Available online at www.sciencedirect.com
ScienceDirect
ELSEVIER Journal of Economic Dynamics & Control 31 (2007) 721–741
JOURNAL OF Economic Dynamics & Control
www.elsevier.com/locate/jedc

A conditional distribution model for limited stock index returns

Ralph Friedmann*, Walter G. Sanddorf-Köhle

Department of Economics, University of Saarland, D-66123 Saarbrücken, Germany

Received 17 March 2004; accepted 11 January 2006
Available online 17 April 2006

Abstract

When a price limit regime exists for all of the stocks involved in an index, the index return is an aggregate of limited variables and thereby it is restricted to the same limits. We argue that neither a censored nor a truncated distribution model is appropriate for the aggregate return. The proposed mixed beta distribution allows for varying conditional mean and volatility, and with increasing volatility it changes from leptokurtic to platykurtic densities. The model is illustrated and statistically evaluated with an empirical application to the Shanghai stock market index returns under a 10% price change limit regime.

JEL classification: C22; C24; C52; G1

Keywords: Price limits; Mixed distributions; Beta distribution; GARCH

1. Introduction

Daily price limits for all traded stocks are implemented in many stock markets, for example, in France, Italy, Japan, and especially in emerging markets, for example, China, Korea, Taiwan, and Thailand. Within a trading day, the price for a single stock cannot move outside the limits, and the daily return is restricted to an interval

*Corresponding author.
E-mail address: friedmann@mx.uni-saarland.de (R. Friedmann).

0165-1889/$ - see front matter
doi:10.1016/j.jedc.2006.01.003

$[a, b]$, $a<0<b$. The intention of price limits is to decrease volatility. Imposing price change limits, stock exchange authorities claim that the limits counter overreaction and provide traders with a cooling-off period needed to re-evaluate market information and to reformulate their investment strategy. In fact, setting a floor a and a ceiling b for the stock price returns within a day, the variance of the observed return is restricted to be less than or equal to $(b-a)^2/4$, where the maximum variance is reached when the probability mass is equally distributed to the extreme returns a and b. Critics, like Fama (1989), however, argue that any system of limits or circuit breakers can only delay the adjustment of prices to changes in fundamental values. Both of the opposing arguments are not necessarily in contradiction, because they refer to different settings. If, due to market imperfections, overreactions leading to extreme, speculative price changes occur in a market, price limits can prevent irrational price changes beyond the limits. On the other hand, if extreme fundamental shocks occur in a market, price discovery will be delayed by price limits. The social costs and benefits of price limits thus depend on how likely each of the scenarios occurs, and on the relative costs of extreme overreactions and of delayed price discovery.

Convincing arguments have been provided that price limits not only prevent extreme price changes, either caused by overreaction or by fundamental shocks, but may also affect the trading strategies and observed price behavior within the allowed price zone. Fama (1989) and Subrahmanyam (1994) argue that trading volume and price volatility could increase by inciting trading in anticipation of reduced liquidity through an impending price-limit-hit. Similarly, Lehmann (1989) and Arak and Cook (1997) suggest the possibility of a *magnet effect* of price limits, i.e. the asset price accelerates towards the limits as it gets closer to the limits. Empirical support for the magnet effect is provided by Cho et al. (2002) using intraday data. Additional arguments for observed prices within the price limit zone to be distinct from their fundamental level are given by Kim and Sweeney (2002) and Levy and Yagil (2005).

Allowing for all the different effects of price limits on the observed price process, there does not appear to be a simple relation between observed prices under the limit regime and equilibrium prices which would be realized without the limits. Thus, statistical volatility analysis of a price process under a price limit regime either can be built on a model of the true, equilibrium prices, at the cost of some simplifying assumptions regarding the relation between the observed prices and the equilibrium prices, or it has to specify directly the volatility dynamics for the observed price data. The first approach is taken by Kodres (1993) in the framework of daily price limits in foreign exchange futures markets. In her model, limit moves are considered as censored observations of equilibrium prices, whereas observed price changes within the limits are identified with equilibrium price changes. The estimation method is considerably simplified in Morgan and Trevor (1999), using a rational expectations algorithm for censored observations in the presence of autoregressive conditional heteroscedasticity.

The focus of this paper is on modelling the conditional distribution of stock index returns, when a price change limit applies to the individual stocks. As far as we