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The Copula ADCC-GARCH model can help PIIGS to fly

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ABSTRACT

Recent crises have revived the interest of researchers to investigate the economic characteristics of regions such as the PIIGS, which have been the Eurozone's most troubled economies. We show that it is possible to obtain benefits from investing in these markets by using time-varying returns and volatility forecasts from a Copula-ADCC-GARCH with structural breaks model. The results show that the use of this approach leads to a significant improvement of the Sharpe ratio when compared to the naïve strategy and the optimal portfolios based on a simple multivariate GARCH approach such as the DCC model, even when different transaction costs are considered.

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1. Introduction

The analysis of time-varying linkages and co-movements between equity markets has received a great deal of attention from researchers and investors in recent years. A wide variety of methodologies have been used by researchers, not only for analyzing time-varying linkages among equity markets, but also to optimize different portfolios, see Syriopoulos and Roumpis (2009), Guidi and Ugur (2014) and Miralles-Marcelo et al. (2015) among others.

Furthermore, recent crises have revived the interest of researchers in investigating the economic characteristics and influence of specific economic regions such as the PIIGS¹ (Portugal, Italy, Ireland, Greece and Spain), BRICS (Brazil, Russia, India, China and South Africa) and MENA (Middle East and North African countries) see Samitas and Tsakalos (2013).

The objective of identifying new diversification opportunities leads us to focus our work on the PIIGS's stock markets. These countries have been the Eurozone's most troubled economies and, in theory, they are not interesting for the international investors. However, apart from Greece, they recently seem to be recovering due to improved fundamentals, rising consumer confidence and demand, booming exports and declining unemployment. These factors have been crucial in steering these economies back on their tracks. Additionally, investor confidence in these countries is increasing since in Portugal, Italy, Ireland and Spain, we find lower yields in the ten-year government bonds than the yield offered on the U.S. ten-year Treasury note on the same day. In our opinion, those facts will lead to a greater interest in these countries and, therefore, to better investment opportunities.

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¹ They are also known by the acronym of GIPSI (Greece, Ireland, Portugal, Spain and Italy) if they are ordered by the magnitude of their credit risk. This acronym was created in 2010, so the data to order them refer to that date.

In this context, the aim of our study is to provide evidence that it is possible to obtain benefits from investing in these markets by using time-varying returns and volatility forecasts from a Copula-ADCC-GARCH with structural breaks model.

We improve the previous empirical evidence in various ways. Firstly, we consider the Copula-based Multivariate GARCH model proposed by [Lee and Long \(2009\)](#), the use of a semiparametric approach to estimate the cumulative distribution function (CDF) of each standardized residual series as in [Harris and Mazibas \(2013\)](#), and the extensions of the DCC model allowing for asymmetries and structural breaks as in [Cappiello et al. \(2006\)](#) and [Kalotychou et al. \(2014\)](#). We then merge all these multivariate techniques in a way that, to our knowledge, is used for the first time in the empirical evidence to propose the use of a Copula-ADCC-GARCH model with structural breaks.

Secondly, most of the empirical evidence based on the DCC models is focused on analyzing the time-varying correlations. However, we employ this approach for forecasting returns, variances and covariances, and solving different allocation problems. Therefore, we provide the out-of-sample performance of an optimal portfolio constructed on the basis of time-varying return and volatility forecasts from the Copula-ADCC-GARCH model with structural breaks approach. The results achieved on the portfolio optimization problems are compared with those obtained from an equally weighted portfolio, also known as naïve portfolio, following the common procedure in the previous empirical evidence.

Finally, the database used, from January 7, 1998 through December 31, 2014 comprises different financial crises in the PIIGS countries, which gives more value to the possibility of finding an approach where performance is improved.

The results show that the use of forecasted returns and volatilities from a Copula-ADCC-GARCH model with structural breaks approach for solving the optimization problems lead to a significant improvement on the portfolio performances. Moreover, we prove that there are benefits in investing in the PIIGS countries using a mean-variance strategy instead of two alternative strategies which were also considered alongside the naïve, which was the benchmark. That mean-variance strategy clearly outperforms the other ones with significant positive Sharpe ratios, even when different transaction costs are considered.

The remainder of this paper is organized as follows. In Section 2 we present a review of related literature. In Section 3 we outline the methodology employed to construct and evaluate the performance of the proposed diversification strategy. Section 4 defines the database. Section 5 shows the principal results and Section 6 provides the main conclusions.

2. Literature review

One of the most important issues in finance in recent years has been the analysis of linkages among stock markets. [Aloui et al. \(2011\)](#) are interested in modeling the co-exceedances of stock market returns below or above a certain threshold on those emerging countries known by the acronym of BRIC (they do not consider the South African stock market). They test for both the degree and type of their dependence at extreme levels. In order to do so, they combine different GARCH models with copula functions and extreme value theory grouping the variables by pairs. They provide evidence of extreme co-movements for all market pairs both in the left and right tails.

[Dimitriou and Kenourgios \(2013\)](#) examine the time-varying linkages among US dollar exchange rates in five currencies. They employ a Multivariate FIAPARCH (1,d,1)-DCC model, which allows long-range volatility dependence and an asymmetric response of volatility to positive and negative shocks. They specify the length and phases of different crises using both an economic and statistical approach (Markov Switching Dynamic Regression model). Based on different analyses over the time-varying correlations and the conditional variances obtained from the model, they find that the majority of the conditional correlations among currencies decline across the different phases, which indicates their varying degrees of vulnerability.

Similar approaches are used by [Dimitriou et al. \(2013\)](#) and [Kenourgios \(2014\)](#). [Dimitriou et al. \(2013\)](#) investigate the existence of contagion mechanism in the US stock market and the BRICS using a Bivariate AR(1)-FIAPARCH (1,d,1)-DCC model. Their findings support a general pattern of decoupling for some of the BRICS's markets at the early stages of the Global Financial Crisis, and a recoupling for almost all markets after the failure of Lehman Brothers.² [Kenourgios \(2014\)](#) investigates volatility contagion across U.S. and European stock markets during the Global Financial Crisis and the Eurozone Sovereign Debt Crisis by employing an AR-GJR-GARCH-A-DCC process. In this case the author finds a different pattern of infection across the phases, which are also specified by combining both an economic and statistical approach (where the VIX is used as an aggregate proxy for international risk).

[Kenourgios et al. \(2011\)](#) investigate contagion in a multivariate time-varying asymmetric framework focusing on the BRIC (once again the South African stock market is not considered), U.S. and U.K. stock markets on different financial crises. They confirm the existence of a contagion effect from each crisis country on all others.

On the basis of a DCC-GARCH model, [Ahmad et al. \(2013\)](#) analyze the time-varying cross market co-movements of GIPSI, U.S., U.K. and Japan markets on BRIICKS.³ They find financial contagion of GIPSI on BRIICKS stock markets. Their results also show that Ireland, Italy and Spain appear to be the most contagious for BRIICKS markets, compared to Greece.

² Other interesting studies are those of [Hon et al. \(2007\)](#), [Syriopoulos and Roumpis \(2009\)](#), [Singh et al. \(2010\)](#), and more recently [Jacobs and Karagozlu \(2014\)](#) and [Guidi and Ugur \(2014\)](#).

³ They are conscious that the usual acronym is BRICS but they include Indonesia and South Korea due to their strong economic and trade relations with the BRICS countries.

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