Linkages Between Equity and Commodity Markets:

An Empirical Evidence

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Abstract

The present study explores the long-run and short-run association among equity, Agro-commodity (NCDEX) gold, silver, crude oil market in India using the Auto-Regressive Distributed Lag (ARDL) and Generalized Method of Moment (GMM) model. Further, Fully Modified Ordinary Least Square (FMOLS)model is employed to determine the sensitivity and robustness of the estimation of ARDL Bounds test approach. Our paper examines the dynamic response of Agro-commodity during periods of financial turmoil, high economic policy uncertainty, and high inflation. Our findings indicate that Agro-commodity is negative and significantly correlated with equity, gold, and crude oil, and in contrast, it has a positive and significant correlation with silver, EPUI, and the inflation rate. Further the results of our study signify the cointegration amid the variables in which Agro-commodity converges to its long-run equilibrium level by 3.809% speed of daily adjustment by the contribution of other independent variables. The positive and significant correlation with control variables like inflation and Economic Policy Uncertainty Index (EPUI) indicates that the diversification benefits can be maximized by including Agro-commodity in asset portfolios as a risk-hedging instrument and safe haven during the period of financial distress, high economic policy uncertainty, and high inflation. Our findings are robust and would benefit policymakers and regulators and help investors, portfolio managers for developing trading strategy before investment decisions.

Keywords: Equity market, Commodity market, ARDL model, GMM model, FMOLS model.

JEL Classifications: G1, C23, C58

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1. Introduction

A study on the relationship between equity, gold, silver, crude oil, EPUI, inflation and agricultural commodity has been a great interest topic for investors, regulators, researchers and academicians today. A strand of research has identified gold, silver, and crude oil as commodities gaining importance in international portfolio diversification and acts as a risk hedging tool and safe haven during a period of financial distress. However, Ildırar and İşcan, (2015) indicated that there is a growing co-movement between commodity and stock price worrying investors that leads to the paradigm shift to agriculture commodity investment as alternative options of gold and silver. Agriculture commodity futures contracts can help portfolio managers to manage risk significantly (Singh and Purankar, 2017). Boyrie and Pavlova (2016) evidenced that agricultural products offer better diversification possibilities in emerging markets and commodity return becomes stronger when inflation is picking up. Kang et al., (2017) also supported this view and suggested that agricultural commodities can be used for hedging and speculative purpose for diversifying portfolio risk.   Further, agricultural commodity financialization plays an essential role in portfolio diversification regarding extreme risk (Živkov et al., 2022).

However very scarce studies on Agro-commodity as an asset class has been explored as a risk-hedging instrument during a period of high economic policy uncertainty and high inflationary pressure in emerging markets like India. So, against this backdrop, we contribute to the literature by identifying the National Commodity and Derivative Exchange (NCDEX), which has 100% Agro-commodity components and is also a highly segmented market with solid barriers for retail investors and global investors as one of the best investment avenues for risk-averse investors during a period of high volatility in the equity market, high EPUI and high inflationary pressure. A modest attempt has been made in this study to address the gap.

The present study attempts to observe the cointegration between commodity market with equity, gold, crude oil market to provide new insights into the existing literature by employing Auto-Regressive Distributed Lag (ARDL) model. Further Generalized Method of Moment (GMM) model is used to corroborate their relationship. Thirdly, Fully Modified Ordinary Least Square (FMOLS)model employed to check the long-run stability of the relationship between them.

The paper is arranged as follows: literature is reviewed in section 2. Section 3 describes the data and methodology and the analysis are elaborated in section 4. The concluding remark is elucidated in section 5.

2. Literature Review

Some studies reported that the inclusion of commodities in an asset portfolio could maximize the diversification benefits by reducing risk and maximizing return on the overall portfolio. (Belousova and Dorfleitner, 2012) Their study applied span tests to determine the diversification contribution of various commodities in an asset portfolio. The study found industrial metals have

diversification contribution in a bearish market, whereas agricultural commodities lead to reduce risk in both bullish and bearish markets. Gokmenoglu and Fazlollahi, (2015) observed the long-run and short-run association amongst gold, oil, and stock market and found that a long-run relationship exists between equity and commodity market where gold has the highest impact on S&P 500 than oil. In contrast, in the short-run no impact is found suggesting that S&P 500 stock market price converges to its long run equilibrium level by 1.2% speed of daily adjustments by contribution of gold and oil. Boyrie and Pavlova, (2016) investigated the link amid emerging and developed equity market co-movements with commodities found commodity return have potential for diversifying risk in portfolio and also suggested that agricultural commodities bid better diversification benefits in emerging markets. Levin, et al (2016) found commodity future index returns were positive and significant in the long run and suggested that commodity can add value to a diversified portfolio. The study also indicated that commodity return become stronger when inflation is picking up. Kang et al., (2017) found that gold and silver are the information transmitter to other commodity future markets.

