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Performance of Listed State-owned Enterprises using Sortino Ratio Optimization

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Abstract: The aim of the study was to empirically investigate the applicability of Sortino ratio optimization approach in examining the performance of the listed State-Owned Enterprises (SOEs). The Sortino performance ratio, risk-adjusted return and downside risk were determined based on a sample of SOEs selected from Malaysia, Singapore and Indonesia. The constrained Sortino ratio optimization approach is the resemblance to the enhanced index tracking method and it is performed under efficient market assumption. This study considered weekly data from January 2004 to December 2009 and further divides it into pre- and global financial crisis sub-periods. The results showed that the performance of SOEs in Malaysia and Indonesia outperformed the non-SOEs owning to their higher returns. In contrast, Singaporean SOEs are inferior to the non-SOEs despite their lower risks. The findings also revealed that the SOEs in all the three countries are superior to the non-SOEs before the global financial crisis, but performed differently during the crisis. In the comparative study of the SOEs' performance, the results revealed that the relative performance ratio of Indonesian SOEs is the highest followed by Singaporean and Malaysian SOEs. The overall findings disclosed that the SOEs in Indonesia relatively yielded the highest returns and risks. This paper also demonstrated that the Sortino ratio optimization method can be an alternative approach in assessing the performance of selected listed companies.

Key words: ASEAN, debt-to-equity, crisis, government-linked, sortino ratio optimization method, portfolio

INTRODUCTION

Privatization of State-Owned Enterprises (SOEs) or Government-Linked Companies (GLCs) as part of economic reform has been vigorous throughout the ASEAN countries since late 1980's. The privatizations of SOEs are commonly driven by factors such as enhancing SOEs' efficiency and competitiveness, reducing government debt and expanding the capital market size. Other reasons are to promote wider share ownership and improve economic efficiency (Milne, 1992; Miller, 1997; Megginson and Netter, 2001; Gupta *et al*., 2008). Despite of the privatization exercise, the government generally still retained a considerable controlling stake and to a certain extent, the government still has influences in the SOEs. Many researchers have used non-SOEs as the benchmark to scrutinize the effects of various factors on the performance of SOEs (Feng *et al*., 2004; Ramirez and Tan, 2004; Yonnedi, 2010). Nevertheless, the findings are at best mixed. Specifically, Viverita and Ariff (2004) compared Indonesian public and private sector firms in the context of the financial and production efficiency. They found that in general, private sector firms outperformed public firms. In another study based on a sample data of Singaporean SOEs for the period 1994-1998, Ramirez and Tan (2004) found that the SOEs are rewarded in financial markets. In a more recent study, Ang and Ding (2006) showed that on the average, Singaporean SOEs provide better returns on both assets and equity as compared to non-SOEs in Singapore.

This study provides additional empirical evidence to current literatures from different perspective as limited works were done to examine and compare the performance of the privatized SOEs particularly in ASEAN countries collectively. Unlike previous works, this paper uses stock market information and Sortino ratio optimization approach instead of accounting performance measures to examine the performance of privatized SOEs. The method is premised on the efficient-market hypothesis which advocated that in an efficient market, all new information on a listed company will instantly be reflected in its stock price. Similar to the enhanced index tracking approach (Oh *et al*., 2005; Chen and Kwon, 2010), the Sortino ratio optimization method collects a representative subset of listed companies under a single portfolio. The optimal portfolio is then used to mimics the overall performance of the listed SOEs and non-SOEs. Subsequently, the ex-post Sortino ratio, risk-adjusted returns and downside risks of the listed SOEs, as well as the relative performance of the listed SOEs between the three countries are scrutinized.

