Forecasting stock market volatility with macroeconomic variables in real time

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Abstract

We compare forecasts of stock market volatility based on real-time and revised macroeconomic data. To this end, we use a new dataset on monthly real-time macroeconomic variables for Germany. The dataset covers the period 1994–2005. We use statistical criteria, a utility-based criterion, and an options-based criterion to evaluate volatility forecasts. Our main result is that the statistical and economic value of volatility forecasts based on real-time macroeconomic data is comparable to the value of forecasts based on revised macroeconomic data.
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1. Introduction

Macroeconomic variables play a key role in asset pricing theories. For this reason, many authors have empirically studied the link between macroeconomic variables and stock market volatility. A common finding in these studies is that stock market volatility tends to be linked to business cycle fluctuations (Errunza & Hogan, 1998; Hamilton & Lin, 1996; Schwert, 1989). For investors, this finding raises the question of whether macroeconomic variables that capture business-cycle fluctuations help to forecast stock market volatility. Finding an answer to this question may help

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investors to refine theories of derivatives pricing, to compute more exact solutions to problems of optimal portfolio selection, and to efficiently monitor and manage financial risks. Finding an answer to this question may also be useful for macroeconomists, politicians, and central bankers to develop a better understanding of potential macroeconomic determinants of systematic financial-sector risk.

For an investor who seeks to forecast stock market volatility based on macroeconomic variables, a key question is whether it is important to account for the fact that macroeconomic data are subject to substantial historical revisions. To the best of our knowledge, empirical evidence that may help an investor to answer this question is not yet available. In the earlier empirical literature, only revised macroeconomic data have been used to analyze macroeconomic determinants of stock market volatility. In fact, only a few studies are available that report evidence of the implications of using real-time macroeconomic data for research in empirical finance (see, for example, Andersen, Bollerslev, Diebold, & Vega, 2003; Christoffersen, Ghysels, & Swanson, 2002; Clark & Kozicki, 2004; Guo, 2003). By contrast, the analysis of real-time macroeconomic data has a long tradition in research on macroeconomics and business-cycle fluctuations (Croushore, 2001; Croushore & Stark, 2003; Diebold & Rudebusch, 1991; Gerberding, Seitz, & Worms, 2005; Morgenstern, 1963; Orphanides & van Norden, 2002; Orphanides & Williams, 2002; Zellner, 1958, to name just a few).

Our contribution to the literature on the macroeconomic determinants of stock market volatility is three-fold. First, by using a new monthly real-time macroeconomic data set for Germany that covers the period 1994–2005, we account for the fact that, in real time, an investor can only make inferences about the macroeconomic determinants of stock market volatility by fully exploiting the then available information set. This information set only contains the then latest release of preliminary real-time macroeconomic data, but not later releases of revised macroeconomic data. We also account for the fact that, in real time, an investor must take into account that preliminary real-time macroeconomic data may only give a noisy account of business-cycle fluctuations. Therefore, we analyze three different potential macroeconomic determinants of stock market volatility: the growth rate of industrial production, orders inflow, and a measure of the output gap. In the earlier literature, empirical studies of the macroeconomic determinants of stock market volatility have focused on the growth rate of industrial production as a measure of business-cycle fluctuations (Campbell, Lettau, Malkiel, & Xu, 2001; Schwert, 1989).

Second, we employ a recursive modeling approach to analyze whether macroeconomic variables help to forecast stock market volatility in real time. By doing this, we account for the fact that an investor's information set changes over time. In the earlier literature, it has been common practice to use an information set based on a full sample of revised data to analyze whether macroeconomic variables help to forecast stock market volatility (Schwert, 1989). Such an information set, however, is not available to an investor in real time. In consequence, it cannot be used by an investor to price derivative securities and to solve portfolio allocation problems in real time. In order to capture changes in an investor's information set over time, we employ a recursive modeling approach (Pesaran & Timmermann, 1995; Pesaran & Timmermann, 2000). An advantage of using a recursive modeling approach is that it also allows the out-of-sample forecasting ability of macroeconomic variables for stock market volatility to be analyzed. Out-of-sample tests have received increasing attention in the recent empirical finance literature (Rapach, Wohar, & Rangvid, 2005; Sollis, 2005).

Third, we use three different criteria to evaluate the accuracy of forecasts of stock market volatility: statistical criteria, a utility-based criterion, and an options-based criterion. As a statistical criterion, we use the root-mean squared error to evaluate volatility forecasts. The advantage