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Ex ante performance from *ex post* models of global equity market correlations

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ABSTRACT

Analysis of *ex post* returns reveals the time series properties of correlations, but *ex ante* correlations are required for efficient diversification. We find that a time-varying parameter model offers the best fit to *ex post* global equity market correlations, suggesting changing mean correlations and changing rates of adjustment back to the means. Nevertheless, we do not find improved forecast performance from time-varying parameter models in holdout periods. The added complexity of time-varying models does not translate into lower forecast errors.

1. Introduction and purpose

Empirical research on international diversification began in the early 1970s (e.g., Levy & Sarnat, 1970; Solnik, 1974). Risk reduction from diversification across national markets should allow investors to reduce total portfolio risk without sacrificing return. The fundamental premise of international diversification is that phenomena unique to each country drive equity performance, resulting in low correlations between national market indices. Potential gains from international diversification rest on the correlation structure of return indexes for different global investment markets over a given planning period. These correlations are key inputs for construction of efficient portfolios and international diversification strategies. More recent research focuses on changes in correlations of international equity indexes and the consequences of such changes for diversification and hedging. The findings are controversial and new approaches are evolving to explore the time series movements of international equity correlations.

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Studies by Erb, Harvey, and Viskanta (1994); Longin and Solnik (1995); and Solnik (1996) suggest that complex changes occur in correlations between national equity markets over time. Solnik, Boucrelle, and Le Fur (1996) (hereafter referred to as SBL) find a pattern where correlations between national market indices increase in periods of high overall market volatility. When long holding periods are analyzed, SBL find that long-run mean correlations have not changed, but deviations of correlations from the long-run mean are higher when major market shocks occur. Researchers commonly use the generalized autoregressive conditional heteroscedastic (GARCH) model or the multivariate version of GARCH (MGARCH) to control for changing volatility with either constant or varying correlations. For example, Karolyi (1995) used different versions of the MGARCH model to study the international transmission of stock returns and volatility. More recently, Longin and Solnik (2001) (hereafter L&S) use "extreme value theory" to show that relationships between international equity market correlations and volatilities found in prior studies are likely to be spurious. They find that correlations are related to market trends, not volatility. L&S do not identify the exact time-varying distribution of correlations, but they reject the use of multivariate GARCH (MGARCH) models with constant correlations. Ang and Bekaert (2002) extend the analysis of changing correlations and volatilities to portfolio construction by using a regime-shifting model. Their findings support L&S in two important ways. First, they find that bear market trends are not associated with high volatility, as suggested in prior research. Second, they also suggest that GARCH models are inconsistent with the asymmetric correlation pattern of international equity market returns.

Tse and Tsui (2002) (hereafter T&T) provide a methodological breakthrough with their version of a MGARCH model with time-varying correlations. Preliminary results from small-sample Monte Carlo analysis of the maximum likelihood estimator in T&T's model are encouraging but more work needs to be done. The T&T paper assumes that the correlations follow an autoregressive moving average stochastic process. They also force the model to converge to this process by using imposed restrictions.[1] We do not know how the model performs with other plausible stochastic processes and a forced convergence with a positive definite correlation matrix. In this paper we test for the time series process for international equity correlations directly as a first step in our analysis.

Of all the various modeling approaches to international equity market correlations, L&S suggest that models allowing for changing correlations could be consistent with the observed international equity market correlation patterns. In this paper we first use a flexible time-varying parameter (hereafter noted as TVP) model to test for the stochastic process that best describes the *ex post* movements of international equity market correlations. Next, we examine the forecasting performance of alternative time series models of correlations to determine if statistically significant time series relationships have a material impact on forecasts of next period correlations. We do not find a material gain from more sophisticated forecast models when we use holdout data to measure the mean absolute error (MAE) and the Mean Square Error (MSE).

2. *Ex post* measures of *ex ante* correlations

A better understanding of the time series properties of global equity market correlations is important for several reasons. First, time variation in global equity indices may mean that correlation estimates from past data do not accurately represent future correlations. Portfolios will not offer the expected "efficient" performance if correlations used in the diversification algorithm are not the correlations during the performance measurement period. Second, errors in forecasting correlations between international equity indexes lead to improper hedge ratios. A number of different models may be applied to *ex post* data to generate the necessary *ex ante* correlations for international investing. Global equity market correlations need not be constant for historical estimates to be valuable. The *ex post* mean correlation is still a good predictor of the *ex ante* correlation if the time series of correlations is a random variable around a stationary mean. In this case, correlations would be reasonably normal and would have a unit root. Alternatively, if the correlation series is a random walk over time, the last observed correlation is the best estimate of future correlations. If an autoregressive process describes the time series of national equity market correlations, a forecasting model based on the rates of autoregression provides the best estimate of

[1] For a specific reference to the assumed stochastic process and restrictions see Tse and Tsui (2002) page 362, col. 1, paragraph 2.