



دائرة الأراضي والأموال
Land Department



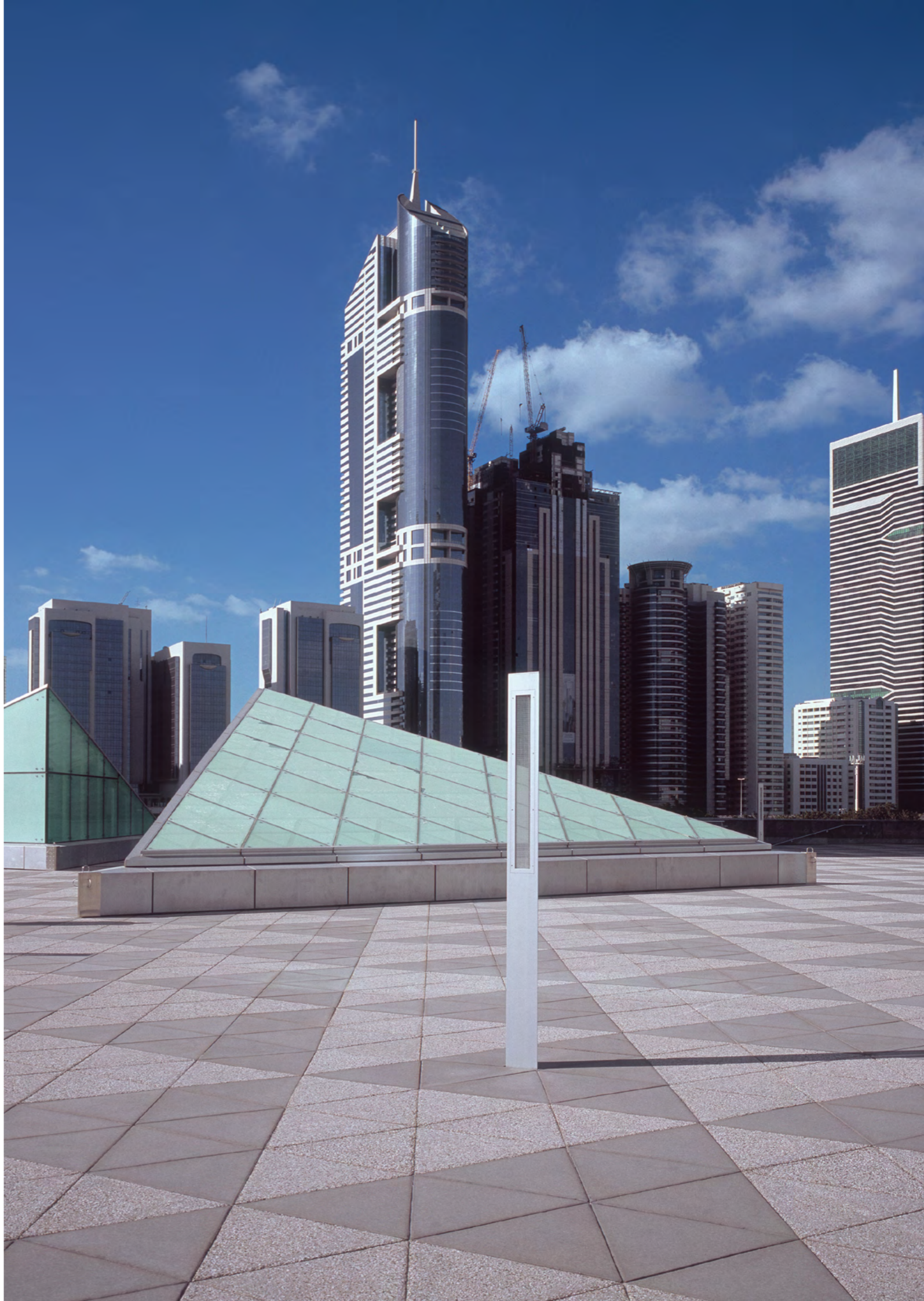
Dubai Commercial Property Price Indices

Methodology

United Arab Emirates | November 2021

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Section 1 - Overview

Introduction

This document describes the background to the development of the Commercial Index, launched by the Dubai Land Department (DLD) in collaboration with JLL. It provides an account of the methodology used to create the Commercial Property Price Indices (CPPI) for

