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Introducing REITs (Real Estate Investment Trusts) to Enhance the Risk Adjusted Returns of the Risky Direct Real Estate Portfolio

David HO, Kim Hin[1*] & Justin WONG, Chia Chern[2]

[1] Tenured Associate Professor, Department of Real Estate (DRE), School of Design Environment, National University of Singapore, Singapore

[2] Ascendas Land Ltd, Singapore

[*] David HO, Kim Hin, E-mail: rsthkhd@nus.edu.sg

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Abstract

Purpose: *The paper has several objectives in mind: to examine whether or not a dynamic, ex ante AHP-SAA model and a dynamic Markowitz QP TAA model that utilizes de-smoothed data, produces an investment strategy, which further optimizes the risk-adjusted return of the pan-Asian real estate portfolio. It examines the required de-smoothing and Modern Portfolio Theory (MPT) for the TAA.*

Design/Methodology/Approach: *This paper reveals that the efficient frontier of risk-adjusted returns for direct real estate portfolio is enhanced by introducing REITS. The portfolio comprises the Pan-Asian office and industrial real estate markets for 13 major Asian cities, to which Asian REITS are added. Direct real estate total return data is in its "smooth" form while the REIT data is "de-smoothed" under the 1st and 4th order autoregressive model. The efficient frontier is constructed under a dynamic Strategic Asset Allocation (SAA) model, incorporating the Analytic Hierarchy Process (AHP) approach. Secondly, the dynamic Markowitz quadratic-programming Tactical Asset Allocation (TAA) model is adopted to obtain a geographically and real estate sector diversified portfolio.*

Findings: *The resulting efficient frontier with the de-smoothed data reveals a higher overall TR for every corresponding standard deviation as compared to the smoothed data. TAA for the de-smoothed returns would lie on the efficient frontier at the maximum Sharpe ratio of 1.44 with a TR on 15.30% and a standard deviation of 7.31%. Conversely, TAA for the smoothed returns would lie on the efficient frontier at the maximum Sharpe ratio of 1.31 with a lower TR of 14.2% and a standard deviation of 7.18%.*

Practical implications: *This paper should serve as a meaningful guide to look at an alternative asset allocation process that can be effectively adopted and refined by practitioners and researchers. It* *enables asset managers/or investors to deploy expert opinions on an ex ante basis for a longer term dynamic SAA model and a short term dynamic Markowitz QP TAA model.*

Originality/Value: *The paper offers insightful information for in adopting the AHP to develop a dynamic SAA and the dynamic Markowitz QP TAA model in utilizing de-smoothed direct real estate TR data. This paper is specific to a Pan Asian direct real estate portfolio of 13 Asian cities together with the introduction of Asian REITS, to provide greater diversification and risk-return benefits.*

Keywords

dynamic SAA model, dynamic Markowitz QP TAA model, de-smoothed data, Pan Asian direct real estate portfolio and Asian REITS

1. Introduction

This paper's contribution is in the enhancement of the efficient frontier of risk-adjusted returns for a Pan Asian direct real estate portfolio by introducing Asian REITS (real estate investment trusts). The real estate portfolio comprises Pan-Asian office and industrial real estate markets of thirteen major Asian cities, to which Asian REITS are introduced. The direct real estate total return data is in its "smooth" form while the REIT data is in its "de-smoothed" form. Initially the efficient frontier for the Pan-Asian real estate portfolio is constructed and examined under a dynamic Strategic Asset Allocation (SAA) model, incorporating the Analytic Hierarchy Process (AHP) methodology. Then a dynamic Markowitz quadratic-programming Tactical Asset Allocation (TAA) approach is adopted to adduce a geographically risk adjusted diversified Pan Asian real estate portfolio. The efficient frontier is re-constructed with the "de-smoothed" direct real estate total return data. As the original smoothed real estate data underestimates the true volatility of direct real estate data, the required de-smoothing under Geltner and Miller (2007)'s 1st and 4th order autoregressive model ensures that the temporal lag error problem is minimized for both the direct real estate and REIT return data.

Three different datasets are utilized in this paper. Two datasets that require de-smoothing are the Jones Lang LaSalle Real Estate Intelligence Service-Asia (JLL REIS-Asia)'s office and industrial real estate for thirteen major Pan-Asia cities. These cities include Beijing, Shanghai, Taiwan, Hong Kong, Seoul, Tokyo, Manila, Jakarta, Singapore, Kuala Lumpur, Bangkok, Bangalore and Mumbai. The de-smoothed JLL REIS-Asia dataset, which is regionally reputable and internationally respected, and the MSCI (Morgan Stanley Composite index) Asia real estate capital index for publicly traded global REITs or REIT equivalent structures in the Asia Pacific region, are both utilized in the Markowitz Modern Portfolio Theory (MPT) mean-variance, constrained Quadratic Programming (QP) optimization model for the efficient frontier construction.

Another contribution of this paper is that the real estate markets in the Asia Pacific region are still on a positive trajectory and they have attracted growing interest from international investment funds that are seeking high enough risk-adjusted yields than those in the traditional Western real estate markets. This paper attempts to address the question of whether a dynamic, *ex ante* AHP-SAA model and a dynamic

Markowitz QP TAA model that utilize de-smoothed data would produce an investment strategy, which further optimizes the risk-adjusted return of the pan-Asian real estate portfolio? The next section of this paper discusses the related literature and explains the theoretical framework of the dynamic, *ex ante* AHP-SAA model, the required de-smoothing and Modern Portfolio Theory (MPT) for the TAA. Finally the results, findings and implications are discussed.

2. Literature Review

2.1 The Analytic Hierarchy Process (AHP) Model

Multi-Criteria Decision Analysis (MCDA) is aimed at supporting decision makers faced with making numerous and conflicting evaluations. One key MCDA model includes the Analytic Hierarchy Process (AHP) model. The AHP developed by Saaty in the 1970s and easily adopted by individuals working on complex problems, involving human perceptions and judgments, whose resolutions have long-term repercussions (Bhushan & Kanwal, 2004). AHP has produced meaningful results in relation to alternative selection, planning, resource allocation, and priority setting (De Steiguer et al., 2003). They extend beyond the real estate context. Ong and Teck (1996) explore the AHP in translating expert judgment into 12-month forecasts of the Singapore private residential market. Bender et al. (2000) examine the AHP in a comparative study of the perceptions of the environmental quality of residential real estate in the three distinct regions of Geneva, Zurich et al. (2005) adopt the AHP to model strategic asset allocation model and find that the SAA-AHP model accurately reflects expert judgment among a cohesive group of real estate investment experts.

The AHP model has two key features, namely, the decomposition of a complex unstructured problem into its component parts or variables into a hierarchic order; and the assignment of numerical values to expert judgment to determine those decision variables of the highest priority that have to be acted upon to influence the outcome. An AHP hierarchy consists of an overall goal, a group of options or alternatives for reaching the goal, and a group of factors or criteria that relate the alternatives to the goal. The hierarchy can be depicted in Figure 1. Nevertheless, there are critics of the model. McCaffrey (2005) mentions that since there is no theoretical basis for constructing the hierarchies and that AHP users can construct different hierarchies for identical decision situations, potentially producing different solutions. AHP rankings are claimed to be arbitrary because they are based on subjective opinions under a ratio scale. There are flaws in the techniques of combining individual weights into composite weights and the AHP model has no sound underlying statistical theory. Proponents argue that in spite of these concerns, the AHP model works well in practice and is extremely popular among decision-makers in the private and public sectors, as posited by De Steiguer et al. (2003).

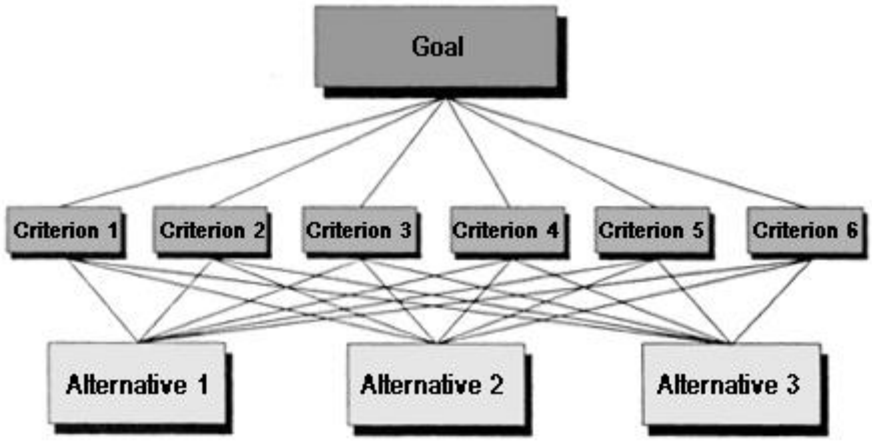

Figure 1. The AHP Hierarchy

Source: Authors, 2014.

The AHP model primarily calls for pair-wise judgments to develop its structured hierarchy that is manipulated analytically to produce a final matrix, representing the overall priorities of the alternatives relative to each other. One can then make logical decisions based on the pair-wise comparisons made between the alternatives and the criteria being used in decision-making. Expert judgment from the investor's perspective is pivotal in formulating the AHP Strategic Asset Allocation (SAA) model. Thus, a thorough real estate market analysis must be conducted to obtain in-depth understanding of the thirteen Asian markets, with the help of JLL market reports, reviews and forecasts. The AHP methodology is outlined below:

Step 1:

Completely define the problem and develop a hierarchy, which accurately represents the problem using the following guidelines:

Level 1—Final goal or objective,

Level 2—Criteria used to judge alternatives,

Level 3—Alternatives.

