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Inflation Hedging of Equity Returns in India (2001-2021)

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ABSTRACT

This study was conducted to investigate whether equity returns are hedge against Inflation risk in the short and long run in India during 2001M1-2021M3 covering a period comprising two great market upheavels, the Global financial Crisis and economic recession which followed after 2008; health risk due to Covid-19 which shook every corner of the world, not just financial markets. ARDL bound cointegration test results reveal that equity returns are hedge against inflation risk in the long run, but they fail to hedge against inflation in the short-run.

JEL Classification: C11; G11
Keywords: Fisher hypothesis; inflation risk; Cointegration;Global Financial Crisis (GFC); Covid-19

I. Introduction

Long-term investors are particularly concerned about the risk of inflation. Treasury inflation-protected securities, for example, are an inflation hedge, but the real returns on these assets are typically low. As a result, investing in stocks to gain from the equity premium is an appealing option for investors. The downside risk to investing in stocks is that they could decrease in value as inflation rises. If the Fisher hypothesis holds true, a common view in economics is that an asset serves as a good inflation hedge (see, for example, E. F. Fama and Schwert (1977); Boudoukh and Richardson (1993); Barnes, Boyd, and Smith (1999); BekaertBekaert and Wang (2010). To put it another way, Irving Fisher posited his classic Theory of Interest (1930) that inflation expectations are fully reflected in ex-ante nominal interest rates. However, he excluded the possibility of a connection between the expected real rate and inflation expectations, highlighting the separation between the real and monetary sectors. According to this theory, ex ante nominal returns reflect the market's expectations for future inflation rates, so the expected nominal returns on any asset would move in lockstep with inflation expectations. The Fisher coefficient refers to the marginal impact of an expected inflation change on nominal returns. The Fisher hypothesis, on the other hand, claims that real asset returns are statistically unrelated to inflation expectations. The fisher hypothesis discussed above is known as the Generalized Fisher Hypothesis (GFH).

Securities, which represent claims on tangible assets, have long been considered good hedges against inflation. There is some debate about the impact of inflation on stock returns, as evidenced by empirical studies such as Boudoukh and Richardson (1993),Solnik and Solnik (1997), Barnes et al. (1999).The proxy hypothesis Fama E. Fama (1981), money illusions by Modigliani and Cohn (1979) and informational frictions byBarnes et al. (1999)could explain the negative impact of inflation rates on stock returns. This study adds to the existing body of literature by investigating the inflation hedging ability of equity returns in India during a period of more than twenty years (2001M1-2021M3), which also contains two of the biggest financial market upheavals: one of them is the Global Financial Crisis (GFC) and the other is Covid-19. Hence, it is interesting to know whether emerging market stocks are able to hedge against inflation risk in the presence of these two risks.

The rest of the article proceeds as follows. A brief review of literature is presented in Section II; Section III describes data and research methodology; we discuss the empirical results in Section IV. Finally, we conclude in Section V.

II. Review of Literature

For the first time, researchers Anari and Kolari (2001) used a cointegration test to look at the long-term link between stock prices and inflation. They found that stock and goods prices have a long-term relationship, and estimates of stock price long-run elasticity with respect to goods prices generally

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exceed, ranging from 1.04 (France) to 1.65 (Japan), and supporting the Generalized Fisher Hypothesis (GFH) in all cases. Researchers claimed that the GFH coefficients (ranging from 1.04 to 1.65) are more in line with those found by Boudoukh and Richardson (1993) than those found byJaffe and Mandelker (1976). According to their estimations, the estimated speed of adjustment coefficients range from 0.01 to 0.03, indicating that stock prices take an extremely long time to return to their long-run relationship following unexpected changes in goods prices. Like Al-Khazali and Pyun (2004) a positive long-term relationship between stock and goods prices in Pacific Basin countries; Luintel and Paudyal (2006)found the same thing; and Alagidede and Panagiotidis (2010) found it as well. According to Kim and Ryoo (2011), U.S. common stocks have served as an inflation hedge since the early 1950s. A century-long U.S. monthly dataset covering the period 1900:01–2009:06 and various window lengths are used to examine the long-term relationship between stock and goods price movements. They show that stock and goods prices are cointegrated with unit elasticity using the Seo (2006) test for cointegration in a two-regime threshold vector error-correction model (TVECM). Stock returns and inflation show asymmetric error correction.

