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CAN INDIAN INFLATION MEASURES EXPRESS BROAD MARKET INDICES OF INDIA?

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ABSTRACT
Fisher hypothesis (1930) tells that stock return will be a directly and positively related with inflation. This study empirically assesses the relationship between daily closing price of two main broad market indices of India – Sensex and S&P CNX Nifty, and two inflation majors - whole sale price index and consumer price index of India. The study has used both Gragner Causality Test and Cointegration Test to check the relationship. The study has decomposed the inflation measures into expected and unexpected forms, because expected part will be able to express the stock return in more effective way. The study has proved that there is effectively no relationship between them.

KEYWORDS: Broad market indices, whole sale price index, consumer price index, Gragner Causality Test and Cointegration Test.

INTRODUCTION

Fisher (1930) hypothesis, in its most familiar version, states that "the expected nominal rate of return on stock is equal to expected inflation plus the real rate of return". Fisher hypothesis, therefore, predicts a positive homogenous relationship between stock returns and inflation. In other words, Fisher hypothesis implies that nominal stock returns offer a hedge against inflation. Inflation in India is unstable since its conceptualization. Though present inflation is not very high but high inflationary situation was observed since January 2011. It was very close to double digit number in December 2011.

Security markets in India have made enormous progress by developing sophisticated instruments and modern market mechanisms. The key strengths of the Indian capital market include a fully integrated and automated trading system on all stock exchanges, a wide range of products, a nationwide network of trading and strong regulation system. This has motivated nearly twenty three million people to invest mainly two stock exchanges of India – Bombay Stock Exchange (BSE) and National Stock Exchange (NSE). Around five thousand companies commanded a total market capitalization of USD 1.06 trillion as of May 15, 2012 at Bombay Stock Exchange. National Stock Exchange (NSE) of India is the 16th largest stock exchange in the world in terms of market capitalization and largest in India for daily turnover and number of trades. Hence in this huge growth story it is necessary to check whether stock market investors are free from worry of Indian inflation. There are two main broad market indices in India - Sensex from Bombay Stock Exchange and S&P CNX Nifty from National Stock Exchange. These two indices comprise of shares of companies form more or less all important sectors of Indian economy. Both the websites tell that they represent not only the respective stock exchanges but also the Indian economy. Hence these two indices have been considered to see whether any relationship exists between their return and inflation. The study has been organized as follows. Section II reviews the published literature pertinent to the topic. Section III mentioned the required data and their sources, section IV outlines the methodology used, section V provides the empirical results and analysis and finally concluding remarks are given in section VI.

REVIEW OF LITERATURE

Adam and Frimpong (2010) studied the relationship of stock price and inflation for Ghana for the sample period 1991:1-2007:12. Cointegration analysis was employed and the findings showed strong support for Fisher hypothesis. Al-Khazali and Pyun (2004) investigated the statistical relationship between stock prices and inflation in nine countries in the Asia Pacific Basin. Using Johansen cointegration test and they concluded that stock prices in Asia reflect a time-varying memory associated with inflation shocks that make stock portfolios a reasonably good hedge against inflation in the long run. Spyrou (2001) and Floros (2004) examined stock returns-inflation relation in Greece, using the Johansen cointegration test and they found that there is no significant long-run relationship between inflation and stock returns in Greece. Spyrou (2004) examined the Fisher hypothesis for 10 emerging countries, namely, Chile, Mexico, Brazil, Argentina, Thailand, South Korea, Malaysia, Hong Kong, Philippines and Turkey. They found little evidence to support this hypothesis in these countries. Kim and Francis (2005) studied the Fisher hypothesis based on a wavelet multi-scaling method for US, for the period from 1926:1 to 2000:12. Their findings revealed that there is a positive relationship between stock returns and inflation in the shorter period, while a negative relationship is found in longer period. Ahmad and Mustafa (2005) studied the relationship for Pakistan, for the period from 1972 to 2002. Full Information Maximum Likelihood (FIML) method was employed. They divided the inflation into two parts – expected and unexpected. Results revealed that

