Impact of Macroeconomic indicators on selected Commodity Futures: Evidence from Indian Derivatives Market

Dr. Prabhakar Nandru*
Srimathi Ganesan**
Dr. Madhavaiah Chendragiri***

Abstract

Derivatives are one of the most innovative financial instruments which help the market participants in eliminating the price risk. Earlier commodity derivatives were considered to be an old concept but recently it got updated with a new face into price risk management. In India, at the initial stage, index-based derivatives were introduced in the securities market and then followed by commodities periodically for the enhancement of the markets and the price realization. At present in India, 21 commodity futures exchanges are actively being traded. Besides, a well-functioning of derivatives market facilitates the economic growth of the nation and consequently increases capital formation. The purpose of this study is to examine the commodity futures price movements by examining the influence of four macroeconomic indicators such as Wholesale Price Index (WPI), Gross Domestic Product (GDP), Mumbai Inter-Bank Offered Rate (MIBOR), and the Exchange Rate, for which, the commodity derivatives are categorized under Bullion, Base Metals, Energy and Agriculture Commodity futures. The study proposed four multiple regression models, and under each regression model, commodity futures price is considered as a dependent variable and the four select macroeconomic indicators are considered as independent variables. The results of the study highlight that the GDP, WPI, and MIBOR have a significant effect on crude oil futures prices; WPI, MIBOR, and exchange rates, significantly determine the Aluminium futures prices; and finally, the exchange rate has a significant relation with cardamom futures price movement.

Keywords: Agriculture Commodities, Energy Commodities, GDP, Exchange Rate, MIBOR, Whole Sale Price index

Introduction

India is one of the largest commodity producers in the world and is also a major market for commodities like precious metals and energy. India has a long history of trading in commodities and related derivatives (Bhattacharya, 2007). Recently, there has been an increase in the investors' participation in commodity derivatives trading mainly agriculture-based commodities, base metals, energy and bullion products. This trend can be observed at global level in general and India in particular. The prices of commodities have surged rapidly in India and the commodity derivative market has also shown a significant growth in recent years (Kapil and Kapil, 2010). The growth of commodity derivatives market is associated with economic development of India. The operating efficiency of the derivatives market depends on the price stability mechanism, and also it balances the demand and supply of necessary commodities (Lokare, 2007). The commodity prices are determined by several macroeconomic indicators and price fluctuations are based on latest news related to macroeconomic indicators in the authentic media sources (Hess et al., 2008; Reddy et al., 2019). Therefore, the investors need to comprehend, insightfully, the macroeconomic indicators on the price fluctuations of each commodity before entering into derivative contracts. Several macroeconomic indicators are greatly affected by commodity prices and to reduce the effect of price fluctuations, commodity derivative contracts have been intensively used. Based on the above discussion, the present study is aimed to investigate the influence of macroeconomic indicators on price movement of select commodities viz., bullion, base metals, and energy and agriculture-based commodities.

* Guest faculty, Department of Commerce, School of Management, Pondicherry University, Karaikal Campus, Karaikal -609605.
Email: prabhakarnandru2020 @gmail.com

** Guest faculty, Department of Corporate Secretaryship, Avvaiyar Government College for Women, Karaikal-609602.
Email: srimathiganesh54@gmail.com

*** Assistant Professor, Department of Management, Pondicherry University, Karaikal Campus, Karaikal – 609605.
Email: drcmadhavaiah@gmail.com

Literature review

To understand the macroeconomic indicators and their effect on commodity prices, a detailed literature review is carried out in global as well as Indian contexts, in this section.

Effect of macroeconomic indicators on commodity prices - global context

Rafiq et al., (2009) empirically examined the impact of volatility in oil prices on main macroeconomic factors in Thailand. The outcome of the analysis shows that oil price volatility has significant impact on macroeconomic indicators, such as unemployment and investment.

Ahmed et al., (2017) investigated the long-run relationship among various macroeconomic variables like the KSE-100 Index, Oil prices, Exchange Rate, and the Consumer Price Index in Pakistan. The findings of the study show that CPI, Oil Prices, PKR/USD, and KSE-100 Index have no such relationship in the long run.

Strpić et al., (2017) examined the influence of macroeconomic reports relating to operating rigs and production quota to closing intra-day oil prices. The result specifies that only the Producer Price Index (PPI) has a significant effect on intra-day closing oil prices.

