EXAMINING A MODEL FOR KUALA LUMPUR OFFICE PRICE INDEX (KL-OPI)

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ABSTRACT

Commercial property index is important and has featured as one of the critical elements in the IMF Financial Soundness Indicators. Despite its importance, a commercial property price indicator has remained practically non-existent in Malaysia. Towards addressing this gap, we engineered a study to investigate the construction of a workable office performance index for Kuala Lumpur. This study has capitalized on the transactions database available in the National Property Information Centre (NAPIC). To this end, this study utilizes a database of 3,247 transactions of office lots in purpose-built office buildings in Kuala Lumpur from year 2006 to 2011 to evaluate the feasibility of developing Kuala Lumpur Office Price Index (KL-OPI). We employed transactions-based methodology, specifically the Hedonic technique on the basis of attributes availability. In addition, the familiarity of the market with Hedonic technique, as employed in Malaysian House Price Index (MHPI) and Purpose-Built Office Rental Index (PBO-RI) emphasized further the practicality of employing the technique for KL-OPI. In addition, we decide to employ three Hedonic Price Models, as adapted from earlier works of similar nature, namely the Conventional Hedonic Price Model, Laspeyres Time-Varying Hedonic Price Model and Chained Time-Varying Hedonic Price Model in arriving at KL-OPI price model. We went further to evaluate the level of precision of each of these models using the signal-to-noise ratio. Our study shows that it is feasible to develop KL-OPI. In terms of the model, the Conventional Hedonic Price Model produced the best precision performance and thus is deemed as the most appropriate model to employ for KL-OPI.

Keywords: Chained, Conventional, Hedonic, Kuala Lumpur, Laspeyres, Signal-to-Noise Ratio

INTRODUCTION

The importance of property market to the overall economy is reiterated by the International Monetary Fund (IMF) with the inclusion of property indicators in the Financial Soundness Indicators Compilation Guide 2006. The Residential Real Estate Prices, Commercial Real Estate Prices, Residential Real Estate Loans to Total Loans and Commercial Real Estate Loans to Total Loans are the four real estate indicators incorporated in the guide, alongside other macroeconomic and financial indicators.

In the context of Malaysia, real estate plays a pivotal role in driving the overall economy. A total of 430,403 property transactions were recorded worth RM137.83 billion in 2011; comprising 62.7% residential property transactions and 10.1% commercial property transactions. In the banking sector, broad property sector took up more than 46.8% of the total loans as at end-December 2011. Due to the significant share of property sector on banking exposure, constant and close monitoring of real estate price performance is seen as crucial.

Development of property price indicators in the country has paved its way since 1997, with the inception of Malaysian House Price Index (MHPI), the first real estate index developed in the country. After more than a decade since its inception, MHPI is regarded as one of the important macroeconomic indicators by the Central Bank of Malaysia and the Ministry of Finance Malaysia. Fifteen years on, the National Property Information Centre (NAPIC) developed the Purpose-Built Office Rental Index (PBO-RI) for Kuala Lumpur office market in 2012. Both MHPI and PBO-RI materialise after several roundtable discussions involving academics, practitioners as well as experts from the banking sector.

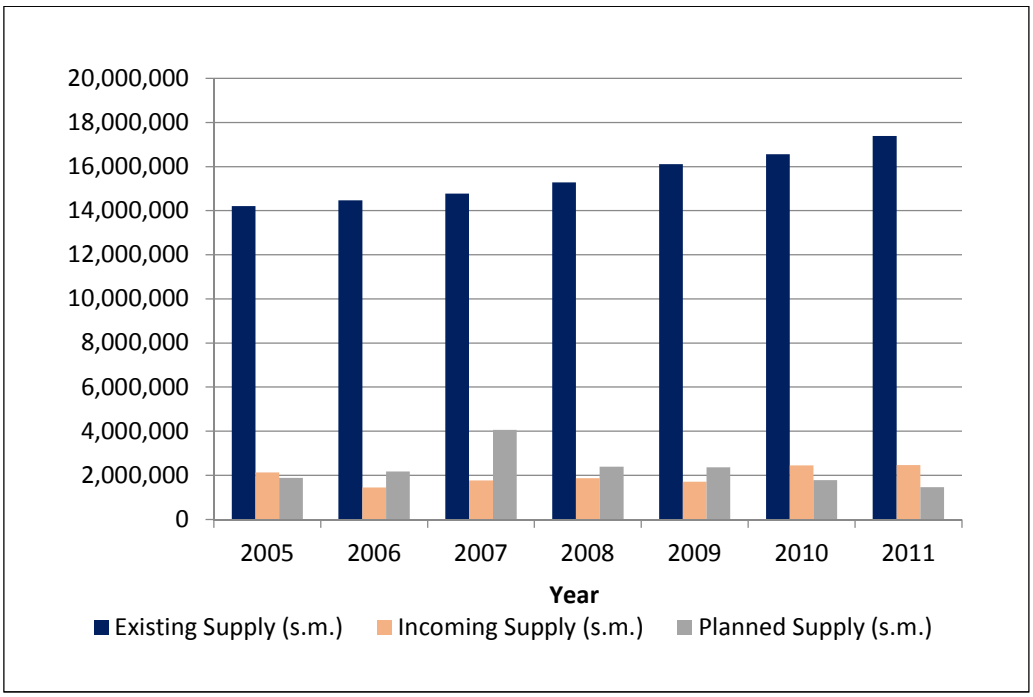
The Malaysia Institute of Economic Research (MIER) and Bursa Malaysia (Malaysia's exchange holding company) have also taken the initiatives to develop property index. The MIER's Residential Property Index is based on perception survey conducted on housing developers while Bursa Malaysia's Property Index Series reflects the performance of property companies. Presently, the MHPI and the PBO-RI are the only two indices related directly to property.

This study is of significance in examining the feasibility of developing a new and pioneer office price index known as Kuala Lumpur Office Price Index (KL-OPI) and examining the model for the index.