- Dubai City Level Commercial Property Price Index (Sales)
- Dubai City Level Office Property Price Index (Sales)
- Dubai City Level Retail Property Price Index (Sales)

The analysis is based on commercial property transactions recorded in Dubai from 2010 onwards.

Overview of Commercial Property Price Index

The CPPI aims to be a key benchmark in terms of analysing the performance of commercial real estate. It will provide valuable insights to investors and corporates on commercial property price trends in Dubai. The CPPI will provide the value of commercial properties over time by measuring performance based on relevant variables. However, in doing so, two important factors need to be taken into consideration: 1) that commercial property transactions are heterogeneous, and 2) occurrence of sales of a particular property are sporadic.

Heterogeneity:

Commercial properties will vary in terms of, for example, design, quality, and location. As a result, these factors will impact pricing levels for separate commercial properties.

Frequency of Transactions:

Due to the varying rate at which a particular commercial property is sold, it is difficult to determine the price at which a specific property will be transacted.

Additionally, it is important to note that commercial property transactions during each quarter will not always comprise properties of similar quality or attributes. For instance, a particular quarter may record an unusually high level of transactions composed of low-grade properties, thereby reflecting a decline in the index. As a result, to maintain an unbiased index and be able to compare commercial properties on a like-for-like basis, we are required to standardize the associated properties' attributes.

To track price changes for commercial properties, we have applied the 'Hedonic Price Measurement' approach. This technique takes into consideration the heterogeneity and frequency of transactions.

Dubai Commercial Property Price Index

We have applied the hedonic price methodology to construct the Dubai Commercial Property Price Index. The hedonic method is an effect method to utilize data and construct constant quality CPPIs for various types of property.

In compiling the hedonic price index we have selected the characteristics approach. This approach runs separate regressions for all time periods and the index is constructed

by making use of predicted prices based on the regression coefficients. This approach is more flexible than the time dummy variable approach as the implicit characteristics can vary over time.

The Commercial Property Price Index will be calculated on a quarterly basis to provide regular insights about the commercial property market in Dubai. Further details regarding the data and variables used are provided in the next section. The index methodology and an explanation of the Hedonic Method is also detailed in Section 3.

Dubai Office Property Price Index

The Dubai Office Property Price Index will be reported on quarterly basis. This index will only comprise transactions categorised as 'office' to ensure that only corresponding

data is taken into account. Further details regarding the data and variables used are provided in the next section. The index methodology and application of the Hedonic Method is consistent with the Commercial Property Price Index.

Dubai Retail Property Price Index

Dubai Retail Property Price Index will be reported on a semi-annual basis. This index will only comprise transactions categorised as 'retail' to ensure that only corresponding

