Commercial Property Index Construction Methodology: A Review on Literature and Practice

Aina Edayu Ahmad[1], Md Nasir Daud[2] & Zulkifli Esha[3]

[123]*Department of Estate Management, Faculty of Built Environment, University of Malaya, Kuala Lumpur, Malaysia*

[1]*ainaedayu@siswa.um.edu.my,* [2]*mdnasir@um.edu.my,* [3]*zules@um.edu.my*

This paper reviews the literature on commercial property index construction methodology. Alongside this, index construction methodology employed by various organizations in producing existing commercial property indices is also discussed. The aim of the review is to identify the best possible methodology option to adopt in developing Kuala Lumpur Office Price Index (KL - OPI). Among the Asean countries, Singapore is the only country in this region that produces retail and office price index. In the case of Malaysia, this is the first study of this nature in the country, which outcome would be useful indicator for the industry. Having reviewed the existing methodologies of commercial property indices, it is best to model KL-OPI by adopting the hedonic price method.

Keywords: *appraisal-based, commercial property, hedonic, Kuala Lumpur, transaction-based*

1. INTRODUCTION

Indices are regarded as important benchmarking and decision-making indicators in the financial and capital markets, and of equal importance, in the real estate market. This is elucidated by the inclusion of Real Estate Price Indicators in the IMF Financial Soundness Indicators Compilation Guide 2006.

In mature economies, the importance of property price index has led to the development of the internationally renowned NCREIF Property Index (NPI), the Moody's/RCA Commercial Property Index, MIT-CRE Transaction-Based Index, among others in the United States and those published by the Investment Property Databank (IPD) in the United Kingdom.

In Malaysia, the inception of property price index began with the Malaysian House Price Index (MHPI) in 1997. The initiative was undertaken by the Valuation and Property Services Department (VPSD), an arm under the Ministry of Finance Malaysia with the collaborative advice from the academics and practitioners. The property index development is spearheaded by the residential sub-sector, which was similar to the experience in the US and the UK.

In mid-2012, approximately 15 years after the launch of MHPI, the VPSD launches another property index known as the Purpose-Built Office Rental Index (PBO-RI). The PBO-RI materialises after several roundtable discussions involving academics, practitioners as well as experts from the banking sector. To date, the PBO-RI is also the only commercial property rental index available in the country.

In the attempt to develop a complementary index for the PBO-RI, this review is undertaken. By reviewing the various index construction methodologies in the literature and practice, it acts as a precursor to determine the feasibility of constructing Kuala Lumpur Office Price Index (KL-OPI) and eventually producing the index. The paper is organized as follows. The first section introduces an overview of Malaysia's property market landscape and specifically on Kuala Lumpur office market. The subsequent section provides a concise literature review on the index construction methodology followed by an insight into the methodologies adopted for constructing existing commercial property price indices. The final section provides justifications for the methodology chosen in the development of KL-OPI.

2. MALAYSIA PROPERTY MARKET LANDSCAPE

In Malaysia, a recent study (Knight Frank Research, 2014) reveals that property in the country remains attractive for local and foreign investors, who are confident in the country's long-term economic potential. On this note, it is clear that property plays a pivotal role in driving the overall economy.

Year 2011 recorded a total of 430,403 property transactions worth RM137.83 billion. The residential sub-sector spearheaded the total market activity, accounted for 62.7% of the total whilst commercial sub-sector held another 10.1% of the total volume (Figure 2.1). In terms of value, the commercial sub-sector remained dominant with RM27.64 billion, accounting for 20.0% of the total value (Figure 2.2).
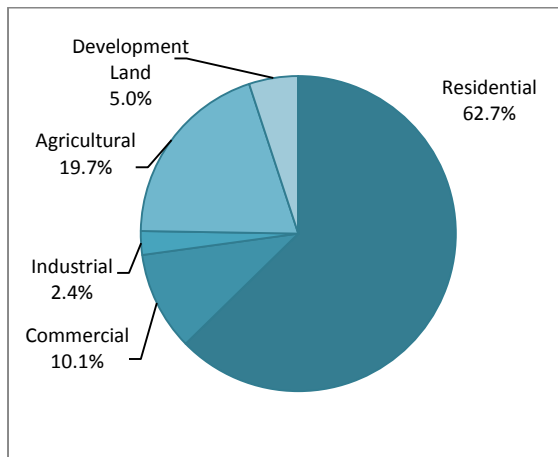

