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Dynamics of global oil prices, exchange rate and precious metal prices in India

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ABSTRACT

This study examines cointegration and Granger causality among global oil prices, precious metal (Gold, Platinum and Silver) prices and Indian Rupee–US Dollar exchange rate using daily data spanning from 2nd January 2009 to 30th December 2011. ARDL bounds tests indicate that the series are cointegrated. Toda–Yamamoto version of Granger causality has been employed to establish the causation amongst the variables. The study also examines generalized error variance decomposition of variables due to various shocks in the system. Such information provides insight into the transmission links between the global oil market and the Indian precious metals and foreign exchange market. These have the potential for significant impact in further research, portfolio management and central bank policy design.

Introduction

Precious metals and oil have received considerable attention post the financial crisis of 2008 as alternative investments. Gold has historically been treated as a store of value and a medium of exchange until the collapse of the Bretton Woods system. Even in the post Bretton Woods world, gold has been held as an investment by investors and by governments as part of their reserves. Due to the belief in the inherent monetary value of gold, it also acts as an effective inflation hedge. Historically, silver has also been considered as a store of value and for monetary exchange. Recently, investors have started to buy and hold platinum as an alternative to gold. This has led to price co-movement in these precious metals.

India is the world's largest importer of gold. In 2010, India imported 92% of its gold consumption with the rest being met by recycling. Gold imports are third overall and lag only behind oil and capital goods. This huge import of gold is hence expected to have effect on the exchange rate of India.

Silver and platinum, though as also being used in jewellery along with gold, find applications in industries too. Both are used in the automotive and chemicals industries. These industries also utilise oil to derive various petrochemical products. Hence these commodities are also expected to have relationships amongst themselves.

Oil is also heavily used as a source of energy in the form of fuel. Most of the countries in the world are net importers of oil, which is traded mostly in US Dollars. This import of oil denominated in US Dollars forms a major chunk of imports for many countries and has serious implications on the movements of foreign exchange rates.

Economic theory has been successful in explaining the links between these commodity and exchange rate markets. For economies which import a huge portion of their oil consumption (such as India), increase in international oil prices can lead to inflation and exchange rate shocks. Investors then flock to precious metals to hedge their portfolios against inflation and currency risk. The precious metals are considered similar to an international reserve currency. As the demand for these metals is also fulfilled through

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imports, this also has an effect on the exchange rate and vice versa. Common uses of oil and precious metals in industries such as automobiles and petrochemicals also forces co-movement in the prices of these commodities.

These theories fail to give significant explanations as to the direction of the causal linkages. For example, the question whether exchange rate variations causes change in prices of locally traded precious metals or does demand for these metals cause increase in their imports leading to change in exchange rate is still open to debate.

One of the earliest studies in this field was conducted by Pindyck and Rotemberg (1990). They analysed seven unrelated commodities and found the presence of unexplained excess co-movement. They attributed this to herding by investors. No testing to examine the direction of relationship amongst commodities was conducted but macroeconomic variables were shown to affect commodity prices. Other studies, such as Palaskas and Varangis (1991) and Trivedi (1995), found less evidence to support the Pindyck and Rotemberg (1990) study.

Ciner (2001) found evidence of the disappearance of long run relationship between gold and silver in the 1990s. This has been explained due to the increase in divergence of uses of these precious metals. This result has been contested by Lucey and Tully (2006) who say that this relationship strengthens and weakens over time but is prevalent over the long run. Shafiee and Topal (2010) present evidence for the linkages between gold prices, oil prices and inflation. Their results indicate a stable range for the ratio of gold and oil prices over a long period, indicating a stable relationship.

Commodities have been shown to have informational content in predicting the direction of inflation, interest rate and industrial production by Awokuse and Yang (2003). Baffes (2007) examines crude price pass through effects on commodities over a period spanning four decades. These effects are significant and high, in spite of controlling for inflationary effects. Hence an underlying economic relationship between oil and precious metal prices has been proposed. Recently, Sari et al. (2010) presented evidence pointing to short term linkages between oil, precious metals and exchange rates. Their study found no evidence of a long term relation between these variables.