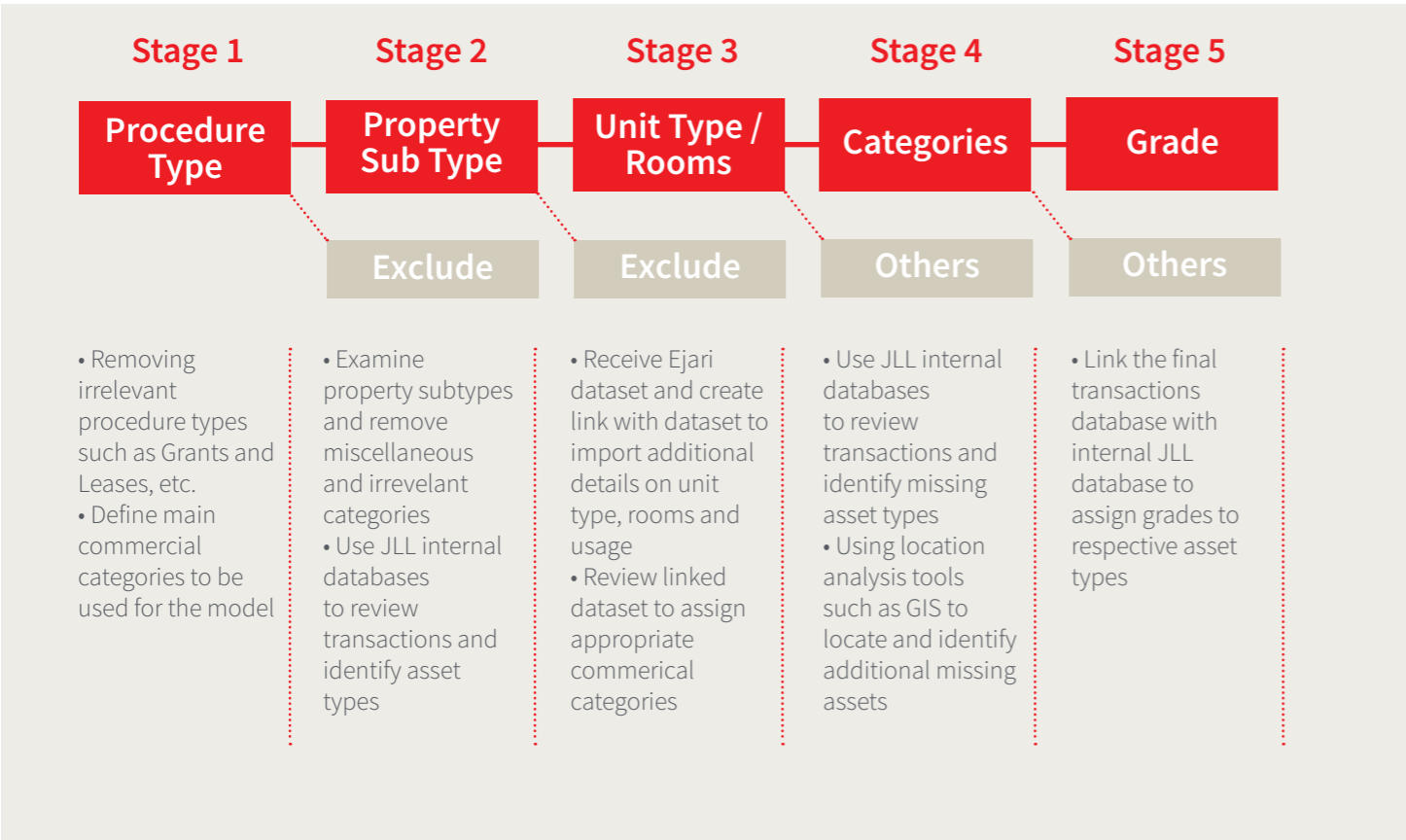
data is taken into account. Further details regarding the data and variables used are provided in the next section. The index methodology and application of the Hedonic Method is consistent with the Commercial Property Price Index.

Section 2 - Data

To construct the commercial property price indices, all residential sales transactions were removed – leaving only transactions relating to the commercial property sector. This included the following categories:

- Hotel**
(Luxury & Others)
- Hotel Apartments**
(Luxury & Others)
- Office**
(Grade A & Others)
- Hotel Rooms**
(Luxury & Others)
- Retail**
(Support Retail & Mall-based)
- Industrial**
- Others**

To identify these categories from the transactions database, a multi-layered approach was applied, utilising both JLL and DLD datasets. From the DLD database, irrelevant transactions were excluded, property subtypes had to be identified and placed in the respective commercial categories. A brief overview of this approach is highlighted in the process diagram below.



