On random walk hypothesis for the crude oil, bituminous coal and natural gas markets: Evidence from regime switching approach

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Submission of Abstract

Testing for a unit root or the random walk hypothesis (hereafter RWH) in asset prices has attracted substantial interest in the empirical finance literature ever since the studies of Fama and French (1988a, 1988b), Lo and MacKinlay (1988) and Poterba and Summers (1988) were published. The reason for this is that if there is a unit root in the asset price, this then implies that asset returns cannot be predicted by previous prices changes. Therefore, given only past price and return data, the current price is the best predictor of the future price, and the price change or return is expected to be zero. This is the essence of the weak-form efficient markets hypothesis (hereafter EMH).

In energy markets, examining whether price movements follow the random walk process and forecasting the future level of prices and their fluctuations have also attracted substantial research over the past two decades. Taking the oil price as an example, three broadly-grouped models are commonly observed in forecasting oil price movements: time series models, financial models, and structural models (Frey et al., 2009). Time series models, especially random walk models, usually serve as the benchmark for comparing the forecasting performance of different models, and are therefore most frequently used in empirical studies (e.g., Pindyck, 1999; Morana, 2001; Chernenko et al., 2004; Abosedra, 2005; Ye et al., 2005; Radchenko, 2005). Financial models have attempted to establish the relationship between spot and futures prices of crude oil, which could then be used to forecast future price movements of oil (e.g. Bopp and Lady, 1991; Samii, 1992; Gulen, 1998; Zeng and Swanson, 1998; Chin et al., 2005; Murat and Tokat, 2009). Structural models, on the

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other hand, have attempted to incorporate useful behavioral information regarding other economic factors, such as production quotas and capacity utilization, to enhance the accuracy of oil price forecasts (e.g., Zamani, 2004; Ye et al., 2002, 2005 and 2006; Kaufmann, 1995 and 2004). Regardless of what models are used, a careful investigation of the non-stationarity property of the data series examined is considered to be very important before the empirical model can be correctly specified.

The central aim of this paper is to revisit the RWH of four natural resource markets, i.e., the prices of the US West Texas Intermediate (WTI) and the UK Brent, bituminous coal and natural gas. A key contribution of this research is with respect to an investigation based on augmented Dickey-Fuller (ADF) unit root testing within a Markov regime-switching framework. The Markov switching approach is in sharp contrast to existing studies of testing RWH and offers valuable new insights into price behavior. These prices are modeled as regime dependent where episodes of stationarity or non-stationarity can be identified and analyzed. In contrast, most existing studies of RWH compute a single test statistic for testing non-stationarity across the entire study period. This approach can lead to a bias towards accepting the non-stationary null thereby accepting RWH because there is no distinction between alternative regimes.

The major findings of this study are as follows. First, for all of prices, the traditional unit root cannot be rejected at the 5% level, suggesting that the price series for these energies are non-stationary processes. Second, results that are based on a battery of nonlinearity tests in favor of the price series could be better characterized by the nonlinear Markov switching model. Finally, based on the results of the Markov switching unit root regression, the findings are indicative of the local non-stationarity in both regimes, and therefore we conclude that the likelihood that the RWH sustains is quite high for markets of the US West Texas Intermediate, the UK Brent and bituminous coal. However, there is a medium likelihood that the RWH will hold for natural gas market.

Selected Reference

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