KUALA LUMPUR OFFICE MARKET

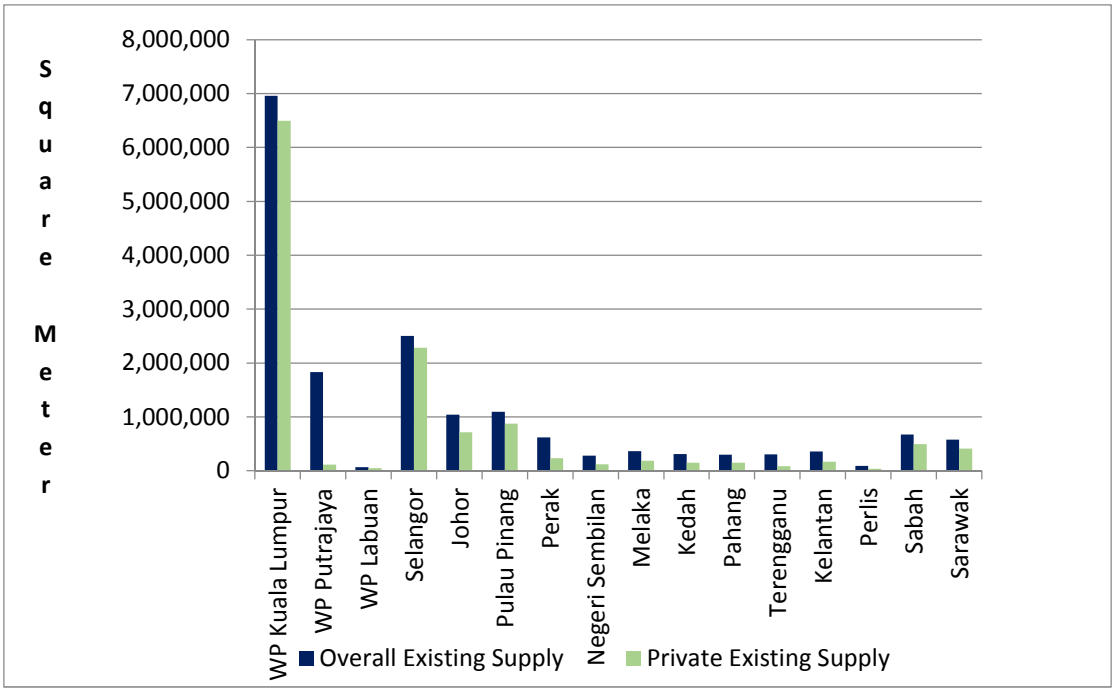
The office property market has experienced rapid growth since the turn of the millennium. In year 2000, there were 1,789 office buildings as compared to 2,282 buildings in 2011. Supply of space in Malaysia grew from 12.07 million square metres in year 2000 to 17.38 million square metres in 2011 as shown in Figure 1, which recorded an increase of 44.0% over the 11-year period.

Figure 1: Supply of Office Space in Malaysia



As Kuala Lumpur, the capital city of Malaysia and the main choice of international real estate investors (Boon, 2003), it is deemed as the most appropriate location to focus the study on. As the major provider of office space in the country, Kuala Lumpur takes up almost 40.0% of the country's total existing office supply with 387 buildings offering 6.96 million square meters of space as presented in Figure 2. Of these, private office buildings comprised 341 buildings with a total space of 3.49 million square meters. In view of Kuala Lumpur transforming into a top-20 city in terms of economic growth by the year 2020 and to be at par with capital cities in advanced economies, it is imperative that more property indicators are developed to further enhance the level of information on commercial property market in Malaysia (Ting, 2002).

Figure 2: Existing Supply of Office Space by State



DEVELOPMENT OF COMMERCIAL PROPERTY PRICE INDEX

In the US, the NCREIF Property Index (NPI) was the pioneer commercial property index developed to measure the performance of income producing real estate, first incepted in 1978. NPI has been recognised as the primary index that institutional investors use to benchmark the performance of real estate (Fisher, 2003). Notwithstanding this, the appraisal-based index tends to be less volatile to market movements and the application of appraisal-based approach comes with a number of technical difficulties in using the approach, namely the appraisal-smoothing (Geltner, MacGregor and Schwann, 2003).

The reliance of the appraisal-based approach on historical data leads to its disadvantage. As appraisal is historical in nature, it tends to suffer from the lag in reflecting the actual market conditions at a particular time period. Fisher (2003) also identifies that the appraisal-based approach has two errors namely the comparable sample error and the comparable lag error. In London commercial property market, the absence of robust aggregate transaction data leads to the employment of appraisal-based (Chegut et. al 2013).

Another methodology is the transaction-based approach, which can be subdivided into repeat-sales model, hedonic pricing model and the hybrid model. This methodology is feasible when property transactions data are sufficiently large and comprehensive. Vigorous methods have been devised with transaction evidence as input decades ago by several scholars (Bailey, Muth and Nouse, 1963; Rosen, 1974; Quigley, 1995).

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. In recent years, the employment of this methodology is more feasible in the commercial sector due to availability of extensive transactions database.

Gatzlaff and Geltner (1998) conducted a study on Florida commercial market and found that repeat-sales index recorded more price movements than the appraisal-based NPI. Similar to appraisal-based, the repeat-sales technique also has its drawbacks. The assumption of quality of a property remains constant across time may not necessarily hold. The quality of property tends to change over time due to age, depreciation and also appreciation resulting from renovation works. Another case in point is that the 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.

Another transaction-based approach is the hedonic technique. Transaction prices are used as a function of characteristics of the property such as age, location, land area, built-up area, condition of building, etc. Although the hedonic model does not require repeat sales of the same property, the model requires the characteristics of the property to be captured extensively along with its spatial features (Haurin, 2003). Fisher, Geltner, Gatzlaff and Haurin (2003) developed an extension version of the hedonic pricing model that incorporates controlling for selectivity bias and adjusting for liquidity variations over the property cycle.

In principle, the technique can be feasibly employed if all of the attributes that affect property value are capture so as to control the differences in the transacting properties' quality across time (Geltner and Pollakowski, 2007). The employment of this methodology is possible if high-quality catch-all hedonic variables of the properties transacted are readily available. Hedonic technique offers an alternative pricing mechanism that can enhance index generated at a metro-level.

Several studies on the application of hedonic technique to model the price or rent of office property are reviewed. Colwell, Munneke and Trefzger (1998) apply the hedonic technique to evaluate the office price trend in Chicago between 1987 and 1993. Their study reveals that prices trended upwards after 1986 and declines in the latter time period, which differs from the prevailing view of the market.

Munneke and Slade (2001) applies variation to the hedonic technique in their study by using three time-varying parameter techniques namely the chained hedonic, Laspeyres hedonic and Paasche hedonic. The aim of their study is to evaluate the most reliable hedonic technique to model the office market.

A more recent study by Nappi-Choulet, Maleyre and Maury (2007), a pioneer on Paris office market reveals the spatial attributes and intertemporal effects on the price index. This study also examines the functional form of the dependent variable (Price) and the implication on the explanatory power of the model. Their study recommends that dependent variable takes the functional form of Log Price over the Log Price per square meter as the former demonstrates higher explanatory power. It is as they suggest the relative price index change that is of essence and not the change in actual price.

Nevertheless, the hedonic method is not without limitations. The use of regression techniques implies that hedonic models are only as good as the specifications used to derive them, which often depend on the quality of the data available. If hedonic regressions omit variables that have a significant impact on property prices, this can result in biased estimates of pure price changes.

The third transaction-based approach is the hybrid technique, which basically combines and modifies attributes of repeat-sales and hedonic pricing models. The irony is that though Quigley (1995) develops the hybrid model, he does not see any clear efficiency gains in using the hybrid model over the hedonic technique.

