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EXTREME VALUES ANALYSIS FOR ASEAN STOCK EXCHANGES

This paper aims to provide a precise estimation for prediction the extreme value of set index points of the ASEAN stock markets. The time series data of set index point from 3 markets in ASEAN Exchange such as the Stock Exchange of Thailand, Kuala Lumpur Stock Exchange (KLSE) and Exchange LTD in Singapore were used. Time series data was used to predict the extreme value of set index points for 1987–2014 (annual data). The precise estimation approach was used applying the Bayesian inference approach. The research result confirmed that the prediction value of each stock exchange is reasonable to prevent the financial crisis after 2015.
Keywords: *extreme value; ASEAN stock exchange; Bayesian inference approach; financial crisis.*

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АНАЛІЗ ЕКСТРЕМАЛЬНИХ ЗНАЧЕНЬ ЗА ДАНИМИ ФОНДОВИХ БІРЖ КРАЇН АСЕАН

У статті наведено розрахунки за екстремальними значеннями індексних позицій на фондових ринках АСЕАН. Дані часових рядів проаналізовано для індексних позицій фондових бірж Таїланду, Малайзії та Сінгапуру, для чого використано щорічні дані за період 1987–2014 років. В аналізі та прогнозуванні використано метод точних оцінок з використанням Байєсівського висновку. Результати дослідження підтвердили, що дані подібного прогнозування можуть бути використані для запобігання фінансовій кризі в умовах після 2015 року.
Ключові слова: *екстремальне значення; АСЕАН; фондова біржа; Байєсівський висновок.*
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АНАЛИЗ ЭКСТРЕМАЛЬНЫХ ЗНАЧЕНИЙ ПО ДАННЫМ ФОНДОВЫХ БИРЖ СТРАН АСЕАН

В статье приведены расчёты по экстремальным значениям индексных позиций на фондовых рынках АСЕАН. Данные временных рядов проанализированы для индексных позиций фондовых бирж Таиланда, Малайзии и Сингапура, для чего использованы ежегодные данные за период 1987–2014 годов. В анализе и прогнозировании использован метод точных оценок с применением Байесовского вывода. Результаты исследования подтвердили, что данные подобного прогнозирования вполне могут быть применимы для предотвращения финансового кризиса в условиях после 2015 года.
Ключевые слова: *экстремальное значение; АСЕАН; фондовая биржа; Байесовский вывод; финансовый кризис.*

Introduction. Exchanges closing index points of stock markets cycle are join extreme forces between the stock markets in ASEAN (www.aseanexchanges.org). Statistical series or indicators relate to "bigger representation" of extreme data used to estimate the extreme value collected from index points at the selected ASEAN stock exchanges. Outliers[3] of particular statistical series were collected for the selected periods, 1987–2014 (annual data). Table 1 measures market performance in descriptive statistics of average closing index points for the selected ASEAN exchanges for the selected period, 1987–2014 (28 years) including: the Stock Exchange of Thailand

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[3] In statistics, outlier is an observation point that is distant from other observations.

(SET) average was equivalent to 792.37 points; the Stock Exchange of Singapore (SGX) average was equivalent to 2,135.10 points; Kuala Lumpur Stock Exchange (KLSE) of Malaysia average was equivalent to 965.72 points. In terms of the maximum closing index point's value of ASEAN Exchange, SGX was ranked first; KLSE was ranked second and SET was third. The research question of this study is to assess how the results encourage risk-averse investor seeking the impression of Bayesian Estimation for GPD parameters, and distribution tails determining for the index points of 3 stock exchanges. What is going to occur to ASEAN financial markets after the end of the Shemitah year in 2015? There are extreme probabilities for future financial crisis which might be alleviated by GDP based analytical solutions. The 7-year Shemitah cycle in 2015 followed by Jubilee year in 2016 have shown that stock markets suffered the biggest sell-off in the last quarter of 2015. The investment risks of the closing index points collapses were rather probable. The possibility for integration of ASEAN stock exchanges, namely, Thailand, Malaysia, and Singapore is based on compelling evidence throughout the ASEAN history. In the view of the economic impact of the Jubilee, the research aims to analyze The Shemitah Jubilee Promises[4] on the evidence of a 10-year closing index points of the Stock Exchange. Index points of 3 AEC Stock Exchanges include evidence of remarkable various curves, but also normal operations. Projected extreme values will be also provided by using Bayesian estimation for generalized pareto distribution (GPD).

