22ND ANNUAL PACIFIC-RIM REAL ESTATE SOCIETY CONFERENCE

SUNSHINE COAST, QUEENSLAND, AUSTRALIA 17-20 JANUARY 2016

TECHNICAL, ALLOCATIVE AND SCALE EFFICIENCY OF MALAYSIAN REITS: THE PRELIMINARY FINDING

NOR NAZIHAH CHUWENI*[1,2,] and CHRIS EVES[1]

[1]Queensland University of Technology, Australia,

[2]Universiti Teknologi MARA (Perak), Malaysia

ABSTRACT

Problem/Purpose *– The paper examined the technical, allocative and scale efficiency in Malaysian Real Estate Investment Trust (M-REITs) to determine best practice for operations to enhance the performance of M-REITs.*

Design/methodology/approach *– Sixteen Malaysian REITs from 2013 to 2014 are examined in terms of input and output variables in the efficiency measurement using the non-parametric approach to benchmark and determine which of the REITs are efficient. Input orientation Variable Return to Scale Data Envelopment Analysis (VRS-DEA model) is used for the year 2014 and 2013 using the DEAP version 2.1.*

Findings *– There were low scores of cost efficiencies for the Malaysian REITs in 2014 and 2013 with 39.90% and 41.60% respectively. The negative inefficient value for the cost inefficiencies is identified in the allocative inefficiencies for both years, showing the mix of inputs to be not correctly utilised. REIT 10 and REIT 16 (of which, one is Islamic) are found to be technical, allocative and scale efficient for both years. For 2014, scale inefficient is identified as the source for technical inefficiency which means Malaysian REITs are not operating at the right scale with 50% operating at economies of scale. Managerial inefficiency however became the source for technical inefficiency in 2013 showing inputs to not be fully minimised to produce more outputs.*

Research limitations/implications *– These preliminary findings highlight that extending the period of understudy particularly post the Global Financial Crisis (GFC) to date, will better establish the key efficiency for Malaysian REITs.*

Originality/value *- The development of the empirical framework determine the source of inefficiency for Malaysian REITs. This will assist the REIT managers and the stakeholder in the formulation of best-practice strategy to enhance the efficiency performance and profitability for Malaysian REITs.*

Keywords: Allocative, Data Envelopment Analysis, Efficiency, REITs, Scale, Technical

---

* Nor Nazihah Chuweni is a PhD candidate from Science and Engineering Faculty, Queensland University Technology under the supervision of Professor Chris Eves, a Professor in Property Economics at Queensland University of Technology. Nor Nazihah Chuweni is also a lecturer at Department of Estate Management, Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA (Perak), Malaysia.

1. INTRODUCTION

Malaysia has become the pioneer in Sharia compliant Real Estate Investment Trusts (REITs) when the Islamic REIT Guideline was introduced in November 2005. There are sixteen Malaysian Real Estate Investment Trusts (Malaysian REITs) listed on Bursa Malaysia, of which, three are *Sharia* compliant, namely Axis REIT, Al-'Aqar Healthcare REIT and the stapled KLCC REIT. The significant difference between the Islamic and conventional capital market is that the Islamic capital market has its own *Sharia* framework.

The Malaysian Islamic REITs for instance must comply with the Securities Commission Act 1993 as well as the Guidelines on Islamic Real Estate Investment Trusts (Islamic REITs Guidelines). These Guidelines highlight three main requirements for Islamic REITs. The first is the need to establish a *Sharia* Advisory Committee to ensure all operations pertaining to investment, deposit and financing of Islamic REITs complies with the *Sharia* principle. Secondly, the property insurance in Islamic REITs must be based on the *Takaful* scheme (a type of Islamic insurance which complies with *Sharia* laws) and in the case of forward sales or purchase of currency, the Islamic REITs fund manager is encouraged to deal with Islamic financial institutions. The third requirement is that the 20% benchmark for the tenant selection for the properties must follow the Sharia principle. For example, tenants are not permitted to exceed 20% of the total space to conduct financial services based on *riba* (usury), conventional insurance, gambling or gaming, manufacture or sale of non-halal products and tobacco based products, entertainment activities that are non-permissible to the *Sharia*, stockbroking or share trading in non-*Shariah* compliant securities, hotels and resorts (Malaysian Securities Commission, 2005). These three requirements must be included when analysing the efficiency of each Malaysian REIT.

This study will therefore measure the performance of M-REITs, both conventional and Islamic, in terms of its efficiency. The remaining of the paper is structured as follows. The next section will discuss the previous studies of efficiency in REITs. This is followed by Section 3, where we provide a brief review on data and research methodology. Then, section 4 will look into the results and discussion of the efficiency of Malaysian REITs. The article concludes in Section 5.

2. PREVIOUS STUDIES

2.1 Performance of Malaysian REITs

Previous studies adopted several methods in measuring the performance for Malaysian REITs. For instance Ong et al., (2012) and Yusof & Bin Mohd Nawawi, (2012) employed the composite index measurement of Sharpe, Treynor and Jensen and compared it with other investment vehicles in the market. Their result revealed that Malaysian REIT outperform the equity market index during and post GFC. This better performance show similar result during the Asian Financial Crisis but not the case in the post crisis period due to the lagging effect experienced by the property sectors (Hamzah, Rozali, & Mohd Tahir, 2010). Malaysian REITs are 2 months lag behind the Asian REITs (portfolio of Malaysian REITs, Singaporean REITs and Japanese REITs (Nawawi et al. 2010). In their study, Singapore REITs and Japan REITs which have stronger market forces and good legislative frameworks, retain some influenced over Malaysian REITs market. The existence of this short term lead-lag relationship could assist the investors to forecast the future performance of the markets. Alias & Soi Tho, (2011) used qualitative method of observations and case study to measure the performance of Malaysian REITs. When comparing the performance of Malaysian REIT and UK REITs, they found that the total revenue is the main determinants contributing towards the performance for both REITs. The sharia compliant property investment in Asia has been identified as having high potential with Malaysia preferred as highest selection investment destination for Sharia compliant funds (Ibrahim et al. 2009).

