IS THERE ANY LINK BETWEEN COMMODITY PRICE AND MONETARY POLICY? EVIDENCE FROM INDIA

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ABSTRACT

The aim of this study is to examine the role of the commodity price for predicting GDP, Inflation, Interest rate, and Money Supply in India. This paper attempt to analyze the relationship between commodity prices with GDP, Inflation, Interest rate, and Money Supply. This paper used advanced time series econometric models such as cointegration (Johansen), Vector Error Correction Model (VECM), and granger causality.Empirical evidence indicates that commodity price indices are helpful to predict GDP and Inflation. The findings of this study can be helpful in important implication for monetary authority. Empirical results provide that non-monetary information variables can be useful in predicting some monetary variables.

Keywords: Commodity, Inflation, Interest Rate, GDP, Monetary Policy, Johansen Cointegration, VECM and Granger Causality

INTRODUCTION:

India, a commodity based economy where two-third of the one billion population depends on agricultural commodities, surprisingly has an under developed commodity market. A commodity may be defined as an article, a product or material that is bought and sold. It can be classified as every kind of movable property, except Actionable Claims, Money & Securities. Commodity market is an important constituent of the financial markets of any country. It is the market where a wide range of products, viz., precious metals, base metals, crude oil, energy and soft commodities like palm oil, coffee etc. are traded. It is important to develop a vibrant, active and liquid commodity market. Consequently four commodity exchanges have been approved to commence business in this regard. They are (1) Multi Commodity Exchange (MCX) located at Mumbai. (2) National Commodity and Derivatives Exchange Ltd (NCDEX) located at Mumbai. (3) National Board of Trade (NBOT) located at Indore. (4) National Multi Commodity Exchange (NMCE) located at Ahmedabad.

Increases in the quantity of money or in the overall money supply (or debasement of the means of exchange) have occurred in many different societies throughout history, changing with different forms of money used. An increase in the general level of prices implies a decrease in the purchasing power of the currency. That is, when the general level of prices rises, each monetary unit buys fewer goods and services. The effect of inflation is not distributed evenly in the economy, and as a consequence there are hidden costs to some and benefits to others from this decrease in the purchasing power of money. For example, with inflation, lenders or depositors who are paid a fixed rate of interest on loans or deposits will lose purchasing power from their interest earnings, while their borrowers benefit. Individuals or institutions with cash assets will experience a decline in the purchasing power of their holdings. Increases in payments to workers and pensioners often lag behind inflation, especially for those with fixed payments.

Kimberly Amadeo (US Economy Guide):Monetary policy is what central banks use to manage the amount of liquidity in the economy. Liquidity is the total amount of money, including cash, credit and money market mutual funds. The important part of liquidity is credit, which includes loans, bonds, mortgages, and other agreements to repay.

REVIEW OF THE LITERATURE:

(Garner, 1985) analysis of the advantages and disadvantages of using commodity prices as target variable suggest that commodity prices are not a feasible policy target, as they cannot be adequately controlled by the central bank, rather, at best, it can be used as one of several information variables in designing and conducting monetary policy. Garner's (1989) research concludes the same, that is, controlling commodity price index will not guarantee stable price level, as they are not cointegrated. (Frankel J. A., 1986) has contributed a kind of overshooting theory of commodity prices. Commodities are exchanged on fast-moving auction markets and, accordingly, are able to respond instantaneously to any pressure impacting on these markets. Following a change in monetary policy, their price reacts more than proportionately, i.e., they overshoot their new long-run equilibrium, because the prices of other goods are sticky. (Boughton & Branson, 1992) investigate if commodity price indexes contain information about the future movements in consumer price inflation in G-7 industrial countries. However, they do not find any support in favor of the notion that there is a long run equilibrium relationship between commodity prices and consumer price inflation. Their study fails to accept the hypothesis that these two variables are cointegrated. (Furlong F. , 1989) study based on VAR model using quarterly data on commodity price index, monetary aggregate, consumer price index and an indicator of the strength of economic activities relative to potential over the period 1965:1 to 1987:4 on US economy, arrives at a different result and concludes that commodity prices can be used as a guide for monetary policy and it will improve inflation forecast.

Some studies find changing relationship between commodity prices and inflation and inappropriateness of commodity prices in conducting monetary policy.

