



## Extreme Value Theory and Value at Risk: Application to oil market

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### ABSTRACT

Recent increases in energy prices, especially oil prices, have become a principal concern for consumers, corporations, and governments. Most analysts believe that oil price fluctuations have considerable consequences on economic activity. Oil markets have become relatively free, resulting in a high degree of oil-price volatility and generating radical changes to world energy and oil industries. Consequently, oil markets are naturally vulnerable to significant high price shifts. An example of such a case is the oil embargo crisis of 1973. In this newly created climate, protection against market risk has become a necessity. Value at Risk (VaR) measures risk exposure at a given probability level and is very important for risk management. Appealing aspects of Extreme Value Theory (EVT) have made convincing arguments for its use in managing energy price risks. In this paper, we model VaR for long and short trading positions in oil market by applying both unconditional and conditional EVT models to forecast Value at Risk. These models are compared to the performances of other well-known modelling techniques, such as GARCH, Historical Simulation and Filtered Historical Simulation. Both conditional EVT and Filtered Historical Simulation procedures offer a major improvement over the conventional methods. Furthermore, GARCH(1, 1)-t model may provide equally good results which are comparable to two combined procedures. Finally, our results confirm the importance of filtering process for the success of standard approaches.

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### 1. Introduction

Recent increases in energy prices, especially oil prices, have become a principal concern for consumers, corporations, and governments. Oil as a primary source of energy is needed for industrial production, electric power generation, and transportation. Several world events have led to major oil disruptions in the past four decades. Most of these disruptions were related to political or military upheavals, especially in the Middle East. Since 1973, four major crises—the 1973 Arab–Israeli war, the 1978–89 Iranian revolution, the 1980 Iran–Iraq war and the 1990–91 Gulf war—resulted in initial shortfalls of between 4.0 and 5.6 million barrels per day. Numerous studies were conducted to investigate possible effects of oil price fluctuations on the main economic indicators of oil-importing countries. Most analysts believe that oil price fluctuations have considerable consequences on economic activity. In an influential paper, Hamilton (1983) argues that oil price shocks are responsible, at least partly, for every U.S. recession in the post-World War II period. Several other studies, such as Mork (1989) reports similar conclusions. Sadorsky (1999) find that oil price volatility shocks have asymmetric effects on the economy and

finds evidence of the importance of oil price movements when explaining movements in stock returns.

Oil prices were primarily determined by long-term contracts between oil producers and international oil companies. OPEC<sup>1</sup> control the most oil and dominate the price and quantity of oil sold. Prices fluctuated when these long-term contracts were revised, but prices were not otherwise responsive to market conditions. However, the rise of competition and deregulation has led to relatively free energy markets that are characterized by high price shifts. Many factors have been introduced to explain these extreme movements in oil prices.

Oil prices change due to many reasons such as OPEC policy, war and political uncertainty in the Middle East and elsewhere, supply disruptions due to natural or other disasters, and changing demand and imbalances between physical supply and demand as well as other constraints. The risk of war in oil producing regions, notably the Middle East, will increase the price of oil. Supply disruptions (and fear of supply disruptions) have been a significant recent influence on the crude oil market. For example, the price of crude oil briefly spiked to more than \$35 a barrel in response to the Iraqi invasion of Kuwait at

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<sup>1</sup> Organization of Petroleum Exporting Countries: the cartel controls 70% of the world's known oil reserves and contributes to about 40% to world oil production. The cartel controls 70% of the world's known oil reserves but contributes only 40% to world oil production.