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Level shifts in stock returns driven by large shocks[☆]

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ABSTRACT

This paper employs a parametric model of persistent (level) shifts in the conditional mean of stock market returns which are endogenously driven by large positive or negative return shocks. These shocks can be taken to reflect important market announcements, monetary policy regime changes and/or changes in business conditions affecting stock market. The model assumes that both the timing and size of breaks are stochastic. The last property of the model distinguishes it from other nonlinear models of the literature employed to capture level shifts in stock returns. Implementation of the model to the US stock market indicates that it can successfully capture level shifts in the mean of the aggregate return of this market which follow a cyclical pattern. Most of these shifts are triggered by negative large return shocks. The latter can be of smaller magnitude than that of the positive ones. Finally, the paper shows that the model can be employed to successfully forecast future expected stock returns.

1. Introduction

There is recently growing research interest in capturing abrupt and persistent (level) shifts in the conditional mean of stock returns based on nonlinear econometric models. These shifts are also referred to in the literature as structural breaks.[1] They are often associated with shifts of the stock market between its bull and bear regimes, or with market and macroeconomic announcements. Two of the most frequent models employed in the literature to model such shifts are the threshold autoregressive model of Tong (1983) (see also Lin and Terasvirta, 1994) and the Markov regime-switching (MRS) model of Hamilton (1989). Both of these models allow for abrupt shifts in stock returns which occur in the market at an unknown point of time. The first model assumes that these shifts are triggered by an observed economic variable, playing the role of a threshold variable, while the second model assumes that they are driven by an unobserved variable which depends on the state (regime) of the stock market. As noted in some of the studies cited above, these models can improve the out-of-sample forecasting performance for stock returns. Ignoring the existence of level shifts in stock returns will lead to substantial forecasting errors (see, e.g., Andreou and Ghysels, 2002; Pesaran et al., 2006) or long-memory illusion (see Smith, 2005).

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[1] See, e.g., Brooks (1997), Sarantis (2001), Clements and Smith (2001), McMillan (2003), Lekkos and Milas (2004), Guidolin and Timmermann (2006), Guidolin et al. (2009) and Matias and Reboredo (2012).

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The above literature considers level shifts in the conditional mean of stock returns (or other financial series) of fixed magnitude. That is, it assumes that the changes in the mean of stock returns between different regimes of the market are of the same magnitude, over the whole sample. This is not in accordance with evidence suggesting the existence of multiple breaks in stock returns (see, e.g., Andreou and Ghysels, 2009; Pettenuzzo and Timmermann, 2011). Furthermore, there is no need for someone to assume that a market regime is always characterized by the same mean or that the number of market regimes is fixed, since investors' preferences and/or the stance of monetary policy may change over time. In this paper, we relax this assumption. Based on the model suggested recently by Kapetanios and Tzavalis (2010), we allow for level shifts in the conditional mean of stock returns which are both stochastic in magnitude and time. They are driven by large stock market aggregate return shocks, identified by being larger, in size, than a threshold parameter. These large shocks may be taken to reflect endogenous responses of the stock market to extraordinary corporate, political, social and economic events (referred to as news) which are discounted in the stock market and, thus, can have persistent effects on the conditional mean of stock returns.

In the empirical finance literature, large return shocks are often treated as outliers, which are often dummied away from the empirical analysis. In contrast, the modeling approach of level shifts considered in this paper enable us to identify these large shocks from the data endogenously, as part of model specification and, then, to investigate their possible effects on stock returns more efficiently. To capture possible asymmetries between positive and negative values of these shocks on the conditional mean of stock returns, we assign different threshold parameters to them. Thus, our model can investigate if the magnitude of large shocks and their effects on stock returns differ depending on the sign of the shocks, which is of major interest in the empirical literature of news impacts on stock returns.[2]

The paper implements the above suggested approach of modeling persistent shifts in the conditional mean of stock returns to the US stock market aggregate return, calculated by the S&P500 index. The results of this application indicate that our model can capture most of the large shocks of this stock market, including those associated with domestic or international financial crises. Most of these shocks are found to be negative and to lead to positive shifts of the conditional mean of the US aggregate stock return one-period ahead. This can be obviously attributed to the need of stock market investors to be compensated for risk premium effects due, for instance, to substantial portfolio (or individual stock) return loses related to bad market news. The size of the large negative shocks which affect the stock return is found to be smaller than that of the positive ones, which can be also associated with the risk aversion behavior of stock market investors, mentioned above. Finally, in an out-of-sample forecasting exercise we have found that our modeling approach of breaks in the conditional mean of stock returns performs satisfactorily. It can be favorably compared to that of the standard threshold and MRS models, especially in terms of mean absolute error and density forecasts.

The paper is organized as follows. Section 2 presents our model and discusses some of its key properties relative to the two other nonlinear models mentioned above, allowing for level shifts in the mean of stock returns. It also shows how to estimate the model consistently and discusses some practical issues in the estimation procedure. Section 3 applies the model to the S&P500 aggregate stock market return and evaluates its forecasting performance. Section 4 concludes the paper.

2. Model

Consider the following autoregressive model for returns, r_t, with one lag, whose intercept is governed by a stochastic break process β_{t+1}[3]:

$$r_{t+1} = \beta_{t+1} + \rho r_t + \epsilon_{t+1}, \quad \text{with} \tag{1}$$

$$\beta_{t+1} = \beta_t + I(\mathcal{A}_t)\gamma_t \quad \text{and} \quad \mathcal{A}_t = \{\epsilon_{t-k} < r_L \text{ or } \epsilon_{t-k} > r_U\}, \tag{2}$$

where ϵ_{t+1} and γ_t are zero-mean *IID* innovations which are uncorrelated with each other, and $I(\mathcal{A}_t)$ is an indicator function taking the value 1 if event $\mathcal{A}_t = \{\epsilon_{t-k} < r_L \text{ or } \epsilon_{t-k} > r_U\}$ occurs at time $t-k$, where $k \geq 0$, and zero otherwise, and where r_L and r_U denote threshold parameters. In the above model, the slope coefficient β_{t+1} constitutes a state variable which can capture endogenous shifts in it lasting for long periods of time. These shifts are in line with the common perception of structural breaks observed in reality. Both the timing (or frequency) and magnitude of these shifts are entirely stochastic and can be endogenously identified by stock market innovations ϵ_{t-k} which are larger (or smaller) in magnitude than the value of the threshold parameter r_L (or r_U). We refer to these innovations as large shocks.

In the empirical literature, these large shocks are often treated as outliers, as noted in the Introduction section. Their impact on stock market is only indirectly measured by, first, isolating them based on a statistical procedure (see, e.g., Bernanke and Kuttner, 2005). They are ad hoc proxied by abnormal returns (e.g., exceeding three standard deviations of stock return distributions) or analyst forecasts (see, e.g., Chen et al., 2003; Pritamani and Singal, 2001; Savor, 2012, or footnote 2). Our specification of the break process β_{t+1}, given by Eq. (2), treats large shocks as part of model specification and, thus, their effects on stock returns can be directly measured.

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[2] See, e.g., Campbell and Hentschel (1992), Beechey and Wright (2009), and Miao et al. (2013).

[3] The AR (1) model is often used in the empirical finance literature to predict future stock returns (or log-prices) over short or long-term horizons (see, e.g., Campbell et al., 1997).

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