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Inflation and Stock Market Returns in US: An Empirical Study

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Abstract:
This paper is effort to examine the impact of inflation on stock market returns for the period of May 2007 to November 2014 in USA. Monthly closing value of Nasdaq 100 index has been taken in this research paper to represent the monthly US stock market returns and monthly Consumer price index values to represent the inflation. In this paper, I have taken CPI monthly values as independent variable and stock index value as dependent variable and used one lag percentage differentials value by converting both the time series to analyze the nature of stationary. These tests examine both long-run and short-run dynamic relationships between the stock market returns and the rate of inflation. This paper found that there is positive but not much significant relationship between inflation and stock market returns in US.

Keywords: *CPR, Inflation, SMR, Stock index, Stock Market*

1 Introduction

The relationship between stock returns and inflation has its wide importance for any economy as whole as inflation is inevitable and if we are able to establish a strong positive relationship between both these variables, we can use stock as good hedge against inflation and preserve our real returns in the economy and this is one of the objective of this study.

The relationship between inflation and stock market returns has been investigated number of times by numbers of researchers but it's still a tough task to clearly express the said relationship in general. Number of researchers argued that there should be a positive relationship between these and some of researchers also shown with their research by using cross sectional and time series data that it varies country to country specially with respect to their particular structural changes during time series data procured and it's quite obvious with respect to cross sectional data and argued that stocks available in the market are can be used as good hedge against inflation. Some researchers have also shown with their research that there is negative relationship between stock market returns and inflation considering various ups and downs in a particular economy or globally and neglecting the stock as good hedge against inflation. Many of them found positive and negative relationship between these two variables but considered as neutral as their studies did not show the much significant results.

In this study I tried to find the relationship between Inflation and stock market returns in US for the period May 2007 to November 2014. In this study I used simple regression model with absolute and one month lag percentage change values of both the variables to generalize results.

2. Review of Literature

Numerous studies have been conducted in order to examine the implications of inflation on stock markets returns in US over the last several decades. However, contradictions prevail in the findings of

the prior research on this issue. Researchers in the area of finance have used various models in order to arrive at a definite set of findings on the perplexing issue of inflation and stock returns. *Pierrel and Kwoks (1992)* concluded that there is a negative relationship between inflation and returns on stock. They used VAR model to test the various hypotheses that explain the relationship between inflation and returns on stock. They have also used the distributed lags to study the dynamic structure of inflation. *Lee, et. al. (2000)* examined the impact of hyperinflation in 1920's on stock returns in Germany and concluded that there is significant and positive relationship between inflation and stock returns irrespective of the realized or expected inflation. ARIMA model was used in their study to test the various hypotheses that explained the relationship between inflation and stock market returns. *Choudhary (2001)* did study the relationship between stock returns and inflation in some selected Latin and Central American countries for the period from 1981 to 1996 and this study shows that there is positive relationship between these two variables. This study also shows that stock can be taken as good hedge against inflation. This study also used ARIMA model and did not show much difference between expected and realized inflation with respect to stock returns.

Crosby (2001) examined the relationship between the inflation and stock returns in Australia (time frame, 1875 - 1996) and found a short run negative relationship between these two variables. Similarly, the study conducted by *Spyros (2001)* examined the relationship between the inflation and stock returns in Greece for the period from 1990 to 2000. This study concluded that there is negative but not significant relationship between these two variables. They used VAR model to test the hypotheses. The study conducted by Floros (2002) highlighted the relationship between the stock returns and inflation in Greece and argued to treat these two variables as independent. The study concluded that there is no relationship between inflation and stock returns in Greece. This study is based on standard causality test.

The study by *Ugur (2005)* underlined that there is a negative relationship between inflation and stock returns. *Alagidede and Panagiotidis (2006)* revealed that the macro variables like money supply, volume of trade and exchange rate have their impact on inflation and the relationship between these two variables is positive for short run as Ill as long run. *Yeh and Chi (2009)* finds that there is short run negative relationship between these two variables and suggested that an increase in inflation reduces the real returns on stock. They used ARDL model to test the hypotheses.

3 Objectives of the Study

1. To analyze the relationship between inflation and stock market returns in US.
2. To analyze the stock returns against inflation as good hedge in US.

4. The Methodology and Econometric Model

I have used monthly data regarding CPI for the period from May 2007 to November 2014 and data were collected from http://data.worldbank.org and Stock market returns are proxies by Nasdaq 100 returns and data has procured from http://online.wsj.com to examine the relationship between stock market returns and inflation.