In summary, both the appraisal-based and transaction-based methodology have their own strengths and weaknesses. For this study, given the availability of extensive and comprehensive data in NAPIC's database, hedonic pricing model is seen as the most appropriate methodology to employ for the office price index development. This is because it is relatively straightforward to apply, is based on actual market prices and fairly easily measured data. Data on sales and characteristics are readily available and data preparation can be carried out within realistic time frame. Furthermore, the familiarity of the industry players towards hedonic as applied in MHPI and PBO-RI makes it more plausible to adopt for this study.

FINDINGS

Data Profiling

This study utilises 3,247 transactions of office lots in purpose-built office buildings in Kuala Lumpur from year 2006 to 2011. The data are sourced from NAPIC's database, which is by far the most comprehensive and extensive database in the country. Table 1 shows the list of variables available in the transactions data and their descriptions.

Table 1: Description of the Variables

Variable		Description of Variable	Level of Measurement
Physical	Name of Building	The name of the office building	-
	Land Area	The size of land area where the office building resides	Ratio - measured in square meter
	Floor Area	The size of the floor space	Ratio - measured in square meter
	Building Completion Date	The date of Certificate of Fitness issuance on the building	Ratio - measured in day/month/year
	Floor Level	The floor level where the office unit resides	Ratio - measured in number
	Condition of Building	The state of building condition rating	Ordinal - rating scale of i. New ii. Very Good iii. Good iv. Moderate v. Poor
	Land Tenure	The tenure of land	Categorical - 'Freehold' or 'Leasehold'
Location	Address	The address of the office unit of office block	-
	Distance from town	Distance of the office building from Kuala Lumpur city centre. City centre is taken as the point where Petronas Twin Tower resides.	Ratio - measured in kilometer

	Classification of Area	Segmentation of Kuala Lumpur into four regions	Categorical - i. Kuala Lumpur City Centre-Golden Triangle (KLCC-GT) ii. Central Business District (CBD) iii. Within City Centre (WCC) iv. Suburban (SUB)
Sale	Date of Transaction	Date of Sale and Purchase Agreement	Ratio - measured in day/month/year
	Consideration	The price stated in the agreement for the purchase of the office unit or office block	Ratio - measured in Ringgit Malaysia
	Reported Value	The value of the office unit or office block reported to IRB, which may be similar to the 'Consideration'. In a case where valuation of the property by VPSD is higher by 10 percent than the 'Consideration', value reported to IRB is based on valuation.	Ratio - measured in Ringgit Malaysia
	Status of Transferor	Status of citizenship of the transferor (seller)	Categorical - i. Local ii. Foreigner iii. Local Company iv. Foreign Company
	Status of Transferee	Status of citizenship of the transferee (purchase)	Categorical - i. Local ii. Foreigner iii. Local Company iv. Foreign Company
	Share Transfer	Share portion of transfer	Ratio - measured in ratio

Table 2 shows that the building sampled are relatively new with an average age of 13 years old (median = 13.0; mean = 13.06 years). As for the proximity to the Kuala Lumpur city centre, the mean 'Distance from town centre' indicates that the buildings are within reasonable distance from the focus point of Kuala Lumpur. The location variable, which segments the Kuala Lumpur office market into four sub-markets, reveals that most of the transactions focus on Suburban market. As shown in Table 6, more than 57.2% of these transactions are held by the Suburban market. The upkeep and maintenance of these properties are generally good as indicated by the 89.9% representation of the 'Condition of Building' variable. In terms of 'Tenure', more than 85.6% of these properties are 'Freehold', indicating buyers' inclination towards freehold units.

Table 2: Descriptive Statistics of Office Lot Transactions

Variables	Minimum	Maximum	Standard Deviation	Median	Mean
Transaction Price (Ringgit Malaysia)	30,000.00	5,500,000.00	541,685.50	406,620.00	576,530.84
Floor Area (square meter)	8.00	932.00	89.60	114.00	128.55
Floor Level	0.00	58.00	5.63	5.00	6.67
Age of building (Years)	1.00	38.00	8.43	13.00	13.06
Distance from town (kilometer)	0.20	15.00	2.90	4.00	4.32

Table 3: Frequency of Dichotomous Variables of Office Lot Transactions

Variables	2006 - 2011	2006	2007	2008	2009	2010	2011
Number of Transactions	3,247	433	514	526	692	672	410
Percentage (%)	100.0	13.3	15.8	16.2	21.3	20.7	12.6
Tenure							
Freehold	2,780	377	441	463	551	564	384
Percentage (%)	100.0	13.6	15.9	16.7	19.8	20.3	13.8
Leasehold	467	56	73	63	141	108	26
Percentage (%)	100.0	12.0	15.6	13.5	30.2	23.1	5.6
Condition of building							
Good	2,920	379	456	472	617	634	362
Percentage (%)	100.0	13.0	15.6	16.2	21.1	21.7	12.4
Moderate	327	54	58	54	75	38	48
Percentage (%)	100.0	16.5	17.7	16.5	22.9	11.6	14.7
Sub-market							
KLCC-GT	706	112	159	133	159	93	50
Percentage (%)	100.0	15.9	22.5	18.8	22.5	13.2	7.1

CBD	81	8	8	8	16	8	33
Percentage (%)	100.0	9.9	9.9	9.9	19.8	9.9	40.7
WCC	602	77	101	96	172	120	36
Percentage (%)	100.0	12.8	16.8	15.9	28.6	19.9	6.0
SUBURBAN	1,858	236	246	289	345	451	291
Percentage (%)	100.0	12.7	13.2	15.6	18.6	24.3	15.7

Determining the Functional Form of Dependent Variable of the Model

Based on Figure 3, it is evident that 'Price' is positively skewed and does not conform to the requirement of normality for regression analysis. Figure 4 depicts the distribution of log transformed 'Price', as denoted by 'Ln_Price'. The transformation has improved the data distribution markedly as with log transformation, 'Ln_Price' is nearly normally distributed. The model adopts a linear regression which is run on a log-level functional form. This means the price is transformed into natural logarithm (Ln) while its independent variables stand at level form.