Figure 2.1- Breakdown of volume of transaction by Property Sector 2011
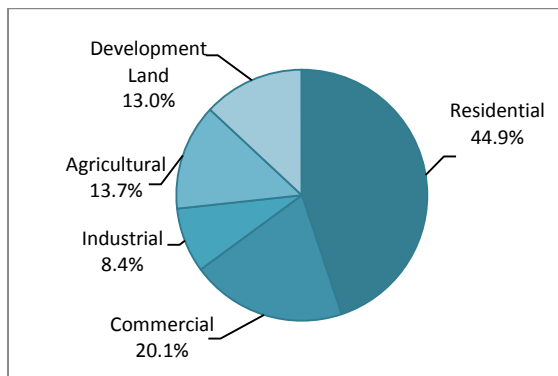(Source: NAPIC, 2011)

Figure 2.2- Breakdown of value of transaction by Property Sector 2011
(Source: NAPIC, 2011)

In the financial segment, broad property sector took up more than 46.8% of bank lending as at the end of December 2011. Therefore, constant and close monitoring of property price movements and its performance are important as nearly half of banking exposure was on property. All these point to the importance of having indicators that enables market players gauge the health of the property market.

3.   KUALA LUMPUR OFFICE MARKET

The prominence of Kuala Lumpur office market is becoming more evident as the country strides towards achieving a developed nation by the year 2020. In a report by PricewaterhouseCoopers (ETP, 2011), real estate forms the largest component in services sector for approved domestic and foreign investments, accounting for 26.0% of the total share.

In terms of office space, Kuala Lumpur is the major provider in the country, taking up almost 40.0% of the country's total existing office supply with 387 buildings offering 6.96 million square meters of space. Of these, private office buildings comprised 341 buildings with a total space of 3.49 million square meters. Therefore, it is pertinent to have commercial price indicators to enable benchmarking by investors and occupiers.

4.   METHODOLOGY OF REAL ESTATE INDEX CONSTRUCTION

The development of property price indices has always been extensively discussed in the housing literature. The length and breadth of the discussion often receive wider geographical coverage across the globe. The liquidity of the residential sector and the homogeneity of the residential property as compared to commercial property facilitate the process of index construction to a certain extent.

The complexity of the market and the heterogeneity of commercial property, among others, constitute the challenges in the development of commercial property indices. Another major impediment is the lack of robust and extensive transactions data, which are essential to developing a transaction-based price index.

Based on the literature reviewed, work on commercial property index construction is mostly confined in the US. The maturity of the US market has seen various studies on commercial indices construction tracing back to the 1960's. However, similar studies are limited in the Asean region, even more so in Malaysia.

There are two distinct methodologies discussed in previous studies which are the appraisal-based methodology and the transaction-based methodology. A summary of the main literature reviewed is produced in Table 1.

4.1 APPRAISAL-BASED METHODOLOGY

The traditional method of valuing commercial properties has been appraisal/valuation-based due

to the nature of the property and its infrequent sales (Fisher, 2003). The NCREIF Property Index (NPI) was the first commercial property index developed to measure the performance of income producing real estate in the late 1970's and has since been regarded as the primary index that institutional investors use to benchmark the performance of real estate (Fisher, 2003).

Although the appraisal-based index tends to show less volatility to market shocks, there are a number of technical difficulties in using the approach, namely the appraisal-smoothing (Geltner et al., 2003). Another drawback is the lag in reflecting the actual market conditions at that point of time as the data used in arriving at the appraised values are historical. Therefore, in a situation where market is booming, the index tends to be lower than the actual price and vice-versa.

Appraisal on its own entity reflects the subjectivity in the measurement of value. The issue of index smoothing can surface from the valuation updating process as examined by Lee et al. (2000). They identified that both the IPD and Jones Lang La Salle annual appraisal-based indices portray consistencies and autocorrelation for lags up to 13 months is statistically significant in both instances. This demonstrates that with appraisal-based approach, the indices generated are unable to depict real-time true market volatility.

