Table: Tests on Time Series Property of Volume Variables

Panel A. Unit Root Tests

Test statistic		ADF	PP	KPSS
Volume		-3.955⁂	-14.869⁂	2.144⁂
Open Interest		-6.275⁂	-5.927⁂	0.452†
Day-trading		-3.141‡	-6.533⁂	2.496⁂
(Asymptotic) Critical Values	1% level	-3.443	-3.443	0.739
	5% level	-2.867	-2.867	0.463
	10% level	-2.570	-2.570	0.347

Note: Augmented Dickey-Fuller (ADF), PP and KPSS tests are used to diagnose a unit root in 3 volumes series. The augmented Dickey-Fuller (ADF) statistics are statistically significant negative values, which imply that the null hypothesis of a unit root in series is significantly rejected. Similar results are provided by the Phillips-Perron (PP, 1988) unit root test and Kwiatkowski-Phillips- Schmidt-Shin (KPSS, 1992) Lagrange multiplier test (Engle, 1982). †, ‡, and ⁂ represent that the

Panel B. Heteroskedasticity Test

	Ljung-Box Statistics
Q（20）	32.65†
Q^2（20）	201.27‡
LM（5）	41.07‡

Note：

1. †, ‡, and ⁂ represent that the null hypothesis is rejected at 1%, 5% and 10% significance, respectively.
2. Q and Q^2 are Ljung-Box tests on the series in levels and squared, respectively, for 20 lags that are distributed as a χ^2_{20} in the null hypothesis of no autocorrelation; $LM(5)$ is Engle's Lagrange multipliers test (1982) to contrast the existence of ARCH effects, which is distributed as a χ^2_5 in the null hypothesis of no autocorrelation.

