Empirical Analysis of Stock Return Volatility with Regime Change: The Case of Vietnam Stock Market

Vietnam Development Forum – Tokyo Presentation
By Vuong Thanh Long
Dept. of Economic Development and Policies
GSICS, KOBE University

LAYOUT

Hypotheses and Findings

- Using the ARCH/GARCH model, the stock return volatility of Vietnam stock market (VSM) is shown to be highly persistent.
- After regime changes are incorporated into the aforementioned ARCH/GARCH model (using a set of dichotomous dummy variables), the high persistence of VSM return volatility reduces.
- Perhaps, financial liberalization has negative effects on the VSM return volatility. The volatility is found to increase after each step of opening of Vietnam stock market.

Section I:
Theoretical Framework

A. LITERATURE REVIEW

B. DATA FOR ANALYSIS

C. THE ECONOMETRIC ARCH/GARCH MODEL

D. THE COMBINED MODEL

LITERATURE REVIEW

- Engle (1982) proposed a class of ARCH (autoregressive conditional heteroskedasticity) model to capture the volatility. Bollerslev (1986) developed it to a class of GARCH (generalized ARCH) model by including more lags of the conditional variance itself.
- Concerning the persistence in volatility: Susmel (2000), Malik et al. (2005), and so on showed evidence of highly persistent volatility in stock market return and how this persistence reduced when regime changes are taken into account.

LITERATURE REVIEW (Cont.)

Concerning the effects of financial liberalization:

- McKinnon (1973) and Shaw (1973) proposed financial liberalization since it will help to stabilize the financial market.

- Keynesians are opposed to this idea because they thought that the increased volume of transactions and pace due to more open equity market to foreign investors would destabilize the equity market.

- Some Reality: The financial crisis that occurred in East Asian countries in the closing years of the last millennium seem to favor the Keynesians' view.

DATA FOR ANALYSIS

- Using the closing market index values (Vnindex) for duration July 2000 - May 2007, a total of 1,547 daily observations were obtained.
- These Vnindex daily return rates are computed on the daily basis in percentage scale as:

$$RR_t = \frac{(P_t - P_{t-1}) * 100}{P_{t-1}}$$

- Where, RR_t is the rate of return of stock on the *t* day, P_t is the stock price on the *t* day, and P_{t-1} is the stock price on the (t-1) day.

Data for Analysis (Cont.)

Vnindex Rate of Return	t-statistic	p-value
ADF test statistic	-11.7705	0.0000
Test critical value at 1% level	-3.4344	
Note: Null Hypothesis: RR has a unit root. *One-sided p-values.		
ADF test includes a constant term. Lag length is chosen as 5 based on Schwarz Information Criterion.		

Statistics	**Vnindex Daily Return Rate**
Mean	0.1681***
Standard Deviation	1.6748
Skewness	-0.2037
Kurtosis	6.9583
Jarque-Bera	1019.992
P-value	0.0000

THE ECONOMETRIC MODEL

The Econometric ARCH/GARCH Model

(1) $RR_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{t-i} RR_{t-i} + \varepsilon_t$ (2) $\varepsilon_t \mid \Omega_{t-i} \sim N(0, h_t),$ (3) $h_t = \gamma_0 + \sum_{i=1}^{q} \gamma_i \varepsilon_{t-i}^2$

Where, RR_t is the return rate of stock market index at time t, RR_{t-i} is return rate of stock market index at time t-i, alphas are the intercept term and coefficients of the lagged return rates of stock market index. h_t is the conditional variance for the current time t, gammas are constant term, and coefficients of the ARCH term. Epsilons (the ARCH term) represent the news about volatility from the previous period, measured as the lags of the squared residual from equation (1). N represents the conditional normal distribution with a mean of zero and a variance h_t, and Ω_{t-i} is the information set available up to time (t-i).

THE ECONOMETRIC MODEL (Cont.)

- The GARCH model introduces one more term into the right-hand side of (3):

(3') $$h_t = \gamma_0 + \sum_{i=1}^{q} \gamma_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \lambda_j h_{t-j}$$

- here, h_{t-j} (the GARCH term) indicates news of the last periods' forecast conditional variance.
- Levels of p, q, and k in this process are identified based on the Box-Jenkins approach and the stability of equation (3).

DETECTING THE BREAK POINTS OF REGIME CHANGES

- First, let the series in equation (1) be a series with zero mean, and an unconditional variance. The variance within each volatility regime is assumed to be homogeneous. T is the total number of observations.
- Second, denote $C_k = \sum_{t=1}^{k} \varepsilon_t^2, k = 1,2,..... T$ as the iterated cumulative sum of squares (ICSS) from the first observation to the k-th point in time. Then, the D_k statistic is defined as below:

$$D_k = \frac{C_k}{C_T} - \frac{k}{T}, \qquad k = 1,2,....,T$$

With $D_0 = D_T = 0$

DETECTING THE BREAK POINTS OF REGIME CHANGES (Cont.)

