Journal of Multinational Financial Management
11 (2001) 385–406

Journal of
MULTINATIONAL
FINANCIAL
MANAGEMENT

www.elsevier.com/locate/econbase

A stochastic volatility model specification with diagnostics for thinly traded equity markets

Per Bjarte Solibakke *

Department of Business Administration and Economics, Molde University College, Servicebokś 8, N-6405 Molde, Norway

Received 15 July 2000; accepted 28 February 2001

Abstract

The majority of world equity markets exhibit non-synchronous- and non-trading for some quoted asset series. This investigation sets out to determine the complexity of illiquid markets applying versions of stochastic differential equation (SDE) specifications. Efficient method of moments (EMM) is used to estimate and evaluate the diffusion models. EMM estimation on SNP scores reveals that a standard SDE with first and second order drift, non-synchronous trading and constant diffusion are rejected. However, a simple two-factor stochastic volatility specification with non-synchronous trading and conditional heteroscedasticity, reports success for illiquid equity markets. Tracking portfolios may therefore not track derivative products perfectly and importantly; the stochastic volatility model seems to be the preferred volatility specification. © 2001 Elsevier Science B.V. All rights reserved.

JEL classification: C14

Keywords: Efficient method of moments; Stochastic differential equations; Non-synchronous trading; Conditional heteroscedasticity

1. Introduction

In this paper, we construct, estimate and test several stochastic differential equations (SDE) for a seasonal adjusted index series from a thinly traded equity market. The main objective is to find SDE characteristics in the mean and volatility

* Tel.: +47-70154407; fax: +47-71214100.
E-mail address: per.b.solibakke@himolde.no (P.B. Solibakke).

PII: S1042-444X(01)00040-8

specifications, due to non-synchronous- and non-trading and conditional heteroscedasticity. Non-synchronous- and non-trading may cause biases to the moments and co-moments of returns owing to irregular recording intervals. Conditional heteroscedasticity is caused by volatility clustering and suggests that volatility changes over time.

The motivation for the use of stochastic calculus in estimation studies is that new (unpredictable) information is revealed continuously in an open market and decision-makers may face instantaneous changes in randomness. For example, the relevant 'time interval' may be different on different trading days, due to volatility changes. Changing volatility may require changing the basic observation period. Furthermore, as numerical methods used in pricing securities are costly, the pace of activity may make the analyst choose coarser or finer time intervals depending on the level of volatility. Such approximations can best be accomplished using random variables defined over continuous time. The mathematics of such random variables is known as stochastic calculus. A technical advantage of stochastic calculus is that a complicated random variable can have a very simple structure in continuous time, once the attention is focused on infinitesimal intervals. If the time interval is 'infinitesimal' then asset prices may safely be assumed to have two likely movements; up-tick or downtick[1]. Under some conditionals, such a binomial structure may be a good approximation to reality during an infinitesimal interval, but not necessarily in a large discrete time interval. Solibakke (2000) shows in an empirical study from the Norwegian thinly traded market that volatility seems to exist independently of trading and non-trading as long as the market is open. Hence, the volatility process seems to exist without any relations to the mean process. Moreover, Solibakke (2001b) finds that changing volatility models (GARCH)[2] report specification errors for return series exhibiting heavy non-synchronous- and non-trading. Consequently, the stochastic volatility specification seems to be the preferred volatility specification in thinly traded markets. Finally, the main tool of stochastic calculus–namely, the Ito integral–may be more appropriate to use in financial markets than the standard Riemann integral (Neftci, 1996).

Several procedures have been proposed for fitting a model based on stochastic calculus[3]. In this paper we employ the efficient method of moments (EMM) proposed by Bansal et al. (1993, 1995) and developed in Gallant and Tauchen (1996) and shown used in Gallant et al. (1997) to estimate and test the SDE model. EMM is a simulation-based moment matching procedure with certain advantages. The moments that get matched are the scores of an auxiliary model called the score generator (SNP). SNP is a method of non-parametric time series analysis, which

[1] With reference to the Binomial Distribution; see for example Grinblatt and Titman (1998).

[2] Solibakke (2001b) discuss the stochastic versus changing volatility specification in more detail.

[3] For method of moments see Duffie and Singleton (1993), Andersen and Sørensen (1996); for bayesian methods see Geweke (1994), Jacquier et al. (1994); for simulated likelihood see Danielsson (1994); for Kalman filtering methods see Harvey et al. (1994), Kim and Shephard (1994). Moreover, two excellent recent surveys are Ghysels et al. (1995), Shephard (1995).