relationship between real returns and unexpected growth and unexpected inflation are negative and significant. Kim (2003) employed quarterly data of Germany for the period from 1971:1 to 1994:4. Symmetric and asymmetric Granger causality test was performed and results demonstrated the negative correlation between stock returns and inflation. Using the monthly data, Nelson (1976) studied the relationship for the US in the postwar period, (from 1953:1 to 1972:12). Box and Jenkins' ARIMA method was used to divide the inflation into expected and unexpected part. They found the stock returns were negatively related with both expected and unexpected inflation. Samarokoon (1996) and Jaffe and Mandelker (1976) used the same method on Sri Lanka and US data respectively and got the same result. Some of the studies had divided the study period into various zones and got various results. Kolluri and Wahab (2008) studied the relationship between stock returns and inflation through asymmetric test specification, which is capable to distinguish stock returns into high and low inflation period. The study period was from 1960:1 to 2004:12 and Findings of the study revealed that there was inverse relationship between stock returns and inflation during low inflation periods. On the contrary, positive relation is observed through high inflation periods. Lee (2008) analyzed the causal relationship in the UK, the sample period ranged from 1830 to 2000. The sample period was further divided into two sub-periods, 1830-1969 and 1970-2000. The empirical findings of the study reported that there is a significant negative correlation between unpredictable stock returns and inflation for the subperiod 1970-2000. However, unpredictable stock returns were hardly correlated to unpredictable inflation during the same subperiod. Employing the wavelet methodology Durai and Bhaduri (2009) examined the relationship between stock returns, inflation for the post-liberalization period in India. The study employed monthly data from 1995:1 to 2006:7. The wavelet analysis helped to decompose the inflation into expected and unexpected components. In short run, the expected component of inflation was insignificant, while in the medium and long run, the expected component was found to be negatively significant with the real stock returns. Therefore Fisher hypothesis is not unanimously applicable on all stock markets. Hence this study will investigate whether whole sale price index and consumer price index of India or any of its form i.e. expected or unexpected part are related to closing price of two main broad market indices i.e. sensex S&P CNX Nifty are related to closing price of two main broad market indices i.e. sensex S&P CNX Nifty. Kumari (2011) investigates the relationship between stock returns and inflation in India during 1991:4 to 2009:3. Weekly, monthly and quarterly indexes of BSE Sensex and NSE Nifty are used. Weekly, monthly and quarterly Wholesale Price Index (WPI) and monthly Consumer Price Index (CPI) are used as measures of inflation. The whole period was subdivided into pre-crisis and post-crisis period of Indian economy. Unit root tests, Granger causality test and regressions are performed for examining the nexus between the variables. Vector Autoregression (VAR) methodology has been employed to investigate the causal link between stock returns and inflation. Impulse Response Functions (IRF) checked the response to disturbance in the system. The results suggest that there is no significant relation between stock returns and inflation in post-reform period in India. Shanmugam and Mishra 2008 did this work taking monthly data from April 1980 to March 2004 and a two-step estimation procedure. Results of the study indicate that the Indian stock market reflects future real activity, the negative stock returns-inflation relation emerges from the unexpected component of the inflation. They divided the sample in pre and post reforms period and the split sample analyses indicate that the Fama hypothesis is valid only in pre reform period. In the post reform period, real stock returns have been independent of inflation, i.e., the Fisher Hypothesis is valid.

DATA

Both consumer price index (CPI) and whole sale price index (WPI) have been used as inflation measure (Kumari 2011, Schwert 1989 and Alagidede 2009, Shanmugam and Mishra 2008). Monthly data covering period from November 1995 to March 2012 of CPI, WPI, Sensex and S&P CNX Nifty have been taken for analysis. Sensex and S&P CNX Nifty data have been collected form website of Bomaby Stock Exchange and National Stock Exchange of India. The Ministry of Industry, Government of India is the sources for the WPI and CPI.

METHODOLOGY

Auto-Regressive Integrated Moving Average (ARIMA) is not applicable on both WPI and CPI data because auto-correlation is not dying exponentially (Gujarati 1995). Hence Hodrick-Prescott (HP) filter is used to derive the expected and unexpected components of the inflation. This filter decomposes the inflation into its trend and unexpected deviations from the trend. As suggested in Hodrick and Prescott (1980) for monthly data, (¤ =14400) have been used as the value of the smoothing pharameter. Gragner Causality Test and Cointegration Test methods have been used to check the relationship.

Equation

There may be two ways causality. This implies that Stock Price can be predicted by Inflation and Inflation may be predicted by stock price.

$$r_t = \sum_{i=1}^{n} \sim_i \bar{}_{t-i} + \sum_{i=1}^{n} {}_j r_{t-j} + u_{1t} \quad \text{---------- (1)}$$

$$\bar{}_t = \sum_{i=1}^{n} \mathsf{a}_i \bar{}_{t-i} + \sum_{i=1}^{n} \partial_j r_{t-j} + u_{2t} \quad \text{---------- (2)}$$

Wherein $r_t = \log\left(\frac{p_t}{p_{t-1}}\right)$ and $\bar{}_t = \log\left(\frac{I_t}{I_{t-1}}\right)$, r is the return of indices, p_t and p_{t-1} is the closing price of both the indices on t th and $(t-1)$ th month. $\bar{}_t$ is the inflation on t th period and I_t and I_{t-1} are the data of WPI and CPI on t th and $(t-1)$ th period.

