ตลาดหลักทรัพย์แห่งประเทศไทย
The Stock Exchange of Thailand

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"SGT Density with Conditional Volatility, Skewness and Kurtosis in the Estimation of VaR: A Case of the Stock Exchange of Thailand"

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Outline

- Research Objectives and Benefits for Thai Capital Market
- Executive Summary
- Introduction
- Methodology
- Results
- Conclusions

Research Objectives and Benefits for Thai Capital Market

- Research Objectives: To investigate the performance of SGT density with conditional volatility, skewness and kurtosis in terms of power to predict the actual VaR threshold in the case of the Stock Exchange of Thailand.
- Research Benefits: While private sector has an alternative tool for financial risk assessment, policy maker can help stabilizing Thai capital market indirectly by encouraging financial institutions to use the new approach that is more efficient.

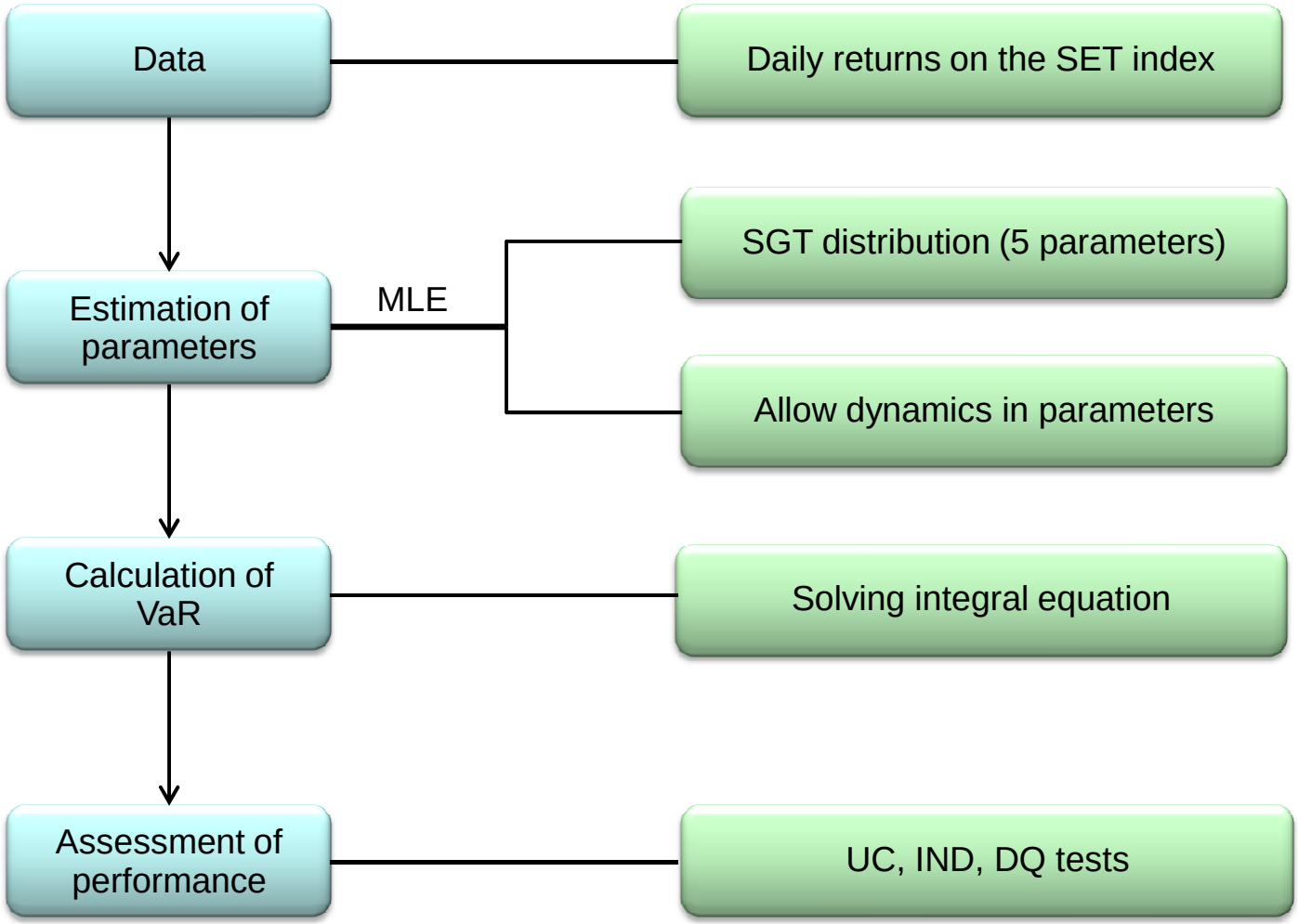
Executive Summary

- One of primary tools used to assess the financial risk recently is Value-at-Risk (VaR). Despite the simplicity of VaR's concept, an accurate calculation of VaR is still statistically challenging. This research proposes an alternative approach using SGT density with conditional volatility, skewness and kurtosis to estimate the actual VaR threshold. The results indicate that the new approach, especially the TS-GARCH model, provides very good prediction of financial risk than the earlier studies.