Stage 1

In the first stage of data cleansing, transactions with irrelevant procedures types that would otherwise not truly depict the sales of commercial transactions activity in Dubai were removed. These included transaction types such as grants, lease to own, portfolio modifications, delayed transactions and others which would not necessarily reflect investment

transactions. Following this, the core commercial categories; hospitality, retail, office and industrial were defined, to be used in constructing the index, noting their significance to the commercial sector. Other transactions that were of commercial in nature but did not fall in the highlighted categories, for example education and healthcare, were classified as others. Residential transactions were wholly excluded from our analysis.

Stage 2

In the second stage, property sub types were examined to sort transactions into their respective commercial categories. This process involved reviewing over 100 unique property subtypes and assigning them the correct categories as per the agreed definitions. For example, subtypes labelled as Shop, Shopping Mall or Store were

agreed to be categorized as Retail. Irrelevant subtypes such as Agriculture, Parking and many others were removed from the analysis. One of the challenges faced was the fact that a significant portion of transactions were missing property subtypes. These transactions were identified and the efforts which were undertaken to find out their usage have been highlighted in stage 3.

Example:

Property Subtypes	Category
Missing	Checked using JLL data if relevant, if not then removed
Agricultural	Removed
Clinic	Categorized as 'Others'
Health Club	Categorized as 'Others'
Hotel	Categorized as 'Hotels'
Industrial	Categorized as 'Industrial'
Parking	Removed
Shop	Categorized as 'Retail'

Stage 3

In the third stage, sale transactions database was combined with lease data from Ejari in order to identify missing subtypes as well as confirm any missing commercial sales transaction. By creating links between the

two databases, we were able to import additional details such as the unit, rooms and usage into the sale transactions database. Additionally, this data was also reviewed against JLL internal database before being assigned the relevant commercial categories where needed.

Stage 4

After linking the two databases, there were still a significant amount of transactions classified as either “Land” or “Buildings” which did not have any other information. These transactions were highlighted, and a two-pronged approach was adopted to assign them their appropriate categories.

Firstly, JLL database was used to identify any missing category/information and secondly location analysis was done using Geographical Information System (GIS). Using both, we were able to categorize all the remaining transactions into their respective categories. Finally, additional data cleansing was done to identify any missing transaction.

Stage 5

The final step was to assign quality/grades to the transactions using JLL’s internal database. In the first instance, properties’ that matched with JLL internal databases were automatically assigned relevant grades and positioning. Properties for which

the grade was not identifiable by JLL’s internal database were assumed to be of the same grade as that of the majority of the stock within that submarket. For retail developments, transactions comprising malls were categorised as mall-based whilst the remainder were classified as support retail.

Variables

In order to identify the right variables (independent variable) which had the highest influence on price (dependent variable) in a transaction, correlation coefficients were calculated for all the variables in the database. The ones with the highest

coefficients were selected and confirmed through R-squared value, which is a statistical measure that represents the proportion of the variance for a dependent variable that’s explained by an independent variable or variables in a regression model.

For the overall commercial index, the following variables were selected from the transactions database:

Variable	Description	Type
Procedure Area	The size of the transaction in sq. m.	Numeric
No. of Floors	Number of floors in the property	Numeric
Nearest Landmark	Distance from the nearest landmark (Airport, Burj Khalifa, etc)	Numeric
Nearest Metro Station	Distance from nearest metro station (GGICO, Noor Bank etc)	Numeric
Category	Type of Commercial Property identified by JLL	Dummy Variable
Office Grade	The office grade identified by JLL	Dummy Variable
Have Parking	Does the property have parking	Dummy Variable
Free Hold	Property is of freehold status	Dummy Variable
Procedure Name	Transaction Type	Dummy Variable

For the office index, the following variables were highlighted from the transactions database:

Variable	Description	Type
Procedure Area	The size of the transaction in sq. m.	Numeric
Built Year	Year the property was constructed	Numeric
No. of Floors	Number of floors in the property	Numeric
Nearest Landmark	Distance from the nearest landmark (Airport, Burj Khalifa, etc)	Numeric
Nearest Mall	Distance from nearest mall (Mall of Emirates, Ibn Battuta etc)	Numeric
Nearest Metro Station	Distance from nearest metro station (GGICO, Noor Bank etc)	Numeric
Office Grade	The office grade identified by JLL	Dummy Variable
Have Parking	Does the property have parking	Dummy Variable
Registration Type	Property is Off-Plan or Existing	Dummy Variable
Procedure Type	Transaction is Full or Partial	Dummy Variable
Free Hold	Property is of freehold status	Dummy Variable
Procedure Name	Transaction Type	Dummy Variable

For the retail index, the following variables were highlighted from the transactions database:

Variable	Description	Type
Procedure Area	The size of the transaction in sq. m.	Numeric
Built Year	Year the property was constructed	Numeric
No. of Floors	Number of floors in the property	Numeric
Nearest Landmark	Distance from the nearest landmark (Airport, Burj Khalifa, etc)	Numeric
Nearest Mall	Distance from nearest mall (Mall of Emirates, Ibn Battuta etc)	Numeric
Retail Type	Type of retail identified by JLL	Dummy Variable
Have Parking	Does the property have parking	Dummy Variable
Registration Type	Property is Off-Plan or Existing	Dummy Variable
Procedure Type	Transaction is Full or Partial	Dummy Variable
Free Hold	Property is of freehold status	Dummy Variable
Procedure Name	Transaction Type	Dummy Variable

These variables can have a significant bearing on a property's transacted value. For example, two commercial properties may be of similar quality, however their age, proximity to transport facilities and landmarks etc. can help us to explain the difference between their values. For our analysis, these variables were assigned weightages for us to measure their influence on prices.

Outliers

To analyse accurate price movements, we excluded transactions from our analysis that would skew our findings. The two methods of outlier detection applied were univariate and multivariate analysis. A univariate outlier is where the data is observed to be extreme based on one variable. A multivariate outlier is where extreme values are noted based on two or more variables. For our analysis, these outliers are transactions with prices and procedure areas noted to be outside the identified ranges.

Initially, the Mahalanobis distance technique was tested to detect multivariate outliers. However, after running the analysis, the results were not accurate, and the technique was not able to identify the outliers correctly. For our analysis the IQR method helped us to correctly identify the outliers within the database. With initial limits of 10th and 90th percentile, however after discussing with market experts, the 5th and 95th percentiles were agreed upon as more realistic upper and lower limits for both procedure area and price.

1. Sales with a procedure area outside of identified limits

Category	Procedure Area (Lower Limit)	Procedure Area (Upper Limit)
Hotel	2,237 sq. m.	72,783 sq. m.
Hotel Rooms	23 sq. m.	72 sq. m.
Hotel Apartments Luxury	35 sq. m.	327 sq. m.
Hotel Apartments Others	33 sq. m.	146 sq. m.
Mall-Based Retail	80 sq. m.	195,673 sq. m.
Support/Strip-based Retail	23 sq. m.	307 sq. m.
Industrial	938 sq. m.	28,105 sq. m.
Land	94 sq. m.	10,685 sq. m.
Office Grade A	163 sq. m.	2,692 sq. m.
Office Others	50 sq. m.	286 sq. m.
Others	49 sq. m.	28,999 sq. m.