Unidirectional causality from inflation $\bar{}$ to r is indicated if the estimated coefficients on the lagged $\bar{}$ in equation 1 are statistically different from zero as a group (i.e. $\sum \sim_i \neq 0$) and the set of estimated coefficient on the lagged r in equation 2 is not significantly different from zero ($\sum \partial_i = 0$). Conversely, unidirectional causality from inflation r to $\bar{}$ exists if the set of lagged $\bar{}$ coefficients in equation 1 is not statistically different from zero as a group (i.e. $\sum \sim_i = 0$) and the set of estimated coefficient on the lagged r in equation 2 is significantly different from zero ($\sum \partial_j \neq 0$). To test this hypothesis F test given by (3) has been applied.

$$F = \left(\frac{(RSS_R - RSS_{UR})/m}{RSS_{UR}/(n-k)} \right) \text{---------- (3)}$$

This follows the F distribution with m and $(n-k)$ degree of freedom. m is equal to the number of lagged $\bar{}$ terms and k is the number of parameters estimated in the unrestricted regression. If the computed F exceeds the critical F value at the chosen level of significance, we reject null hypothesis, in which case $\bar{}$ causes r. Same process may be followed to check whether r causes $\bar{}$. The relationship can be checked with both expected and unexpected value of WPI and CPI also. But the direction of causality may depend critically on the number of lagged terms included in the equation. Hence co-integration test has been used.

Co-integration test

$$SP_{sensex,t} = {}_1 + {}_2 I_{WPI,t} + £_{1,t} \text{----------(4)}$$

$$£_{1,t} = SP_{Sensex,t} - {}_1 - {}_2 I_{WPI,t} \text{----------(5)}$$

$$SP_{sensex,t} = {}_1 + {}_2 I_{\exp ectedWPI,t} + £_{2,t} \text{---------- (6)}$$

$$£_{2,t} = SP_{Sensex,t} - {}_1 - {}_2 I_{\exp ected,WPI,t} \text{---------- (7)}$$

$$SP_{sensex,t} = {}_1 + {}_2 I_{un\exp ectedWPI,t} + £_{3,t} \text{---------- (8)}$$

$$£_{3,t} = SP_{Sensex,t} - {}_1 - {}_2 I_{un\exp ected,WPI,t} \text{---------- (9)}$$

$$SP_{sensex,t} = {}_1 + {}_2 I_{CPI,t} + £_{4,t} \text{---------- (10)}$$

$$£_{4,t} = SP_{Sensex,t} - {}_1 - {}_2 I_{CPI,t} \text{----------(11)}$$

$$SP_{sensex,t} = {}_1 + {}_2 I_{\exp ectedCPI,t} + £_{5,t} \text{---------- (12)}$$

$$£_{5,t} = SP_{Sensex,t} - {}_1 - {}_2 I_{\exp ected,CPI,t} \text{---------- (13)}$$

$$SP_{sensex,t} = {}_1 + {}_2 I_{un\exp ectedCPI,t} + £_{6,t} \text{----------(14)}$$

$$£_{6,t} = SP_{Sensex,t} - {}_1 - {}_2 I_{un\exp ected,CPI,t} \text{---------- (15)}$$

$$SP_{Nifty,t} = {}_1 + {}_2 I_{WPI,t} + £_{7,t} \text{----------(16)}$$

$$£_{7,t} = SP_{Nifty,t} - {}_1 - {}_2 I_{WPI,t} \text{----------(17)}$$

$$SP_{Nifty,t} = {}_1 + {}_2 I_{\exp ectedWPI,t} + £_{8,t} \text{---------- (18)}$$

$$£_{8,t} = SP_{Nifty,t} - {}_1 - {}_2 I_{\exp ected,WPI,t} \text{---------- (19)}$$

$$SP_{Nifty,t} = {}_1 + {}_2 I_{un\exp ectedWPI,t} + £_{9,t} \text{---------- (20)}$$

$$£_{9,t} = SP_{Nifty,t} - {}_1 - {}_2 I_{un\exp ected,WPI,t} \text{---------- (21)}$$

$$SP_{Nifty,t} = {}_1 + {}_2 I_{CPI,t} + £_{10,t} \text{---------- (22)}$$

$$£_{10,t} = SP_{Nifty,t} - {}_1 - {}_2 I_{CPI,t} \text{---------- (23)}$$

$$SP_{Nifty,t} = {}_1 + {}_2 I_{\exp ectedCPI,t} + £_{11,t} \text{---------- (24)}$$

$$£_{11,t} = SP_{Nifty,t} - {}_1 - {}_2 I_{\exp ected,CPI,t} \text{---------- (25)}$$

$$SP_{Nifty,t} = {}_1 + {}_2 I_{un\exp ectedCPI,t} + £_{12,t} \text{---------- (26)}$$

$$£_{12,t} = SP_{Nifty,t} - {}_1 - {}_2 I_{un\exp ected,CPI,t} \text{---------- (27)}$$