2.1.1 Performance of Islamic REITs

Chuweni et al. (2014) reviewed previous studies in measuring the performance of Malaysian Islamic REITs. Islamic REITs are seen to provide better financial and management strength during the GFC (Osmadi & Razali 2014). Using the financial ratios and investment measures, Islamic REITs outperform conventional REITs in term of NAV, share price and market capitalisation (Leong & Abdul Aziz, 2015). Islamic REITs used different strategy in order to maximise the shareholder's return and interest (Chuweni, Ahmad, & Mohd Adnan, 2014; Chuweni, Ahmad, & Ting, 2014) and could provide portfolio diversification benefits when they do not add to the riskiness of the investment (Mokhtar & Masih, 2014) and have lower risk in the risk-adjusted returns measurement (Newell & Osmadi, 2009).

Razali & Sing (2015) measure the systematic risk of Islamic REITs and conventional REITs since 2005 to 2014. Their findings show that the Islamic REITs have lower systematic risks suggesting investor's protection against market volatilities. On the other hand, Akinsomi et al. (2014) measure the idiosyncratic risks of synthetic Sharia compliant REITs using EGARCH model. They screened the US REITs using qualitative approach in lieu with rationale of Ibrahim & Ong (2008) and found a high correlation between the idiosyncratic risks and the portfolio returns for these Sharia compliant REITs. Chuweni & Eves (2015) identified a number of issues that need to be addressed in a Sharia compliant investment, particularly the Islamic REITs. The Sharia requirements added fund management activities include the stage of planning, implementation and controlling.

The concept of good governance has been extensively discussed in Jensen & Meckling (1976) and has been regarded as an important mechanism in relation to investment opportunities. Hartzell et al. (2006) found that REIT with stronger corporate governance response better in investment decision. In the case for Malaysian Islamic REITs, Chuweni & Ahmad (2014) suggested emerging governance model as the best to characterize corporate governance for Islamic REITs due to the concentrated and pyramidal model are dominant in Islamic REITs.

2.2 Measuring REIT efficiency using DEA

Previous studies in REITs research are more focused on these conventional performance measurements which are based on Portfolio Theory and Capital Asset Pricing Model (CAPM), compared with the other performance measurement such as the efficiency measurement. Measuring the market efficiency based primarily on the mean variance theory of portfolio such as CAPM has been frequently viewed as inadequate and imperfect (Sengupta 2003). Therefore, the application of non-parametric approach of Data Envelopment Analysis (DEA) in the REIT efficiency measurement provides new insight into the risky decision making by the REIT manager.

REITs efficiency was measured using the DEA highlighting that most REITs are technically inefficient due to the poor utilisation of input and failure to operate at constant to scale (Anderson et al. 2002; Anderson & Springer 2003; Topuz et al. 2005). The study by Topuz (2002) which measured the allocative and technical efficiency of REITs in the USA using both SFA and DEA, suggests that the REIT industry has an average to low efficiency contributed by technical inefficiencies more than allocative inefficiencies. Efficiency can be measured either using the parametric approach such as the stochastic frontier approach (SFA) or non-parametric approach such as Data Envelopment Analysis (DEA).

The initial REIT efficiency study by Bers & Springer, (1997) used translog cost function to determine significant economies of scale of REITs for the years 1992 to 1994, where economies of scale is the indicator to operating efficiency. The individual REIT characteristics namely management and degree of leverage, both affect the scale of economies. Bers & Springer (1998) later measured the source of scale economies for REITs where two significant sources are general and administrative expense, and management fee. REIT managers therefore, should target these two expenses to improve on their operating efficiency.

Lewis et al. (2003); Miller & Springer (2007); Miller et al. (2006) used the Bayesian Stochastic frontier analysis (SFA) and panel data model of translog function to measure REIT efficiency. REITs are mostly cost efficient and could improve their operating efficiency by expansion or enlarging their portfolio. When risk is

incorporated in the efficiency measurement using a directional output distance function, most REITs which are operating at IRS could benefit from expansion (Devaney & Weber 2005). Chung, Fung, & Hung, (2012) employed the same method of SFA and found the institutional investors ownership could improve the REITs' efficiency.

Asian REITs show no significant values of economies of scale in revenue and operating income for larger REITs using tranlog, semi-log quadratic and simple quadratic where the larger Asian REITs do not have scale advantage over small REITs in terms of equity costs. This implies that asset managers do not generate positive wealth for unitholders in constructing their asset portfolio (Sham et al. 2009). Another study of

2.2.1 Efficiency and Malaysian REITs

Leong & Abdul Aziz (2015) examined the impact of GFC on Malaysian REITs. Using property net income divided by total asset to measure the asset efficiency, their result revealed that Malaysian conventional REIT outperformed the Islamic REIT during GFC. In other study, Jamal (2013) employed a multiple regression model from 2008 until 2012. The interest rate and dividend are found to be the significant factors influencing the performance of Malaysian REIT, implying the importance of interest rate to be included in the development of efficiency measurement model.

Malaysian REIT efficiency has been measured using non-parametric approach of DEA prior GFC (Harun, Md Tahir, & Zaharudin, 2012). They found that recovering Malaysian economies influence the improvement of efficiency score from 66.53% in 2007 to 74.12% in 2009. However, in their study, they only focus technical efficiency of Malaysian REIT prior financial crisis. This study extends the period for M-REIT efficiency after the financial crisis for 2013 to 2014 and compares Islamic REITs and their counterparts' using various efficiency scores. The efficiency measures are allocative, technical, pure technical and scale efficiency. The *Sharia* requirement for Malaysian Islamic REITs is addressed in the selection of the input and output variables in measuring the Malaysian REIT efficiency.