Step2:

Develop matrices that compare the criteria with themselves (within the Level 2) and the alternatives with each criterion (between Level 2 and 3). Use a scale of relative importance.

Step 3:

Compute priority of weights of each matrix using the Eigen values.

Step 4:

Compute composite priorities of the alternatives by linearly adding the priority weights.

Step 5:

Calculate a consistency ratio, which determines the consistency of the decision, and reveal the possible need of revisions to the judgments.

2.2 Pair-Wise Comparison

For ease of understanding, AHP's step-wise approach is narrowed to three key steps. These comprise the pair-wise comparisons, consistency ratio estimation and the factor weight determination (HO et al., 2005). The decision maker starts by laying out the overall hierarchy of the decision. This hierarchy reveals the factors to be considered and the various alternatives in the decision. Then, a number of pair wise comparisons are conducted, that result in the determination of factor weights and their factor evaluations. The alternative with the highest total weighted score is selected as the best alternative. The decision maker needs to compare two different alternatives under a linguistic scale that ranges from equally preferred to extremely preferred, as in the e.g., below (NB. numbers denoting the scale followed by a description). For any pair-wise comparison matrix to be constructed, values of "1" are placed down the diagonal from the upper left corner to the lower right corner of the matrix.

<u>A linguistic scale</u>

(1) Equally preferred.

(2) Equally to moderately preferred.

(3) Moderately preferred.

(4) Moderately to strongly preferred.

(5) Strongly preferred.

(6) Strongly to very strongly preferred.

(7) Very strongly preferred.

(8) Very to extremely strongly preferred.

(9) Extremely preferred.

2.3 Rationale for De-Smoothing

For any real estate portfolio, the reliability of the portfolio depends on the accuracy of the data. Yet several studies have shown that there exists a smoothening of valuation based indices that could underestimate the true volatility of the returns. A study by Matysiak (1995) show that valuation smoothing and temporal aggregation are factors that contribute to the inaccuracy of the measures of volatility in a portfolio. Specifically, the observed variance of the appraisal-based returns has been established to be much lower than the true variance. The main source of this problem is due to the underlying nature of valuation itself. Real estate has lengthy holding periods and infrequent transactions, thus capital values of properties are often estimated by valuers using comparison based valuation. This leads to the effect of smoothening in valuation based indices at the disaggregation level to temporal aggregation and the seasonality of reappraisals.

Evidence in smoothening exists for high first-order serial correlation of 0.8 and 0.6 for U.K monthly and U.S quarterly indexes respectively which are significant till the fourth order lag as posited by Matysiak (1995) and Geltner (2007); The high serial correlation is an additional feature of temporal aggregation. Likewise, the result is an index that has been smoothed over time but does not truly reflect the changes in the market. The JLL-REIS Asia dataset itself does not contain pure transaction based values. Instead, its dataset uses derived valuation based values to establish the index. The occurrence of lagging of the real estate values in the index was previously established by HO (2007). As such and to derive more accurate values, the index would have to be de-smoothed. Our paper adopts the autoregressive de-lagging model of Geltner and Miller (2007) to de-smooth the direct real estate total returns that are subject to temporal aggregation and the seasonality lag review.

2.4 Modern Portfolio Theory (MPT)

Markowitz (1959) developed MPT and reiterated the trade-off between risk and expected return. He establishes the concept of an "efficient portfolio", postulating that rational investors select their investment portfolios to yield the highest possible return for a specified level of risk or minimal level of risk for a specified rate of return. These two sets of portfolios are optimally efficient and lie along the efficient frontier of mean-variance portfolios. The investment decision involves not only the type of assets to own but also the allocation of the investor's wealth amongst them, also known as asset allocation. The model portrays diversification as a powerful means of reducing risk. Studies show that asset allocation decisions are more important than decisions related to asset selection or market timing. The depiction of the Markowitz efficient set of portfolio in Figure 2 represents the boundary of the set of feasible investment portfolios. No portfolio exists above the frontier and the efficient portfolio is preferred over any portfolio below the frontier. The three main components of MPT, return, portfolio risk and correlations of assets are provided for reference purposes in Appendices 2 to 4.

2.5 The Markowitz QP Tactical Asset Allocation (TAA) Model

The Markowitz QP TAA model is the initial step in forming the tactical asset allocation. However, the adoption of this optimization model for private and direct real estate markets may well involve potential difficulties like changing the investment weightings in the Asian cities, because the direct real estate market is less information efficient and liquid than either the equity or bond markets. Lack of liquidity makes it difficult to achieve the forecast returns suggested by the model, as it is impossible to be fully invested in the desired positions for short time frames. Likewise, it is not possible to significantly reduce exposure if required without significant costs. To resolve this difficulty, the TAA portfolio optimization should be updated regularly at the end of every 12 months while the associated longer term 5-year *ex ante* SAA (strategic asset allocation) portfolio optimization be updated regularly at the end of every 3 years. The achievable returns do not factor in transaction costs in this paper. The optimization is constrained by city tactical bands set around the SAA to determine a city-direct-real-estate centered allocation, which minimizes overall portfolio risk while achieving a targeted rate of return, on a risk-adjusted basis via the Sharpe ratio.

The pan-Asian asset allocation adopts the Markowitz QP TAA mode as the starting point. A real estate sector approach in building a portfolio is to be undertaken to ultimately develop a real estate investment strategy. Total Returns (TRs) are forecasted for the office and industrial real estate sectors of each city in local currency terms, on a pre-tax and un-leveraged (i.e., an all private equity) basis. TRs are then de-smoothed via adopting the autoregressive de-lagging model of Geltner and Miller (2007). TR forecasts are provided as an integral part of the JLL REIS-Asia dataset. JLL REIS-Asia prepares its TR forecasts via deploying a combination of economic time-based OLS multiple regression models and qualitative consensus-surveys within their JLL network of Asian regional offices. JLL proprietary property data and relevant data from official sources are utilized to calibrate the JLL REIS-Asia forecast models. As the *ex-ante* TR returns are derived from the JLL REIS-Asia dataset, it would be consistent to use their forecasts. The de-smoothed TR forecasts are examined in their respective real estate market analyses to reflect that the soundness of their direct real estate sectors to be in competitive equilibrium, and of their ability to generate high enough risk-adjusted returns.

The Markowitz QP TAA model utilizes *ex post* and *ex ante* direct real estate returns in US$ terms and their forecast correlations. This is to accord even handed attention to historical real estate market dynamics and their expected market conditions. The model is constrained via tactical bands around the AHP-SAA benchmarks and it is solved via MS Excel's Solver Optimization model, albeit an inherent resolution inaccuracy problem exists when >20 investment or real estate markets (sectors) are involved. The results are adjusted to allow for the expected cyclical positions of the direct real estate markets over the 4-year period ahead, i.e., 2008-2011, as illustrated in Figure 2, and for the qualitative differences between sectors within a city's direct real estate market.

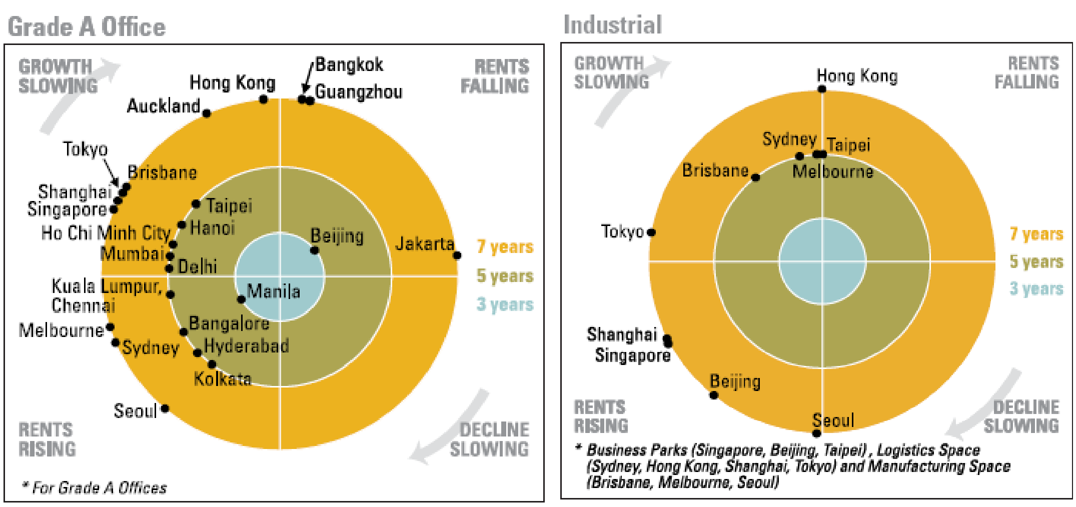

Figure 2. Real Estate Market Cycle Positions

Source: JLL Real Estate Investment Analysis Report, 2007.