Wherein $SP_{sensex,t}$ and $SP_{Nifty,t}$ are the closing price of Sensex and S&P CNX Nifty.

$I_{WPI,t}$, $I_{CPI,t}$, $I_{\exp ectedWPI,t}$, $I_{un\exp ectedWPI,t}$ $I_{\exp ectedCPI,t}$, $I_{un\exp ectedCPI,t}$ are the values of WPI, CPI, expected WPI, unexpected WPI, expected CPI and unexpected CPI at t th period. $£_{1t}, £_{2t}, ----------£_{12t}$ are the error terms.

Here both SP_t and I_t are nonstationary but to satisfy the cointegration $£_t$ s need to be stationary. Expected and Unexpected value of both CPI and WPI can be used to check the relationship.

Section-V Empirical results: As noted earlier, the HP filter is employed to derive the expected and unexpected inflation.

Stationary test: Data needs to be stationary for using Gragner Causality Test

Table-1 Dickey Fuller Test result

Total Data		
	Log Level	
Variable	Intercept	Trend and Intercept
Inflation with WPI	-6.257*	-6.239*
Expected inflation with WPI	-2.817***	-3.033
Unexpected inflation with WPI	-6894*	-6.876*
Inflation with CPI	-6.233*	-6.226*
Expected inflation with CPI	-2.165	-2.095
Unexpected inflation with CPI	-7.003*	-6.984*
Sensex	-5.841*	-5.847*
S&P CNX Nifty	-5.979*	-5.981*

*, **, *** Represents significance at 1%, 5% and 10% level respectively.

Expected inflation with both WPI and CPI are non-stationary. Rest data can be used for Gragner Causality Test.

Table-2 F Statistics with 2 lags

	Inflation with WPI	Expected inflation with WPI	Unexpected Inflation with WPI	Inflation with CPI	Expected inflation with CPI	Unexpected inflation with CPI
Sensex	0.227	1.383	0.245	0.713	1.639	0.432
	0.533	0.990	0.459	0.429	0.021**	0.197
S&P CNX	0.097	1.186	0.147	0.903	1.339	0.638
Nifty	0.584	1.051	0.553	0.475	0.015**	0.252

** implies the test results are significant at 5% confidence level, upper value in each cell indicates the unidirectional causality from inflation ( ) to index return ( ) and lower value indicates the Unidirectional causality from index return ( ) to inflation( )

Table 2 indicates that Gragner Causality test result between return of broad market indices and inflation shows that none of the F values are significant even at ten percent confidence level. Hence none of those can explain to each other. Only expected inflation calculated taking CPI can explain both Sensex and S&P CNX Nifty but this inflation is again nonstationary.

Co-integration Test

Co-integration test can be used if data are nonstationary (Gujarati 1995). Table 3 shows the Dickey Fuller test result for wholesale price index, consumer price index, daily closing price of sensex, expected and unexpected data of both whole sale price index and consumer price index.

Table-3 Dickey Fuller Test result

Total Data				
	Level		1st difference	
Variable	Intercept	Trend and Intercept	Intercept	Trend and Intercept
WPI	-1.768	-2.008	-3.918*	-3.907**
Expected WPI	-1.818	-3.348***	-2.506	-2.536
Unexpected WPI	-3.831*	-3.820**		
CPI	-1.247	-2.081	-3.724*	-3.747**
Expected CPI	-1.590	-2.540	-1.945	-1.724
Unexpected CPI	-3.783*	-3.772**		
Sensex	-0.356	-2.159	-4.226*	-4.269*
S&P CNX Nifty	-0.270	-2.195	-4.374*	-4.426*

*,**,*** Represents significance at 1%, 5% and 10% level respectively.

Except unexpected values of WPI and CPI all data are non-stationary at level.
Hence co-integration test can be used.

