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Abstract on GARCH Models: Financial modeling

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Until the early 1980s, econometrics developed at a relatively slow pace. It was very difficult to break free from the classical statistical paradigm. But with the meteoric rise of information technology, econometrics has experienced a significant increase in the past twenty years. Just think of the rampant proliferation of non-linear econometric models, volatility models and new estimation techniques like GMM or the simulated moment method, to name a few new fields in contemporary econometrics.

But what is even more striking is the advancing pace of econometrics in the field of financial theory. Indeed, the theory of derivatives, which has its source in the early 1970s, increasingly uses econometric models of volatility, such as GARCH models, and the GMM method to estimate the parameters of stochastic differential equations, which are used to determine option prices, among others. Econometrics has also enabled the CAPM model, well known in financial theory, to overcome its static framework. We can now speak of time-varying betas and the transposition of the GARCH approach to CAPM has made it possible to situate it in a multivariate framework.

On the other hand, modeling volatility is an important issue in research on the financial and energy markets. However, there is no answer for the choice of the best models and the measures of price volatility are due to the complexity of the energy price rebate where this problem motivated several researchers after the financial crisis of 2008. Relations between the stock market and the oil market have attracted particular attention from practitioners and academics. A strong relationship between them would have significant implications for political and economic decisions since negative shocks affecting one market can be quickly transmitted to the other through contagious effects.

Empirical evidence on the relationship between stock and oil prices has been documented by numerous studies. Several works deal with the impact of the price of oil on stock market

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indices. However, a limited amount of research addresses the effect of the oil market on asset returns and the effect of its volatility on index prices.

Moreover, Jones et al. (1996) used quarterly data to verify whether the reaction of international stock markets to changes in the price of oil can be justified by the change in expected yields in countries such as the USA, Japan, and Canada. They find a stable and negative relationship between the evolution of the price of oil and the returns of stock market indices. This relationship is more relevant in the case of Japan than that of Canada. Also, these authors show that current prices and lagged oil prices negatively affect stock market performance. Jones and Kaul (1996) use simple regression models to study the impact of oil prices on stock returns in the United States, Canada, Japan and the United Kingdom, and also find that oil prices have a negative effect on all countries. El-Sharif et al. (2005) were used daily and monthly data to examine the relationship between oil prices and inventory returns for states United States and the United Kingdom. More recently, Arouri et al.(2010,2011); also Ji and Fan have used a recently developed VAR-GARCH approach to analyze the volatility spillovers between the oil and stock markets in Europe.

Huang et al.(1996) used a VAR model to examine the existing relationship between oil price returns and the daily return on the S&P 500 index. They find that there is a relationship between the yield of oil and the market value of certain oil companies; on the other hand, there is no significant interaction between the price of oil and the S & P_500 composite index. Sadorsky (1999), is the first to address the issue of asymmetry in the relationship between oil prices and stock market returns. It shows that volatile oil prices play a more important role than that played by the interest rate in explaining the behavior of US stock indices. Indeed, the impulse response function to the shock of the estimated VAR, shows that the positive shocks materialized by an increase in the price of oil had a greater impact on the index, and that a negative shock illustrated by a fall in the price oil, does not have the same effect on the variation of the S & P_500 index.

PARK and Ratti (2008) , analyze the respective impacts of oil prices and their volatility on stock market returns in the United States and in 13 industrialized countries in Europe. Using the same methodology as Sadorsky (1999), they show that oil price shocks have a statistically significant effect on the return on stock market assets, either contemporaneously in the same month or with a lag of one month. In addition, the effects observed vary by country. For most EU countries and not for the USA, the increased volatility reduces the return on assets in a contemporary way or with a lag of one month.

Financial series are characterized by volatility, which varies over time, by high kurtosis, by asymmetry and by persistence of volatility shocks. The conditional variance, which is a measure of the volatility of a series, is no longer constant and the volatility depends on these

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past values.

To take this phenomenon into account, Engle (1982) and Bollerselv (1986) developed the ARCH (AutoRegressive Conditionally Heteroscedastic) and GARCH (AutoRegressive Conditionally Heteroscedastic Generalized) models. These models are an extension of the ARMA model, introduced by Box and Jenkins in 1971.

According to Bera and Higgins (1993) , this ARCH / GARCH modeling and its extensions correspond to a specific representation of non-linearity, which allows a simple modeling of uncertainty.

In the econometrics of univariate time series, GARCH models seem to be the most suitable for forecasting financial series. The choice of these models is dictated by the properties which characterize these series, namely: stationarity, the auto correlation of the squares of price variations, the thick distribution tails, the volatility clusters, the conditional thick tails, the leverage, seasonality, and asymmetry.

In addition, univariate GARCH models have been used to model the volatility of oil prices since the early 1990s and have become standard practice. Despite the explosion of new types of GARCH models, including the multivariate GARCH model from Bollerslev (1986), GARCH from Baillie RT, Bollerslev, T., and Mikkelsen, HO (1996, GARCH nonparametrics de Bühlmann, P. and McNeil, AJ (2002), and GARCH of the multiplicative component of Engle, R. & Sokalska, ME (2012), also Joshua CC Chan, Angelia L. Grant (2015), Zeghdoudi and Bouseba(2015), Zeghdoudi et al.(2013a,2013b), the simple GARCH type models (1,1) remain very useful because they converge much more quickly towards a local maximum when using an estimation by the quasi-maximum likelihood method, while delivering performance of predictions which are not necessarily inferior to the multivariate models of Yudong Wang and Chongfeng Wu (2012).

Recently, Guerouah and al.(2017) examine the dynamic correlations between stock prices namely SP500, NIKKEI225, CAC40 and crude oil (WTI). More precisely, we use a univariate GARCH (1,1) model and the bivariate BEKK GARCH (1,1), DCC GARCH (1,1) models, during the period from August 1987 to October 2016, focusing on the correlations dynamic conditional estimates between stock market indices and the price of oil. This approach makes it possible to study the dynamics of second-order moments in the prices of stock market indices and crude oil, taking into account long-term dependency behavior, asymmetries and leverage.

The BEKK GARCH (1, 1), DCC GARCH (1, 1) models are identified as the best specification and the best flexibility to model the conditional heteroskedasticity of individual time series. We then extended the above univariate GARCH models to a bivariate framework with dynamic conditional correlation parameterization in order to study the interaction between oil prices and stock market indices.

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The above results could be important for better understanding the relationship between oil prices and stock indexes and could be useful for investors and other market participants such as financial managers, analysts and companies to manage their investments and minimize their risks.

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