However, the findings of Hassan et al. (2015) contradict the GFH in some respects. They use alternative cointegration methods, such as Johansen and Juselius (1990) maximum likelihood technique, Pesaran (2006) autoregressive distributed lag (ARDL) method, and HansenHansen and Seo (2002) non-linear two-regime threshold cointegration procedure, on data from 19 OECD countries. In five countries (Ireland, Italy, Japan, the Netherlands, and Switzerland), results based on threshold cointegration technique confirm cointegration, whereas Johansen and Juselius (1990) linear cointegration method only produces cointegration in three countries. When Pesaran (2006) use the ARDL bounds test of cointegration; they discover cointegration in nine countries. All cointegrating vectors have statistically significant long-run Fisher coefficients greater than one, as shown by the findings. According to the authors' findings, stock investments can serve as long-term inflation hedges in nine out of the 19 countries studied. However, when using panel VAR, the authors found no support for the GFH in any of these nine countries, either in the short or long term. There is no global phenomenon like GFH, according to these findings.

Harris and Tzavalis (1999), and Levin, Lin, and Chu (2002)found results that are highly consistent with the GFH (2002). However, results based on Pedroni (2001)fully modified OLS heterogeneous panel cointegration technique show that, except for the period when inflation was brought under control, panel estimates of the long-run elasticity of stock prices with respect to goods prices are always less than 1.0. The magnitude of these elasticity estimates is lower than that of other studies, which generally report coefficients exceeding 1.0. A one-to-one correspondence between stock and goods prices for all periods cannot be ruled out, which means that common stocks provide a perfect long-run inflation hedge when considered together with the other findings. Omay, Yuksel, and Yuksel (2015) use the more comprehensive panel cointegration methods of Pedroni (2001) (fully modified OLS; FMOLS),Pesaran (2006) and Westerlund (2005)in an attempt to extend the work of Gregoriou and Kontonikas (2010)to pay special attention to the cross-section dependence issue in testing the GFH equation and obtain results that strongly support the existence of cointegration between stock and goods prices. Aside from these results, the Fisher coefficient estimates reported by these researchers range from 0.68 to 1.27, supporting the GFH.

According to Bampinas and Panagiotidis (2016), constructing investment portfolios of stocks with higher long-run betas as part of an asset selection and allocation strategy can improve the hedging ability of stocks. Researchers have found that prices of the 25 highest beta stocks in the S&P 500 index, which have been continuously included since 1993, tend to move in tandem with goods prices over the long term, even though overall, the index appears to lack long-term inflation hedging ability during the same time period. This study's findings show that even though the S&P 500 as a whole lacks inflation hedging ability, portfolios constructed from stocks with high long-run beta offer superior hedging ability, regardless of whether the portfolio is built on an in sample basis.

III. Data and Research Methodology

Since the Generalized Fisher Hypothesis (GFH) states that the expected nominal returns on any asset would move in lockstep with inflation expectations, this study has taken monthly NSE-Nifty Index’s nominal returns to represent stock returns in India. The choice of NSE-Nifty Index is arbitrary taking into account its diversification across sixteen sectors and free float market capitalization. The data on Nifty index has been downloaded from NSE’s website and to represent inflation rates monthly CPI index is utilized. The data on CPI has been downloaded from International Financial Statistics database of IMF. The sample period of the study ranges from 2001M1 to 2021M3. The end date of the sample is determined on the basis of the availability of CPI index in IMF database. However, 2001 as the beginning year is chosen with the purpose to include three different periods in the sample. Before 2008, there are more than six years which include no economic crisis or other market upheavals; from 2008 until December, 2019 financial markets suffered from the Global financial Crisis and economic recession which followed after 2008; from 2019 onwards the world suffered from health risk due to Covid-19 which shook every corner of the world, not just financial markets. The nominal equity returns and inflation rates are calculated as follows:

Nominal Equity Returns = $P_t - P_{t-1}/P_{t-1}$**; Inflation Rates=** $CPI_t - CPI_{t-1}/CPI_{t-1}$

Research Objectives

To investigate whether equity returns are hedge against Inflation risk in the short and long run.

