

MO'ASHER

Dubai House Price Index Methodology - 2020

Mo'asher Sales Price Index

April 2020

Dubai Land Department in partnership with Property Finder

Table of Content

Section 1 - Overview	4
Context	4
Overview of House Price Indices	4
Dubai House Price Index	6
Section 2 - Data	7
Variables	7
Outliers	8
Section 3 - Hedonic Methodology	9
Hedonic Method	9
Hedonic Imputation Approach	11
Index Governance	19
References	20

Section 1 - Overview

Context

This paper describes the background to the development of the standardized House Price Index, launched by the Dubai Land Department (DLD) in collaboration with Property Finder Group in April 2020. It provides an account of the enhanced methodology used to create the House Price for:

- Dubai residential properties
- Dubai apartments
- Dubai villas/ villa town house
- Dubai specific communities

The housing market analysis is based on data relating to house sales on the open market in Dubai from 1 April 2010 onwards.

Overview of House Price Indices

Housing comprises a major source of individual wealth, impacting consumer spending and saving decisions and the wider economy. It is important to have an accurate measure of aggregate housing prices. Such measures serve as important guides that consumers, financial institutions, governments and investors look to in order to understand the market movements of a particular city or country's housing market.

A House Price Index aims to show the value of property assets over time through tracking its performance based on relevant variables. However, it is difficult to develop such a measure. Housing is extremely heterogeneous and sales of a particular house are relatively infrequent.

Heterogeneity

No two residential properties are alike; they differ according to various characteristics relating to the physical attributes of the properties themselves or to their locations. Naturally, observed differences in characteristics between two houses will be reflected by differences in price.

Infrequency of Sales

A transaction on any specific house will occur relatively infrequently, therefore it is difficult to gauge the price at which the specific house will sell today.

Also, another complication arises from the fact that the quality or characteristics-mix of properties traded may vary between periods. When calculating the pure property price changes over time it is necessary to compare like with like; this can only be achieved if the 'characteristics-mix' of properties traded is standardized. This is to ensure that the varying mix of properties sold in each period does not give a false impression of the actual change in prices. For example, sales in one-time period could be disproportionately skewed towards low-quality properties, therefore producing a biased estimate of average price.

There are a variety of methods that can be used to calculate an average house price and track trends in the property market:

1. Simple Mean/Median
2. Repeat Sales.
3. Hedonic Price Measurement

It is not the purpose of this report to outline the specifics of each of these methodologies (see [1] for further details). However, it is fair to say that each one deals differently with the issues of heterogeneity and infrequency of sales.

The Hedonic Price Measurement technique is the only method capable of handling both of these issues.

Dubai House Price Index

DLD have adopted the hedonic price methodology to produce the Dubai House Price Index. The rationale for this decision being that the general consensus is that the hedonic method is the most efficient method for making use of available data and that it is the best method that could be used in order to construct constant quality RPPIs for various types of property.

The Characteristics approach to compiling a hedonic price index is defined by Eurostat within the [Handbook](#) on Residential Property Price Indices [1]. It involves separate regressions being run for each time period and the index is constructed by making use of the predicted prices based on the regression coefficients.

The Dubai House Price Index will be constructed for monthly, quarterly and yearly frequencies to provide a deep understanding for the housing market in the Emirate of Dubai.

The data is described fully in Section 2. This is followed in Section 3 by an explanation of the methodology and its application.

Section 2 - Data

To construct and price a hypothetical constant-quality residential property, it is necessary to have data on property characteristics as well as transaction price. Such data are collected by DLD during the registration process for property transactions.

Variables

Information is obtained about the following property characteristics:

- Date of transaction
- Location: master community / area name
- Freehold / non-freehold property (boolean flag)
- Number of bedrooms
- Number of floors
- Parking (boolean flag)
- Balcony (boolean flag)
- Age
- Property type
- Registration type
- Procedure type
- Offering type
- Property size
- Price

These variables are used by the underlying models to ensure that a property's value is more accurately depicted, as excluding such variations from each property would not indicate its truest worth. The variables are weighted so their importance and impact on value is more accurately assessed through the model.