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MATERIALS AND METHODS

This paper focuses on the performance of the listed SOEs in Malaysia, Singapore and Indonesia. Since most Indonesian SOEs data only available after January 2004, this study therefore considers adjusted weekly closing prices for the period 7/1/2004 to 30/12/2009. All the data are sourced from the Data stream. The data set are further divided into pre-global financial crisis (7/1/2004 to 27/6/2007) and during global financial crisis (4/7/2007 to 30/12/2009) sub-periods. The preference of weekly (Wednesday) series aimed primarily to avert the asynchronous in data and any weekend effect among the countries. This study considers the top ten largest listed SOEs as at 30th December 2009, in each country that are assessable during the period of study. In line with earlier studies, the performance of the SOEs is benchmark with the corresponding non-SOEs. The benchmark portfolios are formed by using the identical number of listed non-SOEs of the same study period in effort of making rational evaluations as comparable to the SOEs.

The Jarque-Bera (JB) test (Jarque and Bera, 1980) disclosed that nearly all the returns of the data depart from normality. Thus, Sortino ratio is favored in this study, instead of the well-known Sharpe ratio because the latter requires assumption of normality in the assets returns. Sortino ratio is a portfolio performance measure that evaluates the risk-adjusted returns of investment assets or portfolios (Sortino and Van der Meer, 1991; Sortino and Price, 1994). The Sortino ratio is a variation of Sharpe ratio in which it only penalizes the negative volatility, i.e., returns falling below a specified target. The Sharpe ratio, on the other hand, penalizes both positive and negative volatilities. The weekly rate of return, $r_{i,t}$ of an asset i at time t is computed using:

$$r_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \quad (1)$$

where, $P_{i,t-1}$ and $P_{i,t}$ are the closing prices of the asset at time t-1 and t, respectively. If the difference between the returns of an asset i and a specified target T is:

$$d_i = \begin{cases} r_i - T; r_i < T \\ 0 \quad ; \text{otherwise} \end{cases} \quad (2)$$

Hence, the Sortino ratio can be expressed as:

$$S = \frac{E(r) - T}{\sqrt{\frac{1}{N}\sum_{i=1}^{N} d_i^2}} \quad (3)$$

where, E(r) is the expected returns of the portfolio and N is the total number of assets under consideration over the assessment period.

Equation 3 is rephrased to incorporate the portfolio's weights into the objective function prior to the portfolio optimization process. Therefore, the optimal Sortino ratio and portfolio's weights w_m for N assets under consideration can be obtained by:

$$S_m = \underset{w_m \in [0,1]}{\text{argmax}} \frac{w_m E(r) - E(T)}{\sqrt{w_a \sum w_a^T}} \quad (4)$$

where, w_i is the proportion of weight allocated to asset i, $w_a = [w_m\text{-}1]$ is a vector, E (T) is the expected returns of the specified target and $\sum$ is the covariance matrix of the downside deviation. The maximization of Eq. 4 is subjected to constraints such that:

- The weight of any asset i (without short-selling) is from range [0, 1] or $0 = w_i = 1$
- The sum of weights is equal to one

In spite of many advanced optimization methods are available (Moradi *et al*., 2008; Qasem and Shamsuddin, 2010; Gunasekaran and Ramaswami, 2011; Jasemi *et al*., 2011; Lye, 2011), there are a paucity of studies that use these approaches in the portfolio optimization. Among the earlier researches on portfolio optimization, Benson *et al*. (2008) employed numerical optimization to optimize Sortino ratio, Sharpe ratio and Stutzer's Portfolio Performance Index in their effort to scrutinize the potential of Stutzer Index. Alternatively, Lye and Ng (2010) used sequential quadratic programming to optimize a selection of portfolio performance measures in their study. In light of these literatures, the sequential quadratic programming is used to maximize the Sortino ratio in view of the fact that it is efficient in solving nonlinear continuous objective function (Fletcher, 1987). The constrained optimization of Eq. 4 is performed by using the MATLAB. The optimal portfolios are periodically reviewed at every 2-3 and 4 month, respectively and the FTSE ASEAN index is used as the specified target (or minimum acceptable return). The corresponding optimal portfolio weights are subsequently utilized in the computations of the downside risks and the ex-post optimal returns (the product of the optimal weights and the mean return for the same period). Two-sample t-tests are employed to examine the statistical difference in the performance ratios, risk-adjusted returns and downside risks.