Unit Root Tests

The determination of the integration order of analyzed time series by unit root tests is an important task in econometric modeling. A pair of time series is stationary if and only if the means and variances remain constant with respect to the sample size. Numerous tests are available in statistical theory, but the most common is them are the Augmented Dickey-Fuller test, Phillips-Perron test, KPSS test, and its modifications, the ADF-GLS test and Ng-Perron test.

ARDL Bounds Testing Cointegration Technique

This cointegration method does not call for unit root pretests like others. This means that when dealing with variables that are integrated in different orders, such as I(0), I(1), or both, ARDL cointegration is the better option because it is more robust when there is only one long-term relationship between the underlying variables in a small sample. The F-statistic reveals the long-term relationship between the underlying variables (Wald test). When the F-statistic rises above the critical value band, the long-term relationship between the series is said to be established. When there are multiple cointegrating vectors, this approach has the advantage of identifying them all. However, this technique will crash in the presence of integrated stochastic trend of I(2).

Assumptions of ARDL Bounds Testing Cointegration

One of the key assumptions in Pesaran et al. (2001) ARDL/Bounds Testing methodology is serial independence of ARDL model errors. This requirement, as noted by the authors, could have an impact on the final decision on the maximum lags for the model's variables. Errors are normally distributed and homoscedastic; the model is "dynamically stable".

ARDL Bounds Testing Cointegration Equations

$$\Delta Nominal\_Returns_t = \alpha_0 + \sum_{i=1}^{n} \delta_{1i} \Delta Nominal\_Returns_{t-i} + \sum_{i=0}^{n} \delta_{2i} \Delta Inf\_Rate_{t-i} + \delta_3 Nominal\_Returns_{t-1} + \delta_4 Inf\_rate_{t-1} + \varepsilon_{1t} \ldots (1)$$

Error Correction Method (ECM)

The ECM is, in fact, a reparametrized version of the ARDL model. The following equations show how the ECM is reparametrized from the ARDL model for cointegration.

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \delta_0 X_t + \delta_1 X_{t-1} + \mu_t \qquad (2)$$

To reparametrized eq. (2) to ECM, add $-Y_{t-1}$ to both sides of the equation.

$$Y_t - Y_{t-1} = \alpha_0 - Y_{t-1} + \alpha_1 Y_{t-1} + \delta_0 X_t + \delta_1 X_{t-1} + \mu_t \qquad (3)$$

Further add the folowing term $-\delta_0 X_{t-1} + \delta_0 X_{t-1}$ (i.e. –n+n=0) to the right hand side of the equation.

$$Y_t - Y_{t-1} = \alpha_0 - Y_{t-1} + \alpha_1 Y_{t-1} + \delta_0 X_t + \delta_1 X_{t-1} - \delta_0 X_{t-1} + \delta_0 X_{t-1} + \mu_t \qquad (4)$$

When the terms are rearranged, the following equation emerges

$$\Delta Y_t = (1 - a_1) Y_{t-1} + \alpha_0 + (\delta_1 + \delta_0) X_{t-1} + \delta_0 \Delta X_t + \mu_t; \text{ or} \qquad (4)$$

$$\Delta Y_t = (1 - a_1) Y_{t-1} + \frac{\alpha_0}{(1-\alpha_1)} + \frac{(\delta_0 + \delta_1)}{(1-\alpha_1)} X_{t-1} + \delta_0 \Delta X_t + \mu_t; \text{ or} \qquad (6)$$

$$\Delta Y_t = -\pi (Y_{t-1} - \beta_0 - \beta_1 X_{t-1}) + \delta_0 \Delta X_t + \mu_t \qquad (7)$$

$\pi = (1 - a_1), \pi$ is called adjustment coeffiecint.