3. DATA AND METHODOLOGY

This study examined the technical, allocative and scale efficiency of sixteen Malaysian REITs 2013-2014 (see Table 1 for the list of M-REITs). The financial data was obtained from various annual reports, Thomson Reuters Datastream and Osiris via Bureau van Dijk. DEA program version 2.1 (Coelli 1996) is used to calculate the efficiency scores. The study excludes Al-Hadharah Boustead REIT (plantation-based Islamic REIT) which was delisted in 2014.The stapled KLCC REIT, which was listed in May 2013, is included in the study.

Table 1: Islamic and conventional REITs in Malaysia 2013-2014

No	Islamic REITs	No	Conventional REITs
1	KLCC REIT	1	AmFirst REIT
2	Axis REIT	2	AmanahRaya REIT
3	Al-'Aqar Healthcare REIT	3	Atrium REIT
		4	CapitaMalls Malaysia Trust
		5	Tower REIT
		6	Hektar REIT
		7	IGB REIT
		8	Pavillion REIT
		9	Amanah Hartanah PNB
		10	YTL Hospitality REIT
		11	MRCB-Quill REIT
		12	Sunway REIT
		13	UOA REIT

Source: Securities Commission (2015)

3.1 Data Envelopment Analysis

Many DEA models measure the efficiency levels with three most influential DEA models used are the CCR model [Charnes, Cooper, & Rhodes, (1978), Charnes, Cooper, & Rhodes, (1981),] the BCC model [Banker, Charnes, & Cooper, (1984)] and finally the additive model [Charnes, Cooper, Golany, & Seiford, (1985)] (Liu, Lu, Lu, & Lin, 2013a). Each model measures the best frontier for efficiency and different DEA models produce different shapes of the efficiency frontier. The Constant Return to Scale (CRS) or the CCR model, for instance produces the overall efficiency whilst the Variable Return to Scale (VRS) or the BCC model differentiates between managerial and scale efficiency by measuring pure technical efficiency at given scale of firm operation. The efficiency scores range from 0 to 1, with 1 being the efficient.

This research expected the return to scale to be variable. Therefore, The DEA-VRS model proposed by Banker et al. (1984) is used in the study. The model measures the overall technical efficiency (TE) as being managerial efficiency (PTE) multiplied by the scale efficiency (SE). SE provides information as to whether a REIT is operating at increasing return to scale (IRS) or decreasing return to scale (DRS). DEA allows the REIT managers to identify the sources of inefficiencies, and they formulate a new strategy to ensure greater efficiency. If scale is found to be the source of inefficiency, the DEA model will also identify the reasons for these inefficiencies. For instance, if a REIT is operating at DRS, then the REIT is large in terms of scale and indicates that for every percentage increase in inputs, there will be a lower percentage than proportional increase in output.

3.2 Data Sample, inputs-output definition and the choices of variables

Interest expense and property operating expense are validated as input variables while the output variable is total asset (Topuz et al. 2005; Topuz 2002; Anderson & Springer 2003; Lewis et al. 2003). The input orientation is chosen to minimise the cost or expense of REITs in order to maximise the value of REIT which is measured by the total asset. The specific characteristics of Islamic REITs means the input variables, interest and property operating expense differ from the conventional REITs. For instance, Islamic REITs are required to use *Takaful* insurance (an Islamic insurance) and not allowed to engage in conventional loans which contrast in these two expenses compared to conventional REITs. The efficiency measurement model (EMM) used in this study is depicted in Figure 1.

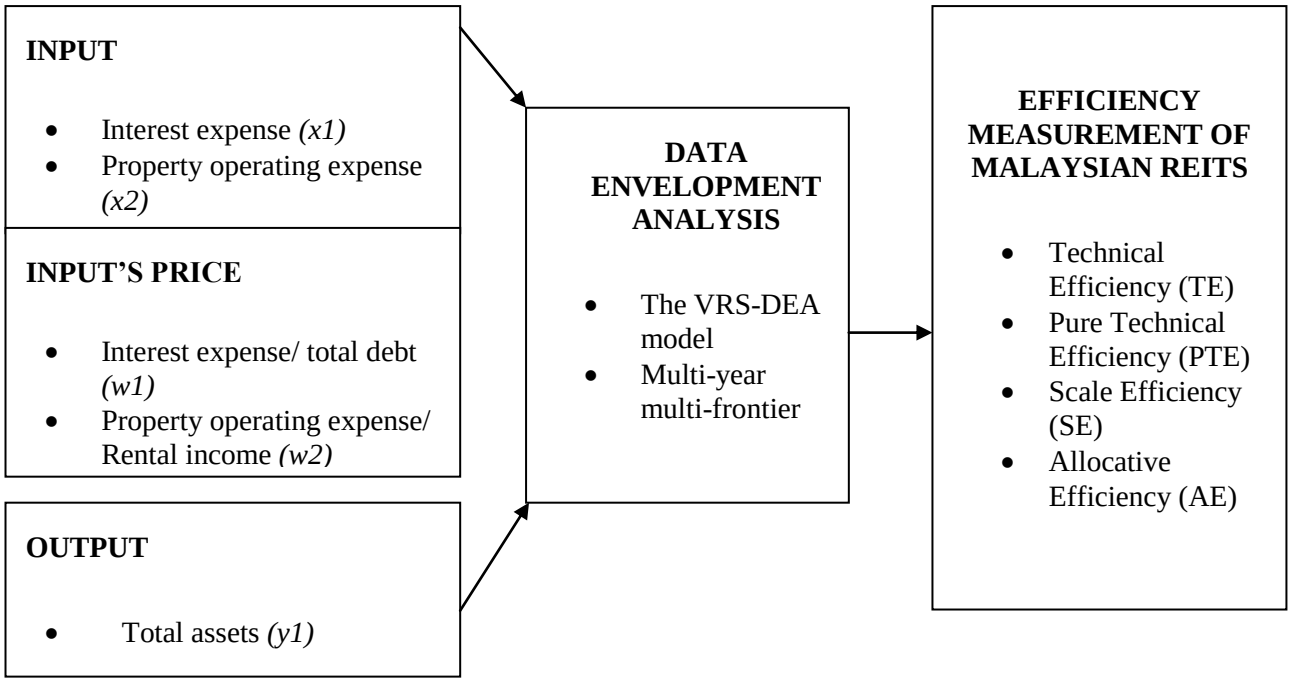

Figure 1: Efficiency measurement model (EMM) for Malaysian REITs

Source: Authors' own (2015)

This research employs the input minimisation orientation, two inputs, two input prices and one output. The two input vector variables are x1: interest expense and x2: property operating expense. The input prices consist of w1: price of interest and w2: price of property operating. The output vector variable is y1: total asset. The summary of statistics of data used for the construction of the efficient frontier is presented in Table 2.