3. The Model Estimations

3.1 A Deterministic SAA Model Using GDP

A deterministic approach to Strategic Asset Allocation (SAA) can be envisaged whereby the economic size indicator in GDP per capita terms would rise to the forecast levels by the end of 2012 from 2006. This a long enough forward period that is constrained by the availability of the consensus forecast data. From Table 1, the SAA neutral weights recommend that the major proportions of the new investment capital should be invested in the real estate markets of Hong Kong (18%), Taiwan (16%), Singapore (15%), Tokyo (13%), Seoul (11%), China (8%), principally in the two key cities of Shanghai (5%) and Beijing (3%); then followed by Kuala Lumpur (6%). Much smaller proportions are recommended for Bangkok (5%), India (4.6%), principally in the two key cities of Bangalore (2.3%) and Mumbai (2.3%), Jakarta (2.6%) and Manila (1%).

Table 1. Matrix and Pair-Wise Reciprocal Relationships among 13 Pan-Asia Cities

Country		**2005 Nominal GDP per Capita* (US$ pc)**	**2012 Nominal GDP per Capita* (US$ pc)**	**2012 SAA Neutral Weights (%)**
China	**BJ**	3749	6532	2.55%
China	**SH**	7678	13379	5.22%
Taiwan	**TPE**	30084	40861	15.95%
Hong Kong	**HKG**	33479	45778	17.87%
South Korea	**SLE**	20590	28234	11.02%
Japan	**TYO**	30615	33877	13.23%
Philippine	**MNL**	1750	2400	0.94%
Indonesia	**JK**	4459	6642	2.59%
Singapore	**SG**	28368	38016	14.84%
Malaysia	**KL**	11201	16278	6.36%
Thailand	**BKK**	8368	12207	4.77%
India	**BG**	3737	5956	2.33%
India	**MBY**	3737	5956	2.33%
		Total	**256,116**	**100%**

Source: Authors, 2014.

3.2 Estimation of the Dynamic, Ex Ante 3-Factor AHP-SAA Model

The AHP is a dynamic approach that is reliant on an *ex ante* assessment of alternative asset allocation strategies on the basis of expert judgment of the macroeconomic environment and the pan-Asian cities. This is because the required product of a factor weight and the associated factor evaluation of an Asian city, under the AHP, would produce a set of total weighted evaluations for all the thirteen Asian cities. Market vacancy is derived from the JLL-REIS Asia dataset while market transparency is obtained from the LaSalle Investment Management transparency index. Among the three key factors, the economic growth prospect factor is envisaged to be a primary macroeconomic factor that is forward-looking while the other two factors are real estate specific factors:

(1) Economic growth prospects: expansion outlook of investor performance.

(2) Market transparency: market depth of agents for transacting and managing properties as well as technology.

(3) Market vacancy: real estate market disequilibria.

Figure 3 depicts the AHP's structured hierarchy comprising the above three key factors, in arriving at the factor weights and factor evaluations of the various pan-Asia markets. Corresponding pair-wise comparisons among the real estate markets in the thirteen Asian cities are presented in Table 1. The table's matrix is to be completed for illustration purposes, on the basis of the authors' own expert judgment and experience, pertaining to their assessment of the real estate markets in the Asian cities.

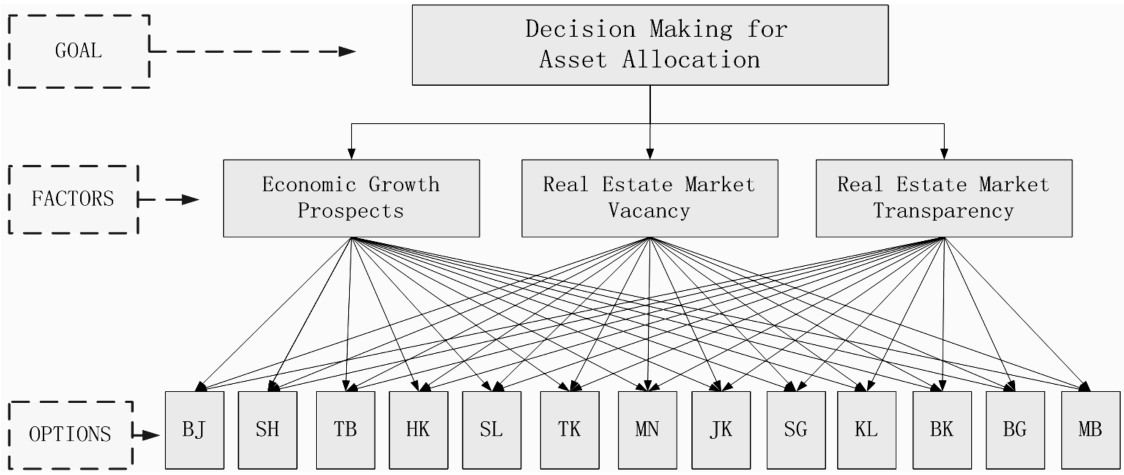

Figure 3. The Pan-Asian AHP Structured Hierarchy

Source: Authors, 2014.

From Table 1, we readily find the following observations:

Beijing city (BJ) is comparatively assessed to be:

Equally to moderately preferred to Shanghai, Seoul and Tokyo (a factor of 2);

Moderately to strongly preferred to Singapore, Bangalore and Mumbai (a factor of 4);

Very strongly preferred to Taiwan (a factor of 7);

Very extremely strongly preferred to Hong Kong (a factor of 8);

Extremely preferred to Manila, Jakarta, Kuala Lumpur and Bangkok (a factor of 9).

Shanghai city (SH) is comparatively assessed to be:

Equally to moderately preferred to Seoul and Tokyo (a factor of 2);

Moderately to strongly preferred to Singapore, Bangalore and Mumbai (a factor of 4);

Very strongly preferred to Taiwan and Hong Kong (a factor of 7);

Extremely preferred to Manila, Jakarta, Kuala Lumpur and Bangkok (a factor of 9).

Taiwan (TPE) is comparatively assessed to be:

Equally preferred to Hong Kong, Seoul and Tokyo (a factor of 1);

Equally to moderately preferred to Manila, Jakarta, Singapore, Kuala Lumpur, Bangkok, Bangalore and Mumbai (a factor of 2).

Hong Kong (HKG) is comparatively assessed to be:

Equally preferred to Seoul, Tokyo and Singapore (a factor of 1);

Moderately preferred to Bangalore and Mumbai (a factor of 3);

Very extremely strongly preferred to Manila and Jakarta (a factor of 8);

Extremely preferred to Kuala Lumpur and Bangkok.

Seoul (SLE) is comparatively assessed to be:

Equally preferred to Tokyo and Singapore (a factor of 1);

Moderately preferred to Bangalore and Mumbai (a factor of 3);

Very extremely strongly preferred to Kuala Lumpur and Bangkok (a factor of 8);

Extremely preferred to Manila and Jakarta (a factor of 9).

Tokyo (TYO) is comparatively assessed to be:

Moderately to strongly preferred to Bangalore and Mumbai (a factor of 4);

Strongly preferred to Singapore (a factor of 5);

Very extremely strongly preferred to Manila, Jakarta, Kuala Lumpur and Bangkok (a factor of 8).

Manila (MNL) is comparatively assessed to be:

Equally preferred to Jakarta, Singapore, Kuala Lumpur, Bangkok, Bangalore and Mumbai (a factor of 1).

Jakarta (JK) is comparatively assessed to be:

Equally preferred to Singapore, Kuala Lumpur, Bangkok, Bangalore and Mumbai (a factor of 1).

Singapore (SG) is comparatively assessed to be:

Strongly preferred to Bangalore and Mumbai (a factor of 5);

Very extremely strongly preferred to Kuala Lumpur and Bangkok (a factor of 8).

Kuala Lumpur (KL) is comparatively assessed to be:

Equally preferred to Bangalore and Mumbai (a factor of 1);

Very strongly preferred to Bangkok (a factor of 7).

Bangkok (BKK) is comparatively assessed to be:

Equally preferred to Bangalore and Mumbai (a factor of 1).

Bangalore (BG) is comparatively assessed to be:

Equally preferred to Mumbai (a factor of 1).

In arriving at the consistency ratio for the Economic Growth Prospect factor (EGP), Table 3 finds the EGP to be consistent (being<=0.10). The row average is estimated through first transforming the matrix of Table 2 by dividing each element in a column by the column's own "Column total"; and secondly, through taking the average of the resulting values for each row of the matrix of Table 2. The estimated consistency vector is obtained by dividing the weighted sum vector of SH for example by the row average for SH. Lambda is the average of the consistency vectors for all the office markets. The weighted sum vector is obtained by multiplying each row under its label into the row average of Table 2.

In the same manner as in Table 2, the pair-wise comparison matrix and reciprocal relationships are then each developed for the following two real estate specific factors among the thirteen Asian office markets:

(1) Market transparency: market depth of agents for transacting and managing direct real estate assets as well as technology.

(2) Market vacancy: real estate market disequilibria.

The rest of the row average and consistency ratio for each of the three real estate specific factors are presented in Tables 4 and 5.