Where, $\epsilon_t = (Y_{t-1} - \hat{\beta}_0 - \hat{\beta}_1 X_{t-1})$ (8)

If statiionary residuals are obtainged from $(Y_{t-1} - \beta_0 - \beta_1 X_{t-1})$, then a cointegrating relationship is established and $(Y_{t-1} - \beta_0 - \beta_1 X_{t-1}) = 0$. since negative shocks in the economy manifest in the errors of the equilibrium model can turn $Y_{t-1} < \beta_0 + \beta_1 X_{t-1}$. Now it is imperative that Y_t rises above to turn ΔY_t positive and thus an equilibrium is achived again. If positive shocks are experienced then $Y_{t-1} > \beta_0 + \beta_1 X_{t-1}$, and Y_t must fall to turn ΔY_t neagtive and an equilibrium is achived.

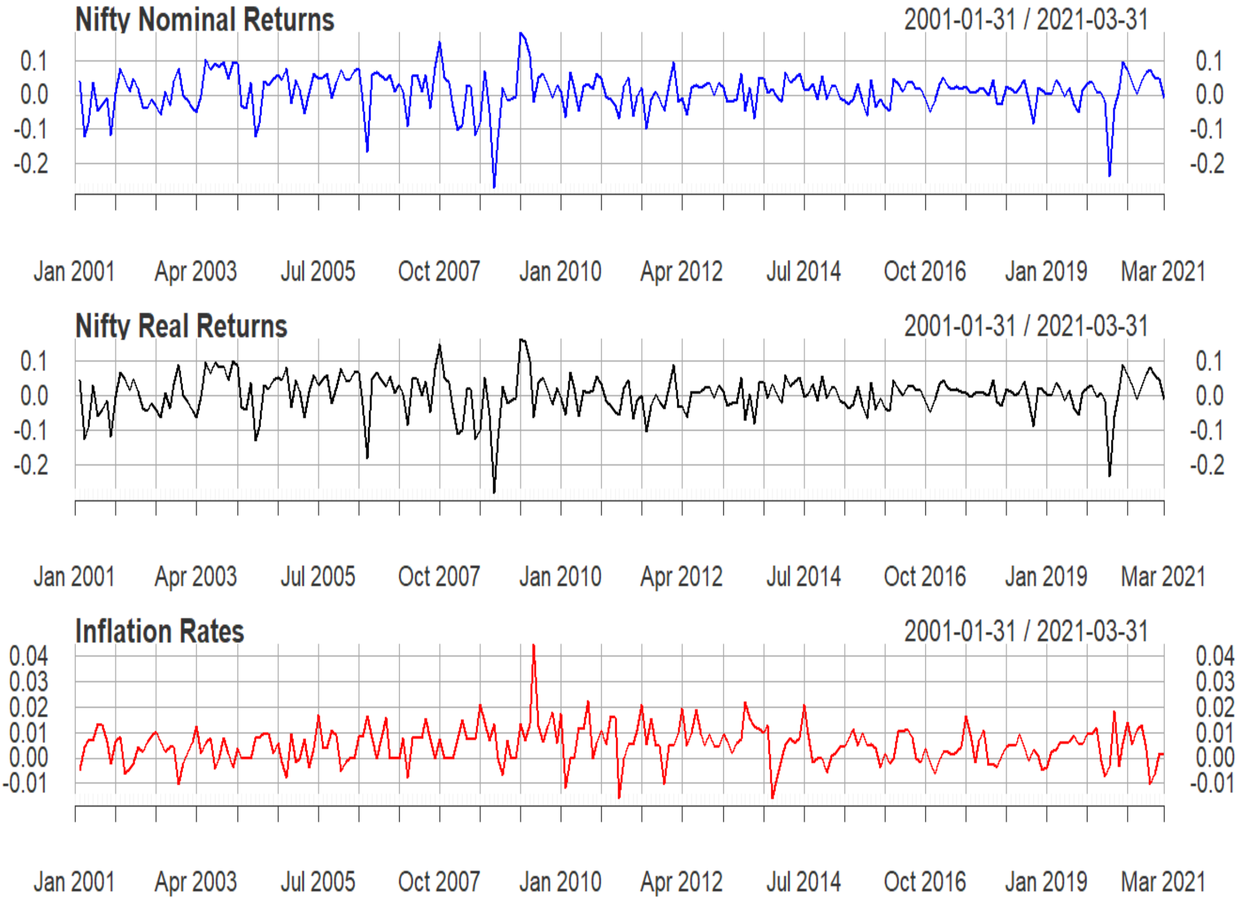
The equilibrium is only the result of the negative sign in π. This is why the deviations of Y_{t-1} from the long run value of $\beta_0 + \beta_1 X_{t-1}$ are corrected., the short-run deviations from equilibrium are not corrected if π carries a positive sign.