(Blomberg & Harris, 1995) study conclude that commodity price index performed well in predicting inflation in the 1970s and early 1980s in the US, however, after early 1980s commodity price index loses this power. They argue that this poor performance is primarily due to the declining importance of commodities, both as a share of final output and as a source of exogenous shocks to the economy. (Furlong

& Ingenito, 1996) finds that commodity prices were relatively strong and statistically strong leading indicator of inflation in the 1970s and early 1980s. Evidence showing redundancy of commodity prices as an indicator of inflation keeps coming. (Hua, 1998) finds that economic activities and the real effective exchange rate of the dollar have significantly "affected the real non-oil primary commodity prices in both long-run and short-run terms." He also finds commodity prices are vulnerable to interest rate shocks. (Polley & Lombra, 1999) finds that commodity price along with two other information variables, namely interest rate spread and exchange rate does not provide the kind of useful information required to improve the policymakers' economic forecast. (Awokuse & Yang, 2002) five variables VAR (money stock, federal fund rate, consumer price index, industrial production index and commodity price index) estimation on US economy with monthly data from 1975:1 to 2001:12 indicate that commodity prices are useful in predicting future inflation rate. (Gillitzer & Kearns, 2005) examines the long term pattern of Australia's terms of trade over a period of 135 years (1870-2004) to see if the long term terms of trade trend can be explained by Prebisch-Singer hypothesis, which states that the countries that primarily export commodities and import manufactures experience a decline in terms of trade. (Bloch, Dockery, & Sapsford, 2006) examines the impact on domestic inflation of world commodity prices are examined in the context of Australia and Canada, two major commodity exporting countries. They find that commodity prices have a positive impact on aggregate price level that comes from the use of commodities in the production of industrial goods. In this paper, they do not cover the issue of causality between inflation and commodity prices, which is necessary to comment on the usefulness of commodity prices in the conduct of monetary policy. (Ocran & Biekepe, 2007) study the issue in VAR framework over the period 1965:1 to 2004:4. Their causality test suggests that average gold price and metal price index contain valuable information about interest rate, money, exchange rate, and inflation and therefore, it would be helpful for the monetary authority to use these commodity prices in formulating monetary policy and predicting the inflation. (Swaray, 2008) also employs a cointegration test, coupled with an error correction model to demonstrate how fluctuations in monetary variables produce commodity price shocks. He found that fluctuations in business cycles and macroeconomic variables, including oil prices, have a significant impact on non-fuel primary commodities. While these studies evaluate the long-term relationship between commodity prices and monetary variables, they fail to explain the characteristics of the volatility itself. Understanding if macroeconomic and monetary variables create price volatility is a crucial determinant of a causal nature between the two. Cointegration and vector autoregressions are useful forecasting tools but fall short of explaining causes of volatility. (Hamori, 2007) estimates a six variable VAR that includes BOJ (Bank of Japan) commodity price index, consumer price index, industrial production index, money supply, interest rate, and exchange rate. He splits the sample period into two parts; before (January 1990–January 1999) and after (February 1999–December 2005) the zero interest rate policy is introduced. The study finds that the commodity price index performs fairly well in predicting inflation before the zero interest rate policy is introduced, however, this connection ceases to exist thereafter. Failure of the commodity price index as a leading indicator of inflation after the introduction of the zero interest rate policy is natural. The BOJ introduced the zero interest rate policy when the Japanese economy was in severe depression. In the face of strong deflationary pressure, the responsiveness of inflation to the movement in commodity prices is impaired and the result is break down of the link. South Africa is one of the major commodity exporting countries. It is the world's largest producer of the platinum group of metal and gold. (Kamrul & Salim, 2011)examines the role of commodity price indices in predicting inflation, unemployment, and short term interest rate in Australia. The suspected role commodity prices play in determining some monetary variables indicate that non-monetary information variables may be useful for monetary policy. Further, Inflation targeting experience has so far been hit by positive supply shocks. In case of negative supply shock, commodity price may be useful in singling out the likely direction of inflation.

RESEARCH METHODOLOGY:

THEORETICAL FRAMEWORK:

This paper examines the causal relationship between commodity price and four macroeconomic variables; Inflation, GDP, Interest Rate, and Money Supply. Due to unavailability of quarterly data of unemployment, it was excluded from study. In the conduct of monetary policy, Commodity price is to be a useful variable, it

should have a significant relationship with the variables, such as; inflation and economic growth (Furlong F. , 1989).Most of the studies in literature focus on commodity prices' role in affecting monetary policy variables. (Frankel J. A., 2006) argues that commodity price itself may be affected by monetary policy actions. According to Frankel high interest rate reduces the demand for storable commodities or increases the supply, which reduces the market price of commodities.