- Inclan and Tiao (1994) show that the plot of D_k oscillates around zero for series with homogeneous variance, and will extend beyond the specified boundaries with high probability when a break point occurs. They computed the critical value of 1.358 being the 95th percentile of the asymptotic distribution of max standardized D_k.
- In our paper, the critical value of 1.4058 (correcting for the kurtosis) is used since the VSM rate of return plot also shows a clear leptokurtic case.
- Inclan and Tiao (1994) also claim that using the D_k statistic to detect the break points simultaneously may be difficult when the data under investigation has multiple variance changes. To avoid this masking effect, Inclan and Tiao (1994) suggested using the D_k function to systematically detect the break points at different parts of the series under concern.

DETECTING THE BREAK POINTS OF REGIME CHANGES: THE COMBINED MODEL (Cont.)

- Detection of break points is done in different sections each time the break point is found. The process is repeated until all break points are found.
- Finally, the modified ARCH/GARCH model becomes:

(1) $$RR_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{t-i} RR_{t-i} + \varepsilon_t$$

(2) $$\varepsilon_t \,|\, \Omega_{t-i} \sim N(0, h_t),$$

(4) $$h_t = \gamma_0 + d_1 D_1 + d_2 D_2 + \ldots + d_n D_n + \sum_{i=1}^{q} \gamma_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \lambda_j h_{t-j}$$

where, D_1, D_2,…,D_n are a set of dummy variables controlling for regime changes, taking a value of one from each point of sudden change of variance onwards, and zero elsewhere.

Section II: Empirical Results

A. EMPIRICAL RESULTS OF ARCH/GARCH MODEL WITHOUT REGIME CHANGES

B. DETECTION OF THE BREAK POINTS OF REGIME CHANGES AND FOLLOWING ANALYSIS

C. EMPIRICAL RESULTS OF THE COMBINED ARCH/GARCH MODEL WITH REGIME CHANGES

EMPIRICAL RESULTS OF THE ARCH/GARCH MODEL WITHOUT REGIME CHANGES

- Regression result for ARCH (1) without regime change:

(5) $RR_t = 0.0378 + 0.01477RR_{t-1} + \varepsilon_t$

$(0.0192)^{**}$ $(0.0076)^{**}$

(6) $h_t = 0.6431 + 0.9592\ \varepsilon^2_{t-1}$

$(0.0161)^{**}$ $(0.0618)^{**}$

Break Points and Regime Changes

Time Period	Possibly Related Events or Policy Changes	Standard Deviation	Mean Daily RR
28Jul2000 - 11Jun2001 (11 months)	From the launch of VSM to the first change point.	1.2978	1.1298**
13Jun2001 - 26Dec2001 (6 months)	The Congress IX of Vietnam Communist Party was held from 19th to 23rd of April 2001.	4.1161	-0.5806
28Dec2001- 10Nov2003 (23 months)	Trading sessions started to be held everyday from March 01st, 2002.	0.7999	-0.1226**

Break Points and Regime Changes (Cont.)

Time Period	Possibly Related Events or Policy Changes	Standard Deviation	Mean Daily RR
11Nov2003-16Feb2006 (26 months)	Three months after foreign investors are allowed to buy up to 30 percent of the stock value of a privatized enterprise.	1.0737	0.1608**
17Feb2006-Present (to be continued) (>15 months)	Three months after the foreign investors are allowed to buy up to 49 percent of the stock value of a privatized enterprise.	2.0958	0.3930**

EMPIRICAL RESULTS OF THE COMBINED ARCH/GARCH MODEL WITH REGIME CHANGES

The modified model regression result:

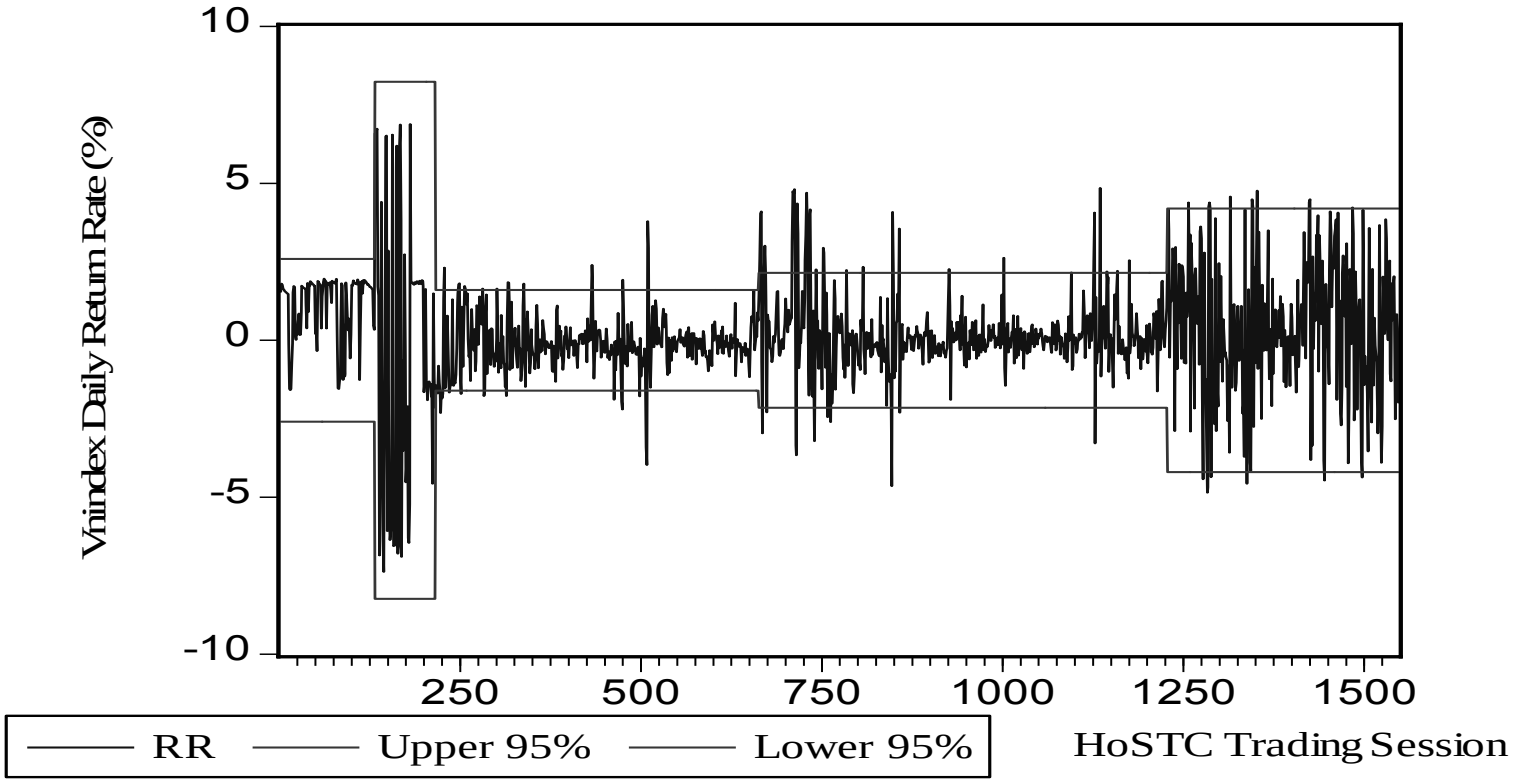
$$RR_t = -0.0188 + 0.262 RR_{t-1} + \varepsilon_t$$

(0.02) (0.0122)**

$$h_t = 0.8333 + 8.122 D1 - 0.5858 D2 - 0.4222 D3 + 1.6961 D4 + 0.6014 \varepsilon_{t-1}^2$$

(0.2208)** (1.8321)** (0.2213)** (0.2211)* (0.3605)** (0.0559)**

Daily return rate of HoSTC with Regime Volatility Bands at +/- 2 S.D (July 2000 – May 2007)



Section III:
Conclusions and Policy Implications

A. SUMMARY OF VIETNAM STOCK MARKET VOLATILITY

B. POLICY IMPLICATIONS BASED ON THE EMPIRICAL RESULTS

SUMMARY OF VIETNAM STOCK MARKET VOLATILITY

- It has been initially found, using the ARCH (1) model without regime change that the VSM stock return rate shows a statistically significant high persistence of volatility.

- When the regime changes are incorporated into the model, it is found that the highly persistent volatility of the VSM stock return rate is reduced.

- Concerning the effects of financial liberalization, the analysis results show that after both steps of financial liberalization (the equity market becomes more open), there are increases in stock return volatility.

POLICY IMPLICATIONS BASED ON THE EMPIRICAL RESULTS

- First, financial liberalization is a good way to attract foreign investment. Although the volatility is getting higher, investors are reaping higher daily return rates.

