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Econometric Modeling for the Management and Decomposition of Financial Risk

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ABSTRACT

This research presents a methodological analysis that will allow to actively man-age the risk of financial assets, through an understandable study and mix of technical differences used by the financial literature. In this way, the research will al-low the delivery of precise information on the risk-generating components of the assets studied. The methodology used corresponds to the wavelet decomposition method, combined with the VaR methodology, which as a whole proves to be an efficient way of controlling the financial risk of the investment portfolios used, thus allowing to identify the main risk generating components to which it is ap-plied. investors and fund managers submit.

Keywords: Financial risk, Latin America, Value at risk, Econometric modeling

INTRODUCTION

The estimation of the processes that generate the financial time series is a topic that has had a strong explosion of scientific development in the last decade, mainly due to the high complexity of the financial series with the one faced by fund managers in the financial market. We can understand this high complexity due to the higher levels of integration of financial markets at the international level, which are subject to factors inherent to the evolution of the markets on which financial assets are based. and others of a temporary nature, which affect the relative positions in a given period of time, which brings with it strong capital gains or losses for the operators of the financial system.

The foregoing generates strong incentives for the use of increasingly complex and sophisticated techniques for estimating financial series, using procedures from developments from the exact sciences to be able to describe behavior to the time series of financial assets, especially the estimation of risk factors faced by investors, operators and administrators of financial markets.

The description of the risks faced by operators in the financial market determines the incentives to which they are exposed and identifies the value that said operator delivers to the fund on which it operates through measurement. one of the performance it demonstrates, as mentioned by (Agarwal and Naik, 2004).

A relatively modern development for the characterization of time series corresponds to the use of Wavelets in estimating models of various kinds, as mentioned by (Kanarachos et al., 2017) who describe the use of these techniques in fields as diverse as prediction of telluric phenomena, analysis of social networks, prevention of heart attacks, etc. being the main growth factor in the area of development of algorithms for the detection of anomalies in the time series, as mentioned by (Akhoondzadeh, 2015; Georgoulas et al., 2013), among other authors.

(Struzik, 2001) mentions the importance of working with wavelet techniques in financial time series since they allow a decomposition of spectral bands, extracting noise or purely random elements and allows obtaining the generating source of the phenomenon. Financial phenomenon, which in turn allows an adequate characterization of the financial phenomenon and subsequent data treatment. Authors such as (Conlon et al., 2008; Conlon and Cotter, 2012; Bruzda, 2017), among many others, use these techniques to develop new procedures for estimating prices, hedging against queue events, portfolio management and other applications that are used in the financial sector as a means of obtaining higher capital gains, taking advantage of the available information contained in the same financial time series.

Specifically, financial risk management, using a wavelet approximation, can be found in (Fernandez, 2005; Jammazi and Nguyen, 2017; Cifter, 2011; Bruzda, 2017), among others, who use an approximation financial risk analysis using Value at Risk, a technique that represents the 'gold standard' as a measure of financial risk and that is widely recognized and used by the financial industry as a methodology to ensure the adequate financial risk management to which financial institutions are subjected (Marhuenda, 2002; Chen, 2014; Stupariu, 2016).

In this work we will use a novel strategy to determine the behavior of the financial series, based on the work of (García-Treviño and Barría, 2014), who determine the behavior of the time series by estimating the distributions of each generating component, coming from a spectral decomposition by means of wavelets. Once the time series have been characterized in their different components, we proceed to carry out a Monte Carlo simulation in order to estimate the expected value of the series, allowing us to work with time series without excessive noise, which favors the study of different phenomena. present in the financial series.

METHODOLOGY

The theory behind wavelets is based, from a mathematical perspective, on the development of Fourier transforms and has become a means of providing information on the fundamentals of behavior that underlie the phenomena behind the time series. The understanding of the generating components of

the time series allows to carry out more enriching analyzes, which entails a greater capacity for inductive analysis on the phenomena found in the generation of the series itself. time, which in the case of a financial time series, allows us to understand the economic phenomenon that generates transactions in the financial market.