I started our study with the regression, by regressing absolute index values over absolute CPI values and taking basic linear regression model as mentioned below. I intentionally kept the regression model as simple as possible because it's generally accepted phenomenon in econometrics that if one can explain the behavior of dependent variables substantially with less number of independent variables and if theory is not strong enough to suggest what other variables might be included, one should prefer not to include more variables. This can also make the experiment easy to deal with autocorrelation, heteroscedasticity and multicollinearity, etc. The following model has been used in the study:

5. Econometric Model

Regression equation: $\mathbf{R_t = \alpha + \beta\pi_t + e_t}$

Where $\mathbf{R_t}$ is index value at time **t**, $\boldsymbol{\pi_t}$ is given **CPI** for corresponding time period **t**. **α** as intercept i.e. the value of **Index**, when the slope coefficient becomes 0. **β** as slope coefficient of the given value of **CPI** as explanatory variable and **Index** value as explained variable. $\mathbf{e_t}$ as the stochastic disturbance variable that has not been captured by **β** as explanatory variable but it do effect the $\mathbf{R_t}$ as per past experiences and past studies and general belief.

6. Data Analysis

In this study, I find the value of α as intercept (14007.11) and β as slope coefficient 159.8113 and T statistics values are also supporting the relationship with "P-Value" as 0 (refer appendix, Table 5). This shows that there is positive and significant relationship between R_t and $\pi t_{\text{ i.e.}}$ series of absolute index values and CPI. Further analysis required as this result cannot be accepted unless one should check for the nature of stationary, because both series are time series and contain absolute values. It is not appropriate to conclude now and one should go for the test of nature of stationary in time series data which could be a big problem and make our efforts useless though we have good value of R^2 in regression analysis (refer appendix, Table 5) but still I need to check the non-stationary. I have used DF Unit Root Test to know the nature of stationary in both the time series.

DF Unit Root Test

$$\Delta Y_t = \delta Y_{t-1} + u_t$$

Ho: $\delta = 0$ (Unit Root)

H1: $\delta \neq 0$

- Let Index Value = Y_t , **the DF Unit Root Test** are based on the following regression form:
- Without Constant and trend
- The hypothesis is: H
- Decision rule:
- If t* > ADF critical value ==> not reject null hypothesis, i.e., unit root exists and hence one can say that time series is non-stationary or it has a stochastic trend.
- If t* < ADF critical value ==> reject null hypothesis, i.e., unit root does not exist and hence one can say that time series is stationary possibly around a deterministic trend.
- I run this test for both time series one by one.

The following table represents the result of the DF Unit Root Test:

Table 1: DF Unit Root Test (ABSOLUTE INDEX VALUE Time Series)

Augmented Dickey-Fuller test statistic	Level	t-Statistic	Prob.*
		1.593444	0.9994
Test critical values	1% level	-3.504727	
	5% level	-2.893956	
	10% level	-2.584126	

Table 2: DF Unit Root Test (ABSOLUTE CPI VALUE Time Series)

Augmented Dickey-Fuller test statistic	Level	t-Statistic	Prob.*
		-1.088754	0.7174
Test critical values	1% level	-3.505595	
	5% level	-2.894332	
	10% level	-2.584325	

The above table (1&2) gives the result of the DF Unit Root Test to examine nature of stationary in both the time series data. The augmented Dickey-Fuller test statistic in Table 1 above shows the t* value is greater than the ADF critical values at all three levels of significance with respect to INDEX VALUE time series, associated with "P-Value" as 0.9994, so one can conclude that do not reject null hypothesis, i.e., unit root exists and hence one can conclude that time series is non-stationary or it has a stochastic trend.