Research objective. The main objective of this study is to develop a precise estimate that determines the index points of the Stock Exchange in terms of interval extreme values and differences in absolute values in the average per year trade. The specific objective of the study is to measure the extreme closing index points of the Stock Exchange t using the Bayesian estimation for the GPD parameters and distribution tails. The result of the statistical analysis would help the encouragement of risk-averse investor.

Scope of this research. This study aims to find the most appropriate method for forecasting stock exchange indices for the case when the volume of these stock exchange indices are larger than other stock exchange indices. Stock exchange transactions in which set prior distributions function influencing on risk-averse investors' intentions to invest focusing on the closing index points of the stock exchange annually are included for 28 year patterns of SET, SGX and KLSE.

Literature reviews. F.S. Mishkin and E.N. White (2003) suggested that stock market crashes can provide some evidence on the impact on the US economy in terms of a bursting bubble economy. M. Sanchez (2011) stated that macroeconomic risk is responded by asset price collapses. It may be influenced by economy slowdown or recession. And in the same situation it may be found that falling price at stock market can happen. Only a few researchers so far have done research on ASEAN exchanges because these stock exchanges are established by cooperation between AEC member countries 3 years ago only (www.aseanexchanges.org). S. Songsak and C. Chukiat (2013) studied the dynamics co-movement between capital markets at ASEAN exchanges during the period of 2012–2013. And it was found that elliptical

[4] Jubilee thereafter = (7 counts of 7 Years = 49 YEARS): 1966 + 7 + 7 + 7 + 7 + 7 + 7 + 7 = 2015 (1973 1980 1987 1994 2001 2008 2015).

distribution was based on the dynamics co-movement among them. P. Chaitip et al. (2013) found that the median of KLSE ExtremeVaR in Malaysia was the AEC efficient equity for investing in these markets. On the basis of the literature mentioned above, this study is motivated to show important it is for risk-averse investors to be aware of extreme-econometric approaches in understanding the closing index points of stock exchanges as the leading indicator of economic movements and business cycle theories. This study measures extreme closing index points of the Stock Exchange t independence for risk using Bayesian estimation for generalized Pareto distribution (GPD) to predict the univariate extreme value in case of both non-stationary and stationary at stock exchange, and the related solutions by using non-stationary extreme value analysis (NEVA) of stock exchanges.

