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Volatility Modelling In Crude Oil and Natural Gas Prices

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Abstract

This study analysis the return volatility of spot market prices of crude oil (WTI) and natural gas (Henry Hub) for two different terms which cover 02.01.2009 – 28.04.2014 and 04.01.2010-28.04.2014 with different version of the GARCH class models such as GARCH, IGARCH, GJRGARCH, EGARCH, FIGARCH, FIAPARCH. In particular, the main idea of employing various GARCH models is to determine which one of these linear and nonlinear asymmetric models perform more accurate in terms of ingroups and intergroups activities. Therefore, the main purpose of the paper is to determine a model which ensures to get a maximum return with response to the minimum loss for returns of the investments held by individual investors and fund managers, private sector budget planning decision makers, and state agencies forecasting about macroeconomic indicators. To do this, the ten-days out-of-sample volatility forecasts of Loss Functions to capture the forecasting performance of GARCH class models and to prevent forecasting errors with efficiency hedge ratio in energy market are being considered. For two periods, asymmetric and integrated GARCH models give relatively more accurate performance than other available models. Respectively, for the first period, minimum loss model is FIGARCH-BBM (SST) and for the second period, is EGARCH(GED) for WTI crude oil series in consideration of MSE and MAE criterion. Similarly, for the first period minimum loss model is FIGARCH-BBM (SST) and for the second period, is EGARCH(GED) for Henry Hub natural gas series in consideration of MSE and MAE criterion. This study has potential recommendations for investors from developed and developing countries, which differs it from the current studies.

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Keywords: Loss Functions (MAE, MSE), GARCH Types Models, WTI, Henry Hub

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1. Introduction

Accurately forecasting of crude oil and natural gas prices return volatility has a key role for policy makers to take decision, hedging strategies of production and refinery companies, and of course short term price movements of traders in financial markets. As well as, notably energy prices volatility affects growth rates, inflation and unemployment rates via production cost channels and is an important cost ingredient for long term and value added "Strategic Investment" decisions (Henrique and Sadorsky, 2011,79; Regnier, 2007, 421; Apergis and Payne, 2010, 2759; Balcılar and Özdemir, 2013, 1; Henrique and Sadorsky, 2011, 79; Akar, 2007, 2; Sarı et. al., 2010, 351).

Volatility is usually one of the most important factors affecting the price of derivative products. Moreover, volatility and the opportunity cost of production of companies will be able to affect the transaction cost and the marginal cost of production. In order to make effective econometric implications intended for the average of variables, volatility must be forecasted accurately. Typically, despite having relatively high volatility in crude oil and natural gas prices, studies in this field focus on mostly other volatility of financial instruments. Therefore, frequency of related analyses in the literature, pricing mechanisms similarity, volatility transmission into each other and very high quantitative and qualitative correlation characteristics were decisive to analyze oil price and natural gas prices return volatility simultaneously (Panagiotidis and Rutledge, 2007, 346; Quanqian and Yang, 2009, 410).

The premise of this study is built on homoeconomicus rationality behaviors, in Neoclassic Economics approach, that admires to get the maximum profit with response to the minimum loss provided by minimum risk strategies. High volatility, high-frequency and rapid jumps, bubbles, volatility clustering, and non-stationary characteristics of crude oil and natural gas markets shape risk perception of investors and traders in crude oil and natural gas markets, hence all these features prove that crude oil and natural gas markets prices and returns are not in a stationary state consistently. The volatility of oil and natural gas, due to the association with most of the raw materials, is transferred to the end users through the number of transfer mechanisms. Crude oil and natural gas volatilities become increasingly crucial on the basis of countries macroeconomic risks, especially for countries that depend more on energy imports and additionally, carry on high current deficit and trade deficit accounts (in 2014, in Turkey, total imports 242.2 billion dollars and energy imports is 48.8 billion dollars, while the current account deficit was recorded as 45.8 billion dollars), because of the major shares of crude oil and natural gas in their balance of payments. These volatilities bring a huge pressure on the current account deficit, and via fluctuating exchange rate regime channel, they affect interest rates and exchange rates and afterwards, deflate domestic currency generating inflationary situation in the medium term. As a matter of course, instead of enhancing productivity measurements in production/industrial sectors, firms will apply to fire employees as a cost cutting strategies, and then inevitably unemployment will crop up. Consequently, governments or states and companies that require effective strategies in derivative markets can intend, with an optimum hedge ratio, for these two commodities (i.e., crude oil and natural gas) calculated with FOB (Free On Board) price on spot market.

The rest of the paper is organized as follows; the second part focuses on the explanation about the importance of selected periods and descriptive statistics. Third part makes some deep statements on the linear (GARCH, IGARCH), nonlinear asymmetric (EGARCH, GJRGARCH) and integrated (FIGARCH, FIAPARCH) models and introduces "Loss Functions" in regard of Mean Squared Error (MSE) and Mean Absolute Error (MEA) used in this study. Fourth part is built on interpretation of empirical results obtained from descriptive statistics, GARCH class models and Loss Functions tests.