Similarly, the augmented Dickey-Fuller test statistic in Table 2 shows the t* value is greater than the ADF critical values at all three levels of significance with respect to CPI time series, associated with "P-Value" as 0.7174, so one can conclude that do not reject null hypothesis, i.e., unit root exists and hence can say that time series is non-stationary or it has a stochastic trend. In order to have a proper understanding of the data, I provide below the graphical representation of the INDEX VALUE series and CPI series of data analyzed:

Fig. 1 Graphical representation: Index value series

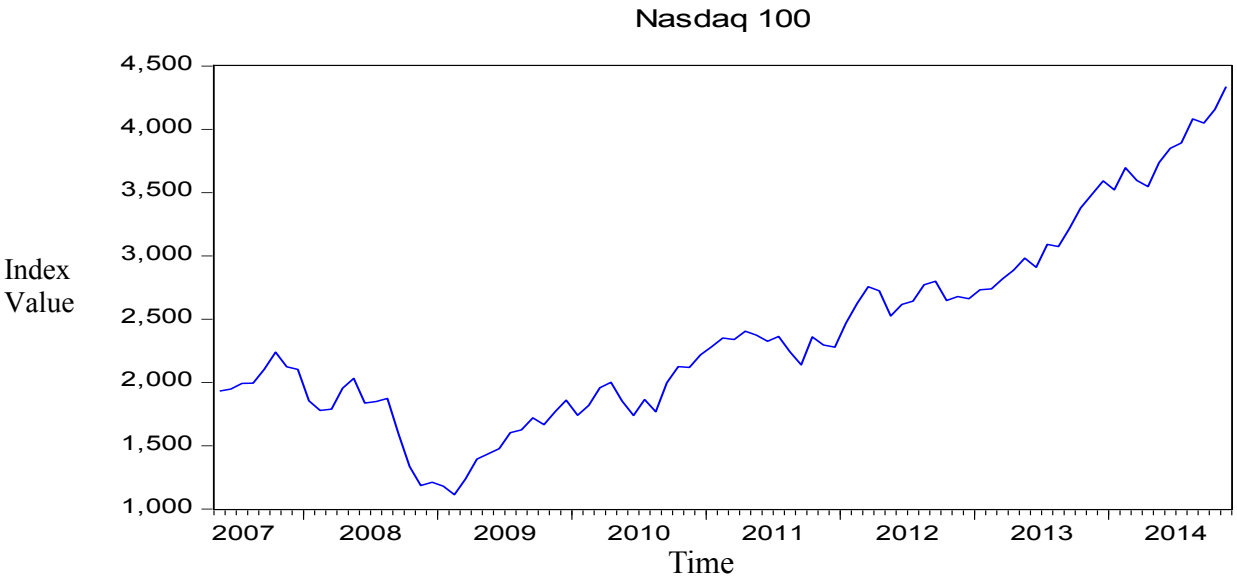
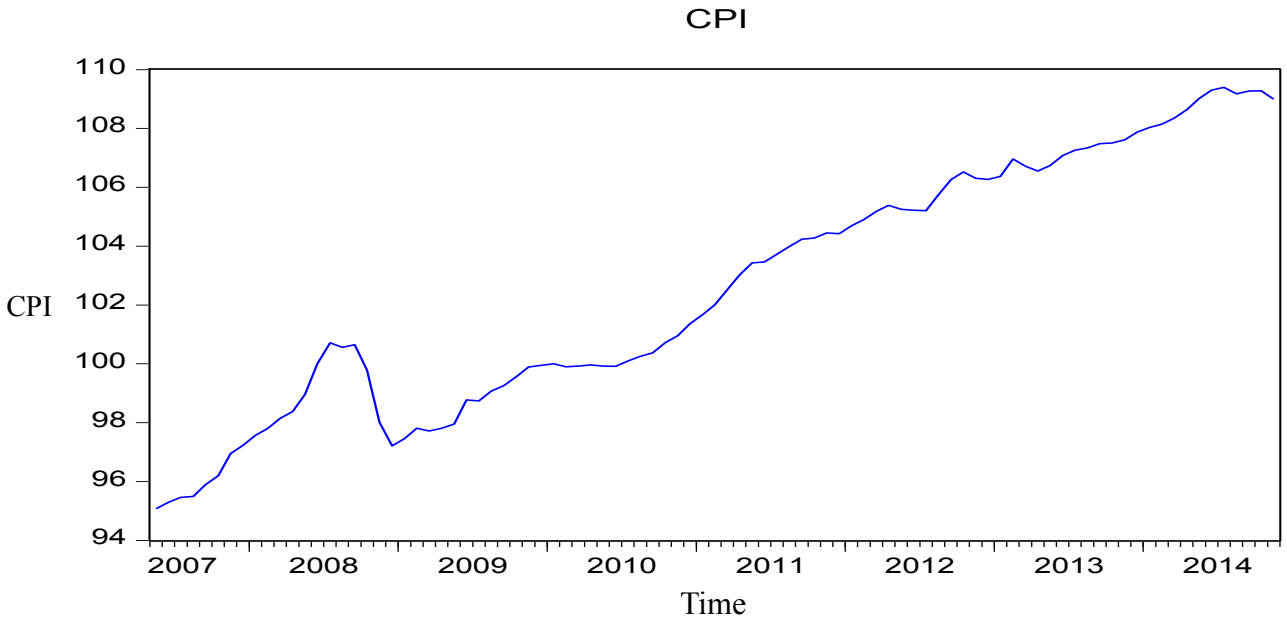