In addition, Fisher (2003) agrees that the appraisal-based approach also has two errors namely the comparable sample error and the comparable lag error. Nevertheless, the NPI has been internationally accepted without much reservation.

For London commercial market, one of the important markets in the world, one would anticipate that the development of commercial property indices would be less challenging. However, limited availability of real-time transactions data ensues to the appraisal-based commercial index. This is due to the absence of robust aggregate transactions data (Chegut, et al., 2013) until the early 2000. Even with sufficient transactions data, it is argued that the appraisal may not be the best tool for identifying market volatility.

4.2 TRANSACTION-BASED METHODOLOGY

Another approach is the transaction-based model, which is applicable when sales transactions data on properties is sufficiently large. This model can be subdivided into repeat-sales model, hedonic pricing model and the hybrid model. Some scholars have devised rigorous methods with transaction evidence as input decades ago (Bailey et al., 1963; Rosen, 1974; Quigley, 1995). With this approach, the issues of smoothing and lagging do not arise. However, as property transactions particularly commercial buildings are usually infrequent and heterogeneous, the statistical control of quality variation could prove a challenge.

4.2.1 Repeat-Sales Technique

The repeat-sales model is an econometric technique developed by Bailey et al. (1963), where transaction prices of the same property are observed from two periods based on the assumption that the quality of the property stays constant over the period of time. Bailey et al. (1963) and Case and Shiller (1987) were the pioneers to employ the repeat-sales methodology in the residential sector. This model often applies to residential sector as transactions are many and frequent, unlike the commercial property.

Gatzlaff and Geltner (1998) conducted a cornerstone study on repeat-sales transaction-based commercial property index. They applied the technique to Florida commercial market and found that repeat-sales index recorded more price movements than the appraisal-based NCREIF index. In recent years, the employment of this methodology is more feasible in the commercial sector due to availability of extensive transactions database.

Ten years on, commercial property index is developed to indicate performance of tradable property derivatives. On this note, Fisher et al. (2007) have taken the initiative to develop derivatives to allow trading of commercial real estate future prices. The goal is to provide indices that are practical and useful in the derivatives market. Fisher et al. (2007) and Geltner and Bokhari (2010) accomplish a national index for the US and 15 sub-regions spanning from 2001 to the present.

A slightly different approach is undertaken by Baroni et al. (2011). In comparing the office values in Paris and its suburbs, Baroni et al. (2011) apply the Weighted Repeat Sales (WRS) and PCA factorial repeat-sales. The study reveals that WRS is sensitive to the number of transactions while PCA is less sensitive to the transactions volume. This is due to the inputs required in developing PCA, which include economic and financial factors. In the author's opinion, future study on PCA technique is feasible as each country has a

good volume on economic and financial indicators in store.

However, this model was not spared the criticisms as it assumes that property quality remains constant across time. This is not necessarily true as property quality tends to change with time as property ages, depreciates, or even appreciates as a result of renovation works. Further, repeat-sales model only takes into account properties that are repeatedly sold across time. This arguably led to the issue of "representativeness" and selectivity bias as only the active properties are taken into account, which could overstate the actual performance of the general property market.

Nevertheless, the repeat-sales methodology paves the way for alternative index construction to complement appraisal-based technique. This can be useful in providing checks and balances to the appraisal-based derived index.

4.2.2 Hedonic Technique

The hedonic pricing model, which has been developed for more than 70 years, uses transaction prices as a function of the characteristics of property such as age, location, land area, built-up area and conditions of building. As opposed to the former model discussed earlier, the hedonic model does not require repeat sales of the same property. However, the model requires the characteristics of the property to be captured extensively along with its spatial features (Haurin, 2003). Fisher et al. (2003) developed an extended version of the hedonic pricing model that incorporates controlling for selectivity bias and adjusting for liquidity variations over the property cycle.

Hedonic measures have a strong theoretical grounding (Griliches, 1971; Rosen, 1974) and use regression techniques to control for compositional and quality change. The key advantage of the general hedonic formulation is that it provides direct estimates of pure price change and can, in principle, control for changes in the composition and quality of properties sold.

In principle, the hedonic regression needs to adequately capture all of the attributes that affect property value so as to control the differences in the transacting properties' quality across time (Geltner & Pollakowski, 2007). The employment of this methodology is possible if high-quality catch-all hedonic variables of the properties transacted are readily available.

Hedonic method offers an alternative pricing mechanism that can enhance a metro-level index.

The discussions in earlier paragraphs have revolved around commercial property in general rather than specifically on office. In so far as office market is concerned, several studies attempt to model office price/rent by applying hedonic technique. Colwell et al. (1998) employ this technique to evaluate the price trend for Chicago's office market. Their study comes to a conclusion that challenges the prevailing view of the market. Whilst the market believes that office values fell from 1987 to 1993, the study reveals that values trend upwards post-1986 and only declines in the latter time study.

Munneke and Slade (2001) give a little flavour to the hedonic technique. Whilst earlier authors seek evidence on office price trend, Munneke and Slade venture to compare three time-varying parameter techniques, namely the chained hedonic, Laspeyres hedonic and Paasche hedonic. Essentially, these techniques allow the parameters to vary over time and include time-dummy variable in the model so as to capture the pure price change. They found the chained technique as the most reliable for constructing price index, as indicated by the signal-to-noise ratio.

Dunse and Jones (1998) applied hedonic analysis to Glasgow office market. In contrast to those stated earlier, the aim of the study is to identify the determinants of office rents. The pioneer study in the UK is of significance as it identifies the determinants, which would be input predictors to the hedonic model. In their study, age and location emerged as significant determinants of rents. Although the study is focused on office rent predictors, the findings could be adapted for the office price index development.

Similar study is also undertaken in Paris office market and its suburbs (Nappi-Choulet et al., 2007). The first office price index initiative in Paris reveals the spatial attributes and inter-temporal effects on the index. In addition, the authors propose to adopt Log price as the dependent instead of Log price per square meter arguing that the latter could lower the predictive power of the model (Adjusted R-Square) by half due to the "spreading" of the area. This finding is worth considering in developing office price index for Kuala Lumpur during the subsequent stage of the research.

Nevertheless, the hedonic method is not without its limitations. The use of regression

techniques inherently implies that hedonic models are only as good as the specifications used to derive them. This often depends on the quality of the data available. In a situation where hedonic regressions omit variables that have a significant impact on the property prices, this can result in biased estimates of pure price changes.

4.2.3   Hybrid Technique

The third model is the hybrid technique that combines and modifies attributes of repeat-sales and hedonic pricing models, which was developed by Quigley (1995). The model essentially involves "stacking" repeat-sales and hedonic models, whilst imposing a constraint that the estimated price change is equal in both models. Even so, Quigley (1995) did not see any clear efficiency gains from using the hybrid model in place of hedonic approach

Table 1 – Summary of Literature Review

Author	Quigley, J. M.	Colwell, P. F., Munneke, H. J., &Trefzger, J. W.	Gatzlaff, D., & Geltner, D.	Dunse, N., & Jones, C.	Munneke, H. J., & Slade, B. A.
Year	1995	1998	1998	1998	2001
Area of study	Los Angeles	Chicago	Florida	Glasgow	Phoenix
Study period	January 1980 to December 1991	July 1986 to June 1993	1975 to 1997	1994 and 1995	January 1988 to September 1996
Data analysed	Condominium sales	Office sales	Commercial property sales	Office rent values	Office transactions
Technique (s) employed	Repeat-sales and hedonic	Hedonic analysis	Repeat-sales regression	Hedonic analysis	Hedonic analysis: - Chained - Laspeyres - Paasche
Discussions/ Findings	- Model incorporates explicit error structure and relies on robust linear techniques	- Shows an uptrend in office property values after 1986 followed by nominal declines in the latter time study period. - The findings differ from the prevailing view that office values fell from 1987 to 1993.	- First initiative to develop repeat-sales transaction-based index of commercial property in the US. - Results show that repeat-sales filter transaction noise and work well at aggregate level. - At micro level i.e. property type, opt for Goetzmann Bayesian/ MOM estimator.	- The first major study in the UK. - Study reveals that age and location are important determinants of rents.	- Assess the reliability of the index by using signal-to-noise ratio. - Concludes that chained technique appeared more superior to the other two.

Table 1 – Summary of Literature Review (continuation)

Author	Fisher, J.D., Gatzlaff, D., Geltner, D., & Haurin, D.	Fisher, J.D., Geltner, D., & Pollakowski, H.	Nappi-Choulet, I., Maleyre, I., & Maury, T	Gektner, D., & Bokhari, S.	Baroni, M., Barthelemy, F., & Mokrane, M.	Cheguta, A.M., Eichholtz, P.M.A., & Rodrigues, P.J.M.
Year	2003	2007	2007	2010	2011	2013
Area of study	US	US	Central Paris and its immediate suburbs	San Francisco Bay metro area	Paris and suburbs	London
Study period	1982 to 2001	1982 to 2005	1991 to 2005	2000 to 2009	1981 to 2005	1996 to 2011
Data analysed	All properties sold within NCREIF	All properties sold within NCREIF	Office transactions	Moody's/ REAL CPPI annual indices	Office transactions	Commercial property transactions
Technique (s) employed	Selection-corrected and constant-liquidity transaction-based (also known as the 'FGGH' model	Enhancement of the 'FGGH' model: selection-corrected hedonic price model	Hedonic analysis	Repeat-sales	Weighted Repeat-sales and PCA factorial repeat-sales	Repeat-sales
Discussions / Findings	- Developed transaction-based indices of the NCREIF property portfolio. - Transaction-based shows greater volatility and cycle amplitude than appraisal-based NCREIF index.	- Explores a new institutional investment real estate index. - Incorporates the demand-side (constant liquidity) and supply-side	- The first transaction-based hedonic price index for Paris office market. - Highlights the spatial and temporal effects of price formations	- Result indicates that higher-frequency indices have lower signal-to-noise ratio compared to low-frequency indices. - Nevertheless, the former provides higher frequency information which may be useful to the market players	- Concludes that Weighted Repeat-Sales lacks robustness when transactions are small in numbers. - Proposes Factorial methodology as less sensitive to the number of observation and trend and volatility are stable.	- The commercial London market is sufficiently liquid across all time periods to enable development of index. - In comparison to IPD's indices, the index has higher volatility and lower autocorrelation

5. APPLICATION OF APPRAISAL-BASED AND TRANSACTION-BASED METHODOLOGY BY INDUSTRY

Having reviewed the methodology as discussed in academic research in the last section, the focus of current section is to discuss the different methodologies employed by renowned property indices producers in the US as listed in Table 2. Commercial property indices in the US are chosen as these are the pioneer and leading property indices in the world. However, it should be noted the list is not exhaustive and the author has listed those to best understand the application of different methodologies.

Based on the review of the existing commercial property indices in Table 2, the development of these indices is seen to focus on properties that are within the holding of the participating institutional investors. A case in example is the NCREIF Property Index (NPI), which saw its inception in 1977.

NPI is a classic example that applies both methodologies. In the early years of its establishment, NPI employs appraisal-based methodology to arrive at the indices. This suits the needs of the participating members of NCREIF well. As at the second quarter of 2012, NCREIF's property database grew to 7,099 properties with a gross fair market value of over USD$336 billion. With growing number of commercial properties and as its property transactions database becomes more established, the NCREIF adopts transaction-based methodology, to complement the appraisal-based index.

In 2006, NCREIF collaborated with MIT Center of Real Estate (MIT-CRE) to develop transaction-based index, using "hedonic" technique. The term is called "hedonic" as the transaction prices of the NCREIF sold properties is regressed to arrive at the index. The collaboration, to the author's opinion, is a commendable initiative that synergises the expertise of the academics and the needs of the industry. Starting from Q2 2011, after five years of collaboration, NCREIF continues to produce the index on its own, known as the NCREIF Transaction-Based Index (NTBI). From this, it is evident that there is no right or wrong method to arrive at the index as both can complement one another.

In the case of Real Capital Analytics (RCA) indices, the data coverage is not limited to properties within the holding of participating institutional members. As NCREIF pioneered the appraisal-based index, RCA pioneered the transaction-based repeat-sales index. RCA has been collecting commercial property transactions in the US since 2000 and expanded its coverage to global markets from 2007. To date, there are more than USD$8 trillion worth of properties in RCA's database. Given the availability of extensive commercial property database, it is feasible to employ the repeat-sales technique for constructing the index.

On similar note, CoStar Commercial Repeat-Sales Index, as the name suggests, also employs repeat-sales technique. As opposed to the RCA database, CoStar transactions data coverage includes investment grade commercial buildings and general commercial properties. To date, CoStar database has more than USD$3.9 trillion worth commercial property transactions, making it feasible to employ repeat-sales technique.

6. CONCLUSION ON INDEX CONSTRUCTION METHODOLOGY

In Malaysia, three organisations have been involved in the initiatives to construct property index: the Valuation and Property Services Department (VPSD) - an arm under the Ministry of Finance, Malaysia - Malaysia Institute of Economic Research (MIER) and Bursa Malaysia (Malaysia's exchange holding company). Of the three, the Malaysian House Price Index (MHPI) published by VPSD is the only property price index that is directly related to physical property. The Residential Property Index published by MIER is based on perception survey conducted on housing developers while the Property Index Series of Bursa Malaysia reflects the performance of property companies.

In order to place Malaysian property market on par with market in advanced countries, it is essential that Malaysia creates more property indicators to further enhance the level of information on commercial property market in Malaysia (Ting, 2002), such as commercial property price index. This is evident with the participation of Malaysia representatives from the Central Bank of Malaysia and VPSD officials in the ECB Eurostat Conference on Commercial Property Price Statistics in 2012. The aim of the conference is to provide framework and good practices in the development of statistical measurement standards such as commercial property price indicators.

Table 2 – Existing Commercial Property Price Index in the US and the UK

Property Index	NCREIF (National Council of Real Estate Investment Fiduciaries) Property Index Returns (NPI)	MIT-CRE TBI * a collaboration between MIT-CRE and NCREIF to produce Transaction-based index based on NCREIF properties.	NCREIF TBI (NTBI)
Inception Year	1977	2006 * From Q2 2011, index is produced by NCREIF and known as NTBI	2011 *as at Q2 2011, TBI is produced & published by NCREIF and known as NTBI
Property Sector	Institutional grade real estate: Office Retail Apartment Industrial Hotel	Institutional grade real estate: Office Retail Apartment Industrial Hotel	Properties in the NPI & sold in the review quarter include: Office Retail Apartment Industrial
Geographical Coverage	Region, Division, State, CBSA, and Zip Code.	Region, Division, State, CBSA, and Zip Code.	Region, Division, State, CBSA, and Zip Code.
Index Calculation Basis/Methodology	**Appraisal-based**: Time Series composite total rate of return. Return of each individual property every quarter [Change in value + cash flow (net operating income – capital expenditure)] &**value weighted** to produce index. Value weighted = NPI as a population or portfolio of all properties held by members	**Transaction-based**: Based on a statistical regression model of the transaction prices of the NCREIF sold properties. Termed as "Hedonic" regression model. Based on a "representative property" that mirrors the average characteristics of the NCREIF properties. Statistical methodology that produces estimates of price movements and total returns based on transactions of properties sold from the NCREIF Index database.	**Transaction-based**: Simplified methodology. Average ratio of current sale price divided by a two quarter lagged appraisal (from the NPI database) among all the sold properties each quarter. That ratio is multiplied the NPI cumulative capital appreciation index level, to convert the result into a transaction price index. An **equal-weighted** transaction and appraisal index. Equal weighted = Properties in the NPI as a sample from a broader population of commercial real estate.

Table 2 – Existing Commercial Property Price Index in the US and the UK (continuation)

Property Index	RCA US CPPI * uses Moody's/RCA CPPI as the benchmark index	Moody's/RCA CPPI * Collaboration between RCA (provide transactions data) and Moody's (calculate the indices) * Subset of RCA CPPI	CoStar Commercial Repeat-Sale Indices (CCRSI)	RCA/PD UK CPPI
Inception Year	December 2012	May 2012	August 2010	July 2013
Property Sector	Office, Industrial, Retail, Apartment, and Hotel Commercial (combined office, industrial, and retail) All Property Types (combined office, retail, industrial, and apartment)	Office (CBD and Suburban), Industrial, Retail, Apartment, Commercial (combined Office, Retail and Industrial), and Hotel	Class A and B commercial properties often purchased by institutional investors and General Commercial	Office, Retail and Commercial (combined office, industrial, and retail)
Geographical Coverage	20 states and 34 metros/ markets in the US	National, Major Markets (aggregate of Boston, Chicago, LA, SF, NY, Wash. DC) and Non-Major Markets (aggregate of everything outside major markets)	Regions of the country: Northeast South Midwest West	3 National indices; Central London vs UK ex- London
Index Calculation Basis/Methodology	**Transaction-based**: Employed Repeat-sales regression methodology. Data captured by RCA (Real Capital Analytics, Inc) priced more than USD2,500,000.	**Transaction-based**: Employed Repeat-sales regression methodology. Data captured by RCA (Real Capital Analytics, Inc) priced more than USD2,500,000.	**Transaction-based**: Employed Repeat-sales regression methodology.	**Transaction-based**: Employed Repeat-sales regression methodology. Data captured by RCA (Real Capital Analytics, Inc) and its UK data partner Property Data Ltd (PD) worth £7.5 million.

In the pursuance of KL-OPI development, Malaysia's state of readiness is assisted by the fact that it has its own property data repository, under the custodian of National Property Information Centre (NAPIC), as arm under the VPSD. To date, NAPIC has the most extensive and comprehensive property data in the country, which includes inventory and transaction.

Given the availability of property data transactions and the capturing of property and neighbourhood features, both appraisal-based and transaction-based approaches seem feasible in developing KL-OPI. In the case of indices produced by NCREIF, the quarterly and annually appraisal of the commercial properties are conducted by the participating institutional investors, which appraisals

are then channelled to NCREIF. The periodical appraisal arrangements enable NCREIF to pursue appraisal-based approach in developing its commercial property indices.

The adaptation of this approach may prove to be an uphill battle in Malaysia. The state of maturity in relation to transparency and the openness of the property industry in Malaysia i.e. building owners in supplying the valuations of the properties could impede the pursuance of appraisal-based approach. On the other hand, should the appraisals of these commercial properties are undertaken by VPSD, the exercise may require a longer time period to complete due to the nature and complexity of the appraisal itself as well as the issue of manpower limitation. Eventually, the effort of producing the property index is wasted as the indices may come too late in the market for its intention use.

On a brighter note, the transaction-based approach appears more promising. This approach is also in line with the recent academic studies undertaken by Fisher et al. (2007) and Nappi-Choulet et al. (2007) which employed hedonic methodology in producing the indices. The review on literature strikes quite a balance between repeat-sales and hedonic technique. However, most of the existing indices are slanted towards repeat-sales.

In relation to Malaysia, although NAPIC has comprehensive property transactions, the number of repeat-sales of similar property recorded in the database is small. The issue on lack of repeat-sales property transactions makes the employment of the repeat-sales technique seems far from feasible. Even if repeat-sales technique is attempted, the index generated could be biased towards the price trend of repeat-sales selected. This would in turn either overstate or understate the price index generated.

The best possible option to consider for KL-OPI would then be the hedonic technique. Since the property and location attributes as well as sales data are readily available from NAPIC's database, is the hedonic technique appears as the most appropriate and most promising methodology to employ for the development of KL-OPI. The familiarity and acceptance of the hedonic technique amongst Malaysia's property industry players is another contributory factor. This is because MHPI and KL-OPI applies this technique. In addition, the hedonic is relatively straightforward to apply, is based on actual market prices and fairly easily measured data.

7. REFERENCES

Bailey, M.J., Muth, R.F., & Nourse, H.O. (1963). A regression method for real estate price index construction. *Journal of the American Statistical Association, 58*, 933-942.

Baroni, M., Barthelemy, F., & Mokrane, M. (2011). A repeat-sales index robust to small datasets. *Journal of Property Investment and Finance*, 29(1).

Case, K.E., & Shiller, R.J. (1987). Prices of single-family homes since 1970: New indexes for four cities. *New England Economic Review,* Sept./Oct. 45-56.

Colwell, P.F., Munneke, H.J., & Trefzger, J.W. (1998). Chicago's office market: Price indices, location and time. *Real Estate Economics, 26*, 83-106.

Chegut, A.M., Eichholtz, P.M.A., & Rodrigues, P.J.M. (2013). The London commercial property price index. *The Journal of Real Estate Finance and Economics, 47*(4), 588-616.

Dunse, N., & Jones, C. (1998). A hedonic price model of office rents. *Journal of Property Valuation & Investment, 16*(3), 297-312.

ETP. (2011). *InvestKL.* Retrieved from, http://etp.pemandu.gov.my/8_September_2011-@-InvestKL.aspx

Fisher, J.D. (2003). *US commercial real estate indices: The NCREIF property index*. BIS Paper No. 21, 359-367. Retrieved from, http://www.bis.org/publ/bppdf/bispap21.pdf.

Fisher, J.D., Gatzlaff, D., Geltner, D., & Haurin, D. (2003). Controlling for the impact of variable liquidity in commercial real estate price indices. *Real Estate Economics*, *31*(2), 269-303.

Fisher, J.D., Geltner, D., & Pollakowski, H. (2007). A quarterly transactions-based index (TBI) of institutional real estate investment performance and movements in supply and demand. *Journal Real Estate Finance and Economics, 34*, 5–33.

Gatzlaff, D., & Geltner, D. (1998). *A repeat-sales transactions-based index of commercial property*. Social Science Research Network. Retrieved from, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=75075

Geltner, D., & Bokhari, S. (2010). Estimating real estate price movements for high frequency tradable indexes in a scarce data environment. *Journal Real Estate Finance and Economics, 45*(2), 522-543.

Geltner, D., MacGregor, B., & Schwann, G. (2003). Appraisal smoothing & price discovery in real estate markets. *Urban Studies, 40*(5-6), 1047-1064.

Geltner, D., & Pollakowski, H. (2007). A set of indexes for trading commercial real estate based on the real capital analytics transaction prices database. Retrieved from, https://mitcre.mit.edu/wp-content/uploads/2012/11/MIT-wp-r2.pdf

Griliches, Z. (1971). Hedonic price indexes of automobiles: An econometric analysis of quality change. In ZviGriliches (ed.), *Price Indexes and Quality Change.* Cambridge: Cambridge University Press.

Haurin, D.R. (2003). *US Commercial Real Estate Indices: Transaction-based and constant-liquidity indices.* BIS Paper No. 21, 232-242. Retrieved from, http://www.bis.org/publ/bppdf/bispap21.pdf

International Monetary Fund (2006). *Financial soundness indicators compilation guide March 2006.* Retrieved from, http://www.imf.org/external/pubs/ft/fsi/guide/2006/index.html

Knight Frank Research. (2014). *Knight Frank Wealth Report 2014.* Retrieved from, http://www.thewealthreport.net/resources/thewealthreport2014.pdf

Lee, S., Lizieri, C., & Ward, C. (2000). *The time series performance of UK real estate indices.* RERI Report 31, 140–387.

Munneke, H.J., & Slade, B.A. (2001). A metropolitan transaction-based commercial price index: A time-varying parameter approach. *Real Estate Economics, 29*, 55-84.

NAPIC. (2011). *Property market report 2011.* Valuation and Property Services Department, Ministry of Finance: Malaysia.

Nappi-Choulet, I., Maleyre, I., & Maury, T. (2007). A hedonic model of office prices in Paris and its immediate suburbs. *Journal of Property Research, 24*(3), 241-263.

Quigley, J.M. (1995). A simple hybrid model for estimating real estate price indexes. *Journal of Housing Economics, 4,* 1-12.

Rosen, S. (1974). Hedonic prices and implicit markets: Product differentiation in pure competition. *The Journal of Political Economy, 82*(1), 34-55.

Ting, K.H. (2002). *Kuala Lumpur class- A office rent index* (Final Research Report). The Research and Consultancy Bureau, University of Technology MARA: Malaysia.

Ahmad, A.E., Daud, M.N. & Esha, Z.