Introduction

- Value-at-Risk (VaR) is a primary tool used to assess the downward risk. For example, Today's return on the Stock Exchange of Thailand (SET) index is 0.3%. The VaR of the return is -2.5% at 5% coverage probability.
- Its greatest advantage is that it summarizes the risk in consideration into a single and easy-to-understand number. A more accurate method of VaR calculation will be beneficial to many financial institutions and also financial market regulators.
- The objective of study is to investigate the performance of a new VaR calculation approach in terms of power to predict the VaR threshold.

Methodology (1)



Methodology (2) - Data

- Daily returns on SET index from January 1976 to December 2010 (8,605 observation) obtained from $r_t = 100[ln(p_t) - ln(p_{t-1})]$

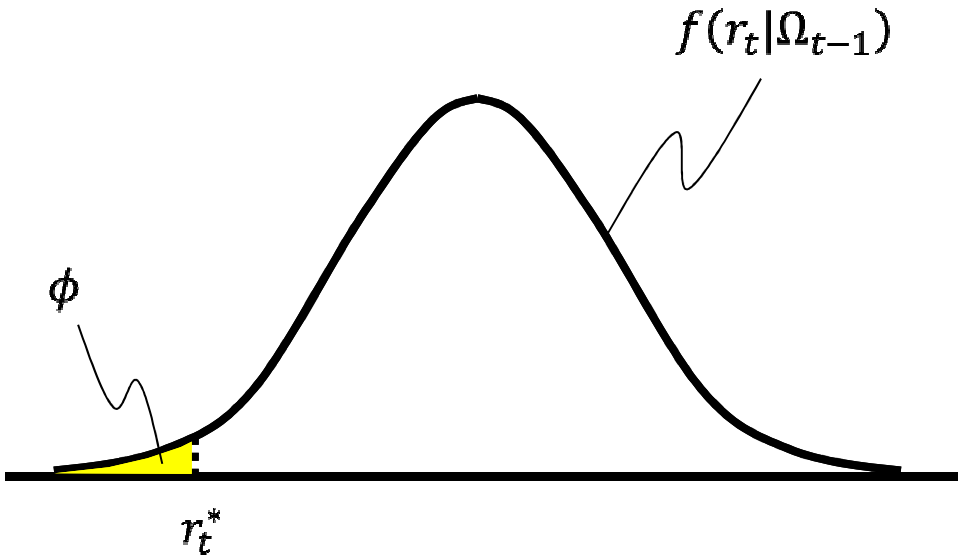
Methodology (3) - Estimation of Parameters

- $r_t = \mu_t + u_t$
- $u_t = \sigma_t \cdot z_t$
- $z_t \sim SGT(\lambda_t, \eta_t, \kappa_t)$
- $r_t \sim SGT(\mu_t, \sigma_t^2, \lambda_t, \eta_t, \kappa_t)$
- All parameters have dynamics as:
  - μ_t follows AR(1) process
  - σ_t^2 follows 8 types of GARCH(1,1) process
  - λ_t, η_t, κ_t follow time-varying process