Table 2: Summary statistics of the variables input and output in the DEA model

Variable	2013 (RM)	2014 (RM)
Inputs		
Interest expense (x1)		
Mean	32,273,440	33,031,526
Min	655,389	1,031,556
Max	123,078,000	144,865,000
S.D	30,417,754	36,985,494
Property operating expense (x2)		
Mean	39,361,266	41,926,666
Min	1,791,000	1,866,000
Max	144,999,000	149,127,000
S.D	46,336,281	47,728,562
Input Price		
Interest expense/ total debt (w1)		
Mean	0.0435824	0.0405468
Min	0.0298000	0.0030174
Max	0.0541987	0.0576797
S.D	0.0063269	0.0119556
Property operating expense/rental (w2)		
Mean	0.2250722	0.2321622
Min	0.0170182	0.0267914
Max	0.4395441	0.4267945
S.D	0.1465588	0.1395201
Output (RM)		
Total Asset (y1)		
Mean	2,483,531,637	2,607,690,336
Min	183,967,100	200,173,410
Max	9,244,295,000	9,336,812,000
S.D	2,448,615,393	2,505,260,732

Source: Datastream Thomson Reuters, Osiris via Bureau van Dijk and authors' own calculation (2015)

4.0 RESULTS AND DISCUSSION

The construction of multiple year multiple frontier is flexible, compared to having a single frontier for all years (Sufian et al. 2008; Isik & Hassan 2002; Bauer et al. 1998). This paper presents the preliminary findings of only the year 2013 and 2014 for comparison of the efficiency scores. Technical efficiency in 2013 produced a higher efficiency score with 75.8%, compared to the following year with 41.2%. There were low cost efficiencies for the Malaysian REITs in 2014 and 2013 with 39.90% and 41.60% respectively. The negative inefficient value for the cost inefficiencies is identified in the allocative inefficiencies for both years, showing the mix of inputs to be not correctly utilised. REIT 10 and REIT 16 (of which, one is Islamic) are found to be technical, allocative and scale efficient for both years. Figure 2 shows the number of efficient REITs is basically similar for both years except for managerial efficiency where the number of efficient REITs has increased from 5 to 7 in 2013 to 2014.

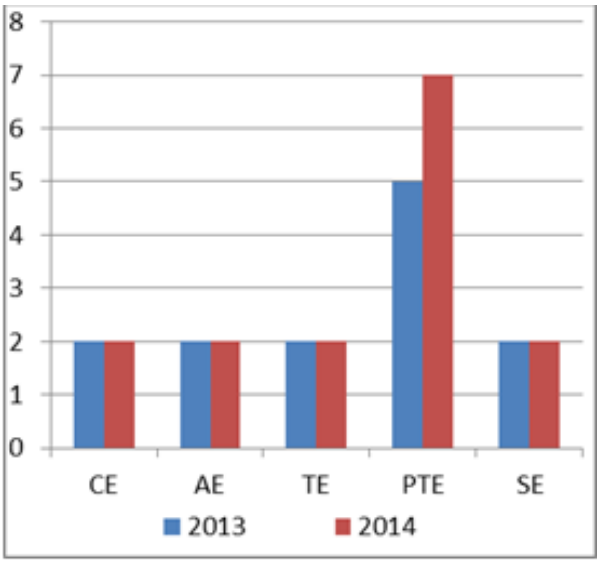

Figure 2: The number of efficient REITs for 2013 - 2014

Table 3 depicts the DEA efficiency result for 2014 with the benchmarks identifier. For instance, REIT 5 is the highest frequency used as a benchmark against eight other Malaysian REITs. Since DEA produces individual results, a performance comparison can be calculated against its peer for a REIT to be efficient. Based on the result, the REIT manager must use the model of others in terms of utilising the right combination of input. For REIT 1 to be efficient, the suggested input utilisation are the sum of 92.6% of REIT 5 input, 5.7% of REIT 16 input and 1.7% of REIT 14 input. In terms of managerial efficiency, REIT 2, 5, 9,10,11,14 and 16 are found to be efficient.

Table 3: DEA result under VRS input minimisation for year 2014

Name of REIT	AE	TE	PTE	SE	Benchmarks
REIT 1	0.859	0.372	0.454	0.819	14 (0.017), 16 (0.057), 5(0.926)
REIT 2	0.600	**1.000**	**1.000**	**1.000**	0
REIT 3	0.960	0.232	0.253	0.916	5 (0.544), 10(0.343), 9 (0.113)
REIT 4	0.729	0.201	0.360	0.558	5 (0.337), 10 (0.292), 11 (0.370)
REIT 5	0.926	**1.000**	**1.000**	**1.000**	8
REIT 6	0.957	0.104	0.118	0.878	5 (0.645), 10 (0.297), 11 (0.058)
REIT 7	0.997	0.140	0.146	0.960	5 (0.774), 9 (0.032), 10 (0.194)
REIT 8	0.985	0.195	0.227	0.858	5 (0.436), 9 (0.045), 10 (0.519)
REIT 9	0.383	0.967	**1.000**	0.967	3
REIT 10	**1.000**	0.468	**1.000**	0.468	5
REIT 11	0.352	0.270	**1.000**	0.270	2
REIT 12	0.278	0.202	0.890	0.227	14 (0.741), 16 (0.226), 5 (0.033)
REIT 13	0.262	0.138	0.583	0.237	16 (0.066), 14 (0.426), 5 (0.508)
REIT 14	0.191	0.205	**1.000**	0.205	4
REIT 15	0.185	0.136	0.820	0.165	16 (0.108), 14 (0.892)
REIT 16	**1.000**	0.965	**1.000**	0.965	4
Mean (industry)	0.667	0.412	0.678	0.656	