2. Sales with a property price outside of identified limits

Category	Price Lower Limit (AED)	Price Upper Limit (AED)
Hotel	AED 17,992,990	AED 646,468,500
Hotel Rooms	AED 499,950	AED 2,100,000
Hotel Apartments Luxury	AED 670,000	AED 7,030,211
Hotel Apartments Others	AED 468,813	AED 3,160,455
Mall-Based Retail	AED 840,000	AED 1,408,000,000
Support/Strip-based Retail	AED 125,000	AED 4,697,877
Industrial	AED 2,077,084	AED 83,018,550
Land	AED 421,223	AED 99,856,000
Office Grade A	AED 2,575,406	AED 47,625,000
Office Others	AED 388,336	AED 3,790,363
Others	AED 181,912	AED 102,838,191

Section 3 – Hedonic Methodology

Hedonic Method

The Hedonic Method is a technique used to assess the value of a property that has unique characteristics or attributes that might individually increase or decrease its actual worth. In the case of the property market these unique characteristics or attributes most likely do not have a market as they cannot be sold separately. The demand and supply for properties with these attributes is the only way in which one would determine the characteristics contribution to a property’s value. Regression techniques are used to estimate the value of those marginal contributions or ‘shadow prices’.

The hedonic imputation method understands that properties have unique attributes and characteristics that all factor into the value of that property. This method will help us to estimate the value of a property’s unique

attributes relative to price and to construct a quality-based price index.

Furthermore, the basis of hedonic imputation is that the price p_n^t – of property n in period t can be described by K different attributes that are measured by quantities z_{nk}^t from the base period 0 to the current period T . In terms of commercial properties these characteristics would include the number of floors, procedure area and the distance from various other relevant locations, ϵ_n^t is a normally distributed error.

According to Eurostat’s guide on RPPIs, to be able to estimate the marginal contributions of the characteristics using standard regression techniques, the equation must be specified as a parametric model. The two best-known hedonic specifications are the fully linear model or the logarithmic linear model.

Linear model

$$p_n^t = f(z_{n1}^t, \dots, z_{nk}^t, \epsilon_n^t)$$

Logarithmic Linear Model

$$\ln(p_n^t) = \beta_0^t + \sum_{k=1}^K \beta_k^t z_{nk}^t + \epsilon_n^t$$

By applying the logarithmic-linear model, we can estimate the marginal contributions for each characteristic. β_0^t is the intercept term, and β_k^t are the relative contributions (model parameters) for every property attribute z_{nk} . The formula uses the values of the quantitative characteristics such as property size, number of floors or the built year. It is important to note that qualitative characteristics will be considered as categorical or ‘dummy’ variables, taking a value of either 1 or 0 in relation to a specific

attribute. By using a log-linear model, we can manage the issue of price volatility. Logically, we cannot measure all the characteristics that impact commercial property prices, such as qualitative factors (e.g. condition of properties and ease of access), it is not possible to explain all the variations in prices that are observed. Taking this into consideration, we are still able to describe approximately 70% of the price variation when we apply the characteristics to equations.

Hedonic Imputation Approach

The three most common Hedonic Imputation Approaches are Laspeyres, Paasche and Fisher. Each method differs slightly, but ultimately the Hedonic Imputation indices

use predicted prices, evaluated at fixed characteristics, based on the hedonic regressions for all time periods. Doing this allows us to evaluate the period t prices of properties sold in period 0 .

Laspeyres Index

The Laspeyres type Index outputs period (t) prices for commercial properties belonging to the base period sample $S(0)$, based on the attributes of that base period as means of measuring quality changes. Since it is also considered a base period weighted index, we can compare analysis over different periods.

The Laspeyres index is used to measure the change in prices of properties relative to a specific base period. This then allows us to measure the general price level of the market relative to the base period. This example of hedonic imputation Laspeyres index is regarded as a single imputation index where prices are unaffected.

$$P_{CPGL}^{0t} = \frac{\exp(\hat{\beta}_0^t) \exp[\sum_{k=1}^K \hat{\beta}_k^t \bar{z}_k^0]}{\exp(\hat{\beta}_0^0) \exp[\sum_{k=1}^K \hat{\beta}_k^0 \bar{z}_k^0]}$$

$$= \exp(\hat{\beta}_0^t - \hat{\beta}_0^0) \exp\left[\sum_{k=1}^K (\hat{\beta}_k^t - \hat{\beta}_k^0) \bar{z}_k^0\right]$$

Paasche Index

The Paasche type index also calculates the general price level of a market. However, the main difference between Laspeyres and Paasche, is that the Paasche type index uses current-period characteristics weightage as opposed to base-period quantity weightage.

