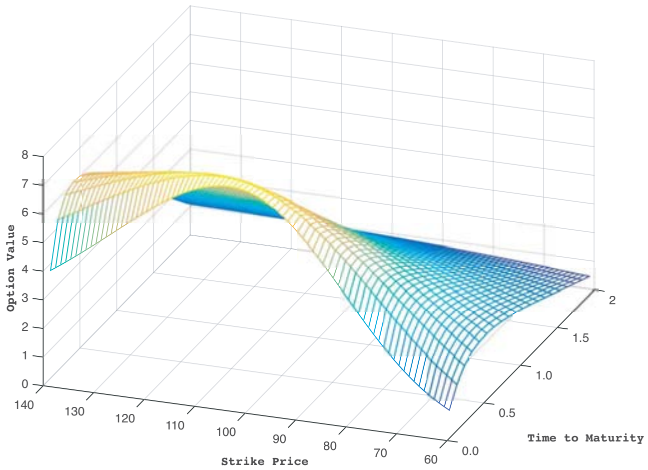

Fig. 5. Differences in call prices with fixed $H = 0.50$ and $H = 0.75$ ($s = 100$; $\sigma = 0.5$; $r = 0.1$).

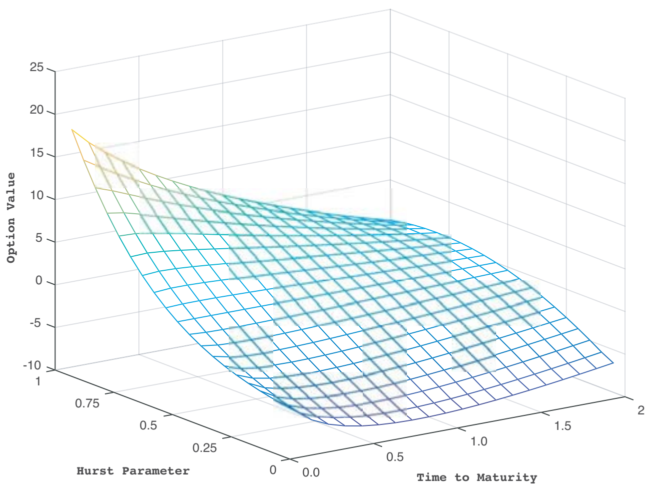

Fig. 6. Differences in call prices as H is varied from 0 to 1 ($s = 100$; $\sigma = 0.5$; $r = 0.1$; $k = 100$).

return, and volatility. We employ the daily closing price data of the Tokyo stock price index (TOPIX) from January 1997 to December 2013, denoting its value at time t by S_t. The daily logarithmic return at time t is defined as $r_t = \log S_t - \log S_{t-1}$. Our analysis also includes the RV defined at time t as the sum of the intraday squared returns (Andersen *et al.*, 2001):

$$RV_t = \sum_{i=1}^{n_t} r_{t,i}^2,$$

where $r_{t,i}^2$ denotes a squared log-return (the ith observation on day t) and n_t is the number of data points in t. Regarding the underlying log-price process as the continuous martingale part in a semimartingale model setup, the RV can be viewed as a proxy variable of the integrated variance calculated from the intraday full high-frequency log-returns. Consequently, the RV estimation requires the full high-frequency data over 24 h as a daily volatility measure. However, the Japanese stock market is divided into two sessions by a lunch break, i.e., the morning session lasts from 09:00 to 11:00 and the afternoon session from 12:30

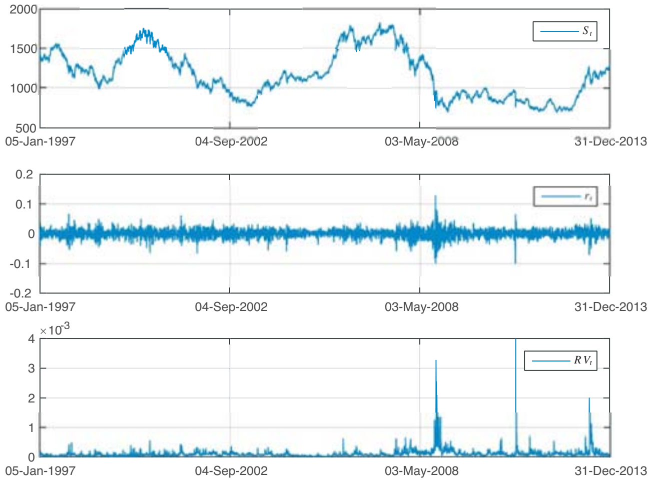

Fig. 7. Paths of S_t, r_t and RV_t time series in the TOPIX data (1997–2013).

Table 1. Summary statistics of TOPIX data (1997–2013).

	S_t	r_t	RV_t
Mean	1173.374	−0.0000	0.01025
Median	1145.760	0.0002	0.00716
Maximum	1816.970	0.1286	0.39879
Minimum	695.510	−0.1001	0.00001
Std. Dev.	293.302	0.0141	0.01489
Skewness	0.317	−0.2925	11.76425
Kurtosis	2.018	8.402	223.907
Obs.	4177	4177	4177
LB(10)	41133.82∗	22.47	8548.13∗

Note that LB(10) denotes the Ljung-Box test statistics at lag 10 and ∗ indicates the rejection of the null hypothesis that the process is not autocorrelated.

to 15:00. Thus, we adopt the weighted RV proposed by Masuda and Morimoto (2012), which is a modified version adjusted to the Japanese market (Hansen and Lunde, 2005). The weighted RV with estimated optimal weights λ_1, λ_2, λ_3 and λ_4 is defined by

$$wRV_t = \lambda_1 Y_{t,1}^2 + \lambda_2 RV_{t,2} + \lambda_3 Y_{t,3}^2 + \lambda_4 RV_{t,4},$$

where $Y_{t,1}^2$, $RV_{t,2}$, $Y_{t,3}^2$, and $RV_{t,4}$ denote the square of the close-to-open return, the RV in the morning session, the square of the lunch break return, and the RV in the afternoon session, respectively, on the tth day. Hereafter, we replace the weighted RV wRV by RV for notational simplicity. In addition, we set the sampling frequency to 1 min, the minimum observation interval of the Japanese stock market. The resulting sample sizes of the morning and afternoon sessions are 120 and 150, respectively.

5.1 Data description

In the empirical analysis, we first describe the three time series data S_t, r_t and RV_t discussed above. Figure 7 depicts the paths of S_t, r_t and RV_t over the sample period, and Table 1 presents the descriptive statistics of these data. The null hypothesis is that the data are independently distributed. According to the Ljung-Box (10) statistics for serial correlation in Table 1, we cannot reject the null hypothesis for