Outliers

There are a number of transactions which are omitted from the analysis because they are atypical or may distort the series. The following criteria were applied to identify sales to be excluded:

- Sales with a property size outside of identified limits
 - Villa: (< 112m², > 900m²)
 - Apartment: (< 31m² , > 250m²)
- Sales with a price outside of identified limits
 - Villa: (< AED 630k , > AED 10.3M)
 - Apartment: (< AED 250k , > AED 6.4M)

Also, it is important to note that the variables used for the Dubai Residential Properties, Dubai Apartments and Dubai Villas indices differ slightly (see Table 1, 2 and 3). Also, different filtering conditions for villa and apartment transactions are applied to ensure robust models. These details are specified below.

Section 3 - Hedonic Methodology

Hedonic Method

In any given housing market, each property has unique characteristics or attributes which can individually increase its actual worth. As such, explaining the housing market's prices is not as simple as calculating the average for a given period of time.

There will be times where more luxurious properties are sold which will cause the average price to be higher than times where such transactions have not taken place. Calculating a simple average would otherwise indicate that property prices overall have increased, indicating increased value in individual properties when in reality the overall market has benefited from property transacted at above average levels, not individual properties.

The hedonic imputation method recognizes that the housing market consists of heterogeneous goods and can be described by their attributes or their characteristics. The hedonic method serves two purposes:

1. To estimate the willingness of individuals to pay for a property's unique attributes
2. The construction of quality-adjusted price indices

The main assumption behind the hedonic imputation is that the price p_n^t of a property n in period t is can be explained by K different characteristics z_{nk}^t from the base period 0 to the current period T

$$p_n^t = f(z_{n1}^t, \dots, z_{nK}^t, \varepsilon_n^t)$$

where, ε_n^t is a normally distributed error. Multiple Regression Analysis (MRA) and the technique of Ordinary Least Squares (OLS) allows the estimation of the relative contribution of each of the variables, on average, to the measurement of house prices.

The previous model can be specified as a logarithmic-linear model in order to estimate the marginal contributions for each characteristic

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

where, β_0^t is the intercept term, and, β_k^t are the relative contributions (model parameters) for every property attribute z_{nk} . This relative contribution is the coefficient of the variables in the regression equation (β), which indicates the relative importance of the variables in explaining the variation of house prices. The equation uses the values of the quantitative characteristics e.g. property size. However, the qualitative characteristics can only be represented by categorical or 'dummy' variables which can take the value of one or zero depending upon the presence or absence of a particular attribute.

The decision to use a log-linear model is to reduce the problem of heteroscedasticity as prices tend to be log-normally distributed [2]. Market conditions in Dubai are constantly changing, thus the assumption of coefficients varying over time.

It is not possible to measure all the characteristics that may influence prices. In particular, qualitative factors relating to, for example, the condition of properties, attributes of the neighborhood, amount of traffic, distance to shopping / places of work are not measured. There are also a number of quantitative financial measures such as household income which are not available but are implicitly linked to the ability to purchase a particular property. Consequently, it is not possible to explain all of the variation in prices that is observed. However, the characteristics used in the equations in this study generally explain around more than 70% of the variation.

Hedonic Imputation Approach

Hedonic imputation indices use predicted prices, evaluated at fixed characteristics, based on the hedonic regressions for all time periods. In doing so, it is possible to evaluate the period t prices of properties sold in period 0. There are multiple imputation techniques, but three common ones are: Laspeyres, Paasche and Fisher.

Laspeyres

The Laspeyres method imputes period t prices for the properties belonging to the base period sample $S(0)$, evaluated at base period characteristics to control for quality changes. It is also known as a base period weighted index, and it provides a meaningful comparison over time. It helps answer the following question: what would be the relative price today of a real estate unit that was typically offered for sale in the base month?