Figure 3: Histogram with 'Price' Distribution

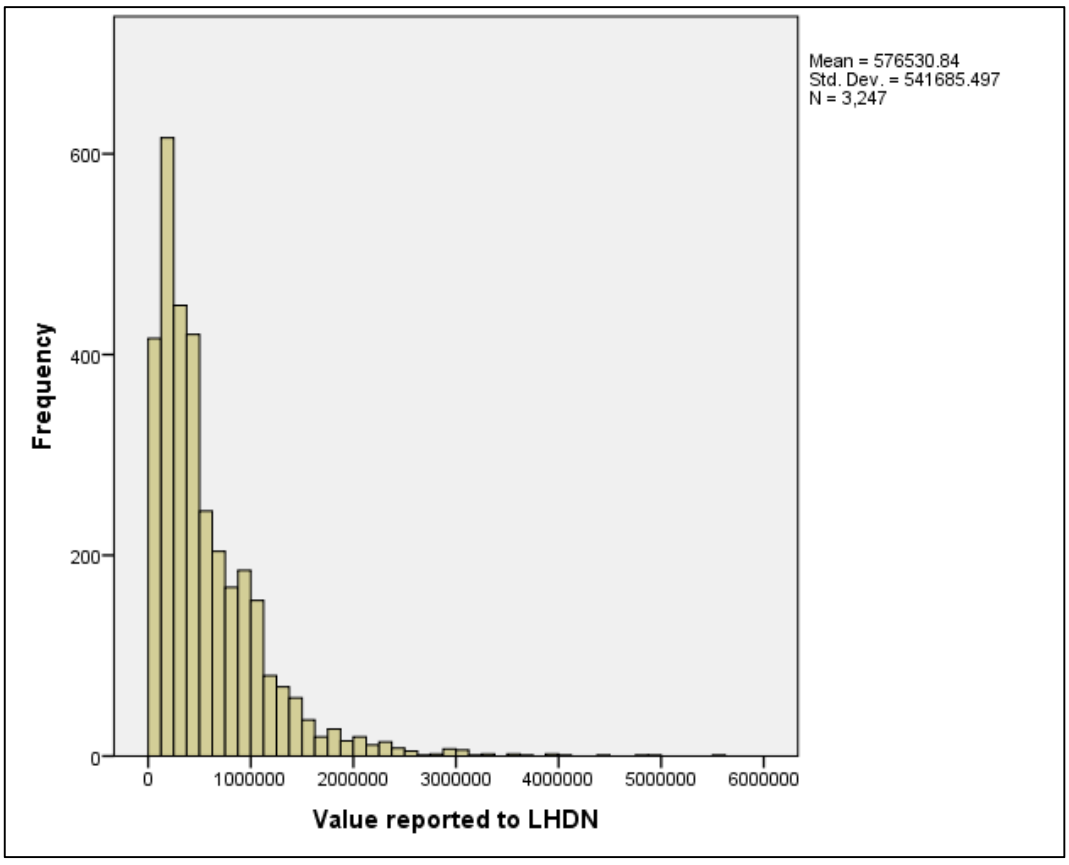
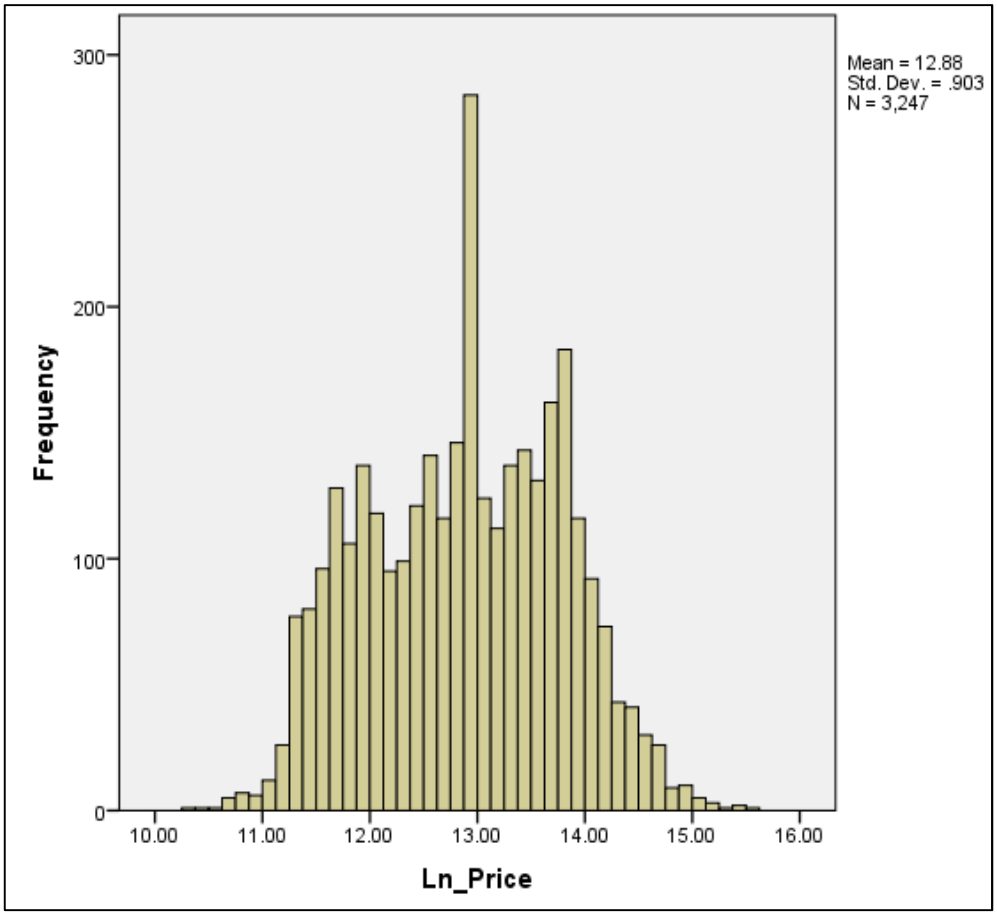


Figure 4: Histogram with 'Ln_Price' Distribution



Determining the Independent Variables - 'Enter' or 'Stepwise' Procedure?

The probable independent variables are those defined in Table 4 and several are dichotomous variables expressed as dummy variables. The details of these variables are as discussed below:

- Floor area relates to the nett space of the office lot.
- Floor level defines the level on which the office lot is located.
- Distance to town is a location attribute, which defines the proximity of the office building (in which the office lot resides) to the Kuala Lumpur city centre.
- Age is computed based on 'Building Completion Date' which states the age of the building at the time the study is undertaken.
- Tenure is categorised as 'Freehold' or 'Leasehold, a qualitative variable that is expressed as dummy variables. Transactions assume the code of '1' if it has 'Freehold' tenure and '0' if otherwise.
- Condition of building, which initially has five rating scale is recoded into two category namely 'Good' and 'Moderate'. This is also a qualitative variable that is expressed as dummy variables. Transactions assume the code of '1' if it has 'Good' condition and '0' if otherwise.
- Classification of Area classifies the area into four sub-markets. This is also a qualitative variable that is expressed as dummy variables. Transactions assume the code of '1' if it is within 'KLCC-GT' sub-market. Similar applies to 'CBD' and 'WCC' sub-markets. 'Suburban' sub-market assumes code '0'and is taken as the base comparison.