Kirithiga et al., (2018) found that there is spillover effect exists in between equity and commodity futures market.   The study suggested that if an investor feels threat in the equity market, investment can switch over to commodity market. Maitra and Dawar(2019) described equity market has a return spill over on NCDEX and also reported that commodity indices have more spillover effect on stock. Oyelami and Yinusa (2019) explored the short term and long-term association between global commodity return and stock market return using ARDL model and found both short term and long-term relationship associated between them. The study also reported that global commodity price index is affecting stock return of both Johannesburg Stock Exchange and Nigerian Stock Exchange. Further, the study also found bidirectional causal relationship exists between global commodity price index and stock market return.

Aziz et al., (2020) examined the volatility spill over between equity and commodity markets of the United States and indicating no spillover effect from commodity to equity market. The study also reported no spillover effect found between gold and equity market. Kaur and Dhiman(2021)tried to examine long run association between agricultural commodities (NCDEX) and FMCG (NSE) and not found long run relationship presence between them. The study also checked the causal relationship and found no causal relationship exist except commodities like barley, cotton seed, jeera, mustard seed and wheat. Hurley and Papanikolaou(2021) observed the both short run and long run bilateral trade dynamics of U.S. and China. They found real exchange rates are affecting most of the commodities in both short and long run in both countries.

3.   Data and Methodology

The study uses daily return data of NCDEX (AGRIDEX) as agro commodity indices, BSE SENSEX as equity market indices, MCX iCOMEDEX includes Gold, Silver and Crude oil. Further EPUI (Economic Policy Uncertainty Index) and Inflation considered as a control variable for the

study. The data are taken from 2015 to 2021. The data are collected from BSE, NCDEX and MCX website. This period has been very important for Indian Economy as the process of integration of equity and commodity market has started since 2008 global financial crisis and also in the last part of this period whole world is struggling against the pandemic Covid-19. We have considered the news-based Economic Policy Uncertainty Index along with inflation in the study. Inflation data is collected from RBI website. We have taken BSE SENSEX as equity and NCDEX as agro-commodity. The log return is calculated by using the closing price:

$$r_t = \ln (p_t/p_{t-1})*100, \tag{1}$$

Where r_t signifies compounded return at time t,

p_t and p_{t-1} denotes daily stock index at time *t* and *t-1* respectively.

To avoid spurious regressions in time series data it is essential to conduct unit root test to check the stationary of variables. So, the standard Augmented Dickey-Fuller (ADF) and Phillips–Perron test (PP) test has been used.

3.1 Auto-Regressive Distributed Lag (ADRL) model

Numerous studies have elaborated that ARDL model is more reliable than conventional co-integration techniques. This approach is appropriate irrespective of whether the underlying regressors are purely I (0) or I (1) or jointly co-integrated and evading the bias related with unit roots and cointegration tests. This model is also appropriate for restricted sample size. It is easier to estimate the short-run and long run mechanisms of the model concurrently using ARDL bounds testing model. The present study utilizes ARDL bounds testing method to assess the short and long-run relations amid the variables which are developed by Pesaran and Pesaran (1997), Pesaran and Shin (1999) and Pesaran et al. (2001). ARDL model circumvents the probable bias related with cointegration and unit roots tests.

Auto-regressive in the ARDL models means the concerned variable is a function of the past values of itself. The past and current values of other variables are called distributed lag. In ARDL (p,q), p epitomizes numerous lags of the different variable while q signifies the number of lags of the explanatory variables. Further, one lagged term in explanatory variables is called dynamic regressor. If the variables cointegrated under this method, it indicates the presence of stable long-run relationship.

