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RISK MANAGEMENT AND PORTFOLIO OPTIMIZATION FOR GAS- AND COAL-FIRED POWER PLANTS IN GERMANY: A MULTIVARIATE GARCH APPROACH

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Overview

This study focuses on the risk management in the German power market and specifically on examining the needs for conventional thermal power generation. The recent reforms in Germany changed the market's structure by subsidizing and prioritizing the electricity produced from Renewable Energy Sources (RES). This decision had a negative impact on the market by eroding the economic viability of a significant portion of coal and NG-fired power plants. Therefore, the rise of RES has undermined the competitiveness of traditional power generation. This fact broke to the forefront the necessity for mitigating the risk exposure in order to confront the sluggish demand and handle this acute for the power plant owners situation.

Methods

The main principle of our method is to assess and choose the optimum forward contract for simultaneously hedging power output and fuel purchase. This is achieved by evaluating the hedging effectiveness of the available futures contracts (NG, electricity, coal) at the EEX. The calculation of the hedging performance is based on the results of applying a multivariate GARCH model (BEKK model). Finally, in the framework of mean-variance portfolio optimization we construct the efficient frontier, in order to identify the point at which the combination of spot and forward prices gives the maximum reduction of risk exposure.

Results

According to our results, it is more prudent, to hedge the spot electricity and coal prices with long-term contracts, while for the NG the short-term futures appear to perform better. Additionally, we find a poor hedging performance of the electricity futures, whereas year electricity futures yield the highest risk reduction, as they undergo the least volatility. Moreover, NG futures seem to attain a better hedging performance compared with electricity. Month NG futures is the optimum contract for curtailing the risk derived from the spot market. In contrast, hard coal futures appear to have a hedging effectiveness of more than 50%. Finally, only NG bears a viable portfolio but the expected returns are so low that investing becomes highly unattractive.

Conclusions

First of all, it is verified and quantified the necessity for hedging in energy markets at a time when energy companies experience the biggest economic problems in their history. NG-fired power plants are suffering from severe losses, because wholesale peak-load electricity prices have plummeted as renewable electricity generation has surged. The historical spot and hedged VaR of the Clean Spark Spread (CSS) reveals that the profitability of the specific power plants is declining. On the flip side, coal-fired power plants have succeeded their profitability since the Clean Dark Spread (CDS) remains positive, also due to the price collapse of the emission allowances. To conclude, the decision to diversify through combining multiple futures contracts or spot commodities prices turn out to be unprofitable.

References

Botterud A., Kristiansen T., 2010. The relationship between spot and futures prices in the Nord Pool electricity market. Energy Economics, 32, 967 – 978.

Chang C., McAleer M. Tansuchat R., 2011. Crude oil hedging strategies using dynamic multivariate GARCH. Energy Economics, 33, 912 – 923.

Charalampous G., Madlener R., 2013. Risk Management and Portfolio Optimization for Gas- and Coal-Fired Power Plants in Germany: A Multivariate GARCH Approach, FCN Working Paper No. 23/2013, Institute for Future Energy Consumer Needs and Behavior, RWTH Aachen University, December.

Cotter J., Hanly J., 2012. A utility based approach to energy hedging. Energy Economics 34, 817 – 827.

Ripple D., Moosa A., 2007. Hedging effectiveness and futures contract maturity: the case of NYMEX crude oil futures. Applied Financial Economics, 17, 683 – 689.