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Co-movement of international crude oil price and Indian stock market: Evidences from nonlinear cointegration tests

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ABSTRACT

This article explores nonlinear cointegration between international crude oil price and Indian stock market in a multivariate framework for the period January 2, 2003 to July 29, 2011 by threshold cointegration tests which determine the structural breaks endogenously. The tests reject any long-run equilibrium relationship among the variables for the entire data span. In order to get better insight, threshold cointegration tests have been applied on three sub-phases; prior (phase I) and post (phase III) to most volatile phase (phase II) spanning from July 2, 2007 to Dec 29, 2008. The tests suggest existence of cointegration in phase III only. Toda–Yamamoto version of Granger causality tests reveals that movements of international crude oil price have impact on Indian stock market in phases II and III with no feedback effect. The findings also suggest that global crude oil price is exogenously determined.

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1. Introduction

India is one of the fastest-growing economies in the world. According to International Monetary Fund (IMF), Indian economy is the eleventh largest in the world by nominal GDP and the third largest by purchasing power parity (PPP). India's financial sector, especially stock market has complemented the growth process significantly since the onset of financial reforms in nineties. Over the past two decades, the stock market has grown stupendously in terms of increase in size and volume of investment by both domestic and international investors. So, the susceptibility of the movements of stock market in relation to country's macroeconomic indicators and external factor like the movements in international crude oil price is extremely important for investors in investment decisions and monetary policy makers for policy decisions.

The movements in crude oil price impact stock prices that have been indicated in many studies like Sadorsky (1999), Arouri and Rault (2011)

among others. The theoretical basis for this relationship is that oil price effect gets transmitted to macroeconomic fundamentals which in turn influence the liquidity in the financial market. Oil-price shocks affect stock market returns or prices through their effect on expected earnings (Jones et al., 2004). On the supply-side, according to the study, increase in oil price may adversely impact the profits of companies due to the increase in the production cost. On the demand side, oil price increase may result in increase in inflation which may discourage investment in stock market due to the increase in interest in bond market.

Historical trend shows that the world seems to have entered into an era of higher crude oil price volatility. Shafiee and Topal (2010) forecast nominal and real fossil fuel prices from 2009 to 2018 using a comprehensive version of the long-term trend reverting jump and dip diffusion model. The prediction shows that nominal and real oil (and natural gas) prices have an increasing trend and the fossil fuel prices will stay in jump for the next years with a reverting trend to the long-term historical trend line until 2018. Ji (2012) establishes that the original mechanism of crude oil markets is destroyed by the financial crisis of 2008 and the contemporaneous causality between oil price and various factors is significantly strengthened after crisis.

Crude oil is the second largest source of primary energy supply in India after coal. In 2011, crude oil contributed 29% of India's total

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primary energy supply. Due to stagnant domestic production the gaps between India's oil demand and supply are widening day by day, which has been met through import. Burgeoning oil import bill, which reaches 144.29 billion US\$ in 2012–13 from 18.26 billion US\$ in 2003–04, is a major cause of concern for India as the huge dollar outflows on this count worsens the current account deficit (CAD). This, in turn, increases the burden of external debt situation, inflation and depreciation for Indian currency. This further discourages investment in financial sector causing an overall macroeconomic instability for the economy. In this backdrop, identification of the effects of movements in international crude oil price on the movements of stock price can unfold many important insights for investors and policy makers.

This study aims to empirically investigate cointegration and long-term causal relationship between international crude oil price and Indian stock market in a multivariate framework with nominal exchange rate as an additional variable for the period of January 2, 2003 to July 29, 2011. A multivariate approach is always preferred over a bivariate approach because it avoids specification bias due to omission of relevant variables. The crude oil price and stock market are plausibly linked via the indirect channel of exchange rate in an economy as the movements in crude oil price have direct impact on the nominal exchange rate.

This article is a unique contribution to the limited literature of emerging economies in two aspects. Firstly, no study has explored the crude oil price and stock market relationship in a multivariate framework for the Indian market. Secondly, the study employs nonlinear threshold cointegration methodology in investigating the long-run relationship which has undergone some structural breaks. The article uses threshold cointegration of Gregory and Hansen (1996) and Hatemi-J (2008) to investigate possible endogenous regime shifts or nonlinearity in the relationship of stock market, oil price and exchange rate. The study also explores Toda–Yamamoto (TY) (1995) version of Granger non-causality tests.

The rest of the paper is organized as follows. Section 2 gives a review of the existing literature. Section 3 provides a brief overview of Indian stock market, oil sector and exchange rate regime. Section 4 provides data descriptions. Section 5 has estimation methodology. Section 6 analyzes the empirical results. Finally Section 7 has conclusions.