The ARDL model involves estimating the following model:

$$\Delta logNCDEX_t = \alpha_0 + \sum_{i=1}^{n} \beta_{1i} \Delta logNCDEX_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta logSENSEX_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta logMCXGOLD_{t-i}$$

$$+ \sum_{i=1}^{n} \beta_{4i} \Delta logMCXSILVER_{t-i} + \sum_{i=1}^{n} \beta_{5i} \Delta logMCXCRUDEOIL_{t-i} + \sum_{i=1}^{n} \beta_{6i} \Delta logINFLATION_{t-i}$$

$$+ \sum_{i=1}^{n} \beta_{7i} \Delta logEUIP_{t-i} + \gamma_1 logNCDEX_{t-1} + \gamma_2 logSENSEX_{t-1} + \gamma_3 logMCXGOLD_{t-1} + \gamma_4 logMCXSILVER_{t-1} + \gamma_5 logMCXCRUDEOIL_{t-1} + \gamma_6 logINFLATION_{t-1} + \gamma_7 logEPUI_{t-1} + \varepsilon_t \tag{2}$$

The symbol Δ indicates the first difference operator and t denotes time while log signifies logarithm, the p, q symbolizes the lag length, α_0 signifies the drift, and ε_t denotes the white noise error term which is presumed to be serially uncorrelated. NCDEX is an Agricultural commodity Indices considered as dependent variable. The other independent variables are SENSEX as equity market index, MCX GOLD, SILVER and CRUDE OIL considered as non-agro commodity indices, finally, EPUI (Economic Policy Uncertainty Index) and Inflation considered as control variables.

To determine the cointegration among the given variables, we test the null hypothesis $H0 = \beta 1 = \beta 2 = \beta 3 = \beta 4 = \beta 5 = \beta 6 = \beta 7 = 0$ against the alternate hypothesis $H1 \neq \beta 1 \neq \beta 2 \neq \beta 3 \neq \beta 4 \neq \beta 5 \neq \beta 6 \neq \beta 7 \neq 0$. To examine these hypotheses, F-test is employed developed by Pesaran and Shin, and Smith (2001), and modified by Narayan (2005) to assess the long-run association among variables. It assumes that all variables are $I(0)$ or $I(I)$ according to Pearson et.al. (2001). The *F*-statistics compared with two sets of critical (5% and 10%) values: lower critical bounds ($I(0)$) and upper critical bounds ($I(1)$).

If F value is greater than the upper bound critical value and vice-versa, the null hypothesis of no cointegration is rejected whereas if F-value falls within lower and upper bound critical values, the results become indecisive. The Bounds test is superior to conventional residual based cointegration analysis since it performs sound irrespective of the degree of integration of the variables. In addition, the test is apposite when the sample data set is small in size. However, the test is suitable only when the remaining variables explain one variable and not vice-versa.

The conditional ARDL (m1, n1, n2, n3, n4, n5, n6) long run model for $NCDEX_t$ is estimated once the co-integration is established in the Equation (3) as shown below.

$$NCDEX_t = \alpha_0 + \sum_{i=1}^{m1} \beta_1\, NCDEX_{t-i} + \sum_{i=1}^{n1} \beta_2\, SENSEX_{t-i} + \sum_{i=1}^{n2} \beta_3\, MCXGOLD_{t-i} + \sum_{i=1}^{n3} \beta_4\, MCXSILVER_{t-i} + \sum_{i=1}^{n4} \beta_5\, MCXCRUDEOIL_{t-i} + \sum_{i=1}^{n5} \beta_6\, INFLATION_{t-i} + \sum_{i=1}^{n6} \beta_7\, EUIP_{t-i} + \varepsilon_t \tag{3}$$

The orders of ARDL (m1, n1, n2, n3, n4, n5, n6) model is selected based on Schwarz Bayesian Criterion (SBC). The short-term dynamics are assessed through the error correction model. The Equation (4) is as follows:

$$\Delta NCDEX_t = \alpha_0 + \sum_{i=1}^{n} \beta_1\, \Delta NCDEX_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta\, SENSEX_{t-i} + \sum_{i=1}^{n} \beta_3\, \Delta MCXGOLD_{t-i} + \sum_{i=1}^{n} \beta_4\, \Delta MCXSILVER_{t-i} + \sum_{i=1}^{n} \beta_5\, \Delta MCXCRUDEOIL_{t-i} + \sum_{i=1}^{n} \beta_6\, \Delta INFLATION_{t-i} + \sum_{i=1}^{n} \beta_7\, \Delta EUIP_{t-i} + \delta\, ECT_{t-1} + \varepsilon_t \tag{4}$$

Betas (ß) represents the short run coefficients of the model's convergence to the equilibrium, δ indicates the speed of adjustment towards long term equilibrium path.