Note: Allocative efficiency (AE), Technical efficiency (TE), Pure Technical Efficiency (PTE) and Scale Efficiency (SE)

Managerial inefficiency however became the source for technical inefficiency in 2013 showing inputs to not be fully minimised to produce more outputs. REIT 16 is the highest frequency used as the benchmarks (industry leader) against ten other Malaysian REITs. Table 4 shows REIT 4, 9,10,11,14 and 16 to be managerially efficient. The other inefficient REIT could identify the best-practice used by other efficient REIT for them to emulate by setting the required target of input/output level.

Table 4: DEA result under VRS input minimisation for year 2013

Name of REIT	AE	TE	PTE	SE	Benchmarks
REIT 1	0.527	0.728	0.747	0.975	16 (0.098), 14 (0.035), 4 (0.867)
REIT 2	0.996	0.839	0.841	0.998	11 (0.0479), 16 (0.306), 10 (0.614)
REIT 3	0.422	0.699	0.713	0.981	16 (0.046), 14 (0.006), 4 (0.947)
REIT 4	0.355	0.974	**1.000**	0.974	7
REIT 5	0.944	0.523	0.569	0.919	16 (0.103), 9 (0.526), 10(0.371)
REIT 6	0.215	0.462	0.495	0.933	16 (0.016), 14 (0.082), 4 (0.902)
REIT 7	0.234	0.556	0.595	0.934	4 (0.867), 16 (0.033), 14 (0.100)
REIT 8	0.413	0.623	0.632	0.985	4 (0.760), 16 (0.036), 11 (0.204)
REIT 9	0.827	0.884	**1.000**	0.884	1
REIT 10	**1.000**	0.966	**1.000**	0.966	2
REIT 11	0.373	**1.000**	**1.000**	**1.000**	2
REIT 12	0.197	0.724	0.799	0.905	4 (0.053), 16 (0.227), 14 (0.720)
REIT 13	0.182	0.628	0.702	0.894	4 (0.416), 16 (0.089), 14 (0.495)
REIT 14	0.133	0.851	**1.000**	0.851	7
REIT 15	0.129	0.672	0.836	0.804	16 (0.144), 14 (0.856)
REIT 16	**1.000**	**1.000**	**1.000**	**1.000**	10
Mean (industry)	0.497	0.758	0.808	0.938	

Note: Allocative efficiency (AE), Technical efficiency (TE), Pure Technical Efficiency (PTE) and Scale Efficiency (SE)

Table 5 provides evidence that Islamic REITs are highly allocative efficient for both years with 82.37% and 92.83%. The source of inefficiency is found to be at a managerial inefficiency as compared to scale inefficiency, for both years. The result indicates the poor utilisation of input by the Islamic REITs, for both years. Contrary in 2014, conventional REITs have a higher scale inefficiency score compared to managerial inefficiency, indicating that conventional REITs are operating at the wrong scale of operation.

Table 5: Efficiency scores according to REITs types 2013-2014

	AE	TE	PTE	SE
Panel A: 2013				
Islamic REITs				
Mean	0.8237	0.7503	0.7720	0.9647
SD	0.2584	0.2393	0.2166	0.0415
Conventional REITs				
Mean	0.4212	0.7598	0.8164	0.9315
SD	0.3150	0.1720	0.1779	0.0609
Panel B: 2014				
Islamic REITs				
Mean	0.9283	0.7790	0.8180	0.9280
SD	0.0705	0.3529	0.3152	0.0960
Conventional REITs				
Mean	0.6061	0.3275	0.6459	0.5930
SD	0.3422	0.3049	0.3720	0.3430

Note: Allocative efficiency (AE), Technical efficiency (TE), Pure Technical Efficiency (PTE) and Scale Efficiency (SE)

Table 6 depicts the categories of scale return for 2013-2014 by REITs types. For 2014, scale inefficient is identified as the source for technical inefficiency which means Malaysian REITs are not operating at the right scale with 50% operating at economies of scale. REITs with IRS could benefit from expansion or growth to increase their efficiency. Contrary in 2013, 62.5% of Malaysian REITs operate at diseconomies of scale followed by 25% of economies of scale and the rest at the constant return to scale. Diseconomies of scale (REITs with DRS) are oversized REITs which can become more efficient by downsizing or spinning off assets, or to segment assets into subgroups that are efficient (Bers & Springer 1997).

Table 6: Categories of scale return 2013 – 2014

	IRS		**CRS**		**DRS**	
	Number	Percent	Number	Percent	Number	Percent
Panel A: 2013						
Islamic REITs	1	6.25	1	6.25	1	6.25
Conventional REITs	3	18.75	1	6.25	9	56.25
Total	4	25	2	12.5	10	62.5
Panel B: 2014						
Islamic REITs	0	0	1	6.25	2	12.5
Conventional REITs	8	50	1	6.25	4	25
Total	8	50	2	12.5	6	37.5

Note: Increasing return to scale (IRS), Constant return to scale (CRS), Decreasing return to scale (DRS)

4.1 Robustness test

The robustness test is based on the methodology of Isik & Hassan (2002); Sufian et al. (2014); Sufian & Kamarudin (2015). The null hypothesis is that Islamic and conventional REITs are drawn from the same efficiency population (environment) using parametric techniques of independent samples of *t*-test and non-parametric of Mann-Whitney [Wilcoxon Rank-Sum], Kolmogorov-Smirnov and Kruskal-Wallis tests. Table 7 shows, the *t*-test results suggest that Islamic REITs indicate a higher mean for allocative efficiency (0.75450>0.54169) than the conventional REITs. Islamic REITs similarly exhibited a higher mean for technical efficiency (0.75450>0.54604) compared to their counterparts. The non-parametric test of Mann-Whitney [Wilcoxon Rank-Sum], Kolmogorov-Smirnov and Kruskal-Wallis tests confirm similar results. Likewise, the parametric *t*-test and non-parametric Kolmogorov-Smirnov, Kruskal-Wallis and Mann-Whitney [Wilcoxon Rank-Sum] tests show the Islamic REITs to exhibit a higher managerial efficiency (0.78267>0.73400) and scale efficiency (0.94867>0.76169) compared to the conventional REITs.