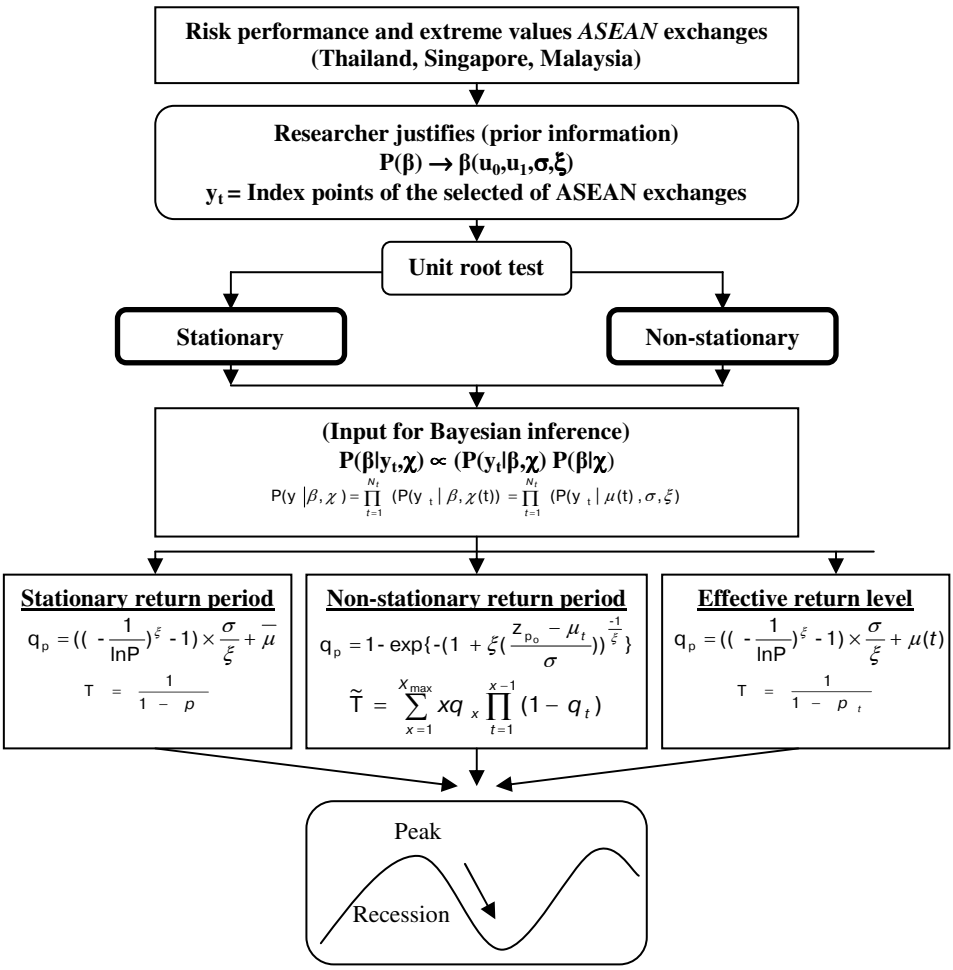

Figure 1. **The conceptual framework and methodology for Extreme Value Analysis,** *modified from* (Cheng et al., 2014; Cheng and Agha Kouchak, 2014)

Conceptual framework and methodology for extreme forecast using generalized Pareto distribution. Prior distributions of the extreme closing index points of the stock exchanges were adopted on the basis of implicit function of the closing index points (Figure 1).

Forecasting with extreme value analysis.

Generalized Pareto distribution (GPD). This research uses the generalized Pareto distribution (GPD) to predict the univariate extreme values in both non-stationary and stationary cases. GPD was applied to solve the problem of analyzing extreme values in case of exceedances over high thresholds. This approach or method was first proposed by J. Pickands (1975). The family of generalized Pareto distributions (Arnold and Laguna, 1977) has 3 parameters – μ, σ and ξ. And these distributions have the cumulative distribution function:

$$F = (\xi, \mu, \sigma)(x) = 1 - (1 + \frac{\xi(x-\mu)}{\sigma})^{-\frac{1}{\xi}}. \quad (1)$$

For $x \geq \mu$, and $x \leq \mu - \sigma / \xi$ when $\xi < 0$, where $\mu \in R$ is the location parameter; $\sigma > 0$ is the scale parameter and $\xi \in R$ is the shape parameter. And this research also sets up the prior information on all the parameters used in estimations basing on the idea from (Cheng et al., 2014).

Forecasting with non-stationary and stationary for AEC extreme value. The Non-stationary Extreme Value Analysis (NEVA) software package was first used by L. Cheng et al. (2014). It was used to obtain the annual temperature maxima of the US covering the period of 1901–2009 for the observable cases, both stationary and non-stationary. The same approach we apply to predict the index points at the selected ASEAN exchanges. The econometric model with Bayesian inference we start with the equation (2) described below.

$$P(y|\beta, \chi) = \prod_{t=1}^{N_t} (P(y_t | \beta, \chi(t)) = \prod_{t=1}^{N_t} (P(y_t | \mu(t), \sigma, \xi). \quad (2)$$