3.2 Generalized Method of Moment model

Arellano and Bover (1995) developed GMM model to identifies the anomalies of heteroscedasticity, serial correlation and endogeneity of explanatory variables. It introduces instrumental variables uncorrelated with errors but corelate with independent variables exterminating the dependence between regressor and error term. The consistency of GMM is based upon soundness of the instruments employed in the study. Sargan Hansen J-statistic is employed to check the strength of the selected instruments used in the GMM model and also assess the validity of the over identifying restrictions and serial correlation test. The rejection of the null hypothesis indicates support to the model.

3.3 Generalized Method of Moment model

The study again checks the validity of existence of cointegration among variables using the FMOLS model proposed by Phillips and Hansen (1990). This model using semi-parametric correction to remove the issues relating to stochastic regressors and cointegration equation. the initial assessment of symmetric and one-sided long-run covariance matrices of the residuals is estimated by the FMOLS model.

4. Result and Discussion

Table 1 depicts the descriptive statistics of NCDEX, BSE SENSEX, MCX Crude Oil, MCX Gold, MCX Silver, EPUI and Inflation.

Table 1. Variables' Summary Statistics

	MCX GOLD	MCX SILVER	MCX CRUDE OIL	NCDEX	SENSEX	EPUI	INFLATION
Mean	0.036971	0.009118	-0.08003	-0.00353	0.036817	0.049568	-0.003438
Median	0.030097	0.025121	0.080857	-0.01294	0.061285	0	0
Maximum	4.851381	6.795515	31.89371	2.720655	8.594739	100.1121	50.52446
Minimum	-5.64737	-11.902	-34.5727	-3.49669	-14.1017	-80.3032	-70.68148
Std. Dev.	0.812465	1.510163	3.286744	0.77844	1.170559	9.638223	4.2248
Skewness	-0.16366	-0.82492	-1.45315	-0.13887	-1.88324	-0.162984	-2.278387
Kurtosis	8.065885	14.12012	37.76098	4.094098	32.30151	50.10969	114.5940
Jarque-Bera	1195.099*	5860.825*	56427.83*	59.09048*	40474.48*	102926	578480.7
Probability	(0)	(0)	(0)	(0)	(0)	(0)	(0)

Note: * denote significance at 1%.

The negative skewness of returns and positive kurtosis with more than 3 (excess kurtosis) signposts that the time series data are leptokurtic relative to the normal. The Jarque-Bera statistics are much higher than the critical value and significant since p value are zero, rejecting the null hypothesis

of normally distributed returns indicating that series are leptokurtic, displays non-normality and existence of heteroscedasticity.

Figure-1 exhibits the trend analysis of all variables such as NCDEX, BSE Sensex, gold, silver, and crude oil. EPUI and Inflation. It is inferred from figure 1 that crude oil is highly volatile in comparison to other variables while BSE Sensex reveals a rising and descending trend.   The trend analysis indicates the existence of volatility in series.
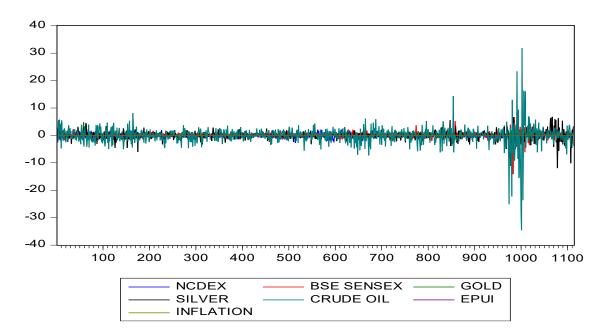

Figure 1. Time Series Plot of all the variables

Table 2. UNIT ROOT TEST

Variables	ADF	PP
MCX ICOMDEX GOLD	-32.3978*	-32.3883*
MCX ICOMDEX SILVER	-20.1281*	-30.2523*
MCX ICOMDEX CRUDE OIL	-14.5688*	-32.5641*
NCDEX	-32.2375*	-32.2319*
SENSEX	-11.5573*	-35.9672*
EPUI	-33.31755*	-33.31755*
INFLATION	-33.31668*	-33.31668*

Note: * denote significance at 1%.

