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Testing the weak-form efficiency of the WTI crude oil futures market

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Abstract

The weak-form efficiency of energy futures markets has long been studied and empirical evidence suggests controversial conclusions. In this work, nonparametric methods are adopted to estimate the Hurst indexes of the WTI crude oil futures prices (1983-2012) and a strict statistical test in the spirit of bootstrapping is put forward to verify the weak-form market efficiency hypothesis. The results show that the crude oil futures market is efficient when the whole period is considered. When the whole series is divided into three sub-series separated by the outbreaks of the Gulf War and the Iraq War, it is found that the Gulf War reduced the efficiency of the market. If the sample is split into two sub-series based on the signing date of the North American Free Trade Agreement, the market is found to be inefficient in the sub-periods during which the Gulf War broke out. Same analysis on short time series in moving windows shows that the market is inefficient only when some turbulent events occur, such as the oil price crash in 1985, the Gulf war, and the oil price crash in 2008.

Keywords: Crude oil futures, Weak-form efficiency, Bootstrapping

1. Introduction

The unfolding financial crisis triggered by the U.S. subprime mortgage crisis in 2007 has been viewed as the most severe in the past centenary after the U.S. stock market crash in 1929. The latest financial crisis is followed by the global economic recession and the European sovereign debt crisis. During this period, we have witnessed the boom and bust of many financial and commodities bubbles [1, 2]. The 2006-2008 crude oil bubble was a significant example [3]. The West Texas Intermediate (WTI) oil prices experienced an accelerated rise followed by a spectacular crash in July 2008. When measured in terms of daily close prices, the peak of USD 145.29 per barrel was reached on July 3, 2008 and a significant low of USD 33.87 was seen on December 19, 2008, which is a level not seen since 2004. The historical high was USD 147.2 per barrel, recorded in the middle of the day of July 11, 2008.

In May 2008 before the July peak, Sornette et al utilize the log-periodic power-law (LPPL) models for financial bubbles [3, 4, 5] to analyze the oil prices and confirmed the presence of a speculative bubble. Furthermore, they successfully predicted the crash of the oil bubble with high precision. The original prediction was posted on the arXiv (0806.1170v1) on 6 June 2008. A few weeks later, Drożdż et al successfully predict the Brent oil price crash (see arXiv:0802.4043v2, 24 June 2008) based on the LPPL models [6]. Yu et al propose a neural network ensemble learning paradigm based on empirical mode decomposition to forecast crude oil prices and successfully predicted the turning point and the oil price plummet[7]. More generally, there are a lot of studies showing that the oil prices are predictable both in turbulent periods and in normal phases. For instance, Shambora and Rossiter use an artificial neural network model with moving average crossover inputs to predict prices in the crude oil futures market and uncovered significant profitability [8], and Wang and Yang find significant out-of-sample predictability of intraday

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