Table 2. Matrix and Pair-Wise Reciprocal Relationships among 13 Pan-Asia Cities

	BJ	S	TP	HK	SL	TY	MN	JK	SG	KL	BK	BG	MB
BJ	**1.**	2	7	8	2	2	9	9	4	9	9	4	4
SH	0.	**1.0**	7	7	2	2	9	9	4	9	9	4	4
TPE	0.	0.1	**1.0**	1	1	1	2	2	2	2	2	2	2
HKG	0.	0.1	1.0	**1.0**	1	1	8	8	1	9	9	3	3
SLE	0.	0.5	1.0	1.0	**1.0**	1	9	9	1	8	8	3	3
TYO	0.	0.5	1.0	1.0	1.0	**1.0**	8	8	5	8	8	4	4
MNL	0.	0.1	0.5	0.1	0.1	0.1	**1.0**	1	1	1	1	1	1
JK	0.	0.1	0.5	0.1	0.1	0.1	1.0	**1.0**	1	1	1	1	1
SG	0.	0.3	0.5	1.0	1.0	0.2	1.0	1.0	**1.0**	8	8	5	5
KL	0.	0.1	0.5	0.1	0.1	0.1	1.0	1.0	0.1	**1.0**	7	1	1
BKK	0.	0.1	0.5	0.1	0.1	0.1	1.0	1.0	0.1	0.1	**1.0**	1	1
BG	0.	0.3	0.5	0.3	0.3	0.3	1.0	1.0	0.2	1.0	1.0	**1.0**	1
MBY	0.	0.3	0.5	0.3	0.3	0.3	1.0	1.0	0.2	1.0	1.0	1.0	**1.0**
Colum	4.	5.5	21.5	21.1	10.1	9.2	52.0	52.	20.	58.	65.0	31.	31.0

Source: Authors, 2014.

Table 3. Derivation of the Consistency Ratio for Economic Growth Prospect

	Weighted Sum Vector	Row Averages	Consistency vector	Lambda	CI	CR, Consistency Ratio
BJ	3.4892	0.2175	16.0439	14.90792	0.1590	0.098753841
SH	3.0979	0.1901	16.2967			=<0.1
TPE	0.8671	0.0562	15.4158			
HKG	1.4119	0.0924	15.2742			
SLE	1.5618	0.1052	14.8484			
TYO	1.8705	0.1221	15.3210			
MNL	0.3284	0.0220	14.9257			
JK	0.3284	0.0220	14.9257			
SG	1.0907	0.0746	14.6210			

KL	0.3693	0.0259	14.2588
BKK	0.2411	0.0177	13.6497
BG	0.3832	0.0272	14.1111
MBY	0.3832	0.0272	14.1111

Source: Authors, 2014.

Table 4. Row Averages and Consistency Ratio for Market Vacancy

	Weighted Sum Vector	Row Averages	Consistency vector	Lambda	CI	CR, Consistency Ratio
BJ	3.3211	0.2101	15.8108	14.92360802	0.1603	0.099565632
SH	3.1190	0.1902	16.3959			=<0.1
TPE	0.8994	0.0589	15.2817			
HKG	1.4382	0.0931	15.4433			
SLE	1.5840	0.1056	14.9956			
TYO	1.8932	0.1225	15.4502			
MNL	0.3322	0.0223	14.8678			
JK	0.3322	0.0223	14.8678			
SG	1.1087	0.0748	14.8320			
KL	0.3928	0.0273	14.3903			
BKK	0.2431	0.0180	13.5187			
BG	0.3862	0.0274	14.0764			
MBY	0.3862	0.0274	14.0764			

Source: Authors, 2014.

Table 5. Row Averages and Consistency Ratio for Market Transparency

	Weighted Sum Vector	Row Averages	Consistency vector	Lambda	CI	CR, Consistency Ratio
BJ	2.2455	0.1444	15.5525	14.66698412	0.1389	0.086282822
SH	2.3823	0.1558	15.2932			=<0.1
TPE	1.0897	0.0684	15.9260			
HKG	1.9054	0.1128	16.8940			
SLE	1.8363	0.1090	16.8511			
TYO	2.2410	0.1309	17.1182			
MNL	0.4156	0.0267	15.5729			
JK	0.4156	0.0267	3.8135			
SG	1.6454	0.1017	16.1778			
KL	0.6573	0.0418	15.7433			
BKK	0.4061	0.0307	13.2404			
BG	0.3650	0.0256	14.2440			
MBY	0.3650	0.0256	14.2440			

Source: Authors, 2014.

The two real estate factors are found to be consistent. In determining the factor weights, pair-wise comparisons are carried out between the economic growth prospect factor and each of the two real estate factors, as presented in Table 6. The table is also based on the authors' expert judgment and experience with these factors for illustration purposes. From Table 6, the economic growth prospect factor (EGP) in turn is comparatively assessed to be:

Moderately preferred to Market vacancy (MV) (a factor scale of 3);

Strongly preferred to Market transparency (MV) (a factor scale of 5).

The market vacancy factor is strongly preferred to market transparency (a factor scale of 5). The corresponding row average and consistency ratio for each of the three factors (EGP, MT and MV) are then presented in Table 7. All three factors are found to be consistent.

Table 6. The Factor Weights Determination

FACTOR	EGP	MV	MT
EG Prospect (EGP)	1	3	5
MKT Vacancy (MV)	0.3333	1	5
MKT Transparency (MT)	0.2000	0.2000	1
Column total	1.5333	4.2	11

Source: Authors, 2014.

Table 7. The Row Averages and Consistency Ratio for EGP, MV and MT

	Weighted Sum Vector	Row Average	Consis-tency vector	Lamda	CI	CR, Consistency Ratio
EG Prospect (EGP)	1.9653	0.6070	3.2377	3.1377	0.0689	0.001187628
MKT Vacancy(MV)	0.9539	0.3033	3.1448			=<0.1
MKT Transparency(MT)	0.2717	0.0897	3.0308			

Source: Authors, 2014.

In deriving the total weighted evaluations for each of the thirteen pan-Asia office markets, the factor evaluations for EGP, MT and MV that correspond to each office market are first presented in Table 8. These factor evaluations are earlier obtained from the row averages of Table 3, Table 4 and Table 5, and they are then multiplied into the factor weights of Table 8 (The row averages for the office market factors, already imputed in Table 9, represent the factor weights of Table 8).

Table 8. The Total Weighted Evaluations

Factor evaluation	EG Prosp (EGP)	MKT Vacancy(MV)	MKT Transparency (MT)
BJ	0.2175	0.2101	0.1444
SH	0.1901	0.1902	0.1558
TPE	0.0562	0.0589	0.0684
HKG	0.0924	0.0931	0.1128
SLE	0.1052	0.1056	0.1090
TYO	0.1221	0.1225	0.1309
MNL	0.0220	0.0223	0.0267
JK	0.0220	0.0223	0.0267
SG	0.0746	0.0748	0.1017
KL	0.0259	0.0273	0.0418
BKK	0.0177	0.0180	0.0307
BG	0.0272	0.0274	0.0256
MBY	0.0272	0.0274	0.0256
Column Total	1	1	1

Source: Authors, 2014.

Table 9. The Factor Weights

Factor	Factor Weight
EG Prospect (EGP)	0.6070
MKT Vacancy(MV)	0.3033
MKT Transparency (MT)	0.0897

Source: Authors, 2014.

Finally, the total weighted evaluations for each of the thirteen Asia office markets are obtained through multiplying each column of Table 8 into each column of Table 9 to produce each row of Table 10. Each individual row of Table 10 should add up to the total weighted evaluation for each of the thirteen Asian cities, and expressed in percentage terms. The respective percentages would total to 100 per cent.

Table 10. The SAA Total Weighted Evaluations under the AHP SAA Model

RE Market	Weighted Evaluations			Total Weighted Evaluation		SAA Portfolio
	EGP	MV	MT			Composition by City
BJ	0.1320	0.0637	0.0129	**BJ**	0.20867	**20.9%**
SH	0.1154	0.0577	0.0140	**SH**	0.18706	**18.7%**
TB	0.0341	0.0179	0.0061	**TB**	0.05813	**5.8%**
HKG	0.0561	0.0283	0.0101	**HK**	0.09447	**9.4%**
SLE	0.0638	0.0320	0.0098	**SL**	0.10566	**10.6%**
TYO	0.0741	0.0372	0.0117	**TK**	0.12301	**12.3%**

MNL	0.0134	0.0068	0.0024	**MN**	0.02252	**2.3%**
JK	0.0134	0.0068	0.0024	**JK**	0.02252	**2.3%**
SG	0.0453	0.0227	0.0091	**SG**	0.07708	**7.7%**
KL	0.0157	0.0083	0.0037	**KL**	0.02774	**2.8%**
BKK	0.0107	0.0055	0.0028	**BK**	0.01892	**1.9%**
BG	0.0165	0.0083	0.0023	**BG**	0.0271	**2.7%**
MBY	0.0165	0.0083	0.0023	**MB**	0.0271	**2.7%**
						100.0%

Source: Authors, 2014.

It is noteworthy that the dynamic AHP-SAA's ranking is not absolutely right but that the ranking is relevant and acceptable by consensus among real estate asset/or investment managers. The ranking is subject to objective assessment and it enables the AHP-SAA to be as objective as an SAA that is based on merely on economic size indicator like the real GDP per capita per city (in *ex post* and *ex ante* terms). The important implication is to compile and analyze the informed assessments of real estate asset/or investment managers concerned into a ranked score; thereafter to statistically derive a ratio that is validated by a consistency ratio. This makes the AHP-SAA readily applicable to achieve greater precision by changing the variables or including more variables.