Variables used under this study

Variables	Symbol
GDP	GDP
Inflation	INFL
Interest Rate	IR
Money Supply (Broad Money)	M3
Agricultural Raw Materials Commodity Index	ARMCI
Beverage Price Commodity Index	BPCI
Overall Commodity Price Index	COM
Fuel Commodity Index	FCI
Food Price Commodity Index	FPCI
Industrial Inputs Commodity Price	IIPCI
Metals Price Commodity Index	MPCI
Non-Fuel Price Commodity Index	NFCI
Crude Oil (petroleum) Price index	COPI

SOURCES OF DATA:

Quarterly data are used in this study from 1997:1(March 1997) to 2012:3 (September 2012). Inflation, GDP, Interest Rate and Money Supply data are extracted from RBI Database and Bulletins. Nine Commodity Indices **(i)** Agricultural Raw Materials Commodity Index (ARMCI) **(ii)** Beverage Price Commodity Index (BPCI) **(iii)** The Overall index of Commodity Price (CPI) **(iv)** Commodity Fuel Index (CFI) **(v)** Food Price Commodity Index (FPCI) **(vi)** Industrial Inputs Commodity Price (IICP) **(vii)** Metals Price Commodity Index (MPCI) **(viii)** Non-Fuel Commodity Price Index (NFCI) **(ix)** Crude Oil Price index (COPI)

To examine the link between the commodity prices and Inflation, GDP, Interest Rate, and Money Supply this paper makes use of standard time series econometric procedures which begins with unit root test as follows:

Unit root Test: Unit root test tests whether a time series variable is non-stationary using an autoregressive model. Dickey-Fuller (DF) and Phillips-Perron (PP) tests are widely used in empirical research, but the problem with the ADF and PP tests is that when the series has a large negative moving average root they suffer from severe size distortion toward over-rejecting the null (Schwert, 1989). Elliot, Rothenberg and Stock (ERS) (1996) (Elliott, Rothenberg, & Stock, 1996) develop a feasible point optimal test that relies on local GLS de-trending to improve the power of unit root tests, (Perron & Ng, 1996))and (Ng & Perron, 2001) suggest modification of PP test to correct this problem which is known as Ng-Perron test. They extend the work of Elliot, Rothenberg and Stock (1996) and develop modified versions of the PP test that have much better size properties and also retain the power of ERS DF^{GLS} test. It is claimed that these tests are improvements over the ADF and PP tests; there is no comprehensive comparative research on these tests (Maddala & Kim, 1998). So, this paper still relies on ADF and PP tests, however, it also uses ERS DF^{GLS} to confirm the results obtained from ADF and PP tests.

$$\Delta R_t = b_0 + b_1 + \pi_0 R_{t-1} + \sum_{t=1}^{i} \psi i \Delta R_{it-1} + \in_t$$

COINTEGRATION TEST:

If two or more series are individually integrated (in the time series sense) but some linear combination of them has a lower order of integration, then the series are said to be cointegrated. Before the 1980s many economists used linear regressions on (de-trended) non-stationary time series data, which Nobel laureate Clive Granger and others showed to be a dangerous approach that could produce spurious correlation. This paper employs the cointegration test procedure developed by(Johansen S. , 1991). There are two types of

Johansen test, either with trace or with eigenvalue, and the inferences might be a little bit different. The null hypothesis for the trace test is the number of Cointegration vectors r ≤ ?, the null hypothesis for the eigenvalue test is r = ? To make inference regarding the cointegrating relationship, the trace and maximum eigen-value are compared with tabulated in (Osterwald-Lenum, 1992)

$$y_t = \mu + A_1 y_{t-1} + \ldots + A_p y_{t-p} + \varepsilon_t$$

$$\Delta y_t = \mu + \prod y_{t-1} + \sum_{i+1}^{p-1} \Delta y_{t-1} + \varepsilon_t$$

$$\prod = \sum_{i=1}^{p} A_i - I \text{ and } i = -\sum_{j=i+1}^{p} A_j$$

GRANGER CAUSALITY:

(or "G-causality") was developed in 1960s and has been widely used in economics since the 1960s. The Granger causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another. Ordinarily, regressions reflect "mere" correlations, but Clive Granger, who won a Nobel Prize in Economics, argued that there is an interpretation of a set of tests as revealing something about causality. A time series X is said to Granger-cause Y if it can be shown, usually through a series of t-tests and F-tests on lagged values of X (and with lagged values of Y also included), that those X values provide statistically significant information about future values of YTo test causal relations between stationery series x_t and y_t can be based on the following equations:

$$X_t = \alpha_0 + \sum_{j=1}^{k} \gamma_j X_{t-j} + \sum_{j=1}^{k} \beta_j y_{t-j} + \mu_{xt}$$

$$Y_t = \alpha_0 + \sum_{j=1}^{k} \gamma / {}_j X_{t-j} + \sum_{j=1}^{k} \beta_j y_{t-j} + \mu_{yt}$$

RESULTS OBTAINED FROM THE STUDY:

DESCRIPTIVE STATISTICS:

Table 1 Result of Descriptive Statistics

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.
ARMCI	107.53	100.74	170.05	81.67	18.11	1.43	5.06	32.44	0.00
BPCI	120.13	111.39	221.99	61.36	40.86	0.59	2.38	4.71	0.00
COM	102.98	83.75	215.72	42.27	50.71	0.64	2.09	6.46	0.04
COPI	96.53	77.71	247.01	19.54	60.94	0.64	2.24	5.80	0.06
FCI	96.85	78.63	243.39	22.08	59.30	0.63	2.24	5.73	0.06
FPCI	114.41	102.16	184.34	77.11	33.73	0.79	2.30	7.86	0.02
GDP	6.86	6.66	11.31	1.66	2.03	-0.23	2.78	0.68	0.71
IIPCI	111.92	91.59	213.11	65.59	42.62	0.69	2.14	6.98	0.03
INFL	6.82	5.98	19.67	0.00	3.61	1.08	4.56	18.59	0.00
IR	6.96	6.00	12.00	6.00	1.45	1.46	4.34	27.20	0.00
M3	2990181	2151537	7799380	699053	2099412	0.86	2.50	8.44	0.01
MPCI	115.10	87.42	244.21	49.69	62.19	0.55	1.77	7.10	0.03
NFCI	113.45	99.60	200.50	70.85	37.63	0.72	2.20	7.06	0.03

The result of the descriptive statistics is shown in table 1. The mean value of GDP is 6.86 with maximum value of 11.31 and minimum value of 1.66. Median value for GDP is 6.66. Standard deviation is 2.03. Skewness value for GDP is -0.23 whereas the Kurtosis has value of 2.78.The mean value of lnflation is

6.82with maximum value of 19.67and minimum value of 0. Median value for lnflation is 5.98. Standard deviation is 3.61. Skewness value for lnflation is 1.08whereas the Kurtosis has value of 4.56. The mean value of Interest Rate is 6.96with maximum value of 12.00and minimum value of 6.00. Median value for Interest Rate is 6.00. Standard deviation is 1.45. Skewness value for Interest Rate is 1.46whereas the Kurtosis has value of 4.34. The mean value of Money Supply is 2990181 with maximum value of 7799380 and minimum value of 699053. Median value for Money Supply is 2151537. Standard deviation is 2099412. Skewness value for Money Supply is 0.86whereas the Kurtosis has value of 2.50.As the values of the kurtosis, Skewness and Jarque – Bera in the table suggests that the variables for the period are not normally distributed. The null hypothesis of normal distribution of time series can be rejected with the p-value of Jarque-Bera Test for all except COPI, FCI, and GDP.(Patel, Patel, & Ashwin, 2010)

UNIT ROOT TEST:

Unit root test examines the stationarity of the data by using ADF, PP and ERS DFGLS. The result (*table 2*) of ADF and PP test shows that all the variables become stationary at first difference I(1) except Interest Rate. Interest Rate becomes stationary on level I(0). Test result of the ERS DFGLS () shows that all the variables are stationary at first difference I(1)

Table 2: Unit Root Test (ADF, PP, DF-GLS)

Augmented Dickey-Fuller (ADF) unit root test				
Variables	**I(0) On level**		**I(1) First difference**	
	Intercept	**Trend & Intercept**	**Intercept**	**Trend & Intercept**
ARMCI	-1.873(3)	-3.102(4)	-6.347(14)*	-6.847(15)*
BPCI	-0.718(4)	-2.098(7)	-6.562(7)*	-6.799(10)*
COM	-0.253(11)	-3.005(7)	-7.640(25)*	-8.987(28)*
COPI	-0.594(11)	-3.409(6)	-10.014(26)*	-11.407(28)*
FCI	-0.531(9)	-3.326(5)	-8.742(20)*	-9.452(21)*
FPCI	0.104(8)	-2.545(8)	-5.899(15)*	-7.025(19)*
IIPCI	-1.037(2)	-2.732(1)	-5.372(9)*	-5.304(9)*
MPCI	-0.926(1)	-2.298(0)	-5.867(5)*	-5.811(5)*
NFCI	-0.480(6)	-2.731(6)	-5.645(17)*	-5.927(18)*
GDP	-3.135(2)	-3.333(2)	-9.186(4)*	-9.241(4)*
INFL	-2.952(1)	-3.184(1)	-7.590(3)*	-7.515(3)*
IR	-3.600(1)*	-2.428(0)	-10.826(3)*	-12.916(3)*
M3	11.165(33)	3.843(61)	-5.697(4)*	-11.018(0)*
Phillips-Perron (PP) unit root test				
ARMCI	-1.873(3)	-3.102(4)	-6.347(14)*	-6.847(15)*
BPCI	-0.718(4)	-2.098(7)	-6.562(7)*	-6.799(10)*
COM	-0.253(11)	-3.005(7)	-7.640(25)*	-8.987(28)*
COPI	-0.594(11)	-3.409(6)	-10.014(26)*	-11.407(28)*
FCI	-0.531(9)	-3.326(5)	-8.742(20)*	-9.452(21)*
FPCI	0.104(8)	-2.545(8)	-5.899(15)*	-7.025(19)*
IIPCI	-1.037(2)	-2.732(1)	-5.372(9)*	-5.304(9)*
MPCI	-0.926(1)	-2.298(0)	-5.867(5)*	-5.811(5)*
NFCI	-0.480(6)	-2.731(6)	-5.645(17)*	-5.927(18)*
GDP	-3.135(2)	-3.333(2)	-9.186(4)*	-9.241(4)*
INFL	-2.952(1)	-3.184(1)	-7.590(3)*	-7.515(3)*
IR	-3.600(1)*	-2.428(0)	-10.826(3)*	-12.916(3)*
M3	11.165(33)	3.843(61)	-5.697(4)*	-11.018(0)*
DF-GLS Unit Root Test				
ARMCI	-2.073(1)	-2.603(1)	-4.529(0)*	-5.653(0)*
BPCI	-0.740(0)	-1.402(0)	-5.006(0)*	-6.049(0)*

