THE ASYMMETRIC DYNAMIC DEPENDENCE BETWEEN RETURN AND VOLATILITY IN OIL MARKET

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Overview

In the Post-financial crisis era, international oil market is becoming more uncertain and unpredictable, whose prices present increasingly volatile feature. Especially, since the second half year of 2014, international oil prices had undergone an abrupt and continuous decrease from $100 per barrel to below $30 per barrel in 2016. Under this situation, trading risk in oil market has been greatly intensified due to the superposition of multi-dimensional risk factors. Thus, crude oil implied volatility index (OVX) is introduced by Chicago Board Options Exchange (CBOE) as the first commodity-based volatility index in 2008 to measure the market's expectation of 30-day volatility of crude oil prices based on options on the United States Oil Fund. Return-volatility relation in oil market has been reconsidered and been paid more attention by market investors and researchers. Especially, the relationship between oil prices returns and the new published OVX need further verification. In this paper, a time-varying mixed copula model is proposed to measure the dynamic dependence between oil price returns and implied volatility index. The hypothesis of OVX as an investor fear gauge will be further verified. Furthermore, the exceedance dependence measurement is introduced to investigate the asymmetric dependence between oil price returns and OVX under market extreme risks. It is of great practical importance for portfolio risk mangement, hedging and option pricing, especially in such a complex market environment.

The paper is organised as follows: After the introduction section 2 constructs methodology of the time-varying mixed copula and measurement of asymmetric dependence. Secotion 3 analyze the main results on the dynamic asymmetric dependence between oil price returns and OVX. In the last section, the concluding remarks and implications are summarized.

Methods

In this paper, a half rotated Gumbel copula is firstly constructed to specifically measure the negative dependence between time series. Second, a time-varying mixed copula model combining the constructed half rotated Gumbel copula and normal copula is proposed to measure the dynamic relationship between oil price returns and OVX. Thirdly, the conditional Kendall coefficient is introduced to build the exceedance dependence coefficient which can provide a better description on the asymmetric comovement under different market conditions.

Results

It is found that the negative relationship between oil price returns and OVX can be verified which demonstrates the role of OVX as a gauge of investor fear. However, the level of their negative dependence is time-varying which greatly influenced by extreme oil related events. In general, the negative dependence presents persistent and jump characteristics in different periods. For example, during the periods of Libya war and the crisis in Ukraine, the magnitude of dependences strengthen significantly which presents jump shape in the time-varying depedence curve. In particular, the asymmetric dependence between oil price returns and OVX is also confirmed. It means there is significant difference of dependence between the situation of oil price increase when OVX decreases and oil price decrease when OVX increases. The results of the mean of exceedance dependence between oil price returns and OVX indicate that a jump exists with respect of the axis of zero, reflecting significantly asymmetric dependence. The dependence is larger when oil prices decrease sharply relative to that of oil prices increase.

Conclusions

In summary, this paper provides a new perspective on the relationship between return-volaility in oil market in which implied volatility is introduced. Moreover, a asymmetric time-varying dependence between oil price returns and OVX is investigated by new model. Our empirical results indicate that OVX has been designed as a well-depicted gauge of investor fear because of its high negative degree of comovement followed by oil price changes. In addition, the asymmetric dependence between them is also disclosed, which provide reference on

risk avoidance by designing asymmetric hedging ratio under different market conditions. Obviously, our empirical results indicate that in the current oil market condition, oil price changes will induce larger impact on the marekt sentiment which can easily disrupt the market confidence of oil price stability.

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