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Forecasting correlations during the late-2000s financial crisis: The short-run component, the long-run component, and structural breaks

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ABSTRACT

The predictive power of recently introduced components affecting correlations is investigated. The focus is on models allowing for a flexible specification of the short-run component of correlations as well as the long-run component. Moreover, models allowing the correlation dynamics to be subjected to regime-shift caused by threshold-based structural breaks of a different nature are also considered. The results indicate that in some cases there may be a superimposition of the long-term and short-term movements in correlations. Therefore, care is called for in interpretations when estimating the two components. Testing the forecasting accuracy of correlations during the late-2000s financial crisis yields mixed results. In general, component models allowing for a richer correlation specification possess an increased predictive accuracy. Economically speaking, no relevant gains are found by allowing for more flexibility in the correlation dynamics.

1. Introduction

Nowadays there is a widespread empirical evidence that asset correlations vary over time and across assets. Starting with the seminal dynamic conditional correlation (DCC) model proposed by Engle (2002) as a generalization of Bollerslev's (1990) constant conditional correlation (CCC) model, researchers have tried to take this time-varying behavior of the correlation dynamics into account. Most such models have focused on the idea that there are different short- and long-run sources that affect correlations, which may be naturally interpreted according to certain economic principles. The approaches proposed in the literature have mainly estimated only one such component (see, for example, the DCC model proposed by Engle (2002) and almost all its generalizations such as, for example, Otranto (2010), Alp and Demetrescu (2010) or Santos and Moura (forthcoming); Ledoit et al. (2003) for the short-run component; and Pelletier (2006) for the long-run component). More recently some studies that place more emphasis on the estimation of both sources simultaneously have been proposed, including, among others, the models proposed by Engle and Rangel (2012), Silvennoinen and Teräsvirta (2009), Hafner and Linton (2010), Colacito et al. (2010), and Audrino and Trojani (2011). This study focuses on the last two modeling approaches.

Following a recent stream in the literature on volatility, Colacito et al. (2010) apply the idea of a component model to the estimation of dynamic correlations. The model proposed in that study uses Engle's DCC-type approach to capture the short-term correlation dynamics in connection with a long-run component. This component is extracted via the mixed data sampling (MIDAS) technique recently discussed by Ghysels et al. (2006) and Forsberg and Ghysels (2007), among others, and applied to the problem of volatility forecasting. In two applications, Colacito et al. (2010) find that extending the standard

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autoregressive short-lived DCC dynamics to take into account a (possibly) economically interpretable long-term component significantly improves the fit of the model and allows one to devise more profitable portfolio allocation strategies.

Audrino and Trojani (2011) propose a unified, generalized framework for dynamic correlations in which the choice of the type of short-run dynamics (i.e., constant, CCC, or dynamically changing, DCC) is completely data-driven. In their model, the long-run component is allowed to change smoothly over time via some rolling, equally weighted unconditional correlation averages constructed in the spirit of the MIDAS approach. Moreover, the long-term correlation component is subjected to drastic structural breaks and regime shifts according to the multivariate dynamic behavior of some relevant (exogenous or endogenous) underlying variables. Fitting their model on three different data sets, Audrino and Trojani (2011) find that both components are not always relevant for improving the accuracy of the correlation estimates and predictions: In some cases, a simple CCC structure for the short-term behavior of correlations and a slowly moving long-run component subjected to jumps caused by structural breaks of a different nature yield performances superior to those from models such as DCC-type models.