The robustness test such as the parametric *t*-test and non-parametric tests of Mann-Whitney [Wilcoxon Rank-Sum], Kolmogorov-Smirnov and Kruskall-Wallis tests indicate that conventional and Islamic REITs are drawn from the same efficiency population (environment) as most of the result failed to reject the null hypothesis at the 0.05 levels of significance implying that the two types of REITs may operate under the same technologies or frontier. Therefore, it is appropriate to pool both REITs under the same frontier when measuring the REIT efficiency.

5.0 CONCLUSION

The paper examined the technical, allocative and scale efficiency of Malaysian REITs for 2013-2014 and determined the best practice by the efficient REITs using the non-parametric approach of DEA. The negative inefficient value for the cost inefficiencies is identified in the allocative inefficiencies for both years. This shows that the mix of inputs of REITs is not correctly utilised. Because the findings indicate that Malaysian REITs are not operating at the constant return to scale, a better practice should be adopted to increase their efficiency. For instance, REITs with IRS could increase performance through expansion and growth.

REIT 10 and REIT 16 (of which, one is Islamic) are found to be technical, allocative and scale efficient for both years. These efficient REITs are more resourceful in terms of operational and interest expense highlighting the capacity of the REIT to adopt in the difficult economic times. These efficient REITs could be used as the benchmarks or the industry leaders for the period understudy. The other conventional and Islamic REITs should adopt the best-practice implemented by these industry leaders.

REIT efficiency measurement provides new insight into the risky decision making by the REIT manager and helps them to allocate the limited resources by managing the input variables of expenses and maximising the output or the value of investment. The Malaysian REIT managers will benefit substantially from the analysis having had their inefficiency determined as either technical, allocative or scale inefficiency. This will enable them to go directly to the source of inefficiencies and make immediate improvement and adjustment in the scale (scale efficiency) or the managerial practice (pure technical efficiency).

REIT investors could use the efficiency scores (ranges from zero to one, with one as being efficient) to identify which REIT having the investment potential. The relative performance result produced by DEA could be used as benchmark against the industry. Therefore, REIT efficiency score need to be incorporated in the investment portfolio selection for better portfolio performance. The efficiency measurement models (EMM) could also be adopted in other similar investments in the market such as the *Sharia* compliant mutual funds or trusts and the ethical or socially responsible investments (SRI). Stakeholder and policy-maker could prevent speculative market and prepare guideline to increase the REIT efficiency.

Further research with similar analysis will be carried out using the return of the investment as the output variable. Determining the significant REIT characteristics which influence the efficiency measurement of Malaysian REITs using the parametric approach will add greater variable and robustness to the existing efficiency measurement model.

ACKNOWLEDGEMENT

The authors would like to acknowledge the Malaysian Ministry of Education, Universiti Teknologi MARA Malaysia and Queensland University of Technology for the scholarship and anonymous referees for the feedback received in improving the research papers. The authors are solely responsible for any error on omission in this paper.

Table 7: Parametric and nonparametric tests results for Malaysian REITs 2013-2014

Efficiency Measures [a]	Test groups Parametric test		Non-parametric test				
Individual test	*t*-test		Mann-Whitney [Wilcoxon Rank-Sum] test		Kruskal-Wallis equality of population test		Kolmogorov-Smirnov [K-S] test
Hypotheses	$Mean_n = Mean_f$		$Median_n = Median_f$		$Distribution_n = Distribution_f$		
Test statistics	*t* (Prb > t) Mean	t	*z* (Prb > z) Mean rank	z	X^2 (Prb > X^2) Mean rank	X^2	*K-S* (Prb > K-S) K-S Z
AE							
Islamic REIT	0.75450	1.396	21.33	-1.401	21.33	1.964	0.906
Conventional REIT	0.54169		15.38		15.38		
TE							
Islamic REIT	0.75450	1.437	21.67	-1.498	21.67	2.244	0.849
Conventional REIT	0.54604		15.31		15.31		
PTE							
Islamic REIT	0.78267	0.370	17.50	-0.300	17.50	0.090	0.425
Conventional REIT	0.73400		16.27		16.27		
SE							
Islamic REIT	0.94867	2.901***	22.33	-1.691*	22.33	2.861*	0.991
Conventional REIT	0.76169		15.15		15.15		

Note: [a] AE = Allocative efficiency, TE = Technical efficiency, PTE= Pure technical efficiency, SE = Scale efficiency, ***, ** and * indicates significance at the 1%, 5% and 10% levels respectively.

REFERENCES

Akinsomi, O. et al., 2014. The idiosyncratic risks of a Shariah compliant REIT investor. *Journal of Property Research*, 31(3), pp.211–243. Available at: http://www.tandfonline.com/doi/abs/10.1080/09599916.2013.841276 [Accessed January 5, 2015].

Alias, A. & Soi Tho, C.Y., 2011. Performance Analysis of REITs: Comparison between M-REITs and UK-REITs. *Journal of Surveying, Construction and Property*, 2(Special issue), pp.38–61. Available at: http://e-journal.um.edu.my/filebank/published_article/3078/JSCP-S11-02.pdf.