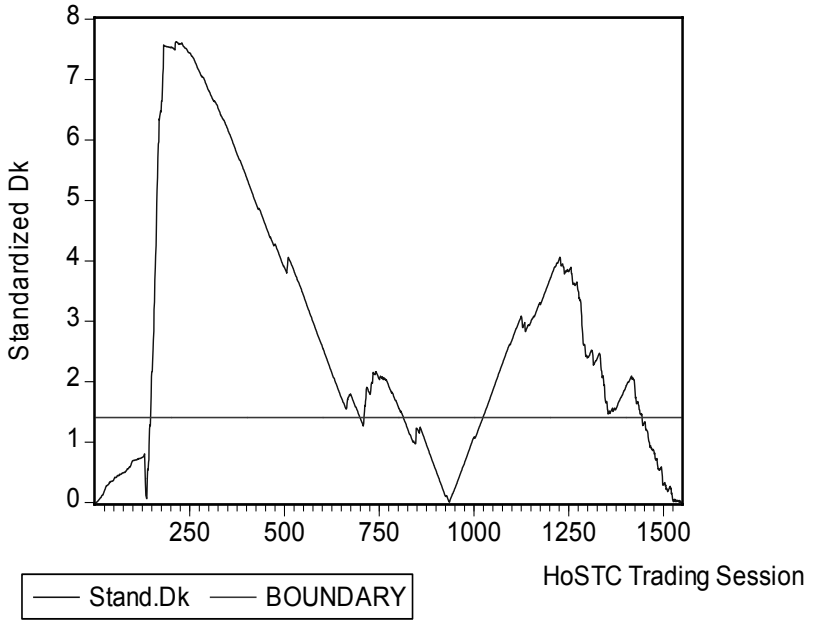
- Second, financial liberalization should be conducted in harmonization with large IPOs to obtain the stability of the market.

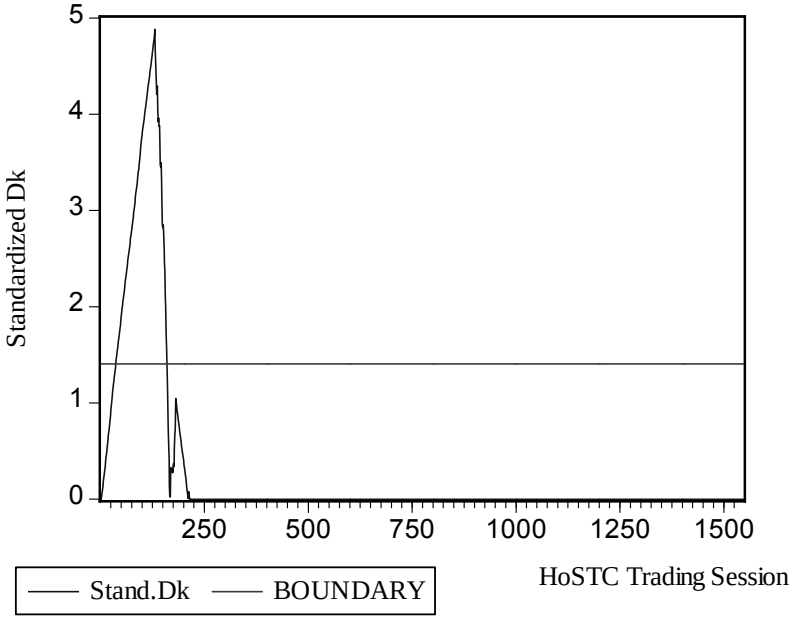
- To sustain its development, VSM should set its most important target as “less volatility with stable rates of return”.

Thank you very much for your attention!