Methodology (4) - Calculation of VaR

- VaR threshold r_t^* can be obtained directly by solving the equation

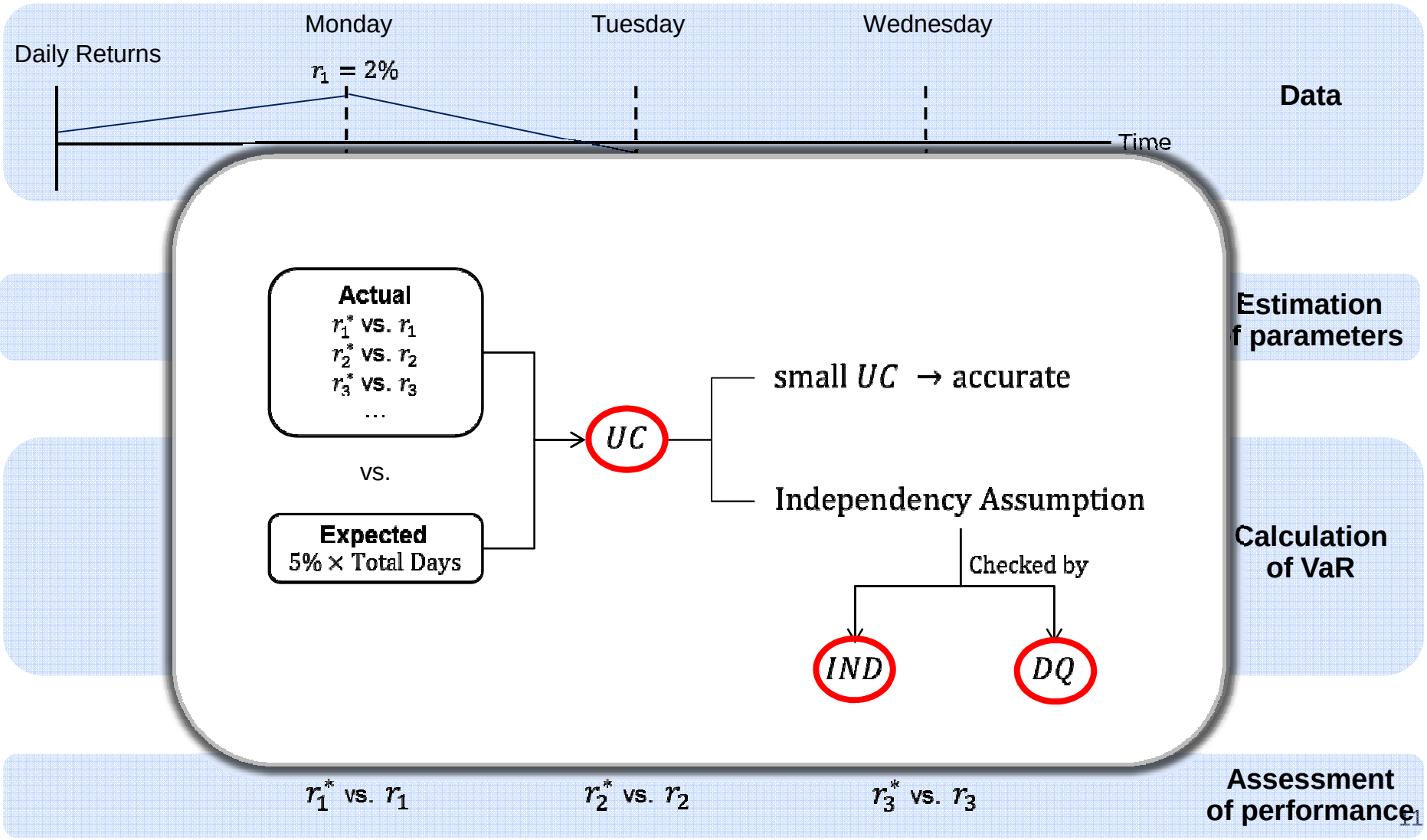
$$Pr(r_t \leq r_t^* | \Omega_{t-1}) \equiv \int_{-\infty}^{r_t^*} f(r_t|\Omega_{t-1}) dr_t = \phi$$