ÅžIKLI and TuÄŸba (2018) have employed VAR model to analyse the relationship between inflation and energy price index which was derived from spot energy prices in international markets, inflation rate, USD currency rate, and sovereign CDS of Turkey. The results showed that energy prices have an adverse effect on both CDS and USD currencies. On the other hand, the USD currency rate has a significant positive effect on CDS currency rate and inflation rate.

Shen et al., (2018) examined dynamic causal effects between global macroeconomic indicators and crude oil prices. The results showed that the uncertainty shocks have a strong impact on economic activities, even in the international context. Furthermore, the uncertainty shocks as a source of business cycle fluctuations, regional as well as a global phenomenon.

Yang et al., (2018) studied the impact of systemic risk in US agricultural commodity markets based on macroeconomic shocks. The study used a combination of four econometric tools: quantile regression, mixed data sampling, wavelet transform, and conditional value-at-risk. The results showed that the macroeconomic shocks (especially the inflation shocks) have highly predicted the systematic risk.

Faseli (2019) investigated the impact of 38 major scheduled macroeconomic news on the crude oil intra-day volatility from 2012 to 2018. The primary objective of this study was to layout news ranking that indicated forthcoming high volatility episodes at some particular point in time. Simple and multiple robust ordinary least squares (OLS) regression was used to analyze the data related to intra-day volatility. The results revealed that the macroeconomic news has a significant effect on pricing crude oil.

Recently, Shaikh (2020) investigated currency markets, equities, commodities, and interest rates regarding the uncertainty index of US economic policy. The generalized autoregressive conditional heteroscedasticity (GARCH) model has been used to examine the relationship between volatility index and policy uncertainty. The study highlighted that the high degree of policy uncertainty affects high volatility in the equity market. Further, the financial crisis and the presidential elections strongly influenced the crude oil and gold prices.

Effect of macroeconomic indicators on commodity prices – Indian context

Mahalik et al. (2014) assessed the price discovery function and volatility spillovers effect on Indian commodities spot and futures markets. The results showed that the indices like energy futures price, agriculture futures price, and aggregate commodity price have effectively influenced the price discovery function in the spot market. This implies that there is the flow of information from a commodity future market to commodity spot markets. But it is found that there is no relationship between metal futures price index and metal spot price index.

Lakshmi et al., (2015) examined the association among the returns of both spot and futures contracts of crude oil and gold futures. The results of the study showed that the volume of gold futures trading reacted faster to information which made the gold spot returns more predictable than crude oil in the Indian commodity markets.

Palaniappan Shanmugam and Raghu (2016) assessed the association between spot prices and futures prices of five agricultural commodities in India. The results showed that there exists a long-run equilibrium relationship among futures prices and spot prices for five agricultural commodities. Also, there was a unidirectional causal relation between futures market prices and spot prices and bidirectional causal relation between agricultural commodities like soya bean and chana.

Arpana and Nandhini (2017) investigated the causal relationship between gold and crude oil prices in India. The study finds that crude oil prices have a negative relation with the returns on volume, whereas Gold price has a positive relationship with the returns on volume.

Gnanendra and Nishta Shri (2018) examined the impact of various macroeconomic indicators viz., stock

market indices, interest rates, the exchange rate on the gold price. The study used regression and correlation tools to examine the association between variables. The results showed that the gold price has a significant association with Sensex and interest rates.

Khalfaoui et al., (2020) investigated the multi-scale lead-lag relationship between money demand and few selected macroeconomic factors such as exchange rate, interest rate, GDP, oil prices, inflation-defining CPI. The results reported that money demand exhibits strong dependency with GDP across the time-frequency domain, while it has a very low dependency with interest rate, exchange rate and oil prices.

Pradhan et al., (2020) examined the relationship between gold and silver stock returns in India. Three macroeconomic variables, such as interest rate, BSE stock index and inflation rate were used in the study as the control variables. The results revealed that there is a causal relationship between the gold and silver markets.

Need for the study and objectives

India is one of the best importers and exporters of both agricultural and non-agricultural commodities in the world. The prices of the commodities are affected by exchange rate and some of the macroeconomic variables. The investor's participation in the commodity market trading also indirectly affects commodity prices. Whenever industries utilize raw materials through the new source, particularly importing from other nations, it will have its own impact exchange rate. Besides, some of the macroeconomic indicators significantly determine the prices of different commodities in India. In this context, present study is undertaken to investigate the determinants of macroeconomic indicators on the commodity futures price, in general. Specifically, the study is aimed to examine the impact of selected macroeconomic variables on gold futures prices, aluminum futures price movements, movements in crude oil futures prices, and movements in cardamom futures prices.