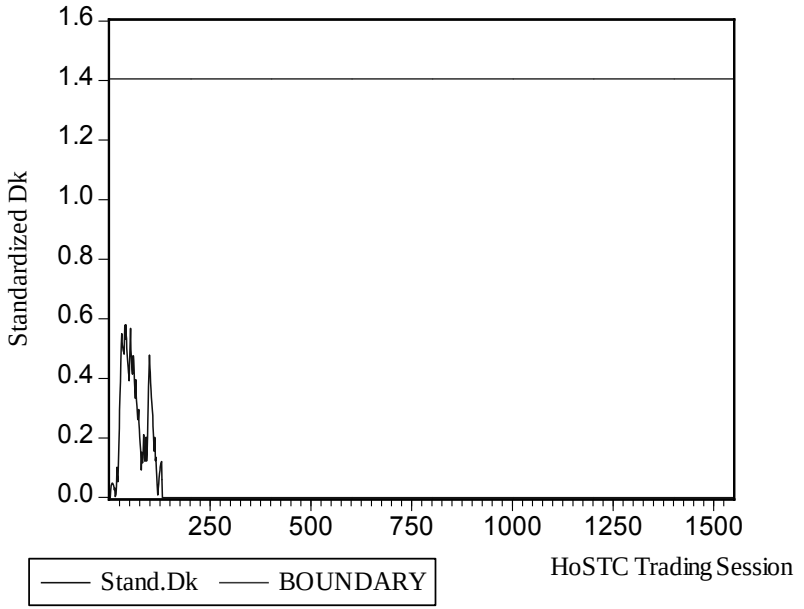
御清聴どうも有り難うございました！

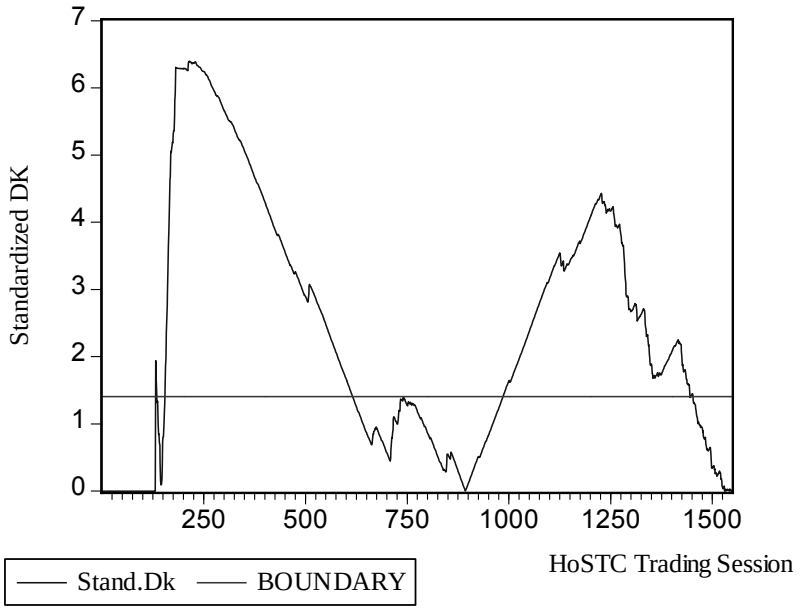
Appendix B: Detection of Break Points



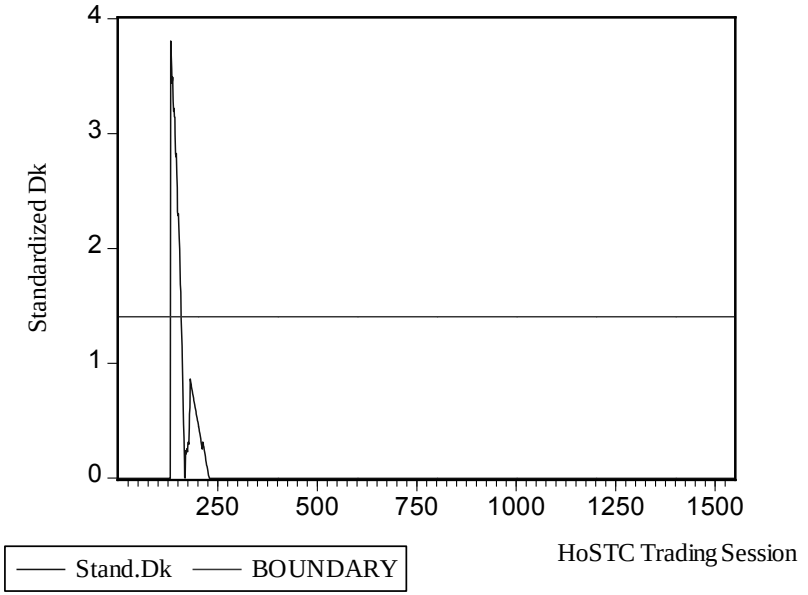


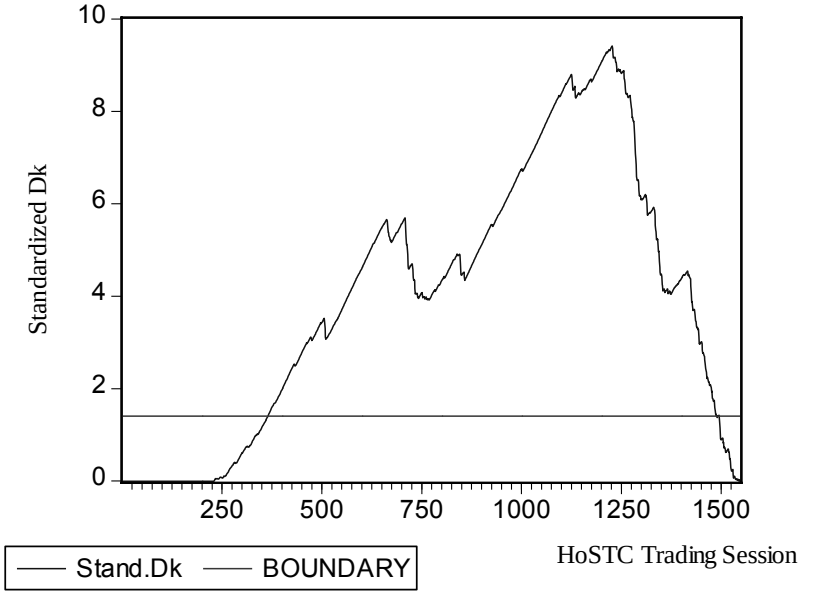
Appendix B: Detection of Break Points (Cont.)