Methodology (5) - Assessment of Performance of Conditional VaR

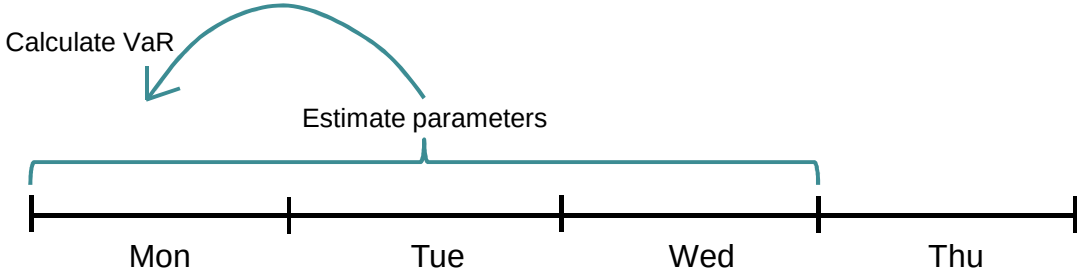
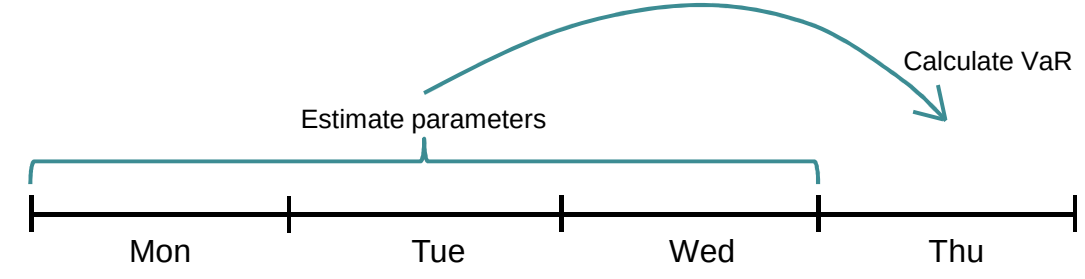
- There are 3 tests: unconditional coverage test (UC), conditional coverage test (IND), and dynamic quantile test (DQ).
- UC test is based on comparison between actual and expected number of observations falling below VaR threshold given independency. The acceptance of null hypothesis refers that the computed VaR threshold is accurate.
- IND and DQ tests are used to test whether independent assumption of UC test is violated. The acceptance of null hypothesis indicates that the UC test is reliable.

Methodology (6) - Summary



Results (1)

- The results will be divided into two parts: In-sample and Out-of-sample performance.

In-sample	
Out-of-sample	

Results (2) - In-sample Analysis

	GARCH	IGARCH	EGARCH	GJRGRH	QGARCH	TGARCH	TSGRCH	APGRCH
1.0%	-2.9559	-3.0247	-3.4144	-3.4979	-2.9712	-3.4028	-3.2255	-2.2495
Actl/Expt	125/86	116/86	74/86	75/86	121/86	78/86	92/86	330/86
UC	15.64**	9.50**	1.78	1.49	12.75**	0.78	0.41	406.41**
IND	0.02	0.24	0.18	1.32	0.35	0.11	0.00	0.88
1.5%	-2.7121	-2.7716	-2.9152	-2.9845	-2.7229	-3.0781	-2.9463	-2.1693
Actl/Expt	175/129	169/129	128/129	126/129	172/129	107/129	127/129	359/129
UC	14.96**	11.45**	0.01	0.07	13.15**	4.06*	0.03	281.02**
IND	0.05	0.14	0.53	0.01	0.09	0.09	0.01	1.09
2.0%	-2.5365	-2.5896	-2.5947	-2.6550	-2.5444	-2.8489	-2.7472	-2.1088
Actl/Expt	219/172	206/172	200/172	190/172	218/172	134/172	162/172	381/172
UC	12.04**	6.43*	4.40*	1.85	11.55**	9.29**	0.61	193.09**
IND	0.06	0.00	0.03	0.01	0.05	0.00	0.43	1.57
2.5%	-2.3984	-2.4465	-2.3631	-2.4169	-2.4041	-2.6714	-2.5918	-2.0590
Actl/Expt	273/215	256/215	280/215	269/215	272/215	177/215	204/215	402/215
UC	14.76**	7.54**	18.38**	12.86**	14.28**	7.35**	0.59	133.22**
IND	0.62	0.05	0.00	0.04	0.23	0.13	0.27	0.98
5.0%	-1.9546	-1.9878	-1.7236	-1.7602	-1.9545	-2.1184	-2.0988	-1.8789
Actl/Expt	475/430	450/430	617/430	620/430	474/430	385/430	391/430	523/430
UC	4.77*	0.95	75.75**	78.07**	4.56*	5.16*	3.86*	19.79**
IND	0.00	0.09	0.14	1.22	0.00	0.85	1.56	0.29

