Economic Modelling 26 (2009) 1283–1299

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

Do macroeconomic variables have regime-dependent effects on stock return dynamics? Evidence from the Markov regime switching model

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ARTICLE INFO

Article history:
Accepted 1 June 2009

JEL classification:
C10
C22
G10

Keywords:
Macroeconomic variables
Stock market dynamics
Regime switching model

ABSTRACT

The predictability of stock return dynamics is a topic discussed most frequently in empirical studies; however, no unanimous conclusion has yet been reached due to the ignorance of structural changes in stock price dynamics. This study applies various regime switching GJR-GARCH models to analyze the effects of macroeconomic variables (interest rate, dividend yield, and default premium) on stock return movements (including conditional mean, conditional variance, and transition probabilities) in the U.S. stock market, so as to clearly compare the predictive validity of stable and volatile states, as well as compare the in-sample and out-of-sample portfolio performance of regime switching models. The empirical results show that macro factors can affect the stock return dynamics through two different channels, and that the magnitude of their influences on returns and volatility is not constant. The effects of the three economic variables on returns are not time-invariant, but are closely related to stock market fluctuations, and the strength of predictability in a volatile regime is far greater than that in a stable regime. It is found that interest rate and dividend yield seem to play an important role in predicting conditional variance, and out-of-sample performance is largely eroded when the effects of these two factors on volatility are ignored. In addition, the three macro factors do not play any role in predicting transition probabilities.

1. Introduction

Because stock price is viewed as a leading indicator of economic condition, and the monetary feedback rule takes stock price into account,[1] the dynamic evolution process of stock price has been a concern of the academic and practitioner circles in recent years. There are many studies which discuss the predictability of stock market through various factors, which include monetary policy variables and macro variables related to economic activity, and studies of this kind keep on increasing.

Is the degree of stock return predictability constant over time? A striking phenomenon found in recent empirical studies states that the strength of evidence for the predictability of U.S. stock return dynamics varies according to the selection of sample periods. Evidence that supports predictability seems to be nonexistent in previous years. Based on the discrepancy of empirical results on the issue of predictability, the perplexing topic warrants further discussion. On the other hand, Menzly et al. (2004) have developed a theoretical framework for the relationship between dividend yield and expected returns. Under the specification that considers time-varying preference and mean-reversion process of dividend growth, they demonstrate that the relationship between return and dividend-price ratio is not linear, but nonlinear. More specifically, this relationship is stronger in bad times compared to in good times. To understand the full picture of predictability of stock return dynamics, this paper aims to use the more elastic regime switching model to examine whether macroeconomic variables, such as interest rate, dividend yield, and default premium, can predict stock return dynamics, which includes conditional mean, conditional volatility, and transition probabilities, and whether the predictability hypothesis has a relation to the endogenous dynamics of stock returns, i.e., it can distinguish the effect of macro factors on the stock return dynamics of the boom market from that of the bust market. Aside from these, another purpose is to discuss the influence of regime switching models on asset allocation performance.

Although literatures concerning return predictability have emerged profusely and quickly since 1980, empirical studies that examine predictability through specification with time-invariant parameters account for a majority. However, Schwert (1990) was first to confirm that the parameters in the mean equation are not fixed, and the predictive power decreases as the sample period extends. Accordingly, the linear predictive model may be the main reason why different conclusions on predictability have been reached by different researchers. Directly comparing parameter estimates calculated from different sample periods is the most popular practice

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[1] For example, Bernanke and Gertler (1999, 2001) and Rigobon and Sack (2003) consider that it is reasonable for policymakers to incorporate stock price into the monetary feedback rule.

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doi:10.1016/j.econmod.2009.06.003

when examining whether evidence of structural changes exists in prior empirical studies. For instance, Pesaran and Timmerman (1995) use many macro variables, such as dividend yield, one-month Treasury bill rate, twelve-month Treasury bill rate, etc., to predict stock returns and to find that the evidence in support of the predictability of U.S. stock return is very weak in the 1960s and the 1980s, but is strong in the 1970s. Ang and Bekaert (2007) demonstrate that, when the sample period covers post-1990s data, the magnitude of the predictive ability of dividend yield falls by half.

The predictability of stock market can also be discussed from the aspect of conditional variance. Because conditional variance is considered a proxy for risk in the financial and economic fields (e.g., Cecchetti et al., 1988; Evans and Wachtel, 1993; Kroner and Sultan, 1993; Holland, 1995; Fleming et al., 2001), it has important influence on monetary policy-making, asset allocation decision, and risk management. Currently, volatility predictability is another important topic. For example, Flannery and Protopapadakis (2002), Marquering and Verbeek (2004), and Avramov and Chordia (2006) find that macro variables can predict the conditional variance of stock returns. Schwert's (1989) empirical result shows that the effects of macro variables on market volatility are also sensitive to the length of the sample period.

In order to avoid dividing sample periods on a subjective basis, another strand of the literature makes use of the Markov regime switching model,[2] in order to study the nonlinear effects of macro variables on stock return dynamics. Some empirical studies have established that the effect of interest rate on conditional return is larger in a volatile regime than that in a stable regime. For an example, see Chen (2007).[3] The merit of this kind of model is that the regression coefficients depend on a random variable with a first-order Markov chain instead of time-invariant parameters. Although the topic of predictability has been discussed time and again, most empirical studies concern the predictability of the first condition moment,[4] and only scant studies discuss the relationship between predictive factors and conditional variance.[5] An inconsistent conclusion is also found in nonlinear specification. Studies, such as those conducted by Perez-Quiros and Timmermann (2000) and Chen (2007), find that interest rate has a significant impact on stock returns, but Ang and Bekaert (2002) confirm that even if the regime switching characteristic is added in an empirical model, the evidence to support the effect of interest rate on returns ceases to exist.