COM	0.078(2)	-3.473(1)	-7.044(1)	-7.237(1)*
COPI	0.049(2)	-4.114(1)	-7.667(1)*	-7.660(1)*
FCI	0.074(2)	-3.966(1)	-7.383(1)*	-7.431(1)*
FPCI	-0.250(0)	-2.286(1)	-5.683(0)*	-6.428(1)*
IIPCI	-1.199(1)	-2.625(1)	-5.363(0)*	-5.652(0)*
MPCI	-0.508(0)	-2.496(1)	-5.973(0)*	-6.022(0)*
NFCI	-0.882(1)	-2.413(1)	-5.533(0)*	-5.852(0)*
GDP	-2.896(0)	-3.327(0)	-6.225(0)*	-7.684(0)*
INFL	-2.345(0)	-2.636(0)	-0.572(8)*	-6.754(0)*
IR	-1.016(0)	-1.174(0)	-0.407(2)*	-2.165(2)**
M3	-0.777(5)	-2.685(5)	1.281(4)*	-0.811(4)
** and ** indicate statistical significance level at 1 per cent and 5 per cent respectively. Figures in the parentheses in PP test indicate Newey-West bandwidth. Figures in the parentheses in ADF and DF-GLS test indicate optimum lag length determined by the SIC.*				

JOHANSEN COINTEGRATION TEST:

Table 3: Johansen Cointegration Test

Variables	Null Hypothesis	Trace Statistics	Max-Eigen Statistic
ARMCI,GDP	r = 0	38.524**	28.887**
	r ≤ 0	9.637	9.637
BPCI,GDP	r = 0	37.482***	28.947***
	r ≤ 0	8.534	8.534
COM,GDP	r = 0	36.598***	27.231***
	r ≤ 0	9.367	9.367
COPI,GDP	r = 0	35.953**	26.599**
	r ≤ 0	9.354	9.354
FCI,GDP	r = 0	34.754**	25.386**
	r ≤ 0	9.368	9.368
FPCI,GDP	r = 0	37.020**	27.676**
	r ≤ 0	9.344	9.344
IIPCI,GDP	r = 0	39.685***	29.841***
	r ≤ 0	9.844	9.844
MPCI,GDP	r = 0	37.804**	28.163**
	r ≤ 0	9.641	9.641
NFCI,GDP	r = 0	42.082***	32.441***
	r ≤ 0	9.641	9.641
ARMCI,IR	r = 0	21.740	16.913
	r ≤ 0	4.827	4.827
BPCI,IR	r = 0	42.545	39.806
	r ≤ 0	2.739	2.739
COM,IR	r = 0	26.691	23.970
	r ≤ 0	2.721	2.721
COPI,IR	r = 0	26.700	24.138
	r ≤ 0	2.562	2.562
FCI,IR	r = 0	25.330	22.764
	r ≤ 0	2.566	2.566
FPCI,IR	r = 0	28.841	25.745
	r ≤ 0	3.097	3.097
IIPCI,IR	r = 0	31.101	28.428
	r ≤ 0	2.673	2.673

MPCI,IR	r = 0	26.688	24.143
	r ≤ 0	2.545	2.545
NFCI,IR	r = 0	34.494	31.577
	r ≤ 0	2.918	2.918
ARMCI,M3	r = 0	27.700	25.687
	r ≤ 0	2.013	2.013
BPCI,M3	r = 0	27.904	25.513
	r ≤ 0	2.390	2.390
COM,M3	r = 0	22.781	21.588
	r ≤ 0	1.193	1.193
COPI,M3	r = 0	22.314	21.050
	r ≤ 0	1.263	1.263
FCI,M3	r = 0	21.449	20.179
	r ≤ 0	1.271	1.271
FPCI,M3	r = 0	23.266	21.711
	r ≤ 0	1.555	1.555
IIPCI,M3	r = 0	24.670	22.624
	r ≤ 0	2.046	2.046
MPCI,M3	r = 0	21.474	19.332
	r ≤ 0	2.142	2.142
NFCI,M3	r = 0	27.364	25.614
	r ≤ 0	1.750	1.750
ARMCI,INFL	r = 0	38.704**	30.747**
	r ≤ 0	7.957	7.957
BPCI,INFL	r = 0	28.611***	21.643***
	r ≤ 0	6.969	6.969
COM,INFL	r = 0	45.994***	38.679***
	r ≤ 0	7.315	7.315
COPI,INFL	r = 0	33.723**	26.369**
	r ≤ 0	7.354	7.354
FCI,INFL	r = 0	32.374***	24.908***
	r ≤ 0	7.466	7.466
FPCI,INFL	r = 0	32.003***	25.109***
	r ≤ 0	6.894	6.894
IIPCI,INFL	r = 0	30.959**	23.029**
	r ≤ 0	7.931	7.931
MPCI,INFL	r = 0	27.063**	19.236**
	r ≤ 0	7.827	7.827
NFCI,INFL	r = 0	34.316***	26.828***
	r ≤ 0	7.488	7.488