3.3 Model Estimation of Total Returns

Prime office annual total returns are obtained for the thirteen Asia real estate markets, namely, Singapore (the Raffles Place CBD), Beijing, Shanghai, Hong Kong (the Central & major business districts), Bangkok, Manila (Makati CBD), Kuala Lumpur and Jakarta. The TR dataset is provided by the Singapore-based JLL REIS-Asia that covers a historical period between 1997 and 2007 in US$ terms. It includes a total of 240 prime CBD (central business district) office buildings of international quality grade, on the basis of 90 such buildings per city. JLL REIS-Asia offers for tertiary research purposes (and upon request) only a historical period and not the full period from 1997 to 2013, which is meant for its commercial purposes on a paid annual subscription. JLL REIS-Asia is the sole service provider that maintains a reliable valuation-based database for the thirteen Asia office markets. In addition to office market TR datasets, JLL REIS-Asia industrial TR data sets for Singapore and Hong Kong markets are utilized. The MSCI Asia Pacific/REIT Index and currency forecasts from 2008-2011 are obtained from Bloomberg. Such a MSCI Asia real estate market index is an integral part of the MSCI ACWI/REITs Index, which is a market capitalization-weighted index that currently includes publicly traded global REITs or REIT equivalent structures. For a 5-year period ending 31 May 2006, its real estate indices generally posted better risk-adjusted performance than the selected US domestic and international equity indices. *Ex post* total returns from 2003 and 2007 are summarized in Table 11. The *ex post* total returns for the 13 different geographical locations are de-smoothed subsequently in the following section to obtain a more accurate measure of the TR.

Table 11. Estimation of *Ex Post* Total Returns

	2003	2004	2005	2006	2007
BJ	1.69%	7.53%	5.97%	18.88%	7.32%
SH	3.92%	9.17%	7.99%	29.52%	18.62%
TPE	-11.02%	-6.73%	10.30%	8.50%	6.56%
HKG	-17.76%	-6.07%	57.56%	42.17%	4.17%
SL	19.56%	15.79%	26.19%	24.27%	24.12%
TYO	-14.30%	-5.24%	21.47%	45.27%	52.64%
MNL	-6.41%	1.21%	9.28%	46.87%	30.96%
JK	7.52%	9.25%	6.06%	25.59%	12.64%
SG	-9.13%	-2.38%	4.17%	10.88%	71.93%
KL	3.06%	6.90%	-2.41%	14.30%	12.10%
BKK	8.16%	39.54%	40.75%	27.95%	20.78%
BG	12.06%	13.29%	27.99%	25.06%	3.19%
MBY	-6.94%	8.98%	34.72%	34.56%	51.48%
SG ID[1]	-5.00%	-3.00%	51.86%	30.23%	14.53%
HK ID[2]	-9.00%	-5.00%	5.81%	8.57%	13.28%
Asia Index[3]	-18.32%	28.90%	25.87%	25.88%	30.20%

[1] Singapore Industry.

[2] Hong Kong Industry.

[3] MSCI Capital Index for Asia Pacific Listed Property Company.

Source: Author 2014 and the JLL REIS-Asia Data Set, 2007.

4. De-Smoothing the JLL REIS Total Returns

The autoregressive de-lagging model of Geltner and Miller (2007) is adopted to obtain the de-smoothed returns for the office sector of 12 geographical locations, the Singapore and Hong Kong Industry returns. The dependent variables and the coefficients used are shown in Table 11, using equations 3 & 4 of Geltner and Miller (2007) and the JLL REIS-Asia data, 1992Q3-2007Q2.

Table 12. Estimation of the De-Smoothed Total Returns

	Coefficient	1 Quarter Lag (01)	4 Quarter Lag (04)	Residual	R-squared	Durbin-Watson stat
BGO	0.160286	0.599159	-0.463994	0.158149	0.638483	1.981469
BJO	0.001685	0.806697	0.165993	-0.464355	0.483213	2.118923
BKO	0.024222	0.883611	-0.066763	-0.029062	0.695353	1.983310
HKO (Hong	0.048827	0.883387	-0.251967	0.125790	0.794434	2.052022
SGO	0.018293	1.067481	-0.190902	0.495270	0.908386	1.944272
SHO	0.039395	0.774267	-0.100249	0.120524	0.584784	1.924918
SLO (Seoul)	0.082155	0.723765	-0.047677	-0.160233	0.359716	2.246243

TBO (Taipei)	0.009840	0.997042	-0.183896	0.108458	0.912296	2.057912
TKO Tokyo	0.014325	1.181853	-0.318357	-0.008129	0.926999	1.958698
JKO	0.020192	0.915785	-0.103167	0.162304	0.819092	2.081880
KLO (Kuala	0.014248	1.010185	-0.219666	-0.382270	0.591573	1.983562
MBO	0.059151	0.812412	0.152870	0.178893	0.739263	1.883436
MNO	0.017365	0.977336	-0.095888	-0.020373	0.866405	1.620734
HKI (HK	0.183667	-0.185135	-0.048944	0.106316	0.999928	3.177700
SGI (SG	-0.021430	1.550851	-0.181945	-0.526041	0.786674	1.919088

Source: Authors, 2014 and Eviews Ver.6, 2014.

Table 12 can be expressed in equation (EQ) 1 for the de-smoothed total returns of the Singapore office sector.

$$\mathrm{SGO} = 0.018293 + 1.067(\mathrm{SGO01}) - 0.191(\mathrm{SGO04}) + 0.495(\mathrm{RESID01\ \ SGO}) \qquad \text{EQ (1)}$$

Equation 1 can be simplified as equation 2.

$$r_t = 0.0682 + 1.067 r_t - 1 + 0.191 r_t - 4 - 0.495 e_t \qquad \text{EQ (2)}$$

Where r_t = Singapore Office Total Returns in quarter t; r_{t-1} = Singapore Office Total Returns lagged by 1 quarter; r_{t-4} = Singapore Office returns lagged by 4 quarter and e_t = the "residuals" of the auto-regression (zero mean and autocorrelation). The estimation output of the equation displays a relatively high adjusted R^2 of 90.8% with the appropriate Durbin-Watson statistic of 2.00 and significant t-ratio for r_{t-1} and partial significant t-ratios for r_{t-4} and the constant. The de-smoothed total returns for the Singapore office sector are corrected for the relevant lags as shown in Figure 4. As shown, the de-smoothed TR data shows more volatility and is a more accurate measure as compared to the smoothed TR data. This trend was reflected in all the other pan-Asian cities.

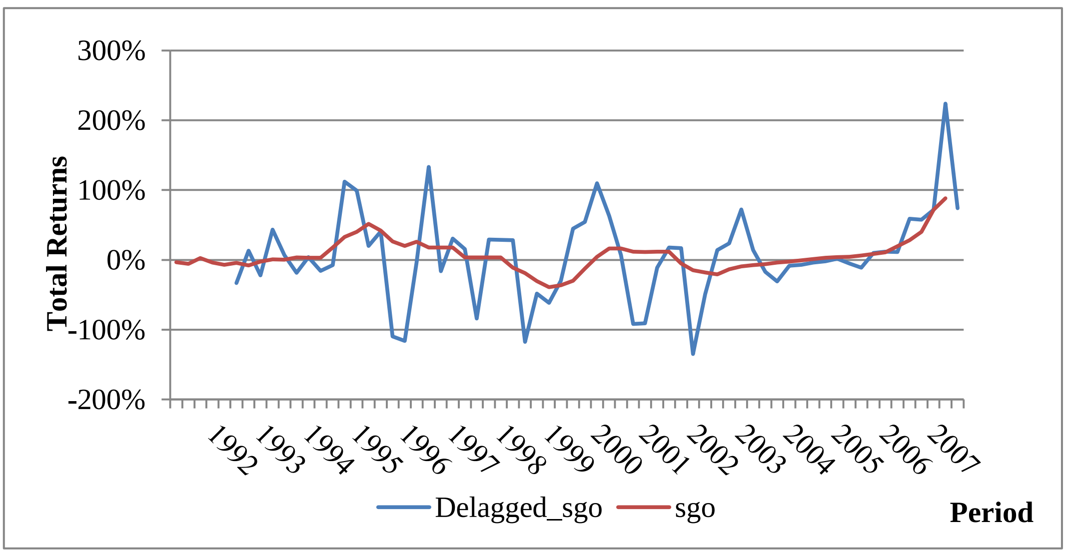

Figure 4. Comparison between Smoothed and De-smoothed Singapore Office Total Returns

Source: Authors, 2014 and Eviews Ver.6, 2014.

3.4 The De-Smoothed Ex-Post Total Returns for the 12 Asian Cities

Table 13 provides the descriptive statistics and summaries of the de-smoothed total returns for the respective cities. As expected, total returns are not normal and the volatility of true returns has been understated. Looking at the statistics, the office markets of Mumbai and Seoul have the highest office returns with means of over 25%. In contrast, the Taipei office market has the lowest returns with a mean of 3.3% in the 4-year period. Nevertheless, the Taipei market has one of the lowest volatility with a standard deviation of 12.4%, second to the Bangalore office market which has a standard deviation of 6.2%.

