S&P Dow Jones Indices

A Division of S&P Global

Halifax House Price Index (HHPI) 1983

Index Manual for HHPI model introduced in 1983

Table of Contents

1) Significant Index Administration Events

The following Index Administration events apply to each index of the **Halifax House Price Index (HHPI) family**.

Table 1: Index Administration Events

Date	Index Administration Event
January 2021	Governance and Regulatory Compliance sections are consolidated under Section 4) — Governance and Regulatory Compliance
January 2018	Annual attestation of IOSCO compliance
June 2016	**IHS Markit Benchmark Administration Limited (IMBA UK)** officially commences Index Administration
January 1983	**Index Commencement Date**
January 1983	**Index Base Date** (base level = 100)

2) Index Overview

When first introduced in 1984, the Halifax House Price Index (HHPI) family represented a major advance in the measurement of house price changes in the United Kingdom. Unlike earlier series, and house price statistics produced by other institutions, the new figures issued by the then Halifax Building Society were standardised rather than based on simple price averages. Given the variety of houses, simple averages are not comparable: they do not compare like with like. However, by allowing for the influence of the different characteristics of houses on their prices, using a database especially established by the Halifax, and maintained by Lloyds Banking Group (LBG), for this purpose, the new series placed the measures on a truly comparable footing, thereby providing a more accurate indication of like for like house price movements than was previously possible.

The research on which the Halifax house price index numbers were based was carried out by M C Fleming and J G Nellis in the early 1980s, and the results of this research remain the basis for how the indices are calculated today.

The following indices comprise the full Halifax House Price Index (HHPI) family series:

Table 2: List of Halifax House Price Index (HHPI) family

Index Series	Frequency	Total Number of Indices
UK AHAB, SA + NSA UK Existing Homes, NSA UK First Time Buyers, NSA UK Former Owner Occupiers, NSA	Monthly	5
UK+12 Regions AHAB, SA + NSA UK+12 Regions Existing Homes, NSA UK+12 Regions First Time Buyers, NSA UK+12 Regions Former Owner Occupiers, NSA	Quarterly	65
UK+12 UK Regions AHAB, NSA UK+12 Regions Existing Homes, NSA UK+12 Regions First Time Buyers, NSA UK+12 Regions Former Owner Occupiers, NSA	Annual	52

3) Index Methodology

The following sections present an overview of the current HHPI (1983) methodology.

The methodology is applied to produce a number of standardised indices covering different categories of houses (all and existing) and of buyers (first-time buyers and former owner-occupiers). Results are published in regular monthly bulletins for the UK as a whole and as quarterly bulletins giving regional analyses.

The need for "standardisation" arises out of the fact that no two houses are alike: they may differ according to a variety of quantitative and qualitative characteristics relating to the physical attributes of the houses themselves or to their locations.

Thus analyses of average house price differences between one region and another, or of changes in average prices over time, are not based on the comparison of like with like if the "characteristics-mix" of houses traded is not standardised.

The problem of comparability cannot be tackled without information about the characteristics, as well as the price, of each house sold. Given the great variety of combinations of characteristics possessed by houses, and given also a desire to measure their influence at regional, as well as at national, levels, it is necessary to establish a data-capturing system large enough to provide representative coverage of all house transactions in each region of the UK.

As a leading mortgage lender in the UK, the Halifax has been in an ideal position for over three decades to obtain large-scale representative data, which are described fully in the next section. This is followed by an explanation of the methodology and its application.

The database established by the Halifax, and subsequently sustained by LBG, has two notable merits.

First, the size of the database is satisfactory because the number of house-purchase transactions financed by LBG each month is very large and all of these are covered in the statistical reporting system.

As a consequence, the analytical procedures permit much more reliable estimation than would otherwise be the case.

Second, the scope of the data collected about house characteristics is extensive. This again helps to improve the reliability of the statistical analyses.

Information is obtained about the following house characteristics.

Table 3: House Characteristics

House Characteristics
Purchase Price
Type of Property: detached, semi-detached, terraced, bungalow, flat
Age
Number of rooms: habitable rooms, bedrooms, living-rooms, bathrooms
Number of garages and garage spaces
Garden
Location (Region)
Number of Separate Toilets
Tenure: freehold, leasehold, feudal
Central Heating: none, full, partial
Land Area: Greater than one acre
Road Charge Liability

The use of these characteristics in index determination is explained in the next section, but note that, although one hundred per cent coverage of all house purchase transactions financed by the Halifax (and the wider LBG group) is obtained, not all data are used.

This is in part because they do not constitute a fully consistent body of data for the purpose of house price analysis.

For instance, certain properties are excluded, namely those which are not for private occupation and those that are likely to have been sold at prices which may not represent "free" or "normal" market prices.