** and *** *indicate statistical significance level at 1 per cent and 5 per cent respectively*

Trace Statistics and Max-Eigen Statistic indicate the presence of Cointegration among the variables. The result indicates that all the variables are not cointegrated. The result shows in the table2that there GDP and Inflation has cointgrating relationship with all commodity indices while Interest Rate and Money Supply has not.
The presence of cointegration between variables suggests a long term relationship among the variables under consideration. The Cointegration term is known as the error correction term since the deviation from long-

run equilibrium is corrected gradually through a series of partial short-run adjustments. The ECM results are reported in *table 3*.

VECTOR ERROR CORRECTION MODEL:

Table 3: Vector Error Correction Model

Variables	ECM Output
ARMCI,GDP	$\Delta GDP = 0.7295 - 0.0379\ \Delta ARMCI + 2.1461_{\hat{u}t-1}$
	(-5.3527)* (-0.2839) (2.8769)*
BPCI,GDP	$\Delta GDP = -0.0549 - 0.0513\ \Delta BPCI + 0.0227_{\hat{u}t-1}$
	(-1. 0143)* (-0.3713) (1.1148)**
COM,GDP	$\Delta GDP = -0.3406 + 0.09057\ \Delta COM - 0.0088_{\hat{u}t-1}$
	(-2.7613)* (0.6191) (-0.0462)
COPI,GDP	$\Delta GDP = -0.3358 + 0.0862\ \Delta COPI - 0.0025_{\hat{u}t-1}$
	(-2.7371)* (0.5896) (-0.0132)
FCI,GDP	$\Delta GDP = -0.3334 + 0.0847\ \Delta FCI - 0.0018_{\hat{u}t-1}$
	(-2.7122)* (0.5773) (-0.0098)
FPCI,GDP	$\Delta GDP = -0.3231 + 0.0702\ \Delta FPCI\ -0.0023_{\hat{u}t-1}$
	(-2.7828)* (0.4885) (-1.0127)**
IIPCI,GDP	$\Delta GDP = -0.4125 + 0.1244\ \Delta IIPCI\ -0.0301_{\hat{u}t-1}$
	(-3.0704)* (0.8485)* (-0.1599)
MPCI,GDP	$\Delta GDP = -0.4361 + 0.1388\ \Delta MPCI\ -0.0449_{\hat{u}t-1}$
	(-3.2067)* (0.9468) (-0.2392)
NFCI,GDP	$\Delta GDP = 0.2506 + 0.7335\ \Delta NFCI + 0.2897_{\hat{u}t-1}$
	(-2.9485)* (0.7358)** (-0.1164)*
ARMCI,INFL	$\Delta INFL = -0.2416 + 0.1447\ \Delta ARMCI + 0.0496_{\hat{u}t-1}$
	(-2.6671)* (1.0433) (0.1665)
BPCI,INFL	$\Delta INFL = -0.4608 + 0.2163\ \Delta BPCI + 0.0587_{\hat{u}t-1}$
	(-2.9804)* (1.0963) (0.1246)
COM,INFL	$\Delta INFL = -0.2915 + 0.1476\ \Delta COM + 0.0370_{\hat{u}t-1}$
	(-2.9924)* (1.0970) (0.1246)
COPI,INFL	$\Delta INFL = -0.2806 + 0.1385\ \Delta COPI + 0.0377_{\hat{u}t-1}$
	(-2.9164)* (1.0341) (0.1267)*
FCI,INFL	$\Delta INFL = -0.2826 + 0.1411\ \Delta FCI + 0.0420_{\hat{u}t-1}$
	(-2.9327)* (1.0528) (0.1408)
FPCI,INFL	$\Delta INFL = -0.3291 + 0.1454\ \Delta FPCI + 0.0435_{\hat{u}t-1}$
	(-3.1824)* (1.0915) (0.1502)
IIPCI,INFL	$\Delta INFL = -0.3020 + 0.1786\ \Delta IIPCI + 0.0350_{\hat{u}t-1}$
	(-3.0681)* (1.3157)** (0.1194)
MPCI,INFL	$\Delta INFL = -0.3064 + 0.1755\ \Delta MPCI + 0.0313_{\hat{u}t-1}$
	(-3.0910)* (1.3065) (0.1065)
NFCI,INFL	$\Delta INFL = -0.3204 + 0.1675\ \Delta NFCI + 0.0299_{\hat{u}t-1}$
	(-3.1500)* (1.2340) (0.1021)
** and ** indicates statistical significance level at 1 per cent and 5 per cent respectively*	