Table-4: Relationship between Sensex, S&P CNX Nifty and all kinds of inflation

	WPI	Expected WPI	Unexpected WPI	CPI	Expected CPI	Unexpected CPI
Constant	14079.85	1297.48	8480.255	18927.92	21155.97	8480.255
	(10.046)	(10.515)	(20.353)	(30.791)	(37.139)	(20.431)
Intercept	-24.348	-33.991	-1.729	-31.178	-37.827	-9.680
term	(-4.356)	(-5.212)	(-0.124)	(-18.605)	(-23.937)	(-1.228)
R^2	0.089	0.1223	0.000	0.639	0.746	0.007
D	0.024	0.020	0.017	0.120	0.069	0.0202

Table-5: Relationship between S&P CNX Nifty and all kinds of inflation

	WPI	Expected WPI	Unexpected WPI	CPI	Expected CPI	Unexpected CPI
Constant	4330.205	55022.025	2548.683	56.00.583	6268.304	2548.683
	(10.9221)	(11.022)	(20.610)	(29.875)	(35.905)	(20.669)
Intercept	-7.7464	-10.7546	-0.789	-9.107	-11.100	-2.507
term	(-4.704)	(-5.609)	(-0.191)	(-17.821)	(-22.920)	(-1.070)
R^2	0.102	0.139	0.000	0.619	0.730	0.006
d	0.0271	0.023	0.019	0.118	0.071	0.021

Validity of the tables 4 and 5 or cointegration between closing price of the two leading indices and WPI, CPI and their expected and unexpected values will be proved if Augmented Dickey-Fuller (ADF) test result of the error terms $£_{1t}$, $£_{2t}$, ----------, $£_{12t}$ are significant.

Table 6: ADF test result

	ADF Value	R^2	D	T
$£_{1t}$	-0.898	0.008	1.993	-0.898
$£_{2t}$	-0.858	0.008	1.994	-0.858
$£_{3t}$	-0.597	0.004	1.993	-0.597
$£_{4t}$	-2.515	0.034	2.002	-2.516
$£_{5t}$	-2.297	0.028	1.995	-2.297
$£_{6t}$	-0.628	0.002	1.995	-2.297
$£_{7t}$	-0.875	0.004	1.999	-0.874
$£_{8t}$	-0.821	0.004	1.998	-0.821
$£_{9t}$	-0.529	0.002	1.998	-0.529
$£_{10t}$	-2.391	0.035	2.002	-2.391
$£_{11t}$	-2.177	0.024	1.999	-2.177
$£_{12t}$	-0.554	0.004	2.001	-0.554

Table 6 shows that none of the ADF result is significant at even ten percent level. As it is cointegration test therefore in place of ADF test augmented Engle-Granger (AEG) test will be used. Values of ts are the ^{2} in AEG test (Gujarati 1985). The critical ^{2} value at one percent level in -2.5899. None of the calculated ^{2} value in table 3 are not more negative than critical value. Hence it can be concluded that closing price of sensex and S&P CNX Nifty are not integrated with WPI, CPI or their expected or unexpected form.

An alternative and quicker way to findout the cointegration between closing price of sensex and S&P CNX Nifty and WPI, CPI and their expected and unexpected values are Cointegrating Regression Durbin-Watson (CRDW) test (Gujarati 1985). Here the CRDWs are the d values in tables 4 and 5. The critical value of CRDW at one percent significance level is 0.511. Here all the d values are less than its critical value. Hence there is no cointegration.

CONCLUSION

The study has critically assessed the relationship between closing prices of leading indices of India i.e. Sensex and S&P CNX Nifty and whole sale price index and consumer price index. Expected inflation will be more applicable to assess the price of Sensex and S&P CNX Nifty. Hence

Hodrick-Prescott (HP) filter has been used to decompose both the inflation measures into expected and unexpected part. To make the result more correct both Gragner Causality test and co-integration test have been used. Gragner Causality test is not applicable on expected inflation as it is non stationary. The test result shows that neither inflation nor Indian indices return can explain to each other. Main problem with Gragner Causality test is that the output varies with the accepted lag lengths. Hence cointegration test has been used. The whole values of indices and inflation measures have been used in place of their logarithmic values. The all kinds of data are non stationary except expected inflation. The test result shows that closing price of sensex and S&P CNX Nifty are not integrated with any inflation measures i.e. whole sale price index and consumer price index or any of their forms. Therefore Fisher Hypothesis is not valid in Indian Economy. This implies that stock prices do not provide any hedge against inflation. So many structural reforms at Indian capital market is not able to safe investors at share market.

Some more sophisticated methods have been used by many researchers to prove this relationship. These are out of the scope of this research work. Some more available Indian indices may be analysed before generalisation of the result. Still the study can provide a clear idea about this.

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