Note: *, ** denote significance at the 5% and 1% level, respectively.

Results (3) - Out-of-sample Analysis

	GARCH	IGARCH	EGARCH	GJRGRH	QGARCH	TGARCH	TSGRCH	APGRCH
1.0%	-2.7706	-2.7581	-2.9126	-2.7735	-2.7934	-2.7666	-2.7935	-2.8850
Actl/Expt	1/0.62	2/0.62	1/0.62	1/0.62	1/0.62	0/0.62	1/0.62	1/0.62
UC	0.19	1.96	0.19	0.19	0.19	1.25	0.19	0.19
IND	0.03	0.14	0.03	0.03	0.03	NA	0.03	0.03
DQ	0.56	1.81	1.25	0.69	0.59	NA	0.62	2.01
1.5%	-2.5020	-2.4589	-2.6330	-2.5049	-2.5213	-2.4929	-2.5196	-2.6077
Actl/Expt	1/0.93	2/0.93	1/0.93	1/0.93	1/0.93	1/0.93	1/0.93	1/0.93
UC	0.01	0.94	0.01	0.01	0.01	0.01	0.01	0.01
IND	0.03	0.14	0.03	0.03	0.03	0.03	0.03	0.03
DQ	0.17	0.98	0.64	0.28	0.18	0.33	0.25	1.15
2.0%	-2.3144	-2.2556	-2.4372	-2.3173	-2.3317	-2.3024	-2.3286	-2.4141
Actl/Expt	1/1.24	2/1.24	1/1.24	1/1.24	1/1.24	1/1.24	1/1.24	1/1.24
UC	0.05	0.40	0.05	0.05	0.05	0.05	0.05	0.05
IND	0.03	0.14	0.03	0.03	0.03	0.03	0.03	0.03
DQ	0.12	0.73	0.48	0.22	0.13	0.26	0.19	0.86
2.5%	-2.1700	-2.1022	-2.2863	-2.1729	-2.1859	-2.1563	-2.1817	-2.2651
Actl/Expt	1/1.55	2/1.55	1/1.55	1/1.55	1/1.55	1/1.55	1/1.55	1/1.55
UC	0.22	0.12	0.22	0.22	0.22	0.22	0.22	0.22
IND	0.03	0.14	0.03	0.03	0.03	0.03	0.03	0.03
DQ	0.22	0.69	0.49	0.29	0.22	0.32	0.27	0.81
5.0%	-1.7228	-1.6436	-1.8181	-1.7266	-1.7351	-1.7061	-1.7274	-1.8045
Actl/Expt	2/3.1	4/3.1	1/3.1	1/3.1	2/3.1	2/3.1	1/3.1	2/3.1
UC	0.47	0.25	2.01	2.01	0.47	0.47	2.01	0.47
IND	0.14	0.56	0.03	0.03	0.14	0.14	0.03	0.14
DQ	0.86	2.92	1.45	1.36	1.04	1.37	1.32	1.36

Note: *, ** denote significance at the 5% and 1% level, respectively.

Conclusions

- The new VaR calculation approach based on the SGT density with conditional volatility, skewness and kurtosis introduced in this research, especially the TS-GARCH model, can provide a good prediction of actual VaR threshold both in in-sample and out-of-sample analyses.
- The new approach can help stabilizing Thai capital market directly and indirectly through the private sector and policy maker, respectively.
- More empirical research for testing the new approach is required, especially in case of out-of-sample analysis.

Q & A

Thank you for your attention