In considering the nonlinear effects discussed above, this paper examines the influence of economic variables on S&P500 stock index returns by extending the generalized regime switching (GRS) model of Gray (1996), which allows the parameters of the GARCH model to change between regimes. In this paper, three macro variables used most frequently in the literature are selected to discuss the regime-dependent predictability of conditional mean and volatility.[6] Based on the fact that economic conditions can affect expected future cash flows as well as the yield spread of bonds with different risk ratings, dividend yield and default premium have been considered as variables that reflect economic conditions, and they are founded to be positively related to stock returns (e.g., Fama and French, 1989; Jensen et al., 1996; Avramov and Chordia, 2006). Interest rate is considered an indicator for the monetary authority to execute tight or loose policies, and the execution of monetary policy affects stock prices through the credit channel (e.g., Bernanke and Gertler, 1995; Kiyotaki and Moore, 1997). It is negatively related to the stock returns. The variables used in this paper include dividend yield,[7] default premium,[8] and interest rate.[9] In light of the empirical findings of Perez-Quiros and Timmermann (2000), who show that the time-varying transition probability matrix is suitable for small firms in the U.S. but not for large firms, we see that, after controlling the effects of macro factors on conditional mean and variance, the impacts of the three variables on the transition probabilities which govern the evolution process of state variable are also discussed in this paper. In addition, investment performance is taken as the criterion to determine which regime switching model has the best predictive power.

The empirical results are briefly summarized below. Similar to previous studies on U.S. stock return dynamics that use the regime switching model, two completely different dynamic processes are found, and they are classified as either the stable regime (high return and low volatility) or the volatile regime (low return and high volatility). The volatile regime includes three periods: 1974M9–1976M3, 1987M10–1987M11, and 1993M4–1994M3. The empirical results highlight that evidence on the predictability of monthly S&P500 index returns and conditional variance is obvious, but evidence on the predictability of transition probabilities is not yet available. The strength of stock return predictability obviously has an obvious relation with the stock market volatility, and the three variables have great explanatory power for the conditional mean during volatile periods. The importance of dividend yield is not obvious in the stable regime, but it is significant in the volatile regime. The influence strength of the default premium in the volatile regime is about 3.7801 times that of the stable regime. The magnitude of the impact of monetary policy (interest rate) on stock return during volatile periods is about 30.6511 times of that during stable periods. Although conditional variance is slightly predictable through dividend yield and interest rate, it leads to substantial decreases in out-of-sample forecasting performance if the influence of macro factors on conditional second-order moment is ignored. Hence, the importance of dividend yield and interest rate on conditional variance should not be ignored. In addition, the fact that the effects of transition probabilities on predicating probabilities are lower than other factors may be the reason for the insignificance of the predictability of time-varying transition probabilities. In sum, the regime switching GARCH model, where the transition probabilities are time-invariant and where macro variables are included in the mean and variance equations, has the best forecasting performance compared to other models used in this paper in terms of out-of-sample performance.

The remainder of this paper is organized as follows: Section 2 introduces the econometric models and the empirical estimation method; Section 3 discusses the data features and major empirical results; Section 4 introduces the method for establishing investment strategy, and compares the out-of-sample investment performance of the regime switching models and the GARCH models; finally, Section 5 provides conclusions.

[2] In a related study, Paye and Timmermann (2006) adopt an objective testing method to detect structural change points, and test whether the validity of macro factors is different under different stock market structures. Although this approach can identify structural changes, it fails to learn anything about the dynamic characteristics of the return series under different regimes, which is a puzzle that needs to be solved by empirical literature.

[3] Other macro variables are also used in related studies. For example, Chen (2009) finds that inflation rates and yield spreads are good predictors of stock returns, especially during periods of stock market decline.

[4] See Schaller and Van Norden (1997), Perez-Quiros and Timmermann (2000), Guidolin and Timmermann (2005, 2006, 2007), Guidolin and Ono (2006), Henkel et al. (2006), and Chen (2007), for example.

[5] For example, Perez-Quiros and Timmermann (2000, 2001) examine whether the short-term interest rate has an asymmetric effect on stock returns.

[6] Schwert (1989)claims that the macro vaiables which can affect the stock returns can also be used to predict conditional volatility.

[7] See, among others, Fama and French (1988), Schwert (1989, 1990), Kandel and Stambaugh (1996), Qi (1999), Barberis (2000), Perez-Quiros and Timmermann (2000), Campbell and Viceira (2005), Avramov and Chordia (2006), Lettau and Van Nieuwerburgh (2008), and Bali (2008).

[8] See, for example, Fama and French (1989), Schwert (1989, 1990), Avramov and Chordia (2006), Guidolin and Ono (2006), and Bali (2008).

[9] See, for example, Perez-Quiros and Timmermann (2000), Campbell and Viceira (2005), Avramov and Chordia (2006), Ang and Bekaert (2007) and Bali (2008).