.

This paper assists the countries not only in developing the model but also the significance of each variable on the stock index.

One of the limitations of this study is that we have not explored whether any nonlinear relationship exists among the macro-economic variables. This could be taken as a further study to check if any nonlinear relationship exists in the behaviour of the model. Then, one can also relax the assumption of stationarity in the data as it is done in this paper for General Linear Model.

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