Table 4: Independent Variables Specifications

Variables	Variable Code	Measure
Price	Report_Value	Number
Floor area	Floor_area	Number
Floor level	Floor_level	Number
Age	Age	Number
Distance from town	Distance_from_town	Number
Tenure - Freehold	Freehold	-
Tenure - Leasehold	Leasehold	Dummy
Condition - Good	Good	-
Condition - Moderate	Moderate	Dummy
Submarket - KLCC-GT	KLCC-GT	-
Submarket - CBD	CBD	Dummy
Submarket - WCC	WCC	Dummy
Submarket - SUBURBAN	SUB	Dummy

The results of the 'Enter' and 'Stepwise' regression are as stated in Table 5 and Table 6. It can be seen that the explanatory power of regression models that included variables using 'Enter' method and 'Stepwise' method is similar at 69.0%. This indicates that there is no significant difference on the explanatory power of both models.

Another notable finding is that variables that are significant in 'Enter' method model are equally significant in 'Stepwise' method. On the other hand, the two dummy variables that are insignificant in 'Enter' procedure, namely 'Condition – Moderate' and 'CBD', have been excluded from the 'Stepwise' procedure. However, as 'CBD' is part of the four categories of location (Sub-markets), it is erroneous to exclude it from the regression model.

Table 5: Comparison of Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
Enter Method	0.831	.690	.690	.50311
Stepwise Method	0.831	.690	.690	.50306

Table 6: Comparison of Regression Result Using 'Enter' and 'Stepwise' Method

Variables	Enter Method			Stepwise Method		
	B	t	Sig.	B	t	Sig.
Intercept	13.253	317.062	0.000	13.255	317.251	0.000
Floor Area	.006	56.735	0.000	.006	58.256	0.000
Floor Level	.012	7.036	.000	.013	7.142	.000
Distance from town (Kuala Lumpur city centre)	-.086	-19.153	.000	-.090	-19.575	.000
Age	-.050	-30.975	.000	-.049	-38.416	.000
Leasehold	-.272	-9.840	.000	-.272	-9.859	.000
Cond_Moderate	.029	.649	.517	Excluded		
CBD	.055	.916	.360	Excluded		
WCC	-.174	-5.410	.000	-.181	-5.742	.000
SUB	-.240	-7.078	.000	-.247	-7.403	.000
Adjusted R Square	0.690			0.690		

SELECTION OF A DECISION MODEL FOR THE CONSTRUCTION OF KL-OPI

The Conventional Hedonic Price Model

In the construction of KL-OPI using the conventional hedonic price model, the vector of time related variables in Equation 5.1, T_1 ……. T_m represent a vector of dichotomous time variables for *5*periods,one variable for each year of the study period, 2007 through 2011, with 2006 as the base period.

With this approach, all the transactions data from 2006 to 2011 are combined into one pool for the analysis and the parameters of non-time related variables are held constant throughout the study period. This allows the parameter of each time dummy variable to capture the pure price change. In other words, the parameter estimates of the dichotomous time variables are regarded as the basis for the construction of KL-OPI. Table 7 provides the model summary of conventional hedonic price model and the results of the model estimates.

All but three variables are significant predictors of the model at the 5% significance level. The exceptions are dummy variables of 'Condition – Moderate', 'CBD' and 'Year 2007'. Overall, the signs of the

coefficients are consistent with expectations. Both 'Floor Area' and 'Floor Level' are statistically significant. The positive coefficients for 'Floor Area' and 'Floor Level' suggest that both variables have positive impact on the values of office.

Table 7: Model Summary of Conventional Hedonic Price Model

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
Conventional	.835[a]	.697	.695	.498
Variables		**B**	**t**	**Sig.**
Intercept		13.087	271.607	0.000
Floor Area		.006	57.515	0.000
Floor Level		.013	7.192	0.000
Distance from town		-.081	-17.989	0.000
Age		-.049	-30.515	0.000
Leasehold		-.282	-10.251	0.000
Cond_Moderate		.030	.684	.494
CBD		.021	.352	.725
WCC		-.186	-5.814	0.000
SUB		-.270	-7.885	0.000
Year2007		.078	2.386	.017
Year2008		.167	5.142	0.000
Year2009		.197	6.397	0.000
Year2010		.211	6.772	0.000
Year2011		.182	5.195	0.000

a. Dependent Variable: Ln_Price

The negative coefficient of 'Distance from town' indicates that office property values decline with distance from the city centre. On similar note, value declines as the property aged over the years as indicated by the negative coefficient of 'Age' variable. The negative coefficient for 'Leasehold' tenure also shows a negative impact on values, as buyers' preference, more often than not is slated towards

freehold property. The indicated coefficient could also be interpreted as on average, the value of leasehold office property is lesser than the freehold ones.

In relation to location variable, in particular the office sub-markets, two locations namely 'WCC' and 'Suburban', reflect negative coefficients. These results suggest that office property in these two sub-markets have lower values in comparison to those in 'KLCC-GT'. This can be explained by the fact that KLCC-GT area has better advantage in terms of location and accessibility as compared to the former two sub-markets. In contrast, the 'CBD' has positive coefficient sign but is statistically insignificant, suggesting that the value of office property in 'CBD' is not statistically different from the ones in 'KLCC-GT'.

The 'Cond_moderate' variable depicts positive sign on value. However, given the fact that the variable is not significant indicates that the value of office property in moderate condition is not statistically different from the ones in good condition.

The time dummy variables are statistically significant in the model, with the exception of year 2007. Its significance indicates that there is a substantial change in office value for the period 2008 to 2011. The time dummy coefficients indicate gradual increases in office values from 2007 through 2010, followed by a decline in 2011.

As explained earlier, the conventional hedonic price model pools the transactions into one, resulting in aggregation effects on the parameters. Although the drawback is related to the constant-parameters, the conventional index sets a benchmark for comparison with the time-varying parameter techniques.

The Laspeyres Time-Varying Parameter Hedonic Model

The application of Laspeyres method in the construction of KL-OPI is similar to the hedonic methodology employed in the construction of Malaysian House Price Index (MHPI). The difference is on the base year, whereby the MHPI employs 2000 as its base year whilst in this study, 2006 is the base year.

The regression results in Table 8 reveal that the explanatory power of the models varies from 63.6% to 81.5%. For most years, the adjusted R^2 are higher than that of the conventional hedonic. This indicates that the models fit the data satisfactorily for the six-year period.

Based on Table 9, it can be seen that the coefficient signs for most variables conform to expectation. Variables namely 'Distance from town' and 'Age' indicate negative coefficients and are statistically significant for all the years. On the other hand, 'Floor Area' and 'Floor Level' has positive signs and are significant for most years.

The 'Leasehold' variable carries negative coefficients, which has also been explained in earlier section. It is significant for years 2006, 2008 and 2009 only. For the three other years, the insignificance of the variable suggests that there is no price difference between freehold and leasehold office property.