And the input for the defined Bayesian inference is $P(\beta|yt,\chi) \propto (P(yt|\beta,\chi)\ P(\beta|\chi)$ for two cases of GPD. The first corner stone is that index points follow the stationary process tested by equation (3) to forecast. The second corner stone, index points follow the non-stationary process as verified by equation (4), respectively.

$$q_p = ((-\frac{1}{\ln P})^{\xi} - 1) \times \frac{\sigma}{\xi} + \bar{\mu},\ T = \frac{1}{1-p}; \quad (3)$$

$$q_p = 1 - \exp\{-(1 + \xi(\frac{z_{p_o} - \mu_t}{\sigma}))^{\frac{-1}{\xi}}\},\ \tilde{T} = \sum_{x=1}^{x_{max}} x q_x \prod_{t=1}^{x-1} (1 - q_t); \quad (4)$$

$$q_p = ((-\frac{1}{\ln P})^{\xi} - 1) \times \frac{\sigma}{\xi} + \mu(t),\ T = \frac{1}{1-p_t}. \quad (5)$$

The equation (5) is used to predict the index points in terms of extreme events called effective return levels for the time period covering 1987–2014. The q_p of each equation presented above represents the forecasted value of our empirical study.

Data description. Table 1 presents the descriptive statistics for index points of ASEAN Exchanges covering for the selected period of 1987–2014 (annual data).

PP-test unit root suggests that the index points of both Thailand and Kuala Lumpur Stock Exchanges have the statistical significance of the 1st level for non-stationary. However, same unit root suggests that the index points of the Singapore Exchange shows the statistical significance at stationary level. Estimation results are shown in Table 2 and they allow finding out the Bayesian estimation of GPD equations for 3 ASEAN stock exchanges.

Table 1. **The descriptive statistics of index points of the selected ASEAN Exchanges, 1987–2014,** *authors'*

Items	Thailand (SET)	Singapore (SGX)	Malaysia, Kuala Lumpur (KLSE)
Mean	792.3775	2135.101	965.7257
Median	724.1350	2141.470	888.2700
Maximum	1682.850	3482.300	1866.960
Minimum	269.1900	823.2000	261.1900
Std. Dev.	402.9687	761.9102	439.8811
Skewness	0.549147	0.192950	0.497845
Kurtosis	2.318465	1.918272	2.218989
Jarque-Bera	1.949197	1.538898	1.868272
Probability	0.377344	0.463268	0.392925
PP-test (Unit root test)	Non-stationary	Stationary	Non-stationary
Observations	28	28	28

Figure 2 shows the time series data on the index points of the 3 selected ASEAN stock exchanges for the period of 1987–2014. It was clarified that they have co-movement among them and they also have the same processes.

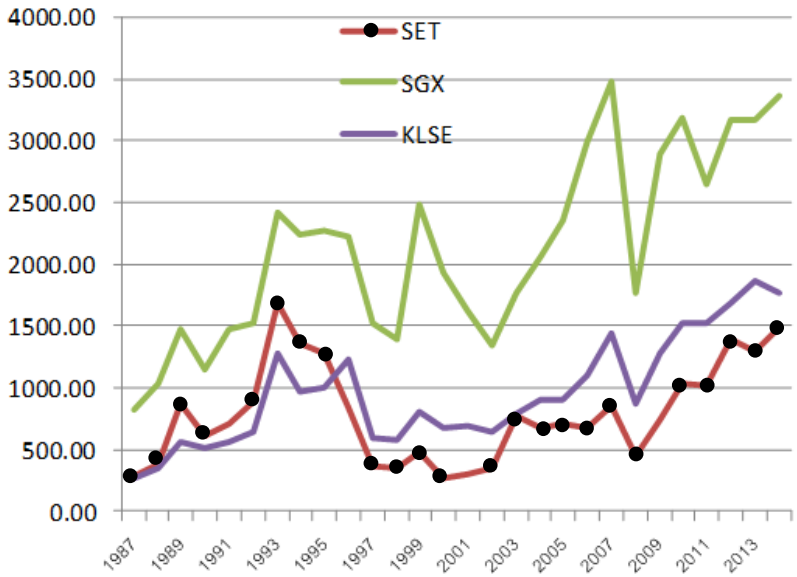

Figure 2. **Time series data on the index points for 3 stock exchanges, 1987–2014,** *authors'*