The objective of this study is to test for the presence of cointegration and Granger causality among global oil prices in dollars, precious metal (Gold, Platinum and Silver) prices in Indian currency (rupee) and Rupee—US Dollar exchange rate using daily data spanning from 2nd January 2009 to 30th December 2011. Unlike Sari et al. (2010), where the price of the commodities was taken in dollars and Euro–US Dollar exchange rate was considered, present study uses Rupee–Dollar exchange rate to function as a medium of information transmission between the oil and precious metal markets.

Present study employs auto-regressive distributed lag (ARDL) bounds testing approach of cointegration developed by Pesaran and Shin (1998) and Pesaran et al. (2001) followed by Toda–Yamamoto (TY) version of Granger non-causality tests and generalized error variance decomposition analysis to establish the direction of causations and impact of various shocks in the system.

The rest of the paper is organised as follows. Section 2 describes the data and econometric methodologies employed. Empirical results are discussed in Section 3 and the conclusion is presented in the last section.

Data description and empirical methodologies

Brent Index published by Intercontinental Exchange (ICE) has been used as the proxy for oil prices in US Dollars. The exchange rate has been taken as the cost of one US Dollar in Indian Rupees. Data for the same has been taken from the Reserve Bank of India. The precious metals considered in this study are Gold, Platinum and Silver. These are traded daily across various markets in India. Gold and silver are heavily traded at Ahmedabad and Platinum at Mumbai. Multi Commodity Exchange of India (MCX) publishes these prices and has been used as the data source. Gold prices are in Rs. per ten gram, silver per kilogram and platinum per gram.

Daily time series data (5-day week) is used for a period of three years, from 2nd January 2009 to 30th December 2011. Present study uses nominal data because of unavailability of daily consumer price index. According Narayan et al. (2008), tracking the daily behavior of oil price, exchange rate and stock market does not require knowledge of real values. Longer span was not considered as reporting of platinum prices started from 15th October 2008 and it was considered as an important precious metal to be included in the data set.

The descriptive statistics of all the raw variables is reported in Table 1. For the purposes of the study, all the variables have been converted to log form. Amongst the metals, gold shows lower volatility then silver, indicating the underlying characteristics of monetary value and hoarding. The variables *Loil, Lex. Lgold, Lsilv* and *Lplat* are the oil price, gold price, sliver price, platinum price and exchange rate after logarithmic transformation.

Table 2 reports the correlations between the variables. The highest level of correlation is between gold and silver, which is because of their close link due to being used heavily in jewellery. Brent shows high correlations with the precious metals, highest with silver. Both oil and silver have major industrial uses, which can explain the high correlation. Correlations of all the variables with exchange rate are low and negative, though significant even at the 1% level. These significant correlations indicate the possible presence of underlying relationships, such as cointegration, between the variables.

ARDL bounds tests approach for cointegration

Cointegration is defined as a systemic co-movement among two or more macroeconomic variables over the long run. The presence of cointegration among the variables rules out the possibility of "spurious" correlation. In many cases, economic theory tells us that two or more variables should be cointegrated and a test for cointegration is the test of the theory.

Table 1
Descriptive statistics of the variables.

	Ex rate	Oil	Gold	Platinum	Silver
Mean	46.939	84.552	19123.12	2276.461	36430.77
Std. Dev.	2.158	21.855	4137.858	318.184	14196.270
Skewness	0.869	0.018	0.837	−0.684	0.595
Kurtosis	3.068	2.123	2.846	2.503	1.891
Jarque–Bera	98.546 (0.000)	25.093 (0.000)	91.923 (0.000)	68.914 (0.000)	86.127 (0.000)
Observations	781	781	781	781	781

*figure in brackets are probability values.

Table 2
Correlation matrix.

	Lex	*Loil*	*Lgold*	*Lplat*	*Lsilv*
Lex	1.0000				
Loil	−0.4630	1.0000			
Lgold	−0.1072	0.8482	1.0000		
Lplat	−0.5257	0.9044	0.8164	1.0000	
Lsilv	−0.3214	0.9208	0.9346	0.8434	1.0000

Note: All correlations are significant at the 1% level.