Table 8: Model Summary of Laspeyres Time-Varying Parameter

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
2006	.905[a]	.819	.815	.38426
2007	.850[a]	.722	.717	.50623
2008	.824[a]	.679	.674	.54724
2009	.800[a]	.640	.636	.59103
2010	.842[a]	.708	.704	.45369
2011	.857[a]	.735	.729	.38307

a. Dependent Variable: Ln_Price

For 'Cond_moderate' variable, negative signs are seen for the four consecutive years from 2006 to 2009 but it turns to positive signs for the following two years. In terms of significance, the variable is significant for years 2007, 2008 and 2011. The sub-market dummy variable of 'Suburban' is statistically significant and shows negative coefficient for all the years. This suggests that office property is Suburban locality has lower value than the ones in KLCC-GT and there is statistically difference in value between those two sub-markets. Mixed coefficient signs are seen for 'WCC' dummy variable. For the years that the variable is significant, the coefficient signs are negative i.e. year 2008 through 2011. The 'CBD' dummy variable also has negative coefficient for most years and remain insignificant for all the years.

The year-by-year analysis process is quite tedious as compared to the conventional hedonic analysis, where estimates are obtained by running the data at one go. On a positive note, the Laspeyres allows the parameter to vary according to the study period; thus, the aggregation effect is eliminated.

Table 9: Results of the Model Estimates

Year	2006			2007			2008			2009			2010			2011		
Variables	**B**	**t**	**Sig.**	**B**	**t**	**Sig.**	**B**	**t**	**Sig.**	**B**	**t**	**Sig.**	**B**	**t**	**Sig.**	**B**	**t**	**Sig.**
Intercept	12.867	124.388	0.000	13.277	127.589	0.000	13.756	26.106	0.000	13.753	131.478	0.000	13.486	133.075	0.000	13.281	135.791	0.000
Floor Area	0.006	25.859	0.000	0.004	23.667	0.000	0.004	1.452	0.147	0.003	20.575	0.000	0.006	24.050	0.000	0.008	21.902	0.000
Floor Level	0.000	0.019	0.985	0.007	1.500	0.134	0.009	0.590	0.556	0.028	5.685	0.000	0.014	3.797	0.000	0.006	2.534	0.012
Distance from town	-0.076	-7.238	0.000	-0.054	-4.960	0.000	-0.138	-13.309	0.000	-0.091	-8.262	0.000	-0.070	-6.570	0.000	-0.085	-6.501	0.000
Age	-0.042	-11.206	0.000	-0.041	-8.782	0.000	-0.048	-10.836	0.000	-0.053	-13.305	0.000	-0.057	-17.311	0.000	-0.059	-13.701	0.000
Leasehold	-0.296	-5.035	0.000	-0.105	-1.457	0.146	-0.327	-5.089	0.000	-0.350	-5.169	0.000	-0.094	-1.609	0.108	-0.148	-1.744	0.082
Cond_moderate	-0.019	-0.194	0.847	-0.322	-2.781	0.006	-0.347	0.452	0.651	-0.177	-1.765	0.078	0.065	0.601	0.548	0.457	3.170	0.002
CBD	-0.101	-0.708	0.479	0.174	0.862	0.389	-0.134	0.517	0.605	-0.281	-1.805	0.072	-0.237	-1.375	0.170	0.202	1.886	0.060
WCC	0.112	1.702	0.090	0.010	0.146	0.884	-0.382	-3.929	0.000	-0.683	-8.187	0.000	-0.349	-4.243	0.000	-0.337	-3.394	0.001
SUB	-0.142	-1.922	0.055	-0.462	-5.677	0.000	-0.202	-1.893	0.059	-0.336	-3.910	0.000	-0.574	-6.489	0.000	-0.346	-3.910	0.000

The Chained Time-Varying Parameter Hedonic Model

Another time varying parameter technique employed is the chained technique. In this procedure, the estimation of the price model requires the two adjacent years' transactions data to be pooled into one. In this instance, data for year 2006 and 2007 are pooled into one, 2007 and 2008 into another pool, and so on and so forth. Eventually, there are five adjacent year pools or five chains. With this model, a single dichotomous time variable which represents the latter year in each of the pool is included. The antilogarithm of the time dummy estimates represents the price change from one year to another.

As presented in Table 10, the adjusted $R^2$for the chained models ranges from 0.62 to 0.74, indicating that the models fit the data quite well. 'Floor area' is significant in all the five chained models and carries positive signs, similar to that in the conventional and Laspeyres models. On the same note, 'Floor level' is also a significant predictor with the exception of 2006 – 2007 chain.

The 'Distance from town' and 'Age' variables are significant for all the models and both have negative impact on value. The negative coefficient for 'Leasehold' indicates that on the average leasehold properties fetch lower values than freehold properties. Likewise, the 'Cond_moderate' variable also depicts similar coefficient sign and is significant for all the chained years. This suggests that on the average, the value of office property in moderate condition is lower from the ones in good condition.

The dichotomous time variable is statistically insignificant for all the chained models except for the 2007-2008 chain, suggesting that for most of the chained years, there is a statistical difference in value between each of the two chained years. The positive signs for the coefficient of this time variable in each model show positive impact on value, with the exception for 2011.

Table 10: Results of Regression for Chained Hedonic Price Model

Year	Chain 06 - 07	Chain 07 - 08	Chain 08 - 09	Chain 09 - 10	Chain 10 - 11
Predictors	**Coeeficients**				
Constant	13.161	13.403	13.734	13.626	13.478
Floor_Area	.005	.004	.004	.004	.006
Floor_Level	.005	.011	.019	.023	.011
Distance_from_town	-.059	-.091	-.112	-.076	-.072
Age	-.042	-.044	-.050	-.050	-.056
Leasehold	-.197	-.200	-.368	-.259	-.125
Condition_moderate	-.202	-.270	-.264	-.166	.176
CBD	-.001	-.016	-.241	-.297	.099
WCC	.044	-.171	-.488	-.514	-.324
SUB	-.375	-.287	-.267	-.520	-.521
Year 2007	.048				
Year 2008		.069			
Year 2009			.023		
Year 2010				.029	
Year 2011					-.018
Adjusted R Square	.744	.675	.644	.621	.689

Dependent Variable: Ln_Price

For the location variable, the 'Suburban' sub-market dummy variable is significant in all the models and has negative coefficients, similar to the ones in the Conventional and Laspeyres models. This indicates that on the average, the office property in 'Suburban' fetches lower value that those in 'KLCC-GT'. For 'WCC' sub-market dummy variable, in the chain models where the variable is significant, the coefficient carries negative sign and vice-versa. This suggests that value in 'WCC' is lower than 'KLCC-GT' on the average and the value is statistically difference between the two sub-markets. On the contrary, the 'CBD' sub-market dummy variable portrays the contrast. The variable is not significant in all of the chained models except for 2009 – 2010 chain and has negative coefficients for most years except for 2010 – 2011 chain. This means that there is no statistically difference in value between 'CBD' and 'KLCC-GT' though it fetches lower value than 'KLCC-GT' with isolated exceptions.