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

Using the Laspeyre method, assuming that the log-linear hedonic model holds true for all t periods, the quality-adjusted price in period t is defined as:

$$P_{laspeyres}^{ot} = \frac{\beta_0^t + \sum_{k=1}^K \beta_k^t z_{nk}^0}{\beta_0^0 + \sum_{k=1}^K \beta_k^0 z_{nk}^0}$$

Paasche

The Paasche method imputes 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. It helps answer the following question: what is the price of a typical real estate unit today relative to the price of the same unit in the base month?

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

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

$$P_{paasche}^{0t} = \frac{\beta_0^t + \sum_{k=1}^K \beta_k^t z_{nk}^t}{\beta_0^0 + \sum_{k=1}^K \beta_k^0 z_{nk}^t}$$

Fisher

The hedonic double imputation Fisher index is found by taking the geometric mean of the Laspeyres Price Index and the Paasche Price Index. It is deemed the ideal index as it corrects the positive price bias in the Laspeyres Price Index and the negative price bias in the Paasche Price Index.

Assuming that the log-linear hedonic model holds true for all t periods, the Fisher Price Index is defined as:

$$P_{fisher}^{0t} = \sqrt{[P_{laspeyres}^{0t} \cdot P_{paasche}^{0t}]}$$

The Dubai House Price Indices are calculated using the hedonic double imputation Fisher index.

Variables

The variables used to develop the underlying period models for the Dubai all, Dubai villa and Dubai apartments indices are shown in Table 1, 2 and 3 respectively.

Table 1: Dubai residential properties - variables used to develop underlying models

Variable	Description	Modelling Representation
Property Type	The type of property that was built on the land in English	Dummy variables. The set of property types are: <ul style="list-style-type: none"> • Villa • Apartment
Property Size	The size of the property in square metres	Numeric variable
Number of Bedrooms	The total number of bedrooms in the property	Numeric variable
Freehold	Is it in the list of locations which allows foreigners to own?	Boolean
Balcony	Does the property have a balcony?	Boolean
Parking	Does the property include at least one parking space?	Boolean
Age	The estimated age of the property: build year - year of the time period	Numeric variable
Registration Type	The type of registration	Dummy variables. The set of registration types are: <ul style="list-style-type: none"> • Off-plan • Secondary
Procedure Type	The procedure type of the registration	Dummy variables. The set of procedure types are: <ul style="list-style-type: none"> • Full • Partial

<p>Offering Type</p>	<p>The offering type of the property transaction</p>	<p>Dummy variables. The set of offering types are:</p> <ul style="list-style-type: none"> ● Sell ● Sell pre-registration ● Mortgage registration ● Mortgage pre-registration ● Delayed sell
<p>Location</p>	<p>Name of the area in which the property is located in English</p>	<p>Dummy variables. The set of locations are:</p> <ul style="list-style-type: none"> ● Al Barshaa South Third & Fourth ● Al Hebiah Fourth & Fifth ● Al Khairan First ● Al Merkadh ● Al Thanayah Fourth ● Al Thanyah Third & Fifth ● Al Warsan First ● Al Yelayiss 1 & 2 ● Burj Khalifa ● Business Bay ● Hadaeq Sheikh Mohammed Bin Rashid ● Jabal Ali First ● Marsa Dubai ● Me'Aisem First ● Palm Jumeirah ● Wadi Al Safa 7