Table 2 presents the unit root test of NCDEX, BSE SENSEX, MCX Crude Oil, MCX Gold, MCX Silver, EPUI and Inflation. To examine the stationary properties of time series, ADF and PP test employed in the study. The result of all these two test statistics rejecting the Null hypothesis of variables that are not stationary. So, the stationary of time series has been confirmed by accepting the alternative hypothesis.

Table 3. Correlation matrix and VIF

	NCDEX	SENSEX	MCX GOLD	MCX SILVER	MCX CRUDE OIL	EPUI	INFLATION	VIF
NCDEX	1.000							
SENSEX	0.152	1.000						1.054
MCX GOLD	0.063	-0.062	1.000					2.484
MCX SILVER	0.111	0.071	0.762	1.000				2.550
MCX CRUDE OIL	0.127	0.147	0.060	0.177	1.000			1.062
EPUI	0.039	0.003	-0.018	-0.019	0.016	1.000		1.015
INFLATION	-0.028	0.031	0.016	0.036	0.006	0.119	1.000	1.017

The correlation between the various variables is exhibited in table-3. A robust relationship is found among NCDEX, BSE Sensex, gold, silver, crude oil and EPUI. However, NCDEX is negatively correlated with inflation. The reason may be attribute to increasing inflation leads to mounting prices of agricultural commodity decreasing the purchasing power and impacted the economy. Equity market is negatively related to gold market while positively related to other markets. Similarly, gold and silver market negatively related to economic policy uncertainty leads to decreases the purchasing power of investors. However crude oil is positively corelated with NCDEX. Similarly, EPUI is positively corelated with inflation. The Variance Inflation Factor (VIF) is employed to overcome the problem of multicollinearity among variables. The table-3 shows that there is no multicollinearity problem presence among variables since VIF is less than eight.

Table 4. Bound Test for Co integration (NCDEX as Dependent Variable)

K	F Statistic	Level of Significance	I(0) Lower Bound	I(1) Upper Bound
		5%	2.4822	3.6368
6	5.0666	10%	2.1485	3.2527

Note: *, ** & *** denote significance at 1%, 5% & 10% level.

Table 4 displays the F- statistics value 5.0666 which is more than the upper bound value and significant at 5% level rejecting the Null Hypothesis. It indicates the presence of long run co-integration among NCDEX, BSE SENSEX, MCX Crude Oil, MCX Gold, MCX Silver, EPUI and Inflation. Therefore, NCDEX as commodity market is integrated with equity market, suggesting that up surging the process of financialization of commodity market in India.

Table 5. Estimated Long Run Coefficients using the ARDL Approach ARDL (1,1,2,0,1,0,2) based on Akaike Information Criterion (Dependent variable is NCDEX)

Variables	Coefficient	Std. Error	t-Statistic	Probability
SENSEX	-0.14910	0.075484	-1.9753	0.048**
MCX GOLD	-0.49349	0.14333	-3.4431	0.001*
MCX SILVER	0.44474	0.077794	5.7169	0.000*
MCX CRUDE OIL	-0.026224	0.040274	-0.65114	0.515
INFLATION	0.072592	0.018790	3.8634	0.000*
EPUI	0.047572	0.019356	2.4578	0.014**
C	3.9302	0.54468	7.2156	0.000*

Note: *, ** & *** symbolize significance at 1%, 5% & 10% respectively.

Table 5 exhibits the long run relationship among NCDEX, BSE SENSEX, MCX Crude Oil, MCX Gold, MCX Silver, EPUI and Inflation. The result indicates that the SENSEX is negatively affecting NCDEX as the estimated coefficient is -0.14910 which statistically significant at 5 % level. The result exhibits that 1% upsurge in SENSEX leads to 14.91% decreases in NCDEX indicating the inverse relationship between NCDEX and SENSEX. The common investors are diversifying their portfolio by investing at NCDEX when there is any declining trend at SENSEX but if there is any increase at SENSEX leads to withdraw investment from NCDEX and shifting to equity investment. So, NCDEX acts as substitute investment avenue for common investors as they prefer to invest at lower return and lower risk if there is any bad news at SENSEX. Similarly, the estimated coefficient of MCX Gold is -0.49349 which also negative and significant at 1 % level having inverse relationship with NCDEX indicates 1% increase in MCX Gold leads to reduction in NCDEX at 49.349%. So, any threats at MCX Gold is affecting positively to NCDEX. On the other hand, the estimated coefficient of MCX Silver is positive and significant at 1% level having a positive and direct relationship with NCDEX signifying that 1% rise in MCX Silver leads to increase NCDEX at 44.475%. However, the MCX Crude oil is negatively affecting also not significant.