The ECM result shows that all the coefficients are significant at 1% or 5% level.The variables that do not have any long run relationship however; they may have relationships in the short run. Cointegration between two variables does not specify the direction of a causal relation. Granger causality test is performed to examine the short run association between the variables. Granger causality test performed on GDP, IR, M3, and INFL with commodity price indices.

GRANGER CAUSALITY TEST:

Table 4: Granger Causality Test

Null Hypothesis	Lags	F-Statistic	Prob.	Decision	Interpretation
GDP does not Granger Cause ARMCI	5	4.3521	0.0025*	Rejected	Bidirectional
ARMCI does not Granger Cause GDP	5	5.22868	0.0007*	Rejected	
GDP does not Granger Cause BPCI	5	5.4965	0.0005*	Rejected	Bidirectional
BPCI does not Granger Cause GDP	5	5.70351	0.0003*	Rejected	
GDP does not Granger Cause COM	5	3.17157	0.0151**	Rejected	Bidirectional
COM does not Granger Cause GDP	5	2.96196	0.021**	Rejected	
GDP does not Granger Cause COPI	5	1.2763	0.2900	Can Not Rejected	No Causality
COPI does not Granger Cause GDP	5	0.47823	0.7906	Can Not Rejected	
GDP does not Granger Cause FCI	5	3.73272	0.0063**	Rejected	Unidirectional
FCI does not Granger Cause GDP	5	1.40559	0.2396	Can Not Rejected	
GDP does not Granger Cause FPCI	5	0.78432	0.5662	Can Not Rejected	No Causality
FPCI does not Granger Cause GDP	5	1.76694	0.1381	Can Not Rejected	
GDP does not Granger Cause IIPCI	5	1.43335	0.2299	Can Not Rejected	Unidirectional
IIPCI does not Granger Cause GDP	5	3.73404	0.0063*	Rejected	
GDP does not Granger Cause MPCI	5	1.18966	0.3287	Can Not Rejected	Unidirectional
MPCI does not Granger Cause GDP	5	5.70351	0.0003*	Rejected	
GDP does not Granger Cause NFCI	5	2.05617	0.0879	Can Not Rejected	Unidirectional
NFCI does not Granger Cause GDP	5	2.96196	0.021*	Rejected	
IR does not Granger Cause ARMCI	5	1.59552	0.1798	Can Not Rejected	No Causality
ARMCI does not Granger Cause IR	5	1.7195	0.1486	Can Not Rejected	
IR does not Granger Cause BPCI	5	1.69529	0.1543	Can Not Rejected	No Causality
BPCI does not Granger Cause IR	5	1.74842	0.1421	Can Not Rejected	
IR does not Granger Cause COM	5	1.76408	0.1387	Can Not Rejected	No Causality
COM does not Granger Cause IR	5	1.71698	0.1492	Can Not Rejected	
IR does not Granger Cause COPI	5	1.18966	0.3287	Can Not Rejected	No Causality
COPI does not Granger Cause IR	5	0.42792	0.8269	Can Not Rejected	
IR does not Granger Cause FCI	5	2.05617	0.0879	Can Not Rejected	No Causality
FCI does not Granger Cause IR	5	1.61982	0.1733	Can Not Rejected	
IR does not Granger Cause FPCI	5	1.42537	0.2326	Can Not Rejected	No Causality
FPCI does not Granger Cause IR	5	2.19642	0.0704	Can Not Rejected	
IR does not Granger Cause IIPCI	5	0.6935	0.6309	Can Not Rejected	No Causality
IIPCI does not Granger Cause IR	5	1.15242	0.3466	Can Not Rejected	
IR does not Granger Cause MPCI	5	0.50255	0.7728	Can Not Rejected	No Causality
MPCI does not Granger Cause IR	5	0.49761	0.7764	Can Not Rejected	
IR does not Granger Cause NFCI	5	0.88504	0.4986	Can Not Rejected	No Causality
NFCI does not Granger Cause IR	5	1.1968	0.3253	Can Not Rejected	
M3 does not Granger Cause ARMCI	5	0.51931	0.7604	Can Not Rejected	No Causality
ARMCI does not Granger Cause M3	5	1.35869	0.2569	Can Not Rejected	
M3 does not Granger Cause BPCI	5	1.03501	0.4083	Can Not Rejected	No Causality
BPCI does not Granger Cause M3	5	2.18575	0.0716	Can Not Rejected	
M3 does not Granger Cause COM	5	1.4058	0.2395	Can Not Rejected	No Causality
COM does not Granger Cause M3	5	1.43419	0.2296	Can Not Rejected	
M3 does not Granger Cause COPI	5	2.06416	0.0868	Can Not Rejected	No Causality
COPI does not Granger Cause M3	5	0.75646	0.5857	Can Not Rejected	