The Paasche method involves assigning base period prices for the properties belonging to

the period t sample $S(t)$, evaluated at period t characteristics. It is also known as a current period weighted index and reflects current trends.

The hedonic imputation Paasche index is an example of a single imputation index in which the observed prices are left unchanged.

If the log-linear hedonic model holds true for all periods, t the quality-adjusted price Paasche index is defined as:

$$P_{CPGP}^{0t} = \frac{\exp(\hat{\beta}_0^t) \exp[\sum_{k=1}^K \hat{\beta}_k^t z_k^t]}{\exp(\hat{\beta}_0^0) \exp[\sum_{k=1}^K \hat{\beta}_k^0 z_k^t]} = \exp(\hat{\beta}_0^t - \hat{\beta}_0^0) \exp\left[\sum_{k=1}^K (\hat{\beta}_k^t - \hat{\beta}_k^0) z_k^t\right]$$

Fisher Index

The Fisher Index is considered a geometric mean of both the Laspeyres and Paasche indices. The advantage of this Index is that it allows us to balance both the positive price

bias of the Laspeyres Price Index and the negative price bias of the Paasche Price Index.

Considering the log-linear hedonic model remains true for all t periods, the Fisher Price Index is calculated as:

$$P_{fisher}^{0t} = [P_{laspeyres}^{0t} P_{paasche}^{0t}]^{1/2}$$

Characteristics Method

The other main approach to compiling a hedonic price index is the Characteristics Method. This method runs separate regressions for all time periods and the index

is constructed by making use of predicted prices based on the regression coefficients. This method is more flexible than the time dummy variable method as the implicit characteristics can vary over time.

$$\frac{\hat{p}^t}{\hat{p}^0} = \frac{\hat{\beta}_0^t + \sum_{k=1}^K \hat{\beta}_k^t z_k^*}{\hat{\beta}_0^0 + \sum_{k=1}^K \hat{\beta}_k^0 z_k^*}$$

Variables

Variables used to test and develop the Hedonic Model.

Variable	Description	Type
Instance Data	Date in which the property transaction took place	Date
Procedure Area	Size of the property	Numeric
Actual Worth	The price of the property	Numeric
Built Year	Year the property was constructed	Numeric
No. of Floors	Number of floors in the property	Numeric
Nearest Landmark	Distance from the nearest landmark (Airport, Burj Khalifa, etc)	Numeric
Nearest Mall	Distance from nearest mall (Mall of Emirates, Ibn Battuta etc)	Numeric
Nearest Metro Station	Distance from nearest metro station (GGICO, Noor Bank etc)	Numeric
Retail Type	Type of Retail identified by JLL	Dummy Variable
Hotel Positioning	Quality of Hotel Development identified by JLL	Dummy Variable
Office Grade	Quality of Office Space identified by JLL	Dummy Variable
Category	Type of Commercial Property identified by JLL	Dummy Variable
Have Parking	Does the property have parking	Dummy Variable
Registration Type	Property is Off-Plan or Existing	Dummy Variable
Procedure Type	Transaction is Full or Partial	Dummy Variable
Free Hold	Property is freehold	Dummy Variable
Procedure Name	Transaction Type	Dummy Variable

Source: JLL, DLD

Base Period

To develop an accurate Commercial Property Price Index, it is important to choose a base period for our model. Since the Index would be updated on a quarterly level, our analysis of the data found Q1 2016 to be the ideal base period. We noted this period to be a time when prices were relatively stable.

- Quarterly: Quarter 1 2016

References

1. zStatistical Office of the European Communities. (2013) Handbook on Residential Property Prices Indices (RPPIs). Publications Office of the European Union. <https://doi.org/10.1016/j.insmatheco.2003.07.004>



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