These would include for example council house sales, sales to sitting tenants, shared ownership, or government-based “help-to-buy” schemes.

Additionally, the data refer to mortgage transactions at the time they are approved, rather than completed.

This has the disadvantage of covering some cases which may never proceed to completion. On the other hand, it has the important advantage that the price information is more up-to-date as an indicator of price movements and is on a more consistent time-base than completions data, given the variable time lags between offer and completion.

3.1) Index Calculation

The Halifax House Price Index (HHPI) family methodology is based on the "hedonic" approach to price measurement in which goods are valued not for themselves as such but for the set of attributes which they possess. Thus in the case of housing, prices will reflect the valuation placed by purchasers on the particular *set* of locational and physical attributes (or characteristics) possessed by each house. The difficulty facing the analyst, of course, is that the implicit "price" placed by a purchaser on each characteristic is not observed because transactions take place in terms of a single total price. Therefore, in order to remove that part of price variation due to changes in the mix of house characteristics over time, and so to measure the variation caused by inflationary factors, it is necessary to disaggregate prices into their constituents statistically. This is done using multivariate regression analysis. On this basis it is possible, given data on the prices and the attributes of the houses sold in different time periods, to estimate the change in average price, from one time period to another, on a standardised basis (that is, keeping the mix of housing attributes or characteristics constant). An obvious analogy is with the standard "basket" of goods in the retail price index ~.

More formally, let a set of house prices, P_i where $i = \{1, 2, ..., m\}$ be observed in any time period in which each house is sold .

Given the supply and demand conditions in the housing market, such houses may be priced differently due to differences in qualitative characteristics (such as the type of property, the availability of certain amenities, the regional location of the property etc), and to differences in quantitative characteristics (such as the age of the property, the number of habitable rooms, garages, bathrooms etc).

Thus, for each house i we can write as some function of these various characteristics, X_j where $j = \{1, 2, ..., n\}$ together with a group of unmeasured factors (assumed to be randomly distributed) which are specific to each house but for which data are not available e_i .

$$P_i = \beta_0 + \beta_1 X_{1,i} + \beta_2 X_{2,i} + ... + \beta_j X_{j,i} + e_i$$

Where $\beta_1, \beta_2, ..., \beta_j$ are the regression coefficients corresponding to the qualitative and quantitative variables X_j .

Given the nature of the data, qualitative characteristics are represented by "dummy variables" which take the value of one or zero depending upon the presence or absence of a particular attribute. Definitions of the variables for each set of characteristics used are listed in Table 4: Definitions and Code Names of Variables Included in Index Determination below.

The technique of ordinary least squares allows us to estimate the coefficients b_j pertaining to each of the explanatory variables for any set of houses. These coefficients indicate the relative importance of the variables in explaining the variation of house prices in any one time period t .

Having obtained estimates of the coefficients, b_j , the average price of any set or sub-set of houses in any period will depend on the number of observations on each characteristic.

Therefore, standardisation to allow for the varying mix of characteristics between one time period and another may be accomplished by applying a standard "representative" set of weights corresponding to the numbers of each characteristic observed in a chosen period. It is common to adopt, as a standard, the set of characteristics that pertained in a base period and this is the practice adopted here, the year 1983 being chosen for this purpose.

3.2) Property Characteristic

Table 4: Definitions and Code Names of Variables Included in Index Determination

House Characteristic	Code(s)	Definition
House type: Detached, Semi-detached, Terraced, Bungalow, Flat	DH, SDH, TH, BUNG, FLAT	Five dummy variables taking the value of 1 if the property corresponds to a particular type. Otherwise 0.
Number of bathrooms	NOBATH	Actual number of bathrooms.
Number of separate toilets	NOTOILET	Actual number of separate toilets.
Number of garages	NOGARAGE	Actual number of garages.
Number of garage spaces	NOGSPACE	Actual number of garage spaces.
Presence of a garden	GARDEN	Dummy variable taking the value of 0 if the property has a garden. Otherwise 1.
Number of acres	A1	Dummy variable taking the value of 1 if the property has one acre or more. Otherwise 0.
Central heating: Full, None, Partial	CHF, CHO, CHP	Three dummy variables taking the value of 1 according to central heating provision. Otherwise 0.
Freehold	FH	Dummy variable taking the value of 1 if the property is freehold. Otherwise 0.
Location: North, Yorkshire & The Humber, North West, East Midlands, West Midlands, East Anglia, Wales, South West, South East, Greater London, Northern Ireland, Scotland	EPR1, EPR2, EPR3, EPR4, EPR5, EPR6, EPR7, EPR8, EPR9, EPR10, EPR11, EPR12	Twelve