Research Methodology

Data Source

The data for the study have been collected from a secondary data source. The study used monthly data of four different commodity prices collected from Multi Commodity Exchange (MCX) for the sample period January 2010 to December 2020. The information related to macroeconomic indicators has been taken from the Reserve Bank of India (RBI) website.

Variables

The dependent and independent variables chosen in the study for developing multiple regression models are given as follows:

Dependent variables: Four commodity futures prices selected form four commodities under of bullion (Gold), base metals (Aluminium), energy (Crude oil) and agricultural commodities (Cardamom).

Independent variables: Four macroeconomic indicators viz., Gross Domestic Product (GDP), Mumbai Interbank Offer Rate (MIBOR), Whole Sale Price Index (WPI), INR/USD (Exchange Rate)

Multiple Regression Analysis

The data analysis was carried out by using the multiple regression analysis to find the effect of selected macroeconomic variables on determining the commodity futures prices. Four different regression models have been developed based on the selected variables pertaining to four commodity futures prices as dependent variables (Gold, Aluminium, Crude oil, and Cardamom), and four macroeconomic variables have been considered as independent variables (GDP, WPI, MIBOR, and USD/INR)

The four different multiple regression models are formulated below:

Model: 1

$$GOLDFUTURESPRICE = \alpha + \beta_1 GDP + \\ + \beta_2 WPI + \beta_3 MIBOR + \beta_4 EXCHANGERATE + \varepsilon$$

Model: 2

$$ALUMINIUMFUTURESPRICE = \alpha + \beta_1 GDP + \\ \beta_2 WPI + \beta_3 MIBOR + \beta_4 EXCHANGERATE + \varepsilon$$

Model: 3

$$CRUDOILFUTURESPRICE = \alpha + \beta_1 GDP + \\ \beta_2 WPI + \beta_3 MIBOR + \beta_4 EXCHANGERATE + \varepsilon$$

Model: 4

$$CARDAMOMFUTURESPRICE = \alpha + \beta_1 GDP + \\ \beta_2 WPI + \beta_3 MIBOR + \beta_4 EXCHANGERATE + \varepsilon$$

Research hypotheses formulation

Hypothesis 1	gold future prices and macroeco nomic variables have significant relationship.
Hypothesis 2	Aluminium futures prices and macroeconomic variables have signifi cant relationship.
Hypothesis 3	Crude oil futures prices and macroeconomic variables have significant relationship.

Hypothesis 4 Cardamom futures prices and macroeconomic variables have significant relationship.

Data Analysis

Stationarity test

The present study employed multiple regression analysis for the time series data and hence a stationary test is conducted to establish the order of integration of each variable. Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) unit root tests are employed to test the level of integration and ascertain the possible co-integration among the variables. The macroeconomic variables, such as WPI, GDP, and MIBOR are non-stationary at level except exchange rate. But, the 1st difference series of all the macroeconomic variables are stationary at 1 % and 5% level of significance. Hence, the 1st difference of all macroeconomic variables series is used for the analysis. Similarly, selected commodity futures also non-stationary at level and stationary at 1st difference. Thus, all selected commodity futures prices are also taken as 1st difference series and are considered for analysis. The variables are Gold futures price, Aluminium futures price, Crude oil futures price, Cardamom futures price, GDP, MIBOR, Exchange Rate, and WPI have presented the unit root test. The results revealed that the null hypothesis of unit root is rejected for the first difference and level at 5 percent and 1 percent statistically significant. The results of the unit root test specifies that if the null hypothesis is rejected it indicates that all selected variables are in stationarity form and further no statistical issues will arise regarding the analysis. The unit root test results are presented below:

Table 1: Results of the unit root test

Variables	Augmented Dickey-Fuller unit root test (ADF)		Philips-Perron unit root test (PP)	
	At Level	1st Difference	At Level	1st Difference
	Adj. t-Stat	Adj. t-Stat	Adj. t-Stat	Adj. t-Stat
Gold Futures Price	-1.4281	-2.8124***	-1.4281	-3.0026***
Aluminium Futures Price	0.9634	-2.6915**	2.4637	-2.6897**
Crude Oil Futures Price	-0.46617	-2.3012**	-0.4707	-2.2722**
Cardamom Futures Price	0.6364	-3.5729**	0.8530	-3.2052**
GDP	-1.3317	-2.2946**	-1.3315	-2.0279**
MIBOR	-1.1069	-3.2619**	-1.1068	-3.2619***
Exchange Rate	-1.6332*	-10.7519***	-3.1401***	12.6476***
WPI	0.3566	-1.9551*	0.2874	-1.9551*