Table 13. Descriptive Statistics of the De-Smoothed *Ex Post* Total Returns

City	Period (Total Return)	Observations	Total Returns (US$)		Skewness	Kurtosis
			Mean	Std. Dev.		
BG	2003Q3-2007Q3	17	17.7%	6.2%	-0.097	2.353
BJ	1999Q3-2007Q3	33	10.4%	30.6%	2.23	10.366
BKK	1996Q2-2007Q3	46	11.5%	67.1%	-0.418	5.34
HKG	1989Q3-2007Q3	73	13.4%	38.2%	0.538	4.608
JK	1989Q3-2007Q3	73	13.1%	73.0%	2.19	15.316
KL	1999Q2-2007Q3	34	7.3%	19.8%	-0.302	3.183
MBY	2003Q3-2007Q3	17	27.8%	233.6%	0.346	3.101
MNL	1998Q2-2007Q3	38	5.7%	75.1%	-1.158	7.95
SG	1992Q3-2007Q3	61	6.8%	62.6%	0.353	4.657
SH	1999Q2-2007Q3	34	10.4%	18.0%	0.515	3.251
SLE	2001Q2-2007Q3	26	26.1%	21.4%	0.715	3.086
TPE	2003Q2-2007Q3	18	3.3%	12.4%	0.23	3.187
TYO	2002Q2-2007Q3	22	18.1%	57.3%	0.195	2.533
HKInd	2006Q2-2007Q3	6	13.1%	3.3%	-0.826	2.471
SGInd	2004Q3-2007Q3	13	9.0%	5.4%	0.847	4.227

Source: Authors, 2014 and Eviews Ver.6, 2014.

3.5 Lag Serial Correlations

Within the calendar year, a city's direct real estate markets tend to move in tandem although the markets may move out of balance between calendar quarters. From the underlying rents and Capital Values (CVs) of the JLL REIS-Asia dataset, very high correlation between the current quarter's industrial (warehouse) rents and the office rental lags is observed. This is shown in the cases of Singapore and Hong Kong in Tables 14 and 15 respectively. It is readily observed that in the Singapore real estate market, the industrial rent is most correlated to a 2-quarter office lag (0.955), and that in the Hong Kong real estate market the industrial rent is most correlated to a 1-quarter office lag (0.993). The implication is the limited real estate sector diversification between the office market and the industrial real estate market within the same city like Singapore and Hong Kong. It can be inferred that a city's office market may well be a reliable proxy of the industrial real estate market and of the overall market.

Table 14. The Singapore Office and Industrial Real Estate Markets (Sectors)

	ERSI to	***ERSO t-1***	***ERSO t-2***	***ERSO t-3***	***ERSO t-4***
ERSI to	1				
ERSO t-1	0.952	1			
ERSO t-2	0.955	0.983	1		
ERSO t-3	0.892	0.886	0.937	1	
ERSO t-4	0.587	0.571	0.672	0.856	1
	CVSI	**CVSO t-1**	**CVSO t-2**	**CVSO t-3**	**CVSO t-4**
CVSI	1				
CVSO t-1	0.980	1			
CVSO t-2	0.966	0.993	1		
CVSO t-3	0.931	0.970	0.979	1	
CVSO t-4	0.737	0.815	0.832	0.914	1

Source: Authors, 2014 and the JLL REIS-Asia Data Set, 2007.

Table 15. The Hong Kong Office and Industrial Real estate Markets (Sectors)

	ERHI	***ERHO t-1***	***ERHO t-2***	***ERHO t-3***	***ERHO t-4***
ERHI	1				
ERHO t-1	0.993	1			
ERHO t-2	0.990	0.994	1		
ERHO t-3	0.978	0.984	0.996	1	
ERHO t-4	0.956	0.963	0.984	0.994	1
	CVHI	**CVHO t-1**	**CVHO t-2**	**CVHO t-3**	**CVHO t-4**
CVHI	1				
CVHO t-1	0.788	1			
CVHO t-2	0.786	0.973	1		
CVHO t-3	0.845	0.885	0.956	1	
CVHO t-4	0.921	0.812	0.872	0.960	1

Source: Authors, 2014 and the JLL REIS-Asia Data Set, 2007.

4. Results and Findings

4.1 The Dynamic, Ex Ante 3-Factor AHP-SAA Model

The set of total-weighted evaluation percentages by city and country, under the dynamic, *ex ante* 3-factor AHP SAA model, essentially provides a consistently derived Strategic Asset Allocation (SAA) portfolio that represents what an investor desires to achieve over a longer-term investment horizon. The AHP-SAA model portfolio is also geographically diversified. As an appropriate interface, the

AHP-SAA model in effect identifies the thirteen Asia cities' markets and the proportions for these markets that would comprise the long-term, desired normal pan-Asia real estate portfolio mix. The subsequent and dynamic MPT QP TAA model is conducted around the AHP-SAA model portfolio through imposing deviations (i.e., the tactical bands) from the AHP-SAA's normal pan-Asia office portfolio mix of the next subsection.

Table 16. The AHP-SAA Model Portfolio's Neutral Weights

City	AHP SAA Portfolio Composition	Country	AHP SAA Portfolio Composition
BJ	20.9%	**}China**	
SHG	18.7%	**}China**	**39.6%**
TPE	5.8%	**Taiwan**	**5.8%**
HKG	9.4%	**Hong Kong**	**9.4%**
SLE	10.6%	**South Korea**	**10.6%**
TYO	12.3%	**Japan**	**12.3%**
MNL	2.3%	**The Philippines**	**2.3%**
JKG	2.3%	**Indonesia**	**2.3%**
SG	7.7%	**Singapore**	**7.7%**
KL	2.8%	**Malaysia**	**2.8%**
BKK	1.9%	**Thailand**	**1.9%**
BGR	2.7%	**}India**	
MBY	2.7%	**}India**	**5.4%**
Total	100.0%	**Total**	**100%**

Source: Authors, 2014.

4.2 The Efficient Frontier from the Markowitz QP TAA Model

Using the dynamic Markowitz QP, the convex efficient frontier is generated (see Figure 5) using the de-smoothed TRs. The efficient frontier is a graphical representation of the risk-return tradeoff combinations the portfolio could adopt. Consequentially, the TAA model would be developed along the Markowitz efficient frontier generated.

Figure 5 clearly shows the enhanced efficient frontier of portfolio risk-adjusted returns using the de-smoothed TR data that is plotted against that efficient frontier using the smoothed JLL REIS-Asia dataset in its natural form. Consequently, the efficient frontier with the de-smoothed data clearly shows a higher overall TR for every corresponding standard deviation, as compared to the smoothed data. The TAA for the de-smoothed returns would lie on the efficient frontier at the maximum Sharpe ratio of 1.44 with a TR on 15.30% and a standard deviation of 7.31. Conversely, the TAA for the smoothed returns would lie on the efficient frontier at the maximum Sharpe ratio of 1.31 with a lower TR of 14.2% and a standard deviation of 7.18%.

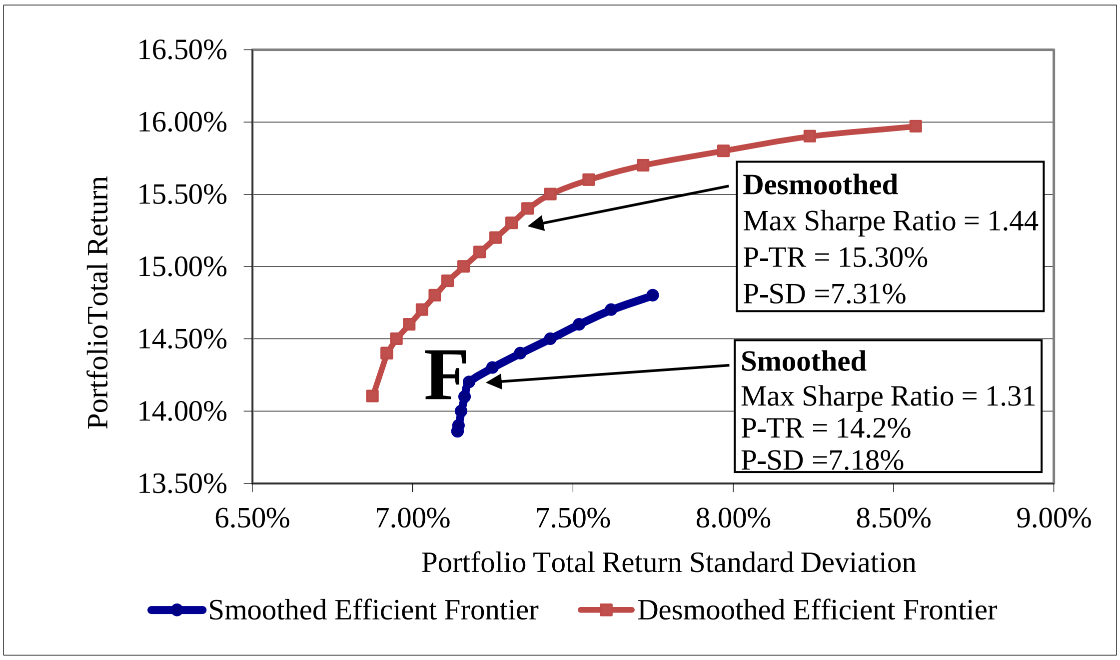

Figure 5. The Resulting Efficient Frontiers from the Markowitz QP TAA Model

Source: Authors, 2014; JLL REIS-Asia Data Set, 2007.

In comparison, the deterministic SAA GDP model for the dynamic Markowitz QP TAA Model would result in an efficient frontier that has higher overall total returns as well as standard deviation (see Figure 6).

4.3 The Dynamic Markowitz QP TAA Model Using the De-Smoothed Dataset

The proposed TAA is located along the Markowitz efficient frontier via the Sharpe-ratio-maximizing portfolio that attains the maximum risk-adjusted TR, in excess of that of a risk less asset for the TAA's risky portfolio. US$ 10-year treasuries are used in imputing the Sharpe ratio. Variation in asset allocation within portfolios can produce quite different results over time. As observed from Figure 5, the Sharpe ratio is imputed to be 1.31 at point F while the profile of the Markowitz QP TAA proposed TAA portfolio is presented in Table 16.