Fig. 2 Graphical representation: CPI series



To convert these time series absolute values into percentage change terms, I have used Dlog function of E-views and then run the test of unit root on converted time series i.e stock returns from index values and rate of inflation from CPI values to test the nature of stationary characteristic of these converted time series to conclude about the relationship in general and the results are as follows:

Table 3: DF Unit Root Test (Index value one period lagged time Series)

Augmented Dickey-Fuller test statistic	Level	t-Statistic	Prob.*
		-7.539912	0.0000
Test critical values	1% level	-3.505595	
	5% level	-2.894332	
	10% level	-2.584325	

Table 4: DF Unit Root Test (CPI one period lagged time Series)

Augmented Dickey-Fuller test statistic	Level	t-Statistic	Prob.*
		-5.302664	0.0000
Test critical values	1% level	-3.506484	
	5% level	-2.894716	
	10% level	-2.584529	

The above table (3 & 4) gives the result of the DF Unit Root Test to examine nature of stationary in both the time series data. The augmented Dickey-Fuller test statistic in Table 3 above shows the t* value is smaller than the ADF critical values at all three levels of significance with respect to **Index value one period lagged percentage change time Series** or Stock Returns time series, associated with "P-Value" as 0, so one can conclude that reject the null hypothesis, i.e., unit root does not exist and can say that time series is stationary possibly around a deterministic trend.

Similarly, the augmented Dickey-Fuller test statistic in Table 4 shows the t* value is smaller than the ADF critical values at all three levels of significance with respect to **CPI one period lagged percentage change time Series** or Inflation Rate, associated with "P-Value" as 0, so one can conclude that reject null hypothesis, i.e., unit root does not exist and can say that time series is stationary possibly around a deterministic trend. In order to have a proper understanding of the data, I provide below the graphical representation of the **Index value one period lagged percentage change time Series** and **CPI one period lagged percentage change time Series** of data analyzed:

Fig. 3 Graphical representation: Stock returns

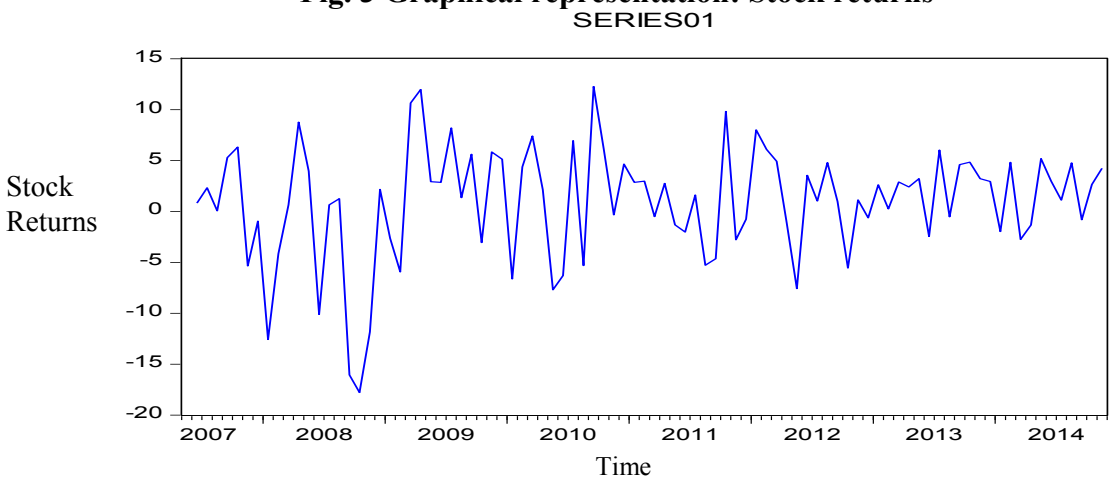
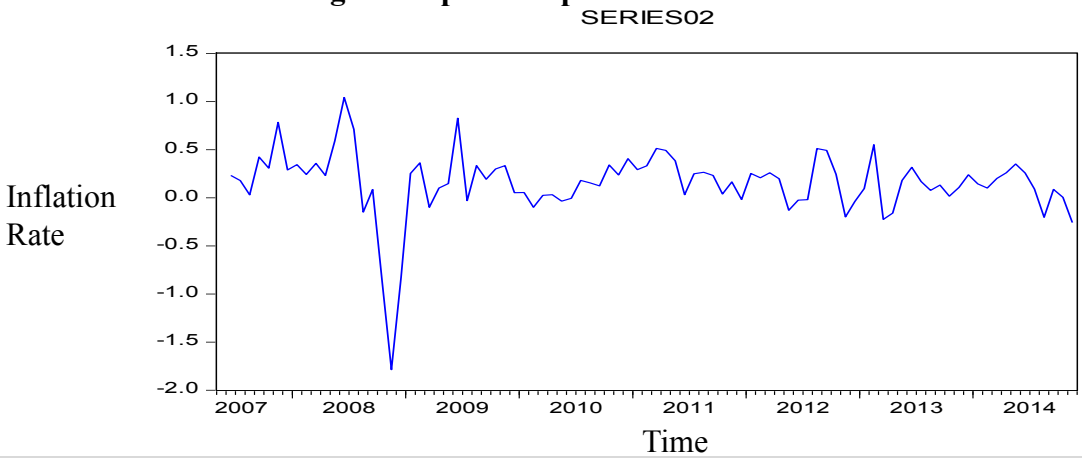