RESULTS AND DISCUSSION

The empirical investigation in this paper is initiated with preliminary study on the reliability of the Sortino ratio optimization approach. Portfolios are formed by considering the top ten largest listed companies (in market capitalization as at 31 December 2009). These portfolios are expected to represent the respective stock market's overall performance in each country. The portfolios are maximized periodically via the optimization of the Sortino ratio and the overall performance is benchmarked against the one obtained using the major stock index. Table 1 presents the performance of the composite index in Malaysia (FTSE Bursa Malaysia Index), Singapore (Straits Times Index) and Indonesia (Jakarta Composite Index), respectively. The results showed higher weekly returns in the stock market of Indonesia (0.0050) as compared to Singaporean (0.0021) and Malaysian (0.0017) stock markets. Moreover, the downside risks in Indonesian stock market (0.0398) are also statistically significantly higher than the risks in the stock markets of Malaysia (0.0211) and Singapore (0.0301), respectively.

The results of the overall performance of the optimal portfolios built by using the respective top ten listed companies in each country are shown in Table 2. The results showed that the Sortino performance ratios of the Indonesian portfolios are the highest with values of (7.000, 1.910, 1.600). Indonesian portfolios also yielded the highest risk-adjusted returns with values of (0.0254, 0.0222, 0.0214), in every 2, 3-and 4 month portfolio review periods. This is tracked by Singapore with performance ratios and risk-adjusted returns of (3.220, 1.790, 1.271) and (0.0139, 0.0115, 0.0122) and followed by Malaysia with values of (1.990, 1.158, 0.939) and (0.0135, 0.0103, 0.0103), respectively. Indonesia also yielded the highest downside risks among the three countries with values of (0.0122, 0.0154, 0.0179). These results serve as an important gauge of the optimization approach's consistency. When the results are matched against with the findings disclosed in Table 1, it can be evidenced that the performance are nearly comparable in terms of the returns and risks. In other words, the results provide reasonably strong evidence on the reliability of the optimization approach in which justified its utilization in this study.

Table 3 summarizes the performance of the listed SOEs in Malaysia, Singapore and Indonesia, benchmarked with non-SOEs. The results revealed that for all portfolio review periods, the Sortino performance ratios, risk-adjusted returns and downside risks are relatively higher in Malaysian and Indonesian SOEs as compared to the respective non-SOEs. In Malaysia, the performance ratios, returns and risks of the SOEs are (2.350, 1.279, 1.002) (0.0193, 0.0167, 0.0150) and (0.0137, 0.0156, 0.0169), respectively. Whereas, the corresponding results given by the non-SOEs are (2.140, 1.184, 0.906) (0.0133, 0.0108, 0.0101) and (0.0100, 0.0116, 0.0126), respectively. In Indonesian SOEs and non-SOEs, the performance ratios are (4.780, 2.450, 1.630) and (4.770, 2.040, 1.610), respectively. Their corresponding risk-adjusted returns are (0.0280, 0.0293, 0.0245) and (0.0260, 0.0222, 0.0209) and their respective risks are (0.0156, 0.0181, 0.0216) and (0.0127, 0.0148, 0.0178). The results showed that the

Table 1: The performance of malaysia (KLCI), singapore (STI) and indonesia (JSCI) composite index

Country	MAL vs. SGP	MAL vs. IND	SGP vs. IND
Return			
MAL	0.0017	0.0017	-
SGP	0.0021	-	0.0021
IND	-	0.0050	0.0050
p-value	0.866	0.205	0.307
Risk			
MAL	0.0211	0.0211	-
SGP	0.0301	-	0.0301
IND	-	0.0398	0.0398
p-value	0.001***	0.000***	0.001***

MAL, SGP and IND denote Malaysia, Singapore and Indonesia, respectively. *** indicates significant at 1% significance level. The Levene's test is used for the test of equal variance (by using variance as a simple proxy of risk)

Table 2: The performance of the top 10 listed companies by market capitalization as at 31 December 2009