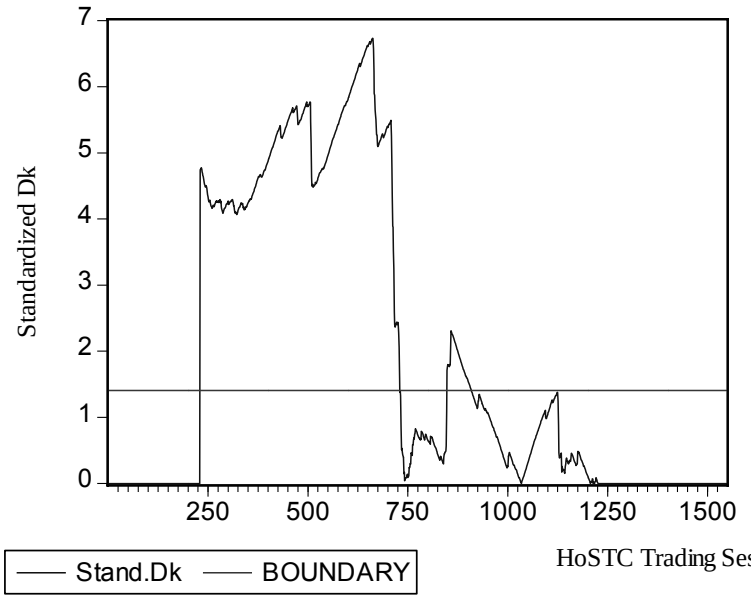


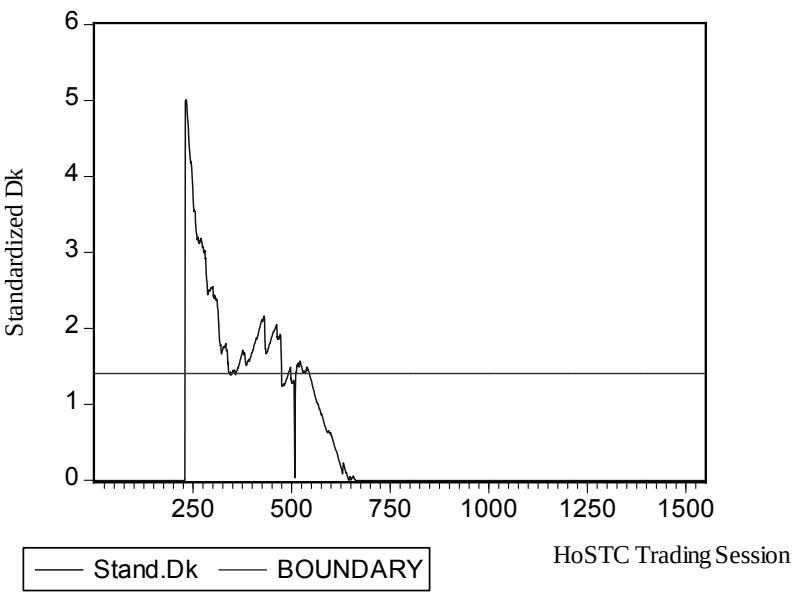
Appendix B: Detection of Break Points (Cont.)