Empirical results of research. Table 2 provides more details on the extreme value prediction in terms of the maximum index points of the selected stock exchanges tested by introducing GPD. Bayesian estimation of GPD employed the principles needed to translate prior information into 3 Asian stock markets. The standard set of procedures requires prior information to be taken into account. The choice to come up with new methods of how to set up the model and what data to include is also needed to approximate the original data together with the simulated data by means of differential evolution Markov chain (DE-MC) approach (more detail – in C.J.F. Ter Braak (2006), C.J.F. Ter Braak and J.A. Vrugt (2008) and L. Cheng et al. (2014)).

Table 2. **Estimation results for Bayesian estimation of GPD for 3 stock exchanges in question,** *authors'*

3 ASEAN stock exchanges	Thailand (non-stationary SET)	Malaysia (non-stationary KLSE)	Singapore (Stationary SGX)
Prior Information $P(\beta) \rightarrow \beta(u_0,u_1,\sigma,\xi)$ (Interval value)	(0-100,0-100, 0-100,0-0.3)	(0-100,0-100, 0-100,0-0.3)	(0-100,0-100, 0-100,0-0.3)
DC-MC (Differential Evaluation Markov Chain			
1) Number of random samples for parameter estimation	20,000	20,000	20,000
2) Number of burned samples	19,000	19,000	19,000
3) Chain number (5 is reasonable)	5	5	5
Post Prior by GPD Bayesian approach	(0,0,1.0098, 0.0407)	(0,0,1.0051, 0.0034)	(0,0,1.0005, 0.0084)
The peak of index points in the selected ASEAN exchanges before recession as prediction at average per year (during 10 years)	1,580–1,590	1,330–1,850	3,000–3,300

For the period 2015–2025, Bayesian estimation of GPD determines the index points of Thailand Stock Exchange in terms of interval extreme value and difference containing absolute value at the average per year that as equivalent to 1,580–1,590 index points. For Kuala Lumpur Stock Exchange, the Bayesian predictive approach offers the interval extreme value at the average per year as equivalent to 1,330–1,850 index points. And finally, for Singapore Stock Exchange, the Bayesian predictive approach in terms of the interval extreme value at the average per year is considered to be 3,000–3,300 index points. This methodology points out the peak point of Thailand Stock Exchange breakdowns and that the securities prices decrease for a possible bear market or leading signs of an economic recession.

Conclusion. For investors, extreme time intervals may be given ahead of time as an aftermath of upcoming predicted interval time called a leading indicator on generalized anxiety symptoms. Even with leading indicators, passive interpretation may call a dramatical whirlwind in the index point flow. This paper shows an approach to predicting the aftermath of a whirlwind as the consequences of stock market crashes. At the crash of stock exchange markets, the aftermath of a predicted interval time will

have a distinct and severe effect on margin loans offered to higher threat borrowers. Thereby, transmitting an independent shock to flows, a passively managed trading investor depends unsympathetically on two passive beliefs. Firstly, the initial impulse of passive investing harmonization is important. If the investing system is weak, being highly leveraged or having cumulative shocks, passive belief is more likely that aftermath will induce lenders to raise rates to higher risk borrowers relative to low risk ones as a general rule and produce financial instability, especially for those investors building their investments on a sandy background (contracted before a whirlwind). Secondly, given a fearful belief that a shock contracted before a whirlwind is transmitted from the stock market crash on stable situations promotes economic downturn and instability under the Shemitah Jubilee influences. And how the authorities would respond to that will be critical for the future of stock markets.

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