	MAL vs. SGP			MAL vs. IND			SGP vs. IND		
Country	2-M	3-M	4-M	2-M	3-M	4-M	2-M	3-M	4-M
Ratio									
MAL	1.990	1.158	0.939	1.990	1.158	0.939	-	-	-
SGP	3.220	1.790	1.271	-	-	-	3.220	1.790	1.271
IND	-	-	-	7.000	1.910	1.600	7.000	1.910	1.600
p-value	0.013**	0.033**	0.136	0.072*	0.012**	0.038**	0.171	0.719	0.276
Return									
MAL	0.0135	0.0103	0.0103	0.0135	0.0103	0.0103	-	-	-
SGP	0.0139	0.0115	0.0122	-	-	-	0.0139	0.0115	0.0122
IND	-	-	-	0.0254	0.0222	0.0214	0.0254	0.0222	0.0214
p-value	0.898	0.670	0.569	0.004***	0.000***	0.004***	0.005***	0.001***	0.028**
Risk									
MAL	0.0113	0.0115	0.0125	0.0113	0.0115	0.0125	-	-	-
SGP	0.0107	0.0113	0.0136	-	-	-	0.0107	0.0113	0.0136
IND	-	-	-	0.0122	0.0154	0.0179	0.0122	0.0154	0.0179
p-value	0.665	0.861	0.459	0.572	0.015**	0.031**	0.299	0.011***	0.095***

MAL, SGP and IND denote Malaysia, Singapore and Indonesia, respectively. *, ** and *** indicate significant at 10, 5 and 1% significance level, respectively

Table 3: The performance of state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs)

		Ratio			Return			Risk		
Country	Period	SOE	non-SOE	p-value	SOE	non-SOE	p-value	SOE	non-SOE	p-value
Malaysia	2-M	2.350	2.140	0.659	0.0193	0.0133	0.143	0.0137	0.0100	0.013**
	3-M	1.279	1.184	0.634	0.0167	0.0108	0.107	0.0156	0.0116	0.014**
	4-M	1.002	0.906	0.619	0.0150	0.0101	0.189	0.0169	0.0126	0.020**
	Pre-Crisis	2.840	1.950	0.233	0.0197	0.0106	0.068*	0.0119	0.0096	0.184
	Crisis	1.670	2.410	0.164	0.0188	0.0170	0.799	0.0164	0.0106	0.031**
Singapore	2-M	3.670	8.100	0.309	0.0138	0.0187	0.205	0.0111	0.0115	0.792
	3-M	1.930	2.190	0.580	0.0129	0.0165	0.326	0.0121	0.0124	0.849
	4-M	1.342	1.449	0.704	0.0118	0.0188	0.134	0.0129	0.0165	0.089*
	Pre-Crisis	4.860	3.430	0.350	0.0162	0.0207	0.247	0.0087	0.0098	0.341
	Crisis	2.010	14.600	0.229	0.0104	0.0160	0.469	0.0145	0.0137	0.754
Indonesia	2-M	4.780	4.770	0.997	0.0280	0.0260	0.685	0.0156	0.0127	0.193
	3-M	2.450	2.040	0.390	0.0293	0.0222	0.166	0.0181	0.0148	0.090*
	4-M	1.630	1.610	0.964	0.0245	0.0209	0.514	0.0216	0.0178	0.284
	Pre-Crisis	5.840	3.830	0.228	0.0314	0.0240	0.149	0.0149	0.0118	0.245
	Crisis	3.290	6.090	0.213	0.0232	0.0288	0.558	0.0165	0.0140	0.513

2-M, 3-M and 4-M denote 2-month, 3-month and 4-month portfolio reviewed periods, respectively. * and ** indicate significant at 10% and 5% significance level, respectively

Table 4: The average Debt-to-Equity (D/E) ratio of the state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs)