Fig. 4 Graphical representation: Inflation rate



7. Interpretation of the Results

- Given the negligible values of intercept, slope, t-statistic and probability, accompanied by 0.025 value of R^2, (refer appendix, Table 6) one can conclude here that there is no significant relationship between stock returns and inflation rate as in case of absolute values time series, but it's still positive (refer appendix, Table 6).
- When I regressed the absolute values of index value series over absolute value of CPI series they resulted as significant positive relationship. However as I know these absolute value time series of index value and CPI has non-stationary characteristic, so I can make valid the first regressed results only for this particular period taken into consideration and the results may not be generalized and can be spurious.
- As the finding suggests that the converted series i.e. stock returns and inflation rate time series has characteristic of stationary. So I can conclude in general irrespective of the time lag and time period taken into consideration that there is positive but not good amount of significance relationship between stock market returns and inflation rate in US.

8. Summary and Conclusion

The objective of the study was primarily to examine the relationship between inflation and stock market returns in US and to analyze the impact of inflation on stock market returns in US. I have accentuated the importance of both the variables, i.e. inflation and stock market returns in our study and run a number of tests to find the relationship between stock returns and inflation during the period (May 2007 to November 2014) in US with the help of index values of Nasdaq 100 as approximate for stock returns and CPI values as approximate for inflation. Initially I directly run the regression for the absolute values of index and CPI and found that there is significant and positive relationship between index value and CPI and one can follow that the stock returns are good hedge against inflation and one can preserve real returns by investing in stock market.

Secondly, I have run the unit root test to know the nature of stationary in the time series available with us and I found that the index value and CPI time series are non-stationary but when I converted these time series into one period lagged percentage change terms by using one lag value with the help of Dlog function in E-views they gave us just opposite results with respect to nature of stationary in both the series.

Finally, I regressed this one period lagged percentage change converted series of stock returns over series of inflation rate and found that there is positive but not much significant relationship between stock returns and inflation rate and hence can say that it is difficult to conclude hare that, are nominal stock returns good hedge against inflation? The answer to this question still remains a paradox. Hence, it provides the basis for academicians and researchers to investigate on this issue at greater depth and

find a reasonable solution to the above problem taking into consideration various other variables if possible that can relate the stock returns and inflation more precisely.

Appendix

Table 5 : Regression Results of both the absolute value time series

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-14007.11	928.0106	-15.09369	0.0000
CPI	159.8113	9.039830	17.67858	0.0000
R-squared	0.778349	Mean dependent var		2385.044
Adjusted R-squared	0.775859	S.D. dependent var		765.5962

Table 6 : Regression Results of both the one period lagged series

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.510026	0.643977	0.791995	0.4305
DLOG(CPI)	2.562908	1.714602	1.494754	0.1386
R-squared	0.024761	Mean dependent var		0.899192
Adjusted R-squared	0.013679	S.D. dependent var		5.626363

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