Note: p-value*** denotes significant at 1% level, p-value ** denotes significant at 5% level, and * denotes significant at 10 % level. Hence reject the null hypothesis that the series has a unit root at the 1% and 5% level of significance

The multiple regression results are presented in Table 2. In model 1, the futures price of gold is considered as the dependent variable and the other four macrocosmic variables are taken as independent variables. The four macroeconomic indicators have not shown any significant influence on determining Gold futures price. In model 2 the futures price of Aluminium is considered a dependent variable. The indicators namely WPI, MIBOR and exchange range have a significant influence on determining the Aluminium futures price and GDP does not have any impact on it. In model 3 Crude oil futures prices are taken as a dependent variable. In this Table 2, the various macroeconomic indicators such as GDP, WPI, and exchange rate have shown a significant impact on determinants of Crude oil futures price. Finally, Model 4 presents the macroeconomic determinants of the Cardamom futures price. The exchange rage only significant association with cardamom futures price and GDP, WPI, MIBOR is not significantly influencing the cardamom futures price.

Table 2: Multiple regression results: Macroeconomic determinants of the commodity futures price

	Model 1 (DV: Gold)		Model 2 (DV: Aluminium)		Model 3 (DV: Crude oil)		Model 4 (DV: Cardamom)	
Variables	**Co-eff.**	***t*-stat.**	**Co-eff.**	***t*-stat.**	**Co-eff.**	***t*-stat.**	**Co-eff.**	***t*-stat.**
Constant	35.0043	0.2919	16.9687	0.1321	1687.350	0.4820	-693.4387	-0.2803
GDP	-4.4741	-0.7353	0.9557	0.1467	252.433	1.4212*	-43.2807	-0.3448
WPI	-0.0348	-0.0448	0.8573	1.0289*	17.160	0.7558***	19.8032	1.2342
MIBOR	2.0661	0.4603	6.5761	1.3676*	-174.750	-1.3338	147.4882	1.5930
INR/USD	-0.3121	-0.3822	-1.2560	-1.4357*	50.975	2.1385*	-46.7054	-2.7727**
R2	0.6250		0.4686		0.881		0.7427	
Adj.R2	0.3910		0.1143		0.802		0.5711	
F-statistic	0.9222		1.3230		11.111		4. 3291	
Durbin-Watson	1.0983		0.9286		2.066		2.1927	

Note: ***denotes p-value significant at 10% level, ** denotes p-value significant at 5 % level, **** denotes p-value significant at 1 % level. DV: dependent variable**

Discussion

First, the regression analysis reports that the commodity futures price has a significant relationship with the four macroeconomic variables viz., GDP, WPI, MIBOR, and USD/INR rates. The indicators namely WPI, MIBOR, and exchange rate have shown a significant relationship with Crude oil futures price, which indicates that when there is an increase in the macroeconomic variables, the Crude oil futures prices also increase. In the case of gold futures price, all macroeconomic indicates have shown an insignificant association with gold futures price, which designates that whenever the GDP, MIBOR, Exchange Rate, WPI increases it will not have a direct impact on gold futures price. The three macroeconomic variables such as WPI, MIBOR, and exchange rates have shown a significant relationship with Aluminium futures price and GDP shows an insignificant effect. This implies when WPI, MIBOR, and exchange rates changes, those will have a direct impact on Aluminium futures price. Finally, the exchange rate has a significant relation with cardamom futures price and the other three macroeconomic indicators have an insignificant impact.

Overall, the results of the study revealed that all considered macroeconomic variables have a significant impact on the determinant of commodity futures price in India.

Conclusion and future research direction

The current study investigated the impact of macroeconomic variables on determining the commodity futures price. The results of the study confirmed that all four macroeconomic indicators viz., GDP, WPI, MIBOR, and USD/INR rate have a significant impact on the determination of commodity futures price in India. It indicated that the market cannot be influenced by individual variables. Hence the four macroeconomic indicators have to be considered for determining the commodity futures prices.

The findings of this study may help policymakers and economists to reform economic policies in India. Therefore, the policymakers should reform the fiscal and monetary policies for the effective control of commodity prices, which may be resulted in the reduction of inflation pressure, stability in the exchange rate. Consequently, the considerable growth rate in the GDP and promotion of economic growth are also possible through higher exports. The study also provides future research direction. The future studies may develop the econometric models by taking into consideration the other macroeconomic variables such, tax rates, tariff rates, and producer price index and also consider other commodities viz., Copper, Lead, Zinc, Natural Gas, and other Agri commodities.

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