	SOEs			non-SOEs		
Country	ALL	Pre-Crisis	Crisis	ALL	Pre-Crisis	Crisis
Malaysia	3.715	3.678	3.975	3.113	3.236	3.519
Singapore	2.191	2.142	2.222	3.000	3.063	3.178
Indonesia	3.596	3.468	3.696	2.614	2.740	2.446

higher performance ratios in Malaysian and Indonesian SOEs are mainly contributed by their higher returns. The present results disclosed similar performance in the SOEs and non-SOEs of the Malaysian and Indonesian stock markets. These observations can provide additional supporting evidence to the work of Ong and Muzafar (2008). On the other hand, the performance ratios, risk-adjusted returns and downside risks of Singaporean SOEs are comparatively lower than the non-SOEs. The corresponding performance ratios, returns and risks of the SOEs are (3.670, 1.930, 1.342) (0.0138, 0.0129, 0.0118) and (0.0111, 0.0121, 0.0129). Whereas, the relative values yielded by Singaporean non-SOEs are (8.100, 2.190, 1.449) (0.0187, 0.0165, 0.0188) and (0.0115, 0.0124, 0.0165), respectively. Despite the contradiction in the Singaporean SOEs' returns, the results are aligned with the findings of Ang and Ding (2006) in the context of lower risks. The overall results revealed that the performance of Malaysian and Indonesian SOEs can be improved if the risks in their SOEs are reduced. Similarly, the performance of Singaporean SOEs can be enhanced if they achieve higher returns. In order for the SOEs to accomplished such objectives, factors such as corporate governance, employee empowerment and corporate accountability may be taken into consideration (Salawu and Agbeja, 2007; Ongori and Shunda, 2008; Rouf, 2011).

The risks found via the Sortino ratio optimization approach are substantiated with the risks calculated from the perspective of financial ratio. The debt-to-equity (D/E) ratio (a proxy of risk in financial ratio) is obtained by computing the relative proportion of the total liabilities of a company to its shareholder's equity. A low D/E ratio signifies lower risk (conservative financing). Conversely, a high D/E ratio signifies higher risk (aggressive financing). The average D/E ratios for all the listed companies are summarized in Table 4. The results are consistent with the risks found via Sortino ratio optimization. The results showed that SOEs in Malaysia and Indonesia disclosed higher average D/E ratio of 3.715 and 3.596 as compared to non-SOEs with lower D/E ratio of 3.113 and 2.614, respectively. The results also showed that the D/E ratio of Singaporean SOEs is lower (2.191) in comparison to the non-SOEs (3.000). This study also interested in investigating the performance of SOEs during financial crisis. Thus, the data are divided into two sub-periods: pre-global financial crisis and during global financial crisis. The portfolios are reviewed (optimized) every 2-month using Sortino ratio optimization. The findings revealed that the SOEs in all the three countries outperformed the non-SOEs before the global financial crisis but on the contrary, under performed the non-SOEs during global financial crisis. The high volatility in listed companies, especially in SOEs is reasonable during financial turmoil. During crisis, these companies are also exposed to the political uncertainty due to their close relationship to the government (Bittlingmayer, 1998). Additionally, the results also revealed that the risks of all SOEs are higher during crisis. All the risks are comparable

Table 5: The relative performance of state-owned enterprises (SOEs) in Malaysia, Singapore and Indonesia