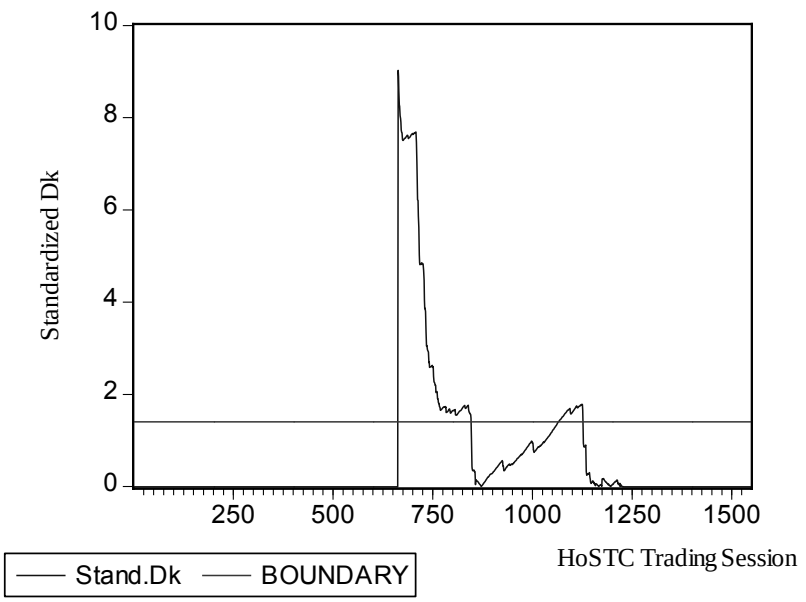


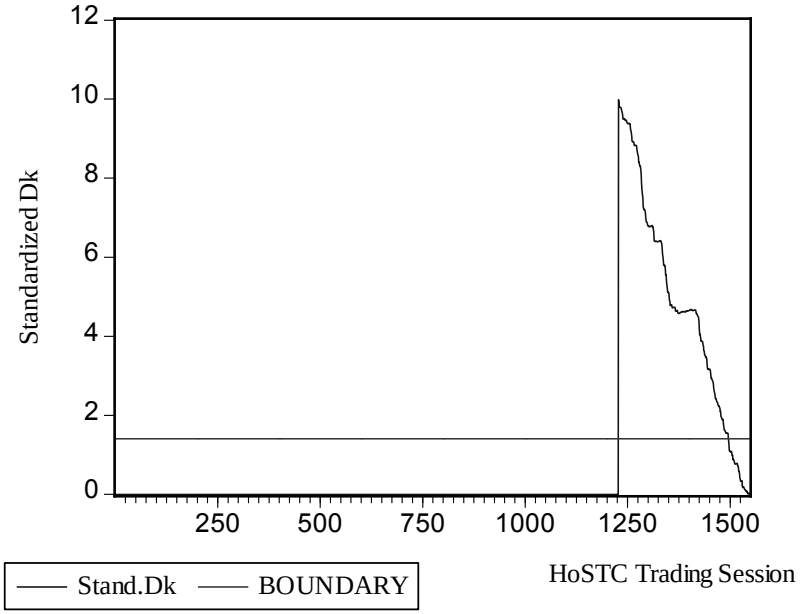
Appendix B: Detection of Break Points (Cont.)