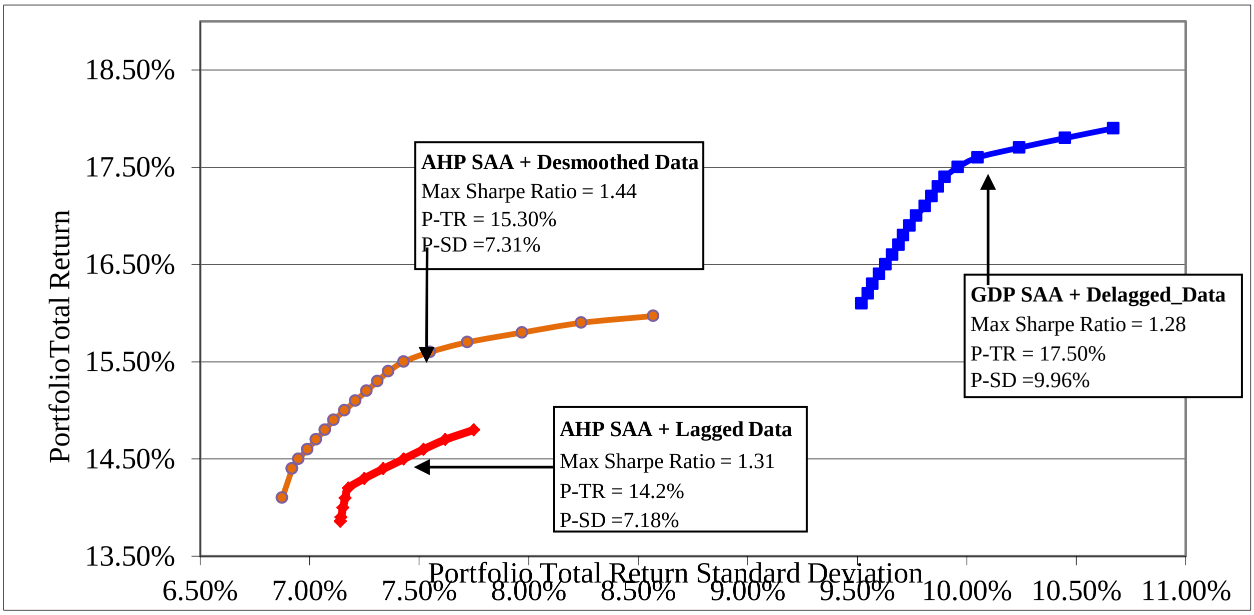

Figure 6. The Resulting Efficient Frontiers from the Dynamic Markowitz QP TAA Model

Source: Authors, 2014; JLL REIS-Asia Data Set, 2007.

Table 16 indicates the relative underweight, overweight or none at all versus the dynamic AHP SAA model portfolio. As the weight of the MSCI Asia real estate index is minimal, it is allocated to the Singapore market as allocation by city confers more flexibility for potential investing in South East Asia's highly developed and stable real estate market of Singapore. For reference purposes, Table 17 provides the breakdown of the appropriate real estate investment strategies, the corresponding Markowitz QP TAA proposed portfolio compositions and their profiles pertaining to the office, industrial real estate and Asia index (REITs).

Table 17. The Markowitz QP TAA Proposed Portfolio

		AHP SAA as the benchmark portfolio by city	**Markowitz QP TAA Proposed Portfolio for 2008, Based on Tactical Bands & Sharpe-Maximizing Ratio**	**Position at the TAA Proposed Portfolio for 2008 With respect to the SAA**	**TAA's Tactical Bands Tightly Imposed around the AHP SAA Portfolio With Market Dynamics Considered**	
Asian Market					**Lower**	**Upper**
Beijing	**BJ**	**20.87%**	**19.71%**	Slight Underweight	18%	25%
Shanghai	**SH**	**18.71%**	**15.00%**	Slight Underweight	15%	20%

Taipei	**TB**	**5.81%**	**3.00%**	Slight Underweight	3%	8%
Hong Kong	**HK**	**9.45%**	**9.00%**	Neutral	7%	11%
Seoul	**SL**	**10.57%**	**14.00%**	Slight Overweight	10%	14%
Tokyo	**TK**	**12.30%**	**9.00%**	Slight Underweight	9%	13%
Manila	**MN**	**2.25%**	**4.00%**	Slight Overweight	2%	4%
Jakarta	**JK**	**2.25%**	**4.00%**	Slight Overweight	2%	4%
Singapore	**SG**	**7.71%**	**8.00%**	Neutral	6%	10%
Kuala Lumpur	**KL**	**2.77%**	**1.00%**	Slight Underweight	1%	4%
Bangkok	**BK**	**1.89%**	**2.29%**	Slight Overweight	1%	3%
Bangalore	**BG**	**2.71%**	**8.00%**	Overweight	2%	8%
Mumbai	**MB**	**2.71%**	**2.00%**	Slight Underweight	2%	8%
Total		**100.00%**	**100.00%**			

Source: Authors, 2014; JLL REIS-Asia Data Set, 2007.

Table 18. Real Estate Investment Strategy & the Markowitz QP TAA Proposed Portfolio Composition

Three Sectors	**Country**		**Defensive**	**Low Growth**	**Balanced**	**Growth**	**High Growth**
Office Markets	**China**	**BJ**	24.08%	22.82%	22.15%	**19.71%**	18.71%
	China	**SH**	15.00%	15.00%	15.00%	**15.00%**	15.00%
	Taipei	**TPE**	3.00%	3.00%	3.00%	**3.00%**	3.00%
	HK	**HKG**	7.00%	7.00%	7.00%	**7.00%**	7.00%
	South Korea	**SLE**	13.48%	14.00%	14.00%	**14.00%**	14.00%
	Japan	**TYO**	9.00%	9.00%	9.00%	**9.00%**	9.00%
	Philippines	**MNL**	4.00%	4.00%	4.00%	**4.00%**	4.00%
	Indonesia	**JK**	4.00%	4.00%	4.00%	**4.00%**	4.00%
	Singapore	**SG**	6.00%	6.00%	6.00%	**6.00%**	6.00%
	Malaysia	**KL**	1.00%	1.00%	1.00%	**1.00%**	1.29%
	Thailand	**BKK**	1.00%	1.00%	1.00%	**2.29%**	3.00%
	India	**BG**	5.44%	6.18%	6.85%	**8.00%**	8.00%
	India	**MBY**	2.00%	2.00%	2.00%	**2.00%**	2.00%
Industrial	**Singapore**	**SG**	2.00%	2.00%	2.00%	**2.00%**	2.00%
	Hong Kong	**HKG**	2.00%	2.00%	2.00%	**2.00%**	2.00%
Asia Index			1.00%	1.00%	1.00%	**1.00%**	1.00%

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Total Allocation	100.00%	100.00%	100.00%	100.00%	100.00%
Minimum Investment Term	2 years	3 years	5 years	**7 years**	10 years
Expected TR Over Term	14.50%	14.70%	14.80%	**15.30%**	15.50%
Expected SD Over Term	6.95%	7.03%	7.07%	**7.31%**	7.43%
Expected %Loss (-) or worse every 6 years (1 SD)	7.55%	7.67%	7.73%	7.99%	8.07%
Expected %Loss (-) or worse every 44 years (2 SD)	0.60%	0.64%	0.66%	0.68%	0.64%
Investor Objectives & Suitability :					
Secure Short-Term Income	High	Moderate	Low	**Not Appropriate**	Not Appropriate
Capital Stability	High	Moderate	Low	**Very Low**	Not Appropriate

Source: Authors, 2014; JLL REIS-Asia Data Set, 2007.

The dynamic TAA is meant to take advantage of short-run office market disequilibria that may emerge, in respect of the thirteen Asian markets (Francis & Ibbotson, 2001; Geltner & Miller, 2001). It is worthwhile to reiterate that making a tilt (i.e., a TAA) is similar to saying that either the market is not fully efficient or that it is efficient but that the investor believes that he or she has expert insight and that the rest of the market has got the investment themes wrong. The recommended dynamic TAA is developed for the next 12 months and is meant to be reviewed in 12-month periods. Thus, it is evident that the Markowitz quadratic programming model fully diversifies the direct real estate portfolio over time by making yearly tilts around the long term, dynamic SAA and that the model verifies the second hypothesis.

4.4 Investment Strategy

An asset allocation strategy can be applied against three main criteria of the investor profile: risk, tax and time horizon. From the three criteria, it is possible to draw up a general guide to strategic asset allocation such as the one in Table 17. The Table 17 shows the "neutral weightings" for different real estate investment strategic alternatives (i.e., styles). These are the target allocations based on the inherent long-term characteristics of the asset classes, rather than the particular circumstances of markets at any one time. They correspond to the upward sloping and convex efficient frontier under the Markowitz portfolio optimization discussed earlier. The portfolios are points on the efficient frontier. The associated investor profile in terms of the investor objectives and suitability are also shown in the Table 18.