COMPUTATION OF KL-OPI

Conventional Hedonic Price Index

Table 11 presents the KL-OPI derived from the Conventional Hedonic Price Model There is a gradual increase in the indices from 2007 to 2010 but the rate of increase diminishes in 2009 and 2010. This is followed by an eventual fall in the index in 2011, recording a negative contraction of 2.9%.

Table 11: KL-OPI from Conventional Hedonic Price Model

Year	Time Dummy Coefficients	Exponential	KL-OPI	Index Change (%)
2006	-	1.00	100.0	0.0
2007	.078	1.08	108.1	8.1
2008	.167	1.18	118.1	9.3
2009	.197	1.22	121.8	3.1
2010	.211	1.23	123.5	1.4
2011	.182	1.20	119.9	-2.9

Laspeyres Hedonic Price Index

Table 12 provides the results of KL-OPI derived from Laspeyres Hedonic Price Model. The trend is quite similar to that of Conventional KL-OPI, recording an increasing trend from 2007 through 2010. Compared with the rate of increase of Conventional KL-OPI, the Lapeyres KL-OPI's scales upwards in 2008 (7.1%), down slightly in 2009 (5.2%) but takes an upturn in 2010 (5.8%) before finally plunged by negative 1.5%.

Table 12: Results of the KL-OPI from Laspeyres Hedonic Price Model

Year	2006	2007	2008	2009	2010	2011	Weights 2006
Variables	**Coefficients**						
Intercept	12.867	13.277	13.756	13.753	13.486	13.281	
Floor Area	.006	.004	.004	.003	.006	.008	134.584
Floor Level	7.642E-05	.007	.009	.028	.014	.006	7.129
Distance from town	-.076	-.054	-.138	-.091	-.070	-.085	4.505
Age	-.042	-.041	-.048	-.053	-.057	-.059	14.025
Leasehold	-.296	-.105	-.327	-.350	-.094	-.148	0.129
Condition moderate	-.019	-.322	-.347	-.177	.065	.457	0.125
CBD	-.101	.174	-.134	-.281	-.237	.202	0.018
WCC	.112	.010	-.382	-.683	-.349	-.337	0.178
SUB	-.142	-.462	-.202	-.336	-.574	-.346	0.545
Product	1.3E+01	1.3E+01	1.3E+01	1.3E+01	1.3E+01	1.3E+01	
KL-OPI	100.0	105.6	113.1	119.0	125.9	124.0	
Index Change (%)	0	5.6	7.1	5.2	5.8	-1.5	

Chained Hedonic Price Index

Table 13 shows the KL-OPI computed based on Chained Hedonic Price Model. The trend records an increase in 2008 and 2008, followed by a negative growth in 2009. The index improves slightly in 2010 at 0.6% increase. However, the index fell by 4.6% in 2011.

Table 13: KL-OPI from Chained Price Model

Year	Time Dummy Coefficients	Exponential	KL-OPI	Index Change (%)
2006	-	1.00	100.0	0.0
2007	.048	1.05	104.9	4.9
2008	.069	1.07	107.2	2.2
2009	.023	1.02	102.3	-4.6
2010	.029	1.03	102.9	0.6
2011	-.018	0.98	98.3	-4.6

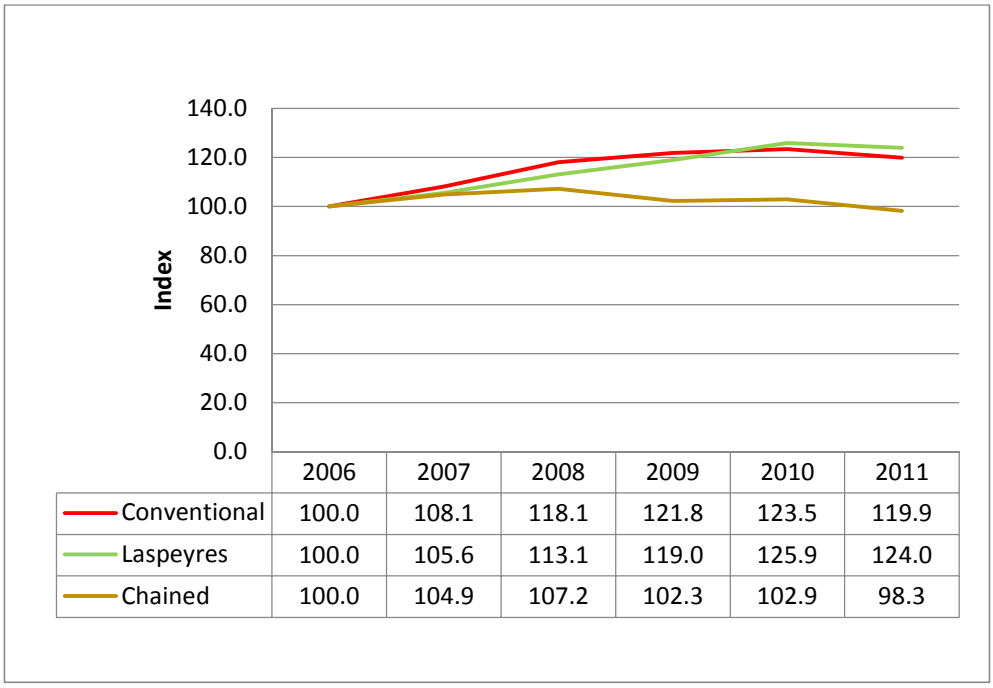
Comparison of the Hedonic Indices

Figure 14 compares the KL-OPI computed based on Conventional, Laspeyres and Chained Hedonic Price Models. It can be seen that the price index trend for Conventional and Laspeyres hedonic models are almost similar. The trends and changes exhibited by the Conventional and Laspeyres' indices are very similar. However, the chained indices are lower and exhibit a much lower growth.