Table: Diagnosis of VAR and EGARCH-M Models

Panel A Model Fitness

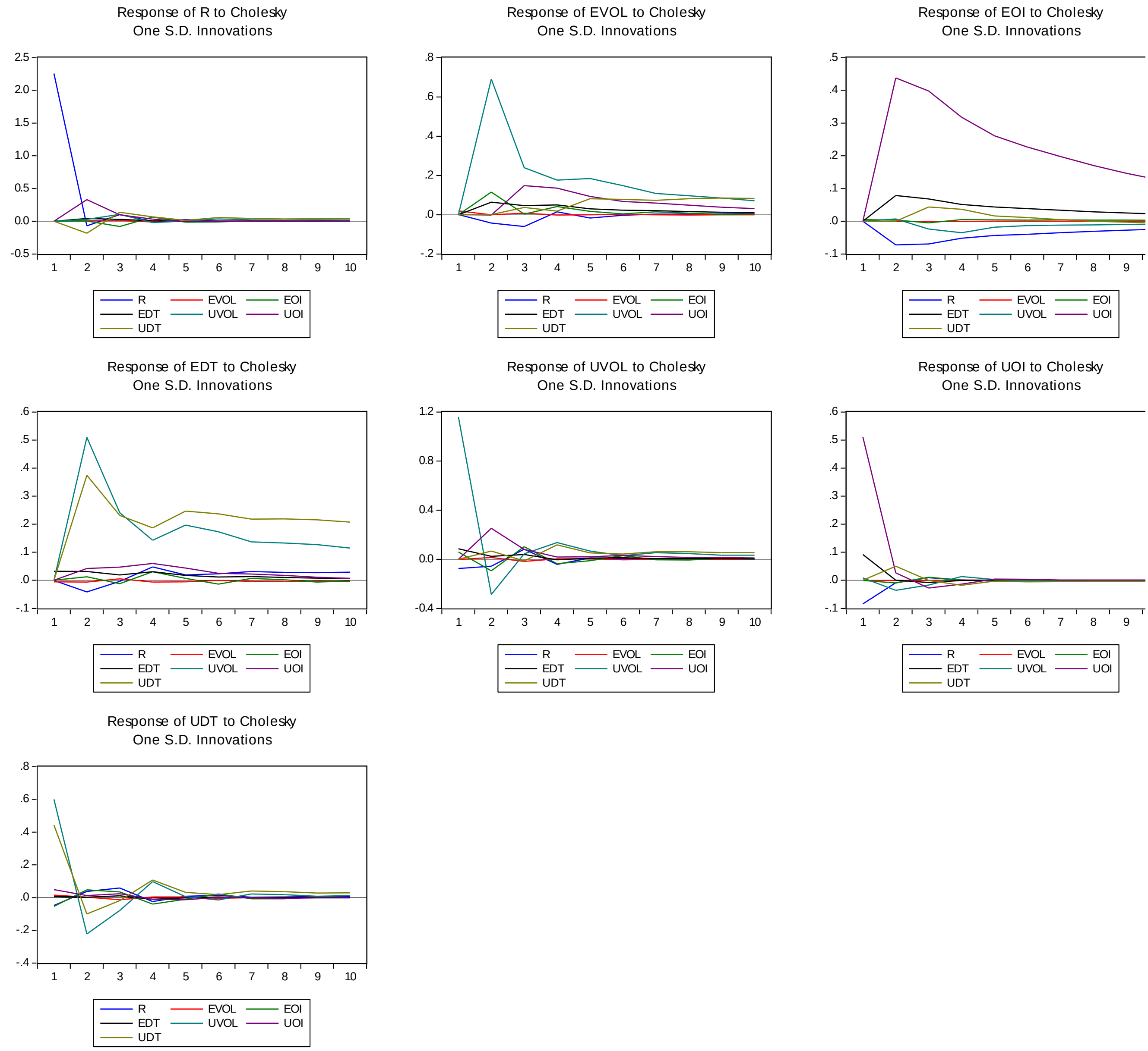
VAR	SIC	EGARCH-M	SIC
VAR(1)	13.881	EGARCH-M (1,1)	**4.418**†
VAR(2)	**11.231**†	EGARCH-M (1,2)	4.511
VAR(3)	11.233	EGARCH-M (2,1)	4.624
VAR(4)	11.299	EGARCH-M (2,2)	4.601
VAR(5)	11.432		
VAR(6)	11.495		
VAR(7)	11.653		
VAR(8)	11.771		
VAR(9)	11.920		
VAR(10)	12.084		

Panel B. The Likelihood-ratio (*LR*) Statistics of Model Diagnosis

		LR Statistics
Unrestricted EGARCH Model	$R_t = a_0 + a_1 V_t + a_2 OI_t + a_3 DT_t + \varepsilon_t$ $\log(\sigma_t^2) = \alpha_0 + \alpha_1 \left\| \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right\| + \alpha_2 \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \beta_1 \log(\sigma_{t-1}^2) + w_1 V_t + w_2 OI_t + w_3 DT_t$	3.969‡ (0.046)
Restricted EGARCH Model	$R_t = a_0 + a_1 V_t + a_2 OI_t + \varepsilon_t$ $\log(\sigma_t^2) = \alpha_0 + \alpha_1 \left\| \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right\| + \alpha_2 \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \beta_1 \log(\sigma_{t-1}^2) + w_1 V_t + w_2 OI_t$	

Note: The Schwarz information criterion (SIC) is used to determine optimum lags in the VAR and EGARCH-M models fitness criteria. The smaller the SIC value is, the better model fit. Table 4, Panel 1 reports that VAR (2) and EGARCH-M (1,1) have the best fitted model. The *p*-value is in parentheses.

Figure 1. Impulse Response Analysis of Cholesky One Standard Deviation Innovation



Note:
This figure provides the impulse response analysis of Cholesky one standard deviation innovation for return, volume, open interest, and day trading, from one to ten days. Cholesky uses the inverse of the Cholesky factor of the residual covariance matrix to orthogonalize the impulses. This option imposes an ordering of the variables in the VAR and attributes all of the effect of any common component of the variable that comes first in the VAR system.