		Ratio				Return				Risk			
Country	Period	MAL	SGP	IND	p-value	MAL	SGP	IND	p-value	MAL	SGP	IND	p-value
MAL vs. SGP	2-M	2.35	3.67	-	0.170	0.019	0.014	-	0.172	0.014	0.011	-	0.419
	3-M	1.28	1.93	-	0.069*	0.017	0.013	-	0.340	0.016	0.012	-	0.213
	4-M	1.00	1.34	-	0.222	0.015	0.012	-	0.421	0.017	0.013	-	0.135
	Pre-Crisis	2.84	4.86	-	0.200	0.020	0.016	-	0.470	0.012	0.009	-	0.031**
	Crisis	1.67	2.01	-	0.529	0.019	0.010	-	0.243	0.016	0.015	-	0.499
MAL vs. IND	2-M	2.35	-	4.78	0.015**	0.019	-	0.028	0.091*	0.014	-	0.016	0.419
	3-M	1.28	-	2.45	0.008***	0.017	-	0.029	0.021**	0.016	-	0.018	0.213
	4-M	1.00	-	1.63	0.060*	0.015	-	0.025	0.090*	0.017	-	0.022	0.135
	Pre-Crisis	2.84	-	5.84	0.048**	0.020	-	0.031	0.065*	0.012	-	0.015	0.261
	Crisis	1.67	-	3.29	0.123	0.019	-	0.023	0.616	0.016	-	0.017	0.974
SGP vs. IND	2-M	-	3.67	4.78	0.377	-	0.014	0.028	0.002***	-	0.011	0.016	0.041**
	3-M	-	1.93	2.45	0.316	-	0.013	0.029	0.002***	-	0.012	0.018	0.003***
	4-M	-	1.34	1.63	0.445	-	0.012	0.025	0.020**	-	0.013	0.022	0.008***
	Pre-Crisis	-	4.86	5.84	0.617	-	0.016	0.031	0.003***	-	0.009	0.015	0.017**
	Crisis	-	2.01	3.29	0.239	-	0.010	0.023	0.144	-	0.015	0.017	0.595

MAL, SGP and IND denote Malaysia, Singapore and Indonesia, respectively. 2-M, 3-M and 4-M denote 2-month, 3-month and 4-month portfolio reviewed periods, respectively. *, ** and *** indicate significant at 10, 5 and 1% significance level, respectively

to the corresponding D/E ratios except for the risks of Singaporean companies during crisis.

Table 5 presents the results of the comparative study between the performance of the SOEs listed in Malaysia, Singapore and Indonesia. The findings revealed that Indonesian SOEs produced the highest Sortino performance ratios of 4.78, 2.45 and 1.63, despite the highest downside risks among the countries. The superior relative performance of the Indonesian SOEs is mainly attributable to its statistically significantly higher risk-adjusted returns of (0.028, 0.029, 0.025). In contrast, the risk-adjusted returns of SOEs in Singapore and Malaysia are (0.014, 0.013, 0.012) and (0.019, 0.017, 0.015), respectively. On the other hand, the downside risks of the Singaporean SOEs are (0.011, 0.012, 0.013) which are the lowest among the three countries. This is followed by the SOEs in Malaysia (0.014, 0.016, 0.017) and Indonesia (0.016, 0.018, 0.022). These observations are in line with the findings of Sharma and Wongbangpo (2002). The comparative performance of the SOEs for the sub-periods (before and during the global financial crisis) is also presented in Table 5. The findings disclosed that the Indonesian SOEs outperformed both Singaporean and Malaysian SOEs in both sub-periods. The performance ratios of SOEs in Indonesia before and during the global financial crisis are 5.84 and 3.29, respectively. These values are higher than the respective SOEs in Singapore (4.86, 2.01) and Malaysia (2.84, 1.67). The superior performance of Indonesian SOEs is principally owing to its statistically significant higher returns, especially during the pre-global financial crisis sub-period. The results also showed that Singaporean SOEs have the lowest downside risks among the countries, with values of 0.009 and 0.015 in the respective sub-periods. This is followed by the SOEs in Malaysia (0.012, 0.016) and Indonesia (0.015, 0.017). The findings are reasonable as the risks during financial crisis are apparently higher than the risks in non-crisis period and it is similar to the results of Angabini and Wasiuzzaman (2011).

CONCLUSION

This paper has demonstrated that the Sortino ratio optimization method can be an efficient approach to study the performance of a selection of listed companies. The findings revealed that the performance of Malaysian and Indonesian SOEs outperformed the non-SOEs, whereas, Singaporean SOEs are inferior to the non-SOEs. The results also disclosed that the SOEs in all the three countries are more superior before the global financial crisis but performed oppositely during crisis period. In general, the present findings accentuate the potential developments of the privatized SOEs in ASEAN. The results suggested that, Malaysian and Indonesian SOEs should focus primarily on reducing their risks, while Singaporean SOEs should focus more on improving their returns. The results are also valuable to prospective investors and can be a useful reference in asset allocations and portfolio diversifications decision making.

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