Table 2: Dubai apartment - variables used to develop underlying models

Variable	Description	Modelling Representation
Property Size	The size of the property in square metres	Numeric variable
Number of Bedrooms	The total number of bedrooms in the property	Numeric variable
Number of Floors	The total number of floors in the tower	Numeric variable
Freehold	Is it in the list of locations which allows foreigners to own?	Boolean
Balcony	Does the property have a balcony?	Boolean
Parking	Does the property include at least one parking space?	Boolean
Age	The estimated age of the property: build year - year of the time period	Numeric variable
Registration Type	The type of registration	Dummy variables. The set of registration types are: <ul style="list-style-type: none"> • Off-plan • Secondary
Procedure Type	The procedure type of the registration	Dummy variables. The set of procedure types are: <ul style="list-style-type: none"> • Full • Partial
Offering Type	The offering type of the property transaction	Dummy variables. The set of offering types are: <ul style="list-style-type: none"> • Sell • Sell pre-registration • Mortgage registration • Mortgage pre-registration • Delayed sell

Location	Name of the area in which the property is located in English	Dummy variables. The set of locations are: <ul style="list-style-type: none">● Al Barshaa South Third & Fourth● Al Hebiah Fourth & Fifth● Al Khairan First● Al Merkadh● Al Thanyah Third & Fifth● Al Warsan First● Burj Khalifa● Business Bay● Hadaeq Sheikh Mohammed Bin Rashid● Jabal Ali First● Marsa Dubai● Me'Aisem First● Palm Jumeirah
-----------------	--	---



Table 3: Dubai villa - variables used to develop underlying models

Variable	Description	Modelling Representation
Property Size	The size of the property in square metres	Numeric variable
Number of Bedrooms	The total number of bedrooms in the property	Numeric variable
Freehold	Is it in the list of locations which allows foreigners to own?	Boolean
Balcony	Does the property have a balcony?	Boolean
Parking	Does the property include at least one parking space?	Boolean
Age	The estimated age of the property: build year - year of the time period	Numeric variable
Registration Type	The type of registration	Dummy variables. The set of registration types are: <ul style="list-style-type: none"> • Off-plan • Secondary
Procedure Type	The procedure type of the registration	Dummy variables. The set of procedure types are: <ul style="list-style-type: none"> • Full • Partial
Offering Type	The offering type of the property transaction	Dummy variables. The set of offering types are: <ul style="list-style-type: none"> • Sell • Sell pre-registration • Mortgage registration • Mortgage pre-registration • Delayed sell
Location	Name of the area in which the property is located in English	Dummy variables. The set of locations are: <ul style="list-style-type: none"> • Al Thanayah Fourth • Al Yelayiss 1 & 2 • Hadaeq Sheikh Mohammed Bin Rashid • Wadi Al Safa 7

Base or Reference Period

The choice of base period is to a certain extent academic. It is usual for price indices to be referenced to a calendar year, although referencing on a shorter period is known. The Dubai House Price Index is referenced as follows:

- **Monthly:** January 2012
- **Quarterly:** Quarter 1 2012
- **Yearly:** 2012

These periods were chosen after assessing the breadth of available data. The house prices in 2012 appeared to be relatively stable and were not impacted by unusual market conditions. The reference period does not affect calculations of inflation rates; the relative magnitude of the index values for the two points in time is unaffected by the reference period.

Data Post-processing

A common problem in the creation of residential house price indices is that thin or sparse data can produce volatile indices. Moreover, it can be argued that selling prices do not always exactly represent the market values of the properties, which can be viewed as a latent variable, and, as such, transaction noise may affect the volatility of the measured price indices. There is thus an argument for smoothing index values which is supported in [1] and [3].

The Dubai House Price Indices apply the following windows for smoothing using the rolling method:

- **Monthly:** 12 periods
- **Quarterly:** 5 periods
- **Yearly:** 2 periods

The resulting index values are less impacted by sparse data, extreme transactions and seasonal fluctuations.

Index Governance

Index Announcements

Announcements with respect to changes in the index will be communicated before deployment.

Recalculation Policy

The continuous monthly update of this index does not modify previous releases. In the event of an error in the data or outputs, all the detected errors will be corrected immediately, including previous releases. After fixing such errors, all the relevant parties and stakeholders will be notified.