Equation (9) now depicts the ECM model, which is a reparametrization of the ARDL model's equation (1) for cointegration.

$$\Delta Nominal\_Returns_t = \alpha_1 + \sum_{i=1}^{n} \delta_{1i} \Delta Nominal\_Returns_{t-i} + \sum_{i=0}^{n} \delta_{2i} \Delta \mathrm{inf\_}rates_{\ t-i} + -\pi \hat{\epsilon}_t + v_t (9)$$

IV. Empirical Results

Figure 1 shows nominal and real monthly equity returns and monthly inflation rates in India.



Complied by authors obtaining monthly data from: https://www.niftyindices.com/reports/historical-data and https://data.imf.org/regular.aspx?key=61545849

Figure 1 Monthly Nominal and Real Equity Returns and CPI Inflation Rates

It can be noticed that monthly nominal and real stock returns were never above 2% during the sample period but they did touch a value less than -20% returns in the global financial crisis period and Covid-19 period. Monthly CPI inflation rates in India also never crossed the limit of 5% in the last two decades; however, it remained near zero or negative in many months.

Descriptive Statistics and Correlation Test

The average monthly nominal returns during the sample period is not very high (=1%), however, the real return is even lesser (=0.5%). Variation is noticed more in equity returns (nominal and real, σ= 5.6%) than inflation rates (σ = 0.7%).

Table 1Descriptive Statistics and Correlation Test

Variables	n	mean	sd	median	min	max	range	skew	kurtosis
Nominal Returns	242	0.010	0.056	0.018	-0.27	0.181	0.452	-1.01	3.857
Real Returns	242	0.005	0.056	0.012	-0.280	0.166	0.446	-1.011	3.654
Inflation Rates	242	0.005	0.007	0.005	-0.016	0.045	0.061	0.568	3.163

Pearson's Correlation

	INF_RATE	STOCK_RET	REAL_RET
INF_RATE	1		

STOCK_RET	-0.0419	1	
	0.0161	-----	
REAL_RET	-0.1687	0.991846	1
	0.4185	0	-----

Pearson's correlation test reveals that nominal equity returns are negatively associated with inflation rates at 0.05 significant levels. Real returns also carry a negative association with inflation rates but it is not statistically significant.

Unit Root Test

ADF unit root results show that inflation rates are not stationary at level with Constant, with Constant & Trend, and Without Constant & Trend.

Table 2 Unit Root Test Results(ADF)

Null Hypothesis: the variable has a unit root				
	At Level			
		INF_RATE	STOCK_RET	REAL_RET
With Constant	t-Statistic	-2.5157	-11.1404	-11.1139
	Prob.	***0.1130***	***0.0000***	***0.0000***
		n0	***	***
With Constant & Trend	t-Statistic	-2.5160	-11.1170	-11.0907
	Prob.	***0.3202***	***0.0000***	***0.0000***
		n0	***	***
Without Constant & Trend	t-Statistic	-1.0334	-10.9133	-11.0796
	Prob.	***0.2710***	***0.0000***	***0.0000***
		n0	***	***
	At First Difference			
		d(INF_RATE)	d(STOCK_RET)	d(REAL_RET)
With Constant	t-Statistic	-12.3193	-19.0471	-19.1685
	Prob.	***0.0000***	***0.0000***	***0.0000***
		***	***	***
With Constant & Trend	t-Statistic	-12.2959	-19.0093	-19.1294
	Prob.	***0.0000***	***0.0000***	***0.0000***
		***	***	***
Without Constant & Trend	t-Statistic	-12.3476	-19.0857	-19.2072
	Prob.	***0.0000***	***0.0000***	***0.0000***
		***	***	***

Notes: a: (*) Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant. b: Lag Length based on SIC. c: Probability based on MacKinnon (1996) one-sided p-values.