Anderson, R.I. et al., 2002. Technical efficiency and economies of scale: A non-parametric analysis of REIT operating efficiency. *European Journal of Operational Research*, 139, pp.598–612. Available at: 10.1111/j.1540-6229.2005.00121.x.

Anderson, R.I. & Springer, T.M., 2003. REIT selection and portfolio construction: Using operating efficiency as an indicator of performance. *Journal of Real Estate Portfolio Management*, 9(1), pp.17–28. Available at: http://search.proquest.com/docview/197889277?accountid=13380.

Banker, R.D., Charnes, A. & Cooper, W.W., 1984. Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. *Management Science*, 30(9), pp.1078–1092. Available at: https://typo3.univie.ac.at/fileadmin/user_upload/orga/Banker_MS84.pdf.

Bauer, P.W. et al., 1998. Consistency Conditions for Regulatory Analysis of Financial Institutions: A Comparison of Frontier Efficiency Methods. *Journal of Economics and Business*, 50(2), pp.85–114. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0148619597000726.

Bers, M. & Springer, T., 1997. Economies-of-Scale for Real Estate Investment Trusts. *Journal of Real Estate Research*, 14(3), pp.275–291. Available at: http://ares.metapress.com/index/FT5520N610X00410.pdf.

Bers, M. & Springer, T.M., 1998. Sources of scale economies for REITs. *Real Estate Finance*, 14(4), pp.47–56. Available at: http://search.proquest.com/docview/223073712?accountid=13380.

Charnes, A. et al., 1985. Foundations of Data Envelopment Analysis for Pareto-Koopmans Efficient Empirical Production Functions. *Journal of Econometrics*,, 30(1-2), pp.91–107. Available at: http://search.proquest.com/docview/56273513?accountid=13380.

Charnes, A., Cooper, W. & Rhodes, E., 1981. Evaluating program and managerial efficiency: An application of Data Envelopment Analysis to Program Follow Through. *Management Science*, 27(6), pp.668–697. Available at: http://search.proquest.com/docview/205834736?accountid=13380.

Charnes, A., Cooper, W.W. & Rhodes, E., 1978. Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2(6), pp.429–444. Available at: http://linkinghub.elsevier.com/retrieve/pii/0377221778901388 [Accessed September 15, 2014].

Chung, R., Fung, S. & Hung, S.Y.K., 2012. Institutional Investors and Firm Efficiency of Real Estate Investment Trusts. *Journal of Real Estate Finance and Economics*, 45, pp.171–211. Available at: 10.1007/s11146-010-9253-4.

Chuweni, N.N., Chuweni, M.M., et al., 2014. A review of performance of Malaysian Islamic Real Estate Investment Trusts. In *International Real Estate Research Symposium*.

Chuweni, N.N. et al., 2015. Performance analysis of hospitality REITs: A case study of YTL hospitality REIT. In S. M. Radzi et al., eds. *Theory and Practice in Hospitality and Tourism Research*. Taylor and Francis Group, pp. 603–606.

Chuweni, N.N. & Ahmad, S.H., 2014. The Neo-governance Model of Malaysian Islamic Real Estate Investment Trusts. *Journal of Administrative Science*, 11(2), pp.1–13. Available at: http://www.rmi.uitm.edu.my/images/stories/JAS/Vol11-no2/jas v11 3.pdf.

Chuweni, N.N., Ahmad, S.H. & Mohd Adnan, Y., 2014. Performance analysis of YTL Hospitality REIT and Axis REIT. In *2nd World Conference on Islamic Thought & Civilisation Contemporary States of Muslim Affairs*. pp. 1114–1122.

Chuweni, N.N., Ahmad, S.H. & Ting, K.H., 2014. Financial analysis of Shariah Compliant REITs : A case study of Malaysian Islamic REITs. In *2nd World Conference on Islamic Thought & Civilisation Contemporary States of Muslim Affairs*. pp. 248–255.

Chuweni, N.N. & Eves, C., 2015. Islamic fund and asset management: The opportunities and challenges of Islamic REITs. In *2015 Australian Conference of Economist*.

Coelli, T., 1996. A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program. *CEPA Working Paper 96/08*, pp.1–49. Available at: http://www.une.edu.au/econometrics/cepa.htm.

Devaney, M. and W.W. & Weber, W.L., 2005. Efficiency, Scale Economies, and the Risk/Return Performance of Real Estate Investment Trusts. *Journal of real estate finance and economics*, 31(3), pp.301–317. Available at: http://link.springer.com/10.1007/s11146-005-2791-5.

Hamzah, A.H., Rozali, M.B. & Mohd Tahir, I., 2010. Empirical investigation on the performance of the Malaysian Real Estate Investment Trusts in pre-crisis, during crisis and post-crisis period. *International Journal of Economics and Finance*, 2(2), pp.62–69.

Hartzell, J.C., Sun, L. & Titman, S., 2006. The effect of corporate governance on investment: Evidence from real estate investment trusts. *Real Estate Economics*, 34(3), pp.343–376.

Harun, S.L., Md Tahir, H. & Zaharudin, Z.A., 2012. Measuring Efficiency of Real Estate Investment Trust Using Data Envelopment Analysis Approach. In *The Fifth Foundaition of Islamic Finance Conference*. pp. 1–12. Available at: http://scholar.googleusercontent.com/scholar?q=cache:dvPmEmzQ4TAJ:scholar.google.com/+reit+efficiency+in+malaysia&hl=en&as_sdt=0,5.

Ibrahim, M.F., Eng, O.S. & Parsa, A., 2009. Shariah Property Investment in Asia. *Journal of Real Estate Literature*, 17(2), pp.233–248. Available at: http://search.proquest.com/docview/746773060?accountid=13380.

Ibrahim, M.F. & Ong, S.E., 2008. Shariah Compliance in Real Estate Investment. *Journal of Real Estate Portfolio Management*, 14(4), pp.401–414. Available at: http://ezaccess.library.uitm.edu.my/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=35980208&site=ehost-live&scope=site.