M3 does not Granger Cause FCI	5	2.06494	0.0867	Can Not Rejected	No Causality
FCI does not Granger Cause M3	5	0.92199	0.4752	Can Not Rejected	
M3 does not Granger Cause FPCI	5	2.06331	0.0869	Can Not Rejected	No Causality
FPCI does not Granger Cause M3	5	2.83677	0.0256	Can Not Rejected	
M3 does not Granger Cause IIPCI	5	1.20005	0.3238	Can Not Rejected	No Causality
IIPCI does not Granger Cause M3	5	0.4547	0.8077	Can Not Rejected	
M3 does not Granger Cause MPCI	5	0.76399	0.5804	Can Not Rejected	No Causality
MPCI does not Granger Cause M3	5	1.62593	0.1717	Can Not Rejected	
M3 does not Granger Cause NFCI	5	0.96316	0.4500	Can Not Rejected	No Causality
NFCI does not Granger Cause M3	5	0.64267	0.6683	Can Not Rejected	
INFL does not Granger Cause ARMCI	5	0.64309	0.6680	Can Not Rejected	No Causality
ARMCI does not Granger Cause INFL	5	1.7254	0.1473	Can Not Rejected	
INFL does not Granger Cause BPCI	5	3.03264	0.0188**	Rejected	Unidirectional
BPCI does not Granger Cause INFL	5	2.1577	0.0749	Can Not Rejected	
INFL does not Granger Cause COM	5	1.78516	0.1343	Can Not Rejected	Unidirectional
COM does not Granger Cause INFL	5	4.89044	0.0011*	Rejected	
INFL does not Granger Cause COPI	5	3.02152	0.0191**	Rejected	Unidirectional
COPI does not Granger Cause INFL	5	1.5557	0.3285	Can Not Rejected	
INFL does not Granger Cause FCI	5	2.5306	0.0415**	Rejected	Unidirectional
FCI does not Granger Cause INFL	5	1.30372	0.2786	Can Not Rejected	
INFL does not Granger Cause FPCI	5	2.6496	0.0344**	Rejected	Unidirectional
FPCI does not Granger Cause INFL	5	1.49964	0.208	Can Not Rejected	
INFL does not Granger Cause IIPCI	5	0.51931	0.7604	Can Not Rejected	No Causality
IIPCI does not Granger Cause INFL	5	1.35869	0.2569	Can Not Rejected	
INFL does not Granger Cause MPCI	5	2.60181	0.0371**	Rejected	Bidirectional
MPCI does not Granger Cause INFL	5	4.51307	0.0019*	Rejected	
INFL does not Granger Cause NFCI	5	2.13589	0.0775	Can Not Rejected	No Causality
NFCI does not Granger Cause INFL	5	0.58389	0.7121	Can Not Rejected	

The finding indicates that GDP and INFLATION has causal relation with commodity price indices. GDP has causal relation with ARMCI, BPCI, COM, IIPCI, MPCI, and NFCI. Inflation has causal relation with COM, MPCI. The reverse causality also found ARMCI, BPCI, COM, and FCI with GDP. BPCI, COPI, FCI, FPCI and MPCI has reverse causality with Inflation. But no causal link is evidenced between IR, M3 and commodity price indices. So the monetary policy has no influence on commodity prices in the fluctuation of the Interest Rate and Money Supply.

CONCLUSION:

This paper examines the role of commodity indices in predicting GDP, Inflation, Interest Rate and Money Supply in India, on the basis of quarterly data from March – 1997 to September – 2012. Nine types of the commodity price indices (ARMCI, BPCI, COM, FCI, FPCI, IIPCI, MPCI, NFCI, COPI) are used under this study to examine whether any specific index is useful in predicting the variables under consideration. Econometric analysis indicates that commodity price indices are helpful to predict GDP and Inflation. The result of this study support Furlong (1989), Awokuse & Yang (2002), Ocran & Biekepe (2007)),Hasan and Salim (2011)while it is also contadict with Polley & Lombra (1999) The findings of this study can be helpful in important implication for monetary authority. Empirical evidence provides that non-monetary information variables can be useful in predicting some monetary variables. Further research can be possible in this area. Structural modeling can be developed in this area to estimating the effects of commodity prices on the variables that are considered for monetary policy.

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