However, inflation rates become stationary after first differencing indicating that inflation rates are I (1) and equity returns are I (0).

Cointegration Test Results

Table 3 shows ARDL Bound testing results. Nominal equity returns are cointegrated with inflation rates in Indiabecause the F-statistic is 18.19 which are greater than 6.73 F-bounds test statistic at 1% level of significance, indicating that nominal equity returns rates and inflation rates are cointegrated.

Table 3 ARDL Bound Test Results

F-Bounds Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	18.19485	10%	4.05	4.49
k		5%	4.68	5.15

		2.5%	5.3	5.83
		1%	6.1	6.73
Actual Sample Size	239		Finite Sample: n=80	
		10%	3.113	3.61
		5%	3.74	4.303
		1%	5.157	5.917

R-squared of the model is 37.56% and ECT(-1) of the model in which the cointegration between nominal equity returns rates and inflation rates is tested is negative and significant as required shown in Table 4. This confirms that the cointegration holds between the two variables and any disequilibrium occurring in the short run is corrected with the speed of 0.66.

Table 4 ECM Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008786	0.005163	1.701648	0.0902
D(STOCK_RET(-1))	0.029749	0.074982	0.396746	0.6919
D(STOCK_RET(-2))	-0.152986	0.063488	-2.409705	0.0167
DUM	-0.009878	0.006836	-1.444953	0.1498
CointEq(-1)*	-0.657536	0.088618	-7.419912	0.0000
R-squared	0.375605	Mean dependent var		0.000318
Adjusted R-squared	0.364932	S.D. dependent var		0.064841
S.E. of regression	0.051672	Akaike info criterion		-3.067090
Sum squared resid	0.624787	Schwarz criterion		-2.994361
Log likelihood	371.5173	Hannan-Quinn criter.		-3.037782
F-statistic	35.19070	Durbin-Watson stat		1.969924
Prob(F-statistic)	0.000000			

Since the data is collected on a monthly basis, it will take approximately 1.5 months (0.66 x 3 = 1.98) to correct any short-term imbalance and restore the long-term relationship between nominal equity return rates and inflation rates.

Another characteristic that Breusch, Pagan, and Godfrey test has revealed about this model is that its null hypothesis of homoscedasticity has not been rejected at a 5% significance level (see Table 5).The null of no autocorrelation of Breusch-Godfrey Serial Correlation LM Test is also not rejected because p-value >0.05.

Table 5 Model Diagnostic Tests

Variables	**Normality of Residuals**	**Breusch-Godfrey Serial Correlation LM Test**	**Heteroskedasticity Test: Breusch-Pagan-Godfrey**
	Jarque-Bera	**F-statistic**	**F-statistic**

1	Nominal equity returns (Inflation Rates)	12.34 (0.004)	2.4431 (0.2014)	6.307571 (0.08345)

Note: Model selection method: Akaike info criterion (AIC)

However, residuals of the ECM regression are not normal because the null of normality of Jarque-Bera test is rejected at 1% significance level.