This allows to estimate the various scenarios that the time series can take, assuming that the wavelet components come from a family of probability distributions and that they are based on a long scale function term that follows the fundamental changes of the economic phenomenon, while the wavelets respond to short and medium term stimuli that are responsible for the existence of market transactions.

The Value at Risk (VaR) is a single and summarized statistical measure of possible portfolio losses, as mentioned by (Linsmeier et al., 1996; Hendricks, 1997; Yamai eta al., 2002), among other authors. Specifically, VaR is a measure of losses due to 'normal' or usual movements in the financial market. The development of this risk measure has been implemented in various financial instruments, not only applied to financial series, but can be applied to the monitoring of investment portfolios, risk of non-payment of the debtors of a portfolio, among many other applications in the financial industry.

The VaR model is very useful when there is evidence of simultaneity between a group of variables, and that their relationships are transmitted along a certain number of periods. By not imposing any restrictions on the structural version of the model, the specification errors that such restrictions could cause the empirical exercise. In fact, the main motivation behind VAR models is the difficulty in identifying variables as exogenous, as must be done to identify a model of equations simultaneous.

Subject to the simplifying assumptions used in its calculation, VaR aggregates all the risks in a portfolio into a single number that can be interpreted simply as a way of describing the magnitude of the potential losses at which it stands. The investor has been subjected to the possession of a portfolio of financial assets, being one of the main methods of performance evaluation in the financial industry.

The importance in the financial industry is given by the need to control possible fluctuations during certain periods in which large losses can occur. For example, during the year 2008-2009 there were significant losses in the financial market due to the financial crisis known as Subprime, affecting a large number of individual and institutional investors due to large bank runs and massive closing of positions in the markets. After this extreme phenomenon in the financial world, public questions were based on the high risks assumed by financial operators and on the low control and risk management that were used in the management of financial assets.

We proceed to link the wavelets decomposition techniques with the use of VaR as a financial risk management method, through the proposal of a methodology that consists of carrying out a simulation Monte Carlo test of each of the components of the wavelet subpatterns of the time series, for the subsequent reconstruction of the series and thus to be able to measure the variability and intrinsic risk of the financial series. The use of the intrinsic risk

of the financial series allows us to take actions on the portfolio composition by actively managing financial risk.

In this paper we use public data from the financial market, specifically the SP500 stock index, considering daily closing data from January 1, 2006 to May 2, 2017, in this way we avoid drawbacks of working with data subject to the payment of dividends and splits, in addition to being a representative series of a major global stock market.

From the application of VaR by means of the decomposition of generating distributions, it can be seen that the confidence bands of each point, using the approximation that has the best fit, in this case by means of the empirical distribution.

It is possible to observe certain periods of high volatility where the VaR loses effectiveness, being that the assumption behind the proposed methodology is that of constant volatility, which in principle can alter the results, but which gives clear indications of the subsequent developments that must be carried out in order to fully understand the phenomenon of construction of financial series.

CONCLUSION

The characterization of the VaR by means of the analysis of the structural generating components, allows to have a different vision on the behavior of the financial series in which now we can identify the families of components that define the behavior of financial assets and, thus, to be able to define new protection strategies against market fluctuations.

If stability is assumed in the parameters of the generative distributions of each wavelet component of the financial series, this allows active risk management by being able to simulate the different return scenarios and, therefore, of prices. of financial assets, which allows new strategies for active financial risk management.

Elements to consider in subsequent studies suggest the study of events of auto-correlation or variable variance, in order to be able to characterize the evolution of the financial series and complete the risk analysis, which loses efficacy in periods of variable volatility (Umaña-Hermosilla et al., 2021; Umaña-Hermosilla et al., 2021b; Cisternas-Caneo et al., 2021; Crawford et al., 2018).

In this research we do not delve into the economic sources that generate the families of distributions of the different generating components, but rather into the statistical characteristics that form it, which in turn is a challenge. from economics science to understand the original sources that cause fluctuations in financial markets (Ayala et al., 2021; Rubilar et al., 2021; Chahuan et al., 2021; De la Fuente-Mella, 2021).

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