Other recent empirical studies analyzed the forecasting accuracy of multivariate GARCH models proposed to estimate the conditional covariance matrix dynamics of a series of financial assets: see, among others, Audrino (2006), Laurent et al. (2012), and Caporin and McAleer (forthcoming). In these studies the role of the different components driving correlations was not investigated. In particular, Audrino (2006) and Laurent et al. (2012) focused on the question of how to choose a GARCH-type model for the individual conditional variances in the different multivariate GARCH settings and its relevance and impact on the final accuracy of the conditional covariance estimates. Recently, Silvennoinen and Teräsvirta (2009) performed an empirical analysis that included the DCC approach and models with short- and long-term components which showed the differences in the resulting correlations. However, their study focused more on in-sample estimation than on forecasting. Engle and Rangel (2012) studied the long-term forecasting power of a model allowing for a slowly varying long-term component in correlations and found that such a model outperforms the classical DCC model. In the same spirit, using different models in the DCC setting and different evaluation criteria, we test the contribution to correlation forecasting accuracy of the components affecting correlations.

The main purposes of this paper are twofold. First, we raise the question whether the models really allow for a natural and clear distinction of the different components driving correlations as asserted when these models were introduced in the literature. Second, we contribute to the correlation literature by better investigating the role of the short- and long-run components outlined above for correlation prediction in periods of market turbulence. Moreover, we allow one or both components to be subjected to regime shifts, and we evaluate the additional forecasting power that may be gained from this increased flexibility in modeling correlation dynamics.

To this end we run a horse race considering the most relevant models applied to two (updated) data sets already used in the past literature by Colacito et al. (2010) and Audrino and Trojani (2011); namely, Fama-French industry portfolios and the long-term bond and a nine-dimensional US stock example. Performance is evaluated both in statistical and economic terms and, at least for the US stock data set, comparisons are based on very accurate correlation measures computed using high-frequency data. In particular, we unify the settings considered in Colacito et al. (2010) and Audrino and Trojani (2011) and we focus more intensively on the differences in the forecasting power of the three effects that have been identified as the main drivers of correlation dynamics: short-run and long-run components, and regime-switches.

For some applications, disentangling the long-run movements from the short-term behavior of correlations may be very difficult. In fact, with certain data sets, analysis cannot yield any clear conclusion about which type of component has been estimated. This superimposition leads to enormous difficulties in interpreting the results and precludes clarification of the predictive power of the different effects. One such example is shown in Fig. 1. The data under investigation are the short-run and long-run components of the daily correlations between two Fama-French industry portfolios, i.e., the energy and the hi-tech portfolios, and the 10-year bond. This data set is an updated version of the one investigated in Colacito et al. (2010).

As can be seen in the figure, the ex-post estimated correlations using a model focusing only on short-lived dynamics (DCC) and those from a model capturing the long-term correlation behavior (CCC-MIDAS) are almost indistinguishable. In fact, the absolute difference between the correlation estimates is never greater than 0.08. As this empirical study demonstrates, this fact will be reflected in a comparable statistical and economic performance of the models. Interpretation of such correlation estimates as short-run or long-run dynamics must therefore be made with caution.

Clearly this may not be the case for other data sets, as shown in Fig. 2. The data considered in this case are part of a nine-dimensional US stock example. As an illustration we report the correlation estimates between Nike and Microsoft. Once again this is an updated version of the data set investigated in Audrino and Trojani (2011).

Differences between the short-term DCC movements and those stemming from a CCC-MIDAS model focusing on long-run dynamics are particularly evident. In particular, the long-run component obtained by the CCC-MIDAS estimation shows some trend movements during the time period under investigation whereas, as expected, the DCC short-run dynamics are less disperse and mean-reverting around a constant long-term correlation value of about 0.3. Such different behavior of the two correlation components allows for a clear distinction and also (possibly) a natural interpretation of the two effects using certain economic principles. This impression is even more evident when we superimpose the correlation estimates obtained using CCC-MIDAS and DCC-MIDAS approaches. Results are shown in Fig. 3.

The plot at the top of Fig. 3 shows that the MIDAS long-run components estimated in the CCC and DCC settings match particularly well and are characterized by a general downward trend during the period under investigation. The bottom panel clearly shows that for these data, the estimation of both short- and long-run components produces different results

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