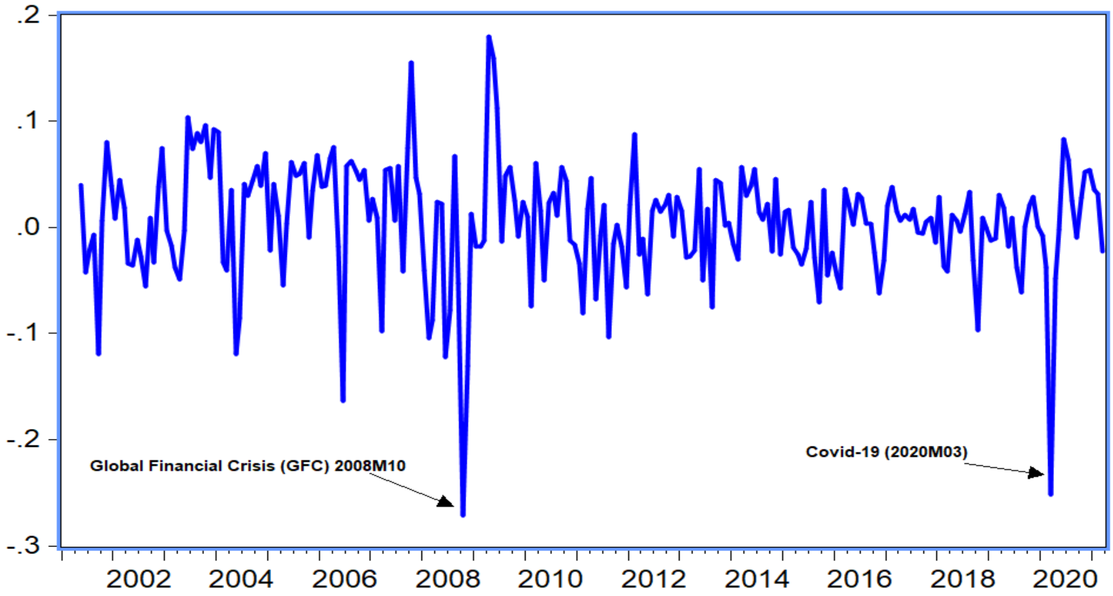


Figure 2 Cointegration Relationship between Nominal Equity Returns and Inflaion Rates

Figure 2 depicts a graphical representation of cointegration relationship between Nominal Equity Returns and Inflation Rates during the sample period. It is evident that two structural breaks are present in the cointegrating relationship. To account for the structural break, a dummy variable was included in the ARDL bound Cointegration test.

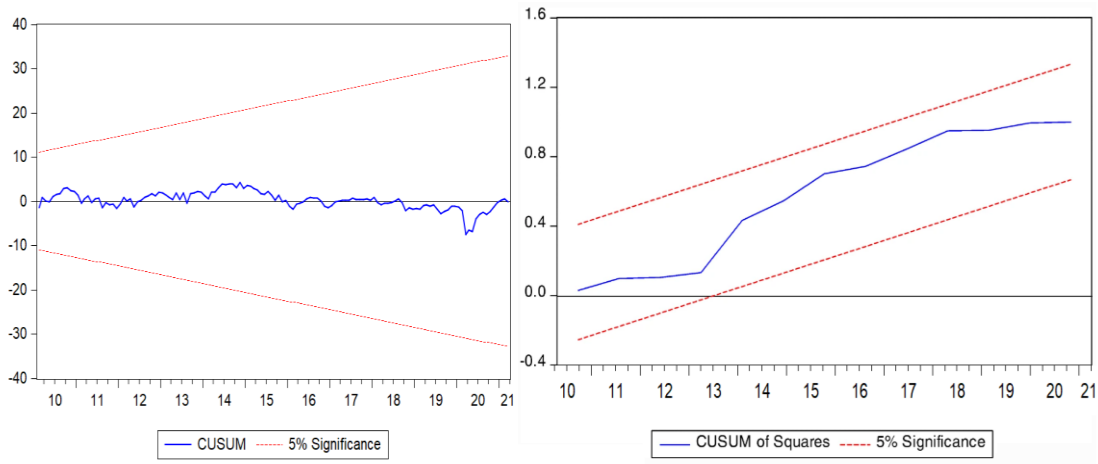


Figure 3Cumulative sum (CUSUM) and CUSUM of squares (CUSUMSQ)

Cumulative sum (CUSUM) and CUSUM of squares (CUSUMSQ) were used to test the models' structural stability by examining the long-term relationship between the nominal equity returns rates and inflation rates, as shown above. Recursive residuals of either test do not deviate from zero as expected, nor do they deviate from symmetric confidence lines above and below 5% significance levels. Therefore, it is concluded that is a stable cointegrating relationship is noticed between the two variables after 2010M1.

V. Conclusions

This study was conducted to investigate whether equity returns are hedge against Inflation risk in the short and long run in India during 2001M1-2021M3 covering a period comprisingtwo great market risks, the Global financial Crisis and economic recession which followed after 2008; health risk due to Covid-19 which shook every corner of the world, not just financial markets. ARDL bound cointegration test results reveal that equity returns are hedge against inflation risk in the long run, but they fail to hedge against inflation in the short-run.

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