Index Dissemination

The available index will be distributed via Property Finder, Data Finder and the Dubai Land Department. Please contact Data Finder for further information.

References

[1] Statistical 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>

[2] Diewert, W.E. (2003), *Hedonic Regressions: A Review of Some Unresolved Issues*, paper presented at the 7th Meeting of the Ottawa Group, Paris, May 27-29.

[3] Silver, M. (2018), *How to measure hedonic property price indexes better*, Eureka: Eurostat Review on National Accounts and Macroeconomic Indicators, Article 2.

Appendix

Appendix A:

Hedonic Modelling Process

The hedonic modelling process can be summarized as follows:

1. From the DLD property transactions database remove any sales that are:
 - a. Sales with a property size outside of identified limits
 - Villa: (< 112m² , > 900m²)
 - Apartment: (< 31m² , > 250m²)
 - b. Sales with a price outside of identified limits
 - Villa: (< AED 630k , > AED 10.3M)
 - Apartment: (< AED 250k , > AED 6.4M)
2. Record the sale price in natural log form and use the technique of OLS to estimate the regression coefficients, β_k^t , for the k explanatory variables for all, t , periods from April 2010.
3. Calculate the price paid for a 'standardised' property in period t , as:

a. **Laspeyres Price:**

Calculate period t price using base (period 0) features and period t model coefficients

$$p_{laspeyres}^t(0) = \beta_0^t + \sum_{k=1}^K \beta_k^t z_{nk}^0$$

b. **Paasche Price:**

Calculate period t price using period t features and base period model coefficients

$$p_{paasche}^0(t) = \beta_0^0 + \sum_{k=1}^K \beta_k^0 z_{nk}^t$$

4. Calculate the hedonic price index in period t , as:

a. **Laspeyres Price Index:**

$$P_{laspeyres}^{0t} = \frac{\beta_0^t + \sum_{k=1}^K \beta_k^t z_{nk}^0}{\beta_0^0 + \sum_{k=1}^K \beta_k^0 z_{nk}^0}$$

b. **Paasche Price Index:**

$$P_{paasche}^{0t} = \frac{\beta_0^t + \sum_{k=1}^K \beta_k^t z_{nk}^t}{\beta_0^0 + \sum_{k=1}^K \beta_k^0 z_{nk}^t}$$

5. Calculate the hedonic double imputation Fisher index as:

$$P_{fisher}^{0t} = \sqrt{[P_{laspeyres}^{0t} \cdot P_{paasche}^{0t}]}$$

This process outlined above applies to the creation of all of the Dubai House Price Indices. The monthly, quarterly and annual index have a different definition of the *time period*. The indices for:

- Dubai apartment
- Dubai villas
- Dubai select communities (still to come)

are developed using a subset of the data used to create the House Price Index for Dubai residential properties.

Disclaimer

At present, we do not provide any accuracy metrics, and although all due care and statistical rigour is taken with the index generation, we do not claim any forecast accuracy. Property Finder and the Dubai Land Department reserve the right to adjust methodologies at any given time, and these changes will be published with appropriate user notes. Users seeking financial guidance from the DHPI do so at their own risk and should note that some external macroeconomic features will not be captured in the model.

The DHPI should not be used for any commercial purposes, including pricing and investment decision making or performance measurement.

You can download a copy of the index from <https://dubailand.gov.ae/en/studies/research/> and www.datafinder.ae

RESEARCH

Lynnette Abad

Director
Research and Data
Property Finder

Mahmoud Ahmed Farghally

Research and Studies Specialist
Department of Real-Estate Studies and
Research
Dubai Land Department
mahmoud.ahmed@rera.gov.ae

MARKETING

Faisal Zaidi

Head of Marketing
Research and Data
Property Finder
faisal@propertyfinder.ae

Manal Mahmoud Haroun

Corporate Communication Officer
Dubai Land Department
media@dubailand.gov.ae