Table 14: KL-OPI by the Three Hedonic Price Models

Year	Conventional	Percentage Change (%)	Laspeyres	Percentage Change (%)	Chained	Percentage Change (%)
2006	100.0	-	100.0	-	100.0	-
2007	108.1	8.1	105.6	5.6	104.9	4.9
2008	118.1	9.3	113.1	7.1	107.2	2.2
2009	121.8	3.1	119.0	5.2	102.3	-4.6
2010	123.5	1.4	125.9	5.8	102.9	0.6
2011	119.9	-2.9	124.0	-1.5	98.3	-4.6

Figure 5: Plotting KL-OPI of the Three Models



	2006	2007	2008	2009	2010	2011
Conventional	100.0	108.1	118.1	121.8	123.5	119.9
Laspeyres	100.0	105.6	113.1	119.0	125.9	124.0
Chained	100.0	104.9	107.2	102.3	102.9	98.3

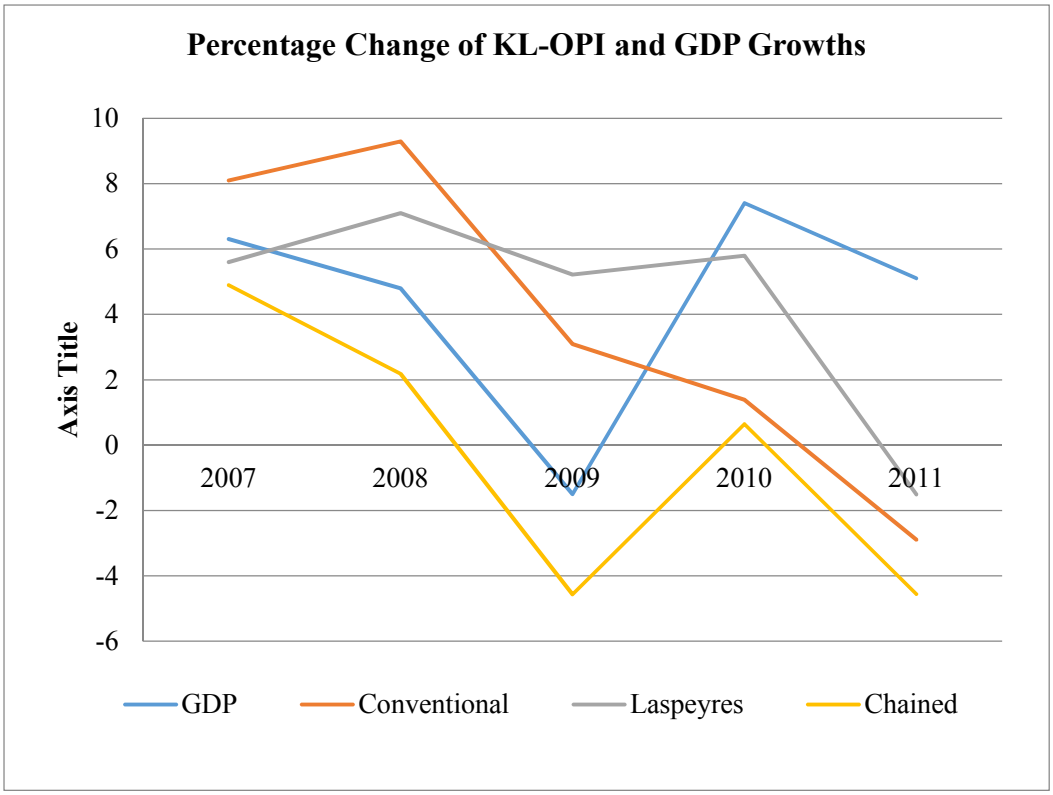
Both models record positive growth in price index from 2007 to 2009 with the highest growth seen in 2008. This is followed by a lower growth rate in 2009 and 2010. The movement is of particular interest as 2008 was the year when the US economy was hit by the subprime meltdown. The impact of the US economic recession slowly crept to other parts of the world and in Malaysia the pinch on our economy was felt in 2009. This could have explained the lower growth ratein the price index recorded for 2009 and subsequently in 2010.

For the Chained index, lower index points are recorded from 2007 to 2011 as compared to those of Conventional and Laspeyres indices. Whilst the Chained index shows diminishing growths in 2007 and 2008, the Conventional and Laspeyres index show a reverse trend. This could be explained by the "pooling" effect of the transactions data in the Chained model.

In 2010, all three indices see an increase in price index but vary in terms of magnitude. The Laspeyres index records the highest growth rate, whilst the Conventional and Chained indices record low growths. All the three indices portray contractions in growth in 2011.

Figure 6 depicts the annual percentage change of the Conventional, Laspeyres and Chained indices from 2007 to 2011 together with GDP growths. Chained index growth and GDP growth are in tandem in terms of growth. Another distinct feature is the downfall in indices in 2009, which is similar to GDP series. Based on Figure 5, it is fair to conclude that the economic factor does have an impact on the price index changes. However, the magnitude of the impact is not within the ambit of this study.

Figure 6: Plotting KL-OPI Changes and GDP Growths



Measurement of Precision

The signal-to-noise ratios in the study range from 0.53 to 1.54 as shown in Table 15. The Conventional indices exhibit the highest signal-to-noise ratio of 1.54 as compared to Chained indices at a ratio of 1.297 and Laspeyres at an even lower ratio of 0.53. This indicates that the Conventional indices have a higher degree of precision as compared to the other two.

Table 15: The Comparison of Signal-to-Noise Ratios

Year	Conventional	Laspeyres	Chained
	Annual Growth Rate		
2007	0.081	0.056	0.049
2008	0.093	0.071	0.022
2009	0.031	0.052	-0.046
2010	0.014	0.058	0.006
2011	-0.029	-0.015	-0.046

Standard deviation of the annual growth rate		
0.050	0.034	0.042

Mean of standard error of time dummy parameter	Mean of standard error of the coefficients	Mean of standard error of time dummy parameter
0.032	0.064	0.032

Signal-to-noise ratio		
1.541	0.532	1.297

CONCLUSION

The availability of property price indicators in the region and Malaysia, in particular, is limited. which motivates the pursuance of this study. This study acts as a pilot initiative in laying the foundation upon which more property price indices can develop. The study opted for three types of hedonic price models namely Conventional Hedonic Price Model, Laspeyres Time-Varying Paramater Hedonic Price Model and Chained Time-Varying Paramater Hedonic Price Model. Since the common type of hedonic employed in MHPI and PBO-RI is Laspeyres, this study explores the possibility of constructing indices using two other hedonic techniques.

Having reviewed and analysed the results of the models, the Conventional Hedonic Price Model estimates 69.5% variability of price, Laspeyres Hedonic Price Model year-by-year estimates on average 71.2% whilst Chained Hedonic Price Model records a lower 67.4%. Judging from the explanatory power of the three models, Laspeyres has the highest and should be the model to best adopt for KL-OPI. This study improves on model selection by means of measure of precision test known as 'Signal-to-Noise' ratio. The results of this test show that Conventional Hedonic Price Model records the highest 'Signal-to-Noise' ratio, signifying that the Conventional model has the highest degree of precision over the other two models. In conclusion, it can be deduced that a price model with a high explanatory power is not necessarily the one with the highest degree of precision.

This study opens up more avenues for future research in developing commercial property price index and a composite property price index for the country. As to the methodology to be chosen is subjected to the comprehensiveness of data, quality of data, expertise of prospective researchers and the application of computer software. In years to come, there is a possibility for repeat-sales to be explored and a comparison can then be made between hedonic and repeat-sales techniques.

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