Inflation have selected as control variable and the estimated coefficient 0.072592 is positive and statistically significant at 1% level demonstrating the existence of optimistic and direct relationship between NCDEX and Inflation in India. The 1% increase in inflation causes 7.259% rise in NCDEX. The result clearly explains that rise in inflation rate has favorable impact on NCDEX and adverse impact on corporate earnings and finally on SENSEX which motivates the common investors to invest in NCDEX after withdrawals from SENSEX. So, there is a dynamic of interdependency between equity and commodity depending upon different market situation. Finally, the global indicator like Economic Policy Uncertainty Index (EPUI) estimated coefficient is 0.047572 which is positive and statically significant at 5% level indicating that 1% surge in EPUI leads to rise NCDEX at 4.7572%. An existence of positive and direct relationship with NCDEX signifies that NCDEX gives better result when there is an economic uncertainty.

Table 6. Error Correction Representation for the Selected ARDL Model ARDL (1,1,2,0,1,0,2) selected based on Akaike Information Criterion (Dependent variable is NCDEX)

Variables	Coefficient	Std. Error	t-Statistic	Probability
SENSEX	0.086865	0.019499	4.4549	0.000*
MCX GOLD	0.040640	0.028143	1.4441	0.149
MCX GOLD1	0.075047	0.027838	2.6959	0.007*
MCX SILVER	0.016939	0.0044483	3.8081	0.000*
MCX CRUDE OIL	0.023873	0.0070470	3.3876	0.001*
INFLATION	0.0027649	0.7884E-3	3.5072	0.000*
EPUI	0.3634E-3	0.0023581	0.15411	0.878
EPUI1	-0.0058183	0.0023592	-2.4662	0.014**
ECM (-1)	-0.038088	0.0074072	-5.1420	0.000*
Diagnostic Statistics				
R-squared		0.989555		
Adjusted R-squared		0.989431		
Schwarz info Criterion (SIC)		-8.546982		
Akaike info Criterion (AIC)		-8.610107		
Hannan-Quinn Criter.		-8.586239		
Durbin-Watson Stat		1.944953		
Heteroscedasticity Test		0.29043(0.590)		
Ramsey RESET Test		0.49169(0.483)		
F-Statistic		0.561959(0.5703)		
Obs*R-squared		1.139158(0.5658)		

Note: *, ** & *** symbolize significance at 1%, 5% & 10% level.

Table 6 presents the dynamics of short run relationship among NCDEX, BSE SENSEX, MCX Crude Oil, MCX Gold, MCX Silver, EPUI and Inflation. The estimated coefficient for error term ECM (-1) is -0.038088 which is negative and significant at 1% level demonstrating that there is an existence of short run relationship among variables. The estimated result confirms that error of previous day of dependent variable NCDEX has corrected on current day at a speed of 3.8088%. So, the speed of adjustment towards long run equilibrium or in otherwise the whole system is getting adjusted at the speed of 3.8088% towards long run equilibrium. Further, the positive and significant short run coefficient at 1% level of SENSEX indicates that the unidirectional short run causality is running from SENSEX to NCDEX. There is an optimistic relation exists between SENSEX and NCDEX in short run signifying the interdependency between equity and commodity market. The study successfully captures the positive and significant short run impact of control variable inflation on degree of interdependency between equity and commodity markets. In case of higher inflation, common investors would prefer to invest at NCDEX as a safe haven from the perspective that no rivalry from retail investors like Banks, Financial Institutions, mutual funds, FIIs etc. as Indian

commodity markets are highly segmented. The diagnostic test result confirms that the predicted errors are normally distributed indicating no problem of heteroscedasticity. So, the long run model is well designed. The results of Ramsey Test indicate that model is well fitted to the data.

Table 7. FMOLS Regression Estimates

Variables	Coefficient	Std. Error	t-Statistic	Probability
Sensex	0.078824	0.019955	3.950012*	0.0001
Gold	-0.016131	0.044131	-0.365515	0.7148
Silver	0.052330	0.024058	2.175138**	0.0298
Crude oil	0.022165	0.007134	3.106811*	0.0019
EPUI	0.334127	0.237854	-1.404755	0.1604
Inflation	-0.711058	0.543027	1.309435	0.1907
C	-0.006487	0.022822	-0.284252	0.7763
R-squared	0.044133			
Long-run variance	0.575495			
Phillips-Ouliaris τ-statistic	-32.90283*			
Prob(τ-statistic)				
Phillips-Ouliaris z-statistic	0.000000			
Prob(Z-statistic)	-1079.149*			
	0.000000			

Note: *, ** & *** symbolize significance at 1%, 5% & 10% level.