At one extreme the pan-Asia defensive real estate portfolio investment strategic alternative has an expected TR of 14.50% and a high SD of 6.95%, over a short investment term of 2 years. The risk-taking investor is very concerned with securing short-term income, capital stability and moderately concerned with steady growth. This means that a small portfolio gain or loss of 7.55% or worse (i.e., negative TR) can be expected every 6 years; and a portfolio gain or loss of worse than 0.60% every 44 years. At the other extreme would be the pan-Asia high-growth portfolio investment strategic alternative, for the risk-averse investor, with a very much higher expected TR of 15.50% and a relatively small increase in SD to 7.43% but over much longer investment term of 10 years. This means that a high portfolio gain of not exceeding 8.07% can be expected every 6 years; and a more modest portfolio gain of not exceeding 0.64% every 44 years. More of the allocations are diverted to the only the less volatile real estate market. Only wealth accumulation is the primary concern of the investor. The rest of the investment strategic alternatives (styles) lie between the two extremes.

4.5 The Recommended Pan-Asia Growth Investment Strategy

The pan-Asia growth investment strategy is recommended for this study, with a portfolio composition that is similar to the Sharpe-optimal Tactical Asset Allocation (TAA) portfolio of Table 20. The recommended Growth Investment Strategy, at Point F on the portfolio efficient frontier of Figure 5, would attain a very high expected TR of 15.30% and a very low SD of 7.31% but over a long investment term of 7 years. This means that a high portfolio gain of not exceeding 7.99% can be expected every 6 years; and a very small portfolio gain not exceeding 0.68% every 44 years. Capital stability is a very low concern while securing short-term income is not a concern at all. This verifies the hypothesis that the dynamic AHP-SAA model and the Markowitz-TAA model develop an integrated investment strategy that has an optimal risk-adjusted return, direct real estate pan-Asian portfolio.

5. Conclusion

This paper indicates that the efficient frontier with the de-smoothed data shows a higher overall TR for every corresponding standard deviation as compared to the smoothed data. The dynamic TAA for the de-smoothed returns would lie on the efficient frontier at the maximum Sharpe ratio of 1.44 with a TR on 15.30% and a standard deviation of 7.31. Conversely, the TAA for the smoothed returns would like on the efficient frontier at the maximum Sharpe ratio of 1.31 with a lower TR of 14.2% and a standard deviation of 7.18%. With the de-smoothing treatment of the direct real estate TR data, the enhancement of the efficient frontier for the risky direct real estate portfolio to which REITs can be introduced, would be readily noticeable and the benefits easily appreciated by real estate investors and practitioners.

A dynamic, *ex ante* AHP-SAA model is found to be rigorous in forming and estimating the Strategic Asset Allocation (SAA) model portfolio, which geographically diversifies the pan-Asian real estate international portfolio. It objectively and precisely reflects investor-expert judgment through pair-wise comparisons, subject to Consistency Ratio (CR) checks that are non-conflicting for assessing the macroeconomic and real estate specific factors. The Markowitz QP TAA model produces a proposed portfolio (Table 18) that is diversified along time. Tactical bands, based on real estate market analysis of the pan-Asian cities, can be tightly imposed around the dynamic AHP-SAA model portfolio for every 12-month period. The tighter bands tend to minimize or eliminate the potential smoothening of the direct real estate data. The Markowitz QP TAA model enables a diversified portfolio along time through making yearly tilts around the dynamic, *ex ante* AHP-SAA model portfolio weights. This paper finds the Pan-Asia real estate growth investment strategy to be appropriate for the thirteen pan-Asian cities with a very high, expected TR of 15.3% and an expected standard deviation of 7.31%, on an optimal risk-adjusted portfolio return basis. It has a minimum investment term of 7 years.

The paper establishes an alternative asset allocation process that can be effectively adopted and refined by practitioners and researchers. There is a practicality of approach for asset managers/or investors as it deploys expert opinions on an *ex ante* basis and quantifies them into a statistically significant approach in adopting the AHP to develop a dynamic SAA and the dynamic Markowitz QP TAA model in utilizing de-smoothed direct real estate TR data. The primary findings are consistent and extends similar studies undertaken in the Western developed real estate markets. Another contribution of this paper is that it is specific to a Pan Asian direct real estate portfolio of 13 Asian cities together with the introduction of Asian REITS, to provide greater diversification and risk-return benefits of adopting a de-smoothing approach.

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Appendix 1

Total Return

The investment return is measured in terms of total returns received over the holding period and is a measure of two components; capital appreciation/depreciation and the income (i.e., rental) received over the investment period. It is expressed as

$$R_t = \frac{(V_1 - V_0) + I_t}{V_0}$$

Where R_t = total return on asset

V_0 = price of asset at the beginning of period

V_1 = price of asset at end of period

I_t = income received during period

The expected portfolio return is the weighted average of returns of the individual assets

$$E(R_p) = \sum_{i=1}^{n} W_i R_i$$

where $E(R_P)$ = expected return on portfolio p.

W_i = proportion of investor's fund in asset i.

R_i = expected return on asset i.

Appendix 2

Portfolio Risk

Overall portfolio risk is a function not only of individual asset means and standard deviations, but also the degree to which their returns are correlated. It is dependent on the degree of covariance between the returns of the assets in the portfolio, especially when the portfolio is big. The covariance is measured in the same units as the asset returns. Thus, it is sometimes difficult to interpret. Therefore, the coefficient of correlation (ρ) of the asset is used. Portfolio risk is represented by the following:

$$\sigma_P = \sqrt{\sum_{i=1}^{n} W_i^2 \sigma_i^2 + W_j^2 \sigma_j^2 + 2\sum_{i=1}^{n}\sum_{j=1}^{n} W_i W_j \rho_{ij} \sigma_i \sigma_j}$$

$i \neq j$

Where

σ_P = portfolio standard deviation.

Wi, Wj = proportion of funds in investment i and j.

$\sigma_i, \sigma_j =$ standard deviation of asset i and j.

$$SD^2 = \frac{1}{T-1}\sum_{t=1}^{T}[(R_t - \overline{R})]^2$$

ρ_{ij} = correlation coefficient between return of asset i and j.

Subject to $W_i, W_j \geq 0$ and $\sum_{i=1}^{n} W_i = 1$

There must be no short sales and the total investment proportion must sum up to one.

Appendix 3

Correlation Coefficient of Assets

$$\rho_{ij} = \frac{(R_i - R_{ei})(R_j - R_{ej})}{\sigma_i \sigma_j}$$

Where

ρ_{ij} = correlation coefficient between asset i and j.

Ri, Rj = return on asset i and j.

Rei, Rej = expected return on asset i and j.

σ_i, σ_j = standard deviation of asset i and j.

A correlation coefficient of -1 indicates that the returns of two assets are perfectly negatively correlated. Theoretically, building a portfolio with assets whose returns are perfectly negatively correlated would reduce the portfolio risk to zero. However in practice, it is difficult to find assets which are perfectly negatively correlated.

A correlation coefficient of +1 indicates that assets are perfectly positively correlated. Forming a portfolio with such assets bear no diversification benefits (i.e., no risk reduction). However, assets that have a positive correlation of less than +1 will still provide risk reduction to a portfolio, although less than those with negative correlation. A pair of assets that are completely uncorrelated, correlation coefficient of 0, will also reduce portfolio risk.

Appendix 4

Model Estimation: Autoregressive De-Smoothing Model

The Geltner and Miller (2007) 1st and 4th order autoregressive model is applied for de-smoothing the JLL REIS-Asia Total Returns data set. The following are the descriptive statistics from Eviews 6 for the 13 geographical locations and sectors.

Descriptive Statistics for Desmoothed Total Returns Data

	BGO	BJO	BKO	HKO	JKO	KLO	MBO	MNO	SGO	SHO	SLO	TBO	TKO	HKI	SGI
Mean	0.177	0.104	0.115	0.134	0.131	0.073	0.278	0.057	0.068	0.104	0.261	0.033	0.181	0.131	0.09
Median	0.169	0.032	0.188	0.097	0.117	0.096	-0.31	0.038	0.068	0.103	0.248	0.018	0.195	0.138	0.10
Maximum	0.286	1.370	2.191	1.557	4.240	0.531	4.942	1.789	2.240	0.578	0.808	0.270	1.414	0.161	0.22
Minimum	0.065	-0.464	-1.69	-0.77	-1.482	-0.44	-4.46	-2.90	-1.34	-0.24	-0.05	-0.23	-0.83	0.074	0.01
Std. Dev.	0.062	0.306	0.671	0.382	0.730	0.198	2.336	0.751	0.626	0.180	0.214	0.124	0.573	0.033	0.05
Skewness	-0.09	2.230	-0.41	0.538	2.190	-0.30	0.346	-1.15	0.353	0.515	0.715	0.230	0.195	-0.82	0.84
Kurtosis	2.353	10.366	5.340	4.608	15.316	3.183	3.101	7.950	4.657	3.251	3.086	3.187	2.533	2.471	4.22
Jarque-Ber	0.323	101.95	11.83	11.39	519.69	0.563	0.347	47.27	8.250	1.594	2.220	0.185	0.339	0.751	2.36
Probability	0.851	0.000	0.003	0.003	0.000	0.755	0.841	0.000	0.016	0.451	0.329	0.912	0.844	0.687	0.30
Sum	3.012	3.417	5.282	9.800	9.579	2.490	4.732	2.158	4.159	3.522	6.783	0.601	3.980	0.785	1.16
Sum Sq.	0.061	3.006	20.26	10.50	38.376	1.296	87.30	20.86	23.53	1.074	1.145	0.260	6.892	0.005	0.03
Observatio	17	33	46	73	73	34	17	38	61	34	26	18	22	6	13