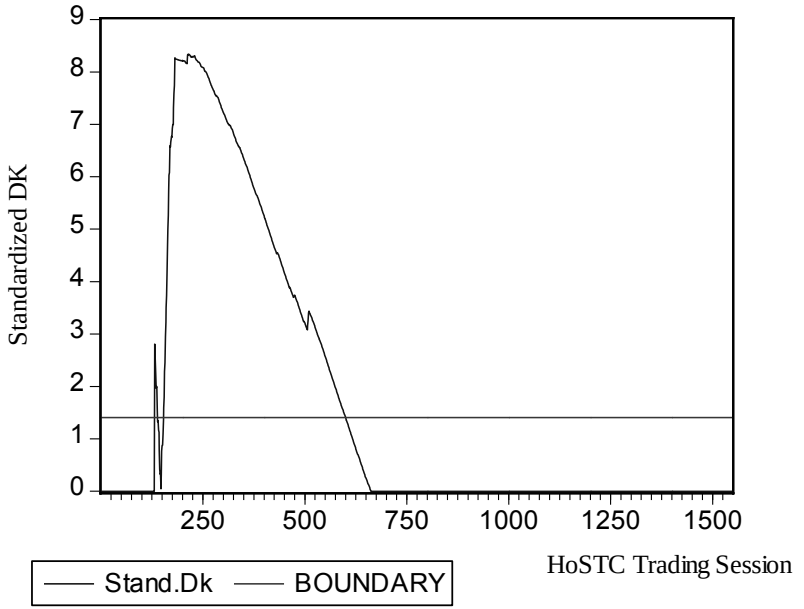


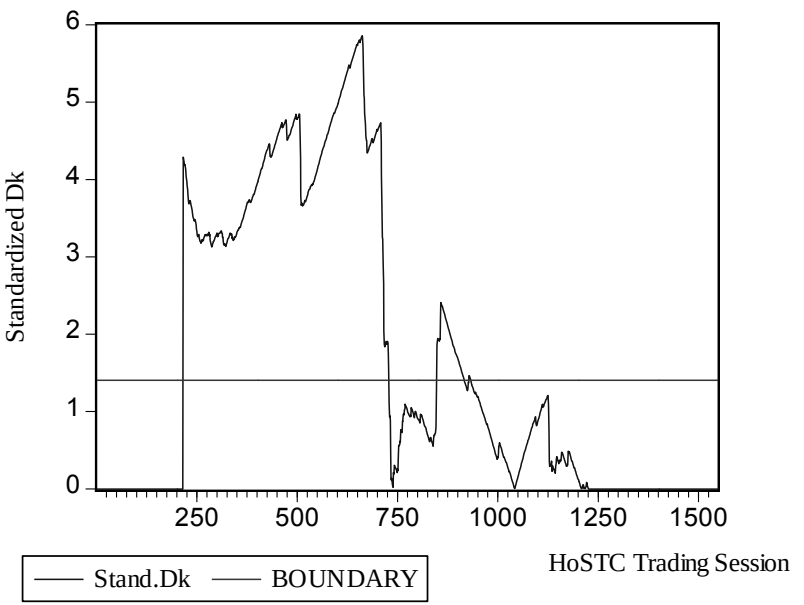
Appendix B: Detection of Break Points (Cont.)



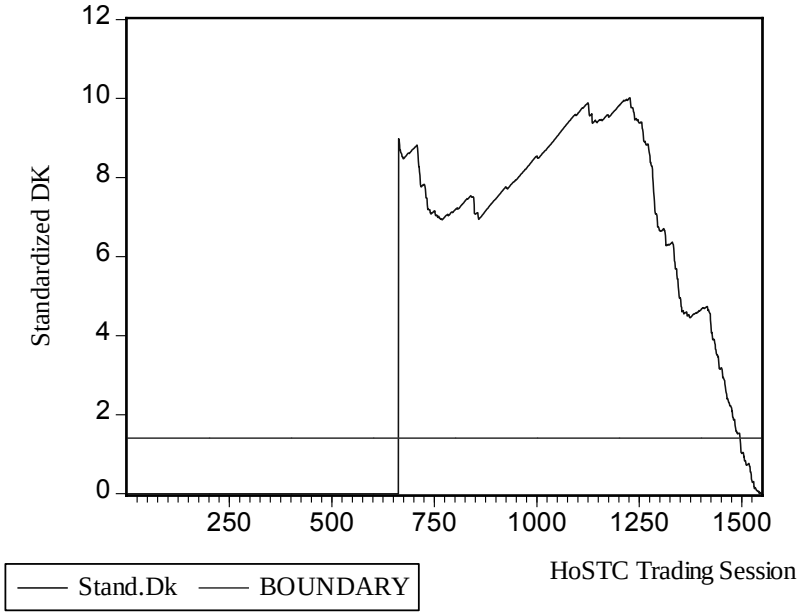


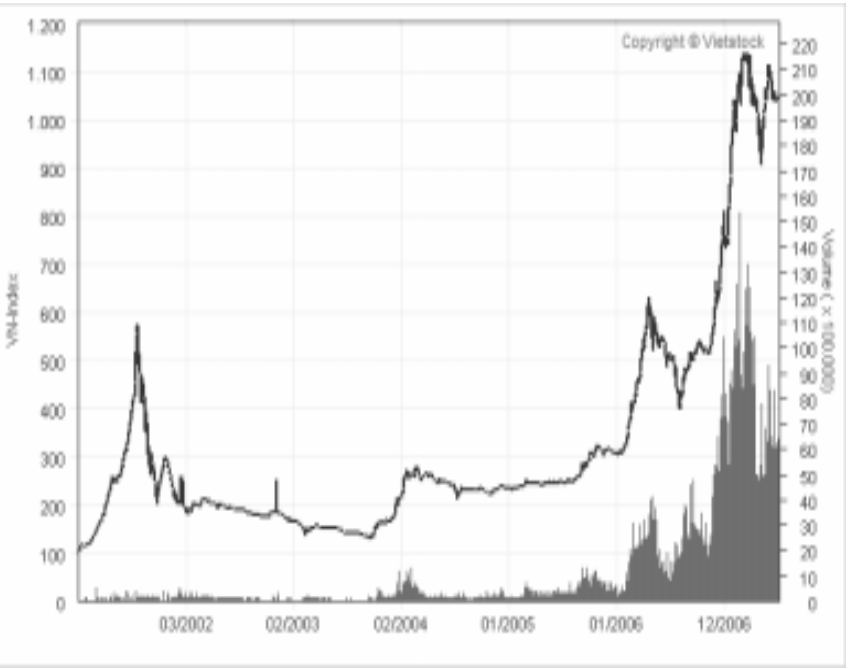
Appendix B: Detection of Break Points (Cont.)





Appendix B: Detection of Break Points (Cont.)





Appendix B: Conditional Standard Deviation with & without Regime Change