2. Literature survey

Hamilton (1983) suggests that crude oil price movements become a vital factor for every post world-war II US recessions. Since then identification of linkages between crude oil price and the real sectors of the economy has been a major area of theoretical and empirical research. Burbridge and Harrison (1984), Loungani (1986), Gisser and Goodwin (1986) and Uri (1996) are some earlier ones. Hamilton (2003), Cunado and Perez de Garcia (2005) and Bachmeier (2008) have modeled crude oil price and economic activities (aggregate demand, inflation, employment and real economic growth).

Empirical literature on the relationship between crude oil price and stock market is evolved with the assumption that the performance of stock market is a good indicator of economic activity (Nasseh and Strauss, 2000; Pethe and Karnik, 2000; Henry et al., 2004; Cook, 2006; Singh, 2010; Dhiman and Sahu, 2010).

The empirical literature on the crude oil price and stock market relationship is vast and can be mainly categorized into four kinds. The conclusion of these studies is mixed.

First, crude oil price movements have significant negative impact on stock market returns. These studies include Jones and Kaul (1996), Sadorsky (1999) and Papapetrou (2001), Ciner (2001), Kilian and Park (2007), Hammoudeh and Li (2005), Ghouri (2006), Miller and Ratti (2009), Aloui and Jammazi (2009), Chen (2010), Basher and Sadorsky (2006), Hammoudeh and Choi (2007) and Nandha and Hammoudeh (2007). Jones and Kaul (1996) and Sadorsky (1999) have looked into the effects of crude oil price on stock markets for US, Canada, Japan

and UK. He finds that oil prices bring strong negative impact on stock returns. Papapetrou (2001) supports this finding with further additions that the negative impact stays for the first four months. Ciner (2001) and Kilian and Park's (2007) finding is also consistent with Jones and Kaul (1996) and Sadorsky (1999).

Second, the relationship between crude oil price and stock market is significant but positive. The studies in this category are not plenty. Some of these studies include Chen et al. (1986), El-Sharif et al. (2005), Narayan and Narayan (2010), and Arouri and Rault (2011). El-Sharif et al. (2005) find a positive impact on the stock returns of oil and gas sectors in UK when there is an increase in oil price. Findings of other studies are similar. Narayan and Narayan (2010) find that oil prices have significant positive impact on Vietnam's stock market. Gulf Cooperation Council (GCC) countries other than Saudi Arabia show that oil price increases bring positive stock returns (Arouri and Rault, 2011). Zhu et al. (2011), using threshold panel cointegration, establish that increased crude oil prices have a positive impact on stock prices for the 14 OECD and non-OECD countries from January 1995 to December 2009. Positive effect of real oil price on sectoral stocks has also been established by Li et al. (2012) for China. Zhu et al. (2014) confirm the positive dependence between crude oil prices and Asia-Pacific stock market returns except in Hong Kong. Their study uses unconditional and conditional copula models. Positive relationship has also been observed for Lebanese stock market (Dagher and El Hariri, 2013).

Third, the relationship between crude oil price and stock market is significant but positive or negative relationship depends on several conditions. These works include Park and Ratti (2008), Cong et al. (2008), and Zhu et al. (2011). Park and Ratti (2008) establish that the nature of relationship between crude oil price and stock market mostly depends on whether the economy is an oil-importer or oil-exporter. Cong et al. (2008) reveal that different market conditions of an economy are the main trigger of positive or negative relationship. Zhu et al. (2011) study the relationship for OECD and non-OECD countries in panel cointegration approach. The results are consistent with previous studies in this category. There exists a subcategory within this third type of crude oil price and stock market relationship. The empirical literatures, in this category challenge the linear and symmetrical assumptions of earlier studies. These studies demonstrate that the relationship of crude oil price and macroeconomic or financial variables is not only dependent on different factors but it is asymmetric and non-linear (Mork, 1989; Lee et al., 1995; Hamilton, 1996, 2003). Moya-Martínez et al. (2014) examine the sensitivity of the Spanish stock market at the industry level to movements in oil prices over the period 1993–2010, paying special attention to the presence of endogenously determined structural changes in the relationship between oil price changes and industry equity returns. The empirical results show that the degree of oil price exposure of Spanish industries is rather limited, although significant differences are found across industries.

Finally, the relationship between crude oil price and stock market is not significant. Some of these studies include Henriques and Sadorsky (2008), Apergis and Miller (2009), and Al Janabi et al. (2010). Henriques and Sadorsky (2008) establish that the stock returns of energy companies respond insignificantly to the crude oil price movements. Apergis and Miller's (2009) analysis shows that oil price movements impact the international stock market returns insignificantly. Al Janabi et al.'s (2010) analysis on GCC stock markets reveals similar finding.

Hence, it is evident that the effects of oil price changes on stock market could vary significantly depending on economic structure of individual countries, empirical methodology employed and data span considered for the study.

So far as India is concerned, Ghosh and Kanjilal (2014) investigate the dynamic impact of linear and non-linear specifications of oil price shocks on macroeconomic fundamentals for India by employing Toda and Yamamoto version of extended vector autoregressive (VAR) model along with two-state Markov regime-switching VAR model The

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