Isik, I. & Hassan, M.K., 2002. Technical, scale and allocative efficiencies of Turkish banking industry. *Journal of Banking and Finance*, 26, pp.719–766. Available at: 10.1016/S0378-4266(01)00167-4.

Jamal, E., 2013. The Effectiveness and Efficiency of REITs Performance in Malaysia. Available at: http://ssrn.com/abstract=2273937 or http://dx.doi.org/10.2139/ssrn.2273937.

Jensen, M.C. & Meckling, W.H., 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, 3, pp.305–360.

Leong, B.T. & Abdul Aziz, A.R., 2015. GFC impact on real estate investment trusts (REITs) in Malaysia. In *21st Annual Pacific Rim Real Estate Society Conference*.

Lewis, D., Springer, T.M. & Anderson, R.I., 2003. The Cost Efficiency of Real Estate Investment Trusts: An Analysis with a Bayesian Frontier Model. *Journal of real estate finance and economics*, 26, pp.65–80. Available at: 10.1023/A:1021522231824.

Liu, J.S. et al., 2013. Data envelopment analysis 1978-2010: A citation-based literature survey. *Omega (United Kingdom)*, 41(1), pp.3–15. Available at: http://dx.doi.org/10.1016/j.omega.2010.12.006.

Malaysia, S.C., 2005. Guidelines for Islamic Real Estate Investment Trusts S. C. Malaysia, ed. , p.6. Available at: http://www.sc.com.my/wp-content/uploads/eng/html/resources/guidelines/UTs/Islamic REIT GL.pdf.

Miller, S.M., Clauretie, T.M. & Springer, T.M., 2006. Economies of Scale and Cost Efficiencies: A Panel-Data Stochastic-Frontier Analysis of Real Estate Investment Trusts. *The Manchester School*, 74(4), pp.483–499. Available at: 10.1111/j.1467-9957.2006.00505.x.

Miller, S.M. & Springer, T.M., 2007. *Cost Improvements , Returns to Scale , and Cost Inefficiencies for Real Estate Investment Trusts*, Available at: http://dx.doi.org/10.2139/ssrn.1006300.

Mokhtar, M. & Masih, M., 2014. Are diversification benefits obtainable within the same asset class? New evidence from Malaysian Islamic REITs. Available at: http://mpra.ub.uni-muenchen.de/id/eprint/56990.

Nawawi, A.H. et al., 2010. Relationship and lead-lag effect between Asian Real Estate Investment Trusts (REITs) performance and Malaysian REIT market: Cointegration modelling. In *2010 International Conference on Science and Social Research (CSSR 2010)*. Ieee, pp. 522–527. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=5773833.

Newell, G. & Osmadi, A., 2009. The development and preliminary performance analysis of Islamic REITs in Malaysia. *Journal of Property Research*, 26(4), pp.329–347.

Ong, T.S. et al., 2012. Malaysian Real Estate Investment Trusts: A performance and comparative analysis. *International Journal of Economics and Finance*, 4(5), pp.73–84. Available at: http://search.proquest.com/docview/1011330241?accountid=13380.

Osmadi, A. & Razali, M.N., 2014. Assesing the financial and management strentgh of Islamic Real Estate Investment Trusts (I-REITs) during the Global Financial Crisis (GFC). *PERINTIS E Journal*, 4(1), pp.48–69. Available at: http://ejournal.perintis.org.my/pdf/2014 - Article 3.pdf.

Razali, M.N. & Sing, T.F., 2015. Systemic risk of Islamic REITs and conventional REITs in Malaysia. *Journal of Real Estate Portfolio Management*, 21(1), pp.77–92. Available at: http://search.proquest.com/docview/1721551229?accountid=13380.

Sengupta, J.K., 2003. *New Efficiency Theory*, Springer Berlin Heidelberg.

Sham, H.T., Sing, T.F. & Tsai, I.-C., 2009. Are there efficiency gains for larger Asian REITs? *Journal of Financial Management of Property and Construction*, 14(3), pp.231–247. Available at: 10.1108/13664380911000459.

Sufian, F. & Kamarudin, F., 2015. Determinants of revenue efficiency of Islamic banks: Empirical evidence from the Southeast Asian countries. *International Journal of Islamic and Middle Eastern Finance and Management*, 8(1), pp.36–63. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/IMEFM-12-2012-0114.

Sufian, F., Kamarudin, F. & Mohd Noor, N.H.H., 2014. Revenue efficiency and return to scale in Islamic Banks: Empirical evidence from Malaysia. *Journal of Economic Cooperation and Development*, 35(1), pp.47–80. Available at: http://www.sesric.org/jecd/jecd_articles/ART12040601-2.pdf.

Sufian, F., Noor, M.A.M. & Abdul majid, M.-Z., 2008. The efficiency of Islamic banks: Empirical Evidence from the MENA and Asian countries Islamic Banking sectors. *The Middle East Business and Economic Review*, 20(1), pp.1–19. Available at: http://mpra.ub.uni-muenchen.de/19072/.

Topuz, C., 2002. *Efficiency and Performance of Real Estate Investment Trusts: An Empirical Examination*. Ann Arbor: Lousiana Tech University. Available at: http://search.proquest.com/docview/305514298?accountid=13380.

Topuz, J.C., Darrat, A.F. & Shelor, R.M., 2005. Technical, Allocative and Scale Efficiencies of REITs: An Empirical Inquiry. *Journal of Business Finance & Accounting*, 32(9 & 10), pp.1961–1994. Available at: http://doi.wiley.com/10.1111/j.0306-686X.2005.00653.x.

Yusof, A.Y. & Bin Mohd Nawawi, A.H., 2012. Does Malaysian REITs outperform the equity market? In *ICSSBE 2012 - Proceedings, 2012 International Conference on Statistics in Science, Business and Engineering: "Empowering Decision Making with Statistical Sciences."* IEEE, pp. 298–302. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=6396576 [Accessed January 6, 2015].

Email contact: nornazihah.chuweni@hdr.qut.edu.au