Table 7 presents the FMOLS estimates and confirms the cointegrating association among variables. This model adjusts the leads and lags of the predictor variable for eliminating the interruption allied with lesser sample bias, endogeneity and serial correlation. The results indicate that the P-value is significant at 1% level signifying that there is long run cointegration presence among NCDEX, BSE Sensex, Gold, Silver, Crude Oil, EPUI and Inflation.

Table 8. Generalized Method of Moments (GMM) Model (Dependent variable is NCDEX)

Variables	Coefficient	Std. Error	t-Statistic	Probability
Sensex	0.100146	0.041635	2.405313*	0.0163
Gold	0.004093	0.057931	0.070649	0.9437
Silver	0.020572	0.030352	0.677766	0.4981
Crude oil	0.023327	0.010532	2.214892**	0.0270
EPUI	0.209257	0.233481	-0.896246	0.3703
Inflation	-0.226226	0.414930	0.545214	0.5857
C	-0.016364	0.023248	-0.703873	0.4817
R-squared	0.041355			
Durbin-Watson stat	1.943498			
Sargan Hensen -statistic	99.15527			
Prob(J-statistic)	0.000000			
Instrument rank	8			

Note: *, ** & *** symbolize significance at 1%, 5% & 10% level.

Table 8 shows the result of Generalized Method of Moments (GMM) where NCDEX as Dependent Variable and BSE SENSEX, MCX Crude Oil, MCX Gold, MCX Silver, EPUI and Inflation are independent variables. The study found the estimated coefficient of SENSEX, and MCX Crude Oil are positive and statistically significant confirms the presence of association with NCDEX while the estimated coefficient of MCX Gold and Silver, EPUI are positive but insignificant relation with NCDEX. Further inflation is negative inverse relationship with NCDEX. The Sargan Hansen J-test p-value is 99.15 and significant at a 1 % level, signposts that instruments variables correlate with the set of residuals.

5.   Concluding Observation and Managerial Implication

The present study attempts to investigate the long run and short run relationship between equity and commodity markets in India using ARDL model, GMM model and FMOLS model. The study found the presence of long run and short run association amid equity and commodity markets. The long run independent variables like SENSEX, MCX Gold, and MCX Crude Oil are negatively affecting NCDEX, and found MCX Silver, EPUI, and Inflation has a positive effect on NCDEX, indicating that during financial distress and high inflation period, NCDEX is giving better result and its inclusion in asset portfolio can maximize the diversification benefits. Further, in the short run, the study found that NCDEX converges to its long run equilibrium level by 3.8088% speed of daily adjustment by contributing other independent variables. FMOLS model indicating the existence of long run cointegration among NCDEX, BSE Sensex, Gold, Silver, Crude Oil, EPUI and Inflation. The estimated coefficient of the GMM model supports the result of the ARDL model. The findings of the GMM model indicate that EUPI, BSE Sensex (equity), Gold, Silver, and Crude Oil market are related to the Agricultural commodity market, while inflation is inversely related. The analysis

indicates that in the long run, investment in the commodity market enables investors to diversify their portfolios and improve their portfolio performance by adjusting the economic cycles in their asset allocations to leverage the gain in the market.

The present study's findings will provide valuable acumens to the investors/ institutional investors to understand the market integration effect to make better investment decisions by diversifying their risk. It will also be helpful to policymakers, regulators, and commodity traders. The study's results may have a significant influence on shaping the portfolio risk management strategies for individuals and institutional investors participating in equity and commodity markets. The analysis and the information from the market movement can be instrumental to the investors/ traders in making better investment decisions and portfolio diversifications. These findings will guide the regulators to strengthen the economic sector to attract global investors to invest more in the country. The limitation of our study is that we have not considered some influential factors like Environmental, Social, and Governance (ESG), climate change, etc., which could have a different explanation of the relationship. Finally, we have considered only India from emerging markets, but some other nations from emerging markets and advance economy could have been included in the study.

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