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Quarterly beta forecasting: An evaluation

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Abstract

Ever since the inception of betas as a measure of systematic risk, the forecast error in relation to this parameter has been a major concern to both academics and practitioners in finance. In order to reduce forecast error, this paper compares a series of competing models to forecast beta. Realized measures of asset return covariance and variance are computed and applied to forecast beta, following the advances in methodology of Andersen, Bollerslev, Diebold and Wu [Andersen, T. G., Bollerslev, T., Diebold, F. X., & Wu, J. (2005). A framework for exploring the macroeconomic determinants of systematic risk. *American Economic Review*, *95*, 398–404; and Andersen, T. G., Bollerslev, T., Diebold, F. X., & Wu, J. (2006). Realized beta: Persistence and Predictability. In T. Fomby & D. Terrell (Eds.), *Advances in Econometrics, vol 20B: Econometric Analysis of Economic and Financial Times Series.*, JAI Press, 1–40.]. This approach is compared with the constant beta model (the industry standard) and a variant, the random walk model. It is shown that an autoregressive model with two lags produces the lowest or close to the lowest error for quarterly stock beta forecasts. In general, the AR(2) model has a mean absolute forecast error half that of the constant beta model. This reduction in forecast error is a dramatic improvement over the benchmark constant model.

Keywords: Portfolio management; Realized beta; Systematic risk

1. Introduction

Beta, emanating from the pioneering work of Sharpe (1964) and Lintner (1965), is a foundation stone of modern finance theory, and is a focal point of countless investment and financing decisions. Despite the widespread usage of beta, its effectiveness as a parameter in asset pricing, cash flow evaluation and portfolio management is severely hindered by forecast error, and therefore a high degree of attention is paid to its precise measurement. In this paper we reduce the forecast error by half, relative to the constant model which has been the industry standard for around 40 years.

Forecasting betas has puzzled academics and practitioners for decades, as they are recognized to be time-varying in nature (Breen, Glosten, & Jagannathan, 1989; Ferson, 1989; Keim & Stambaugh, 1986; Mandelker,

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1974). To date, a forecasting technique that can outperform the constant beta model is still lacking. Ghysels (1998) examined various parametric time-varying beta models, including models from Ferson (1989), Ferson and Harvey (1991, 1993) and Ferson and Korajczyk (1995), but showed that these well known models are less accurate than the constant beta model, even though beta is known to be time-varying.

The beta of a security represents its sensitivity to movements in the market. The beta of a portfolio is the weighted average of the individual betas of the securities comprising the portfolio. Market players form portfolios with a specific portfolio beta corresponding to their desired purpose, such as tracking portfolios with a beta of one and hedging portfolios with negative betas. Betas also have strong implications in the valuation of cost of capital. Beta forecasting techniques therefore directly benefit portfolio managers and have valuation applications. Wang (2003) emphasizes the importance of having accurate beta forecasts, and Ghysels and Jacquier (2005) stress the crucial importance of good beta forecasts for hedge fund managers who need to neutralize risk factors, or pension fund managers. Beta is generally estimated as a constant parameter, despite the extensive empirical research that suggests that beta is time-varying.

The recent advances in non-parametric volatility measurement follow on from the seminal work of French, Schwert, and Stambaugh (1987) and Schwert (1989), and are encapsulated in the recent realized beta measurement framework of Andersen, Bollerslev, Diebold, and Wu (2005, 2006). A realized beta is the ratio of the stock and market return realized covariance to the market realized variance. These non-parametric measures of covariance and variance have recently been heavily documented by people such as Andersen and Bollerslev (1998), Andersen, Bollerslev, Diebold, and Labys (2000, 2001, 2003) and Barndorff-Nielsen and Shephard (2001, 2002a,b, 2004). It has been demonstrated that traditional autoregressive time series models, computed on realized variance, outperform popular models such as GARCH (Bollerslev, 1986; Engle, 1982). These volatility forecasting evaluations were performed by Andersen et al. (2003); Andersen, Bollerslev, Diebold, and Ebens (2001); Maheu and McCurdy (2002); Martens, van Dijk, and de Pooter (2004); Ghysels, Santa-Clara, and Valfanov (2006); and Koopman, Jungbacker and Hol (2005). Our forecast evaluation methodology for betas follows a similar approach to these works, based upon realized measures.

In this paper we compute realized betas for the UK stock market, using daily data. Out-of-sample betas are forecasted using the constant, autoregressive and random walk models. Experimentation is conducted with in-sample estimation sizes of 20, 40, 60 and 80 quarters. This leads to a finding that the autoregressive model with two lags, based upon the previous 80 quarterly realized betas, is the dominant model. The results demonstrate dramatic improvements in beta forecasting for firms. On average, the mean absolute error values of the constant beta model forecasts are reduced by approximately one half when using the autoregressive models with a specification containing two lags. For stocks where data is only available for a short period of time, for example only 5 years, the AR (1) model is the most accurate forecaster.

This paper is organized as follows: Section 2 describes the sample of UK stocks, Section 3 describes realized beta measurement and Section 4 provides an evaluation of the constant, autoregressive and random walk models for one-quarter-ahead forecasting of beta for a range of in-sample estimation sizes. The final section concludes the study.

2. Data

Daily security prices are collected from DataStream; prices are also adjusted for dividends and market capitalization changes. The companies are selected based upon having a complete time series of daily data commencing the 4th January 1965, as well as being listed in the FTSE100 Index. Our sample extends through to 30th June 2005 and consists of 40 companies. The British market index used is the Financial Times 30 (FT30) index.

3. Beta measuring

The theoretical framework presented by Barndorff-Nielsen and Shephard (2004) and Andersen et al. (2006) provides a solid foundation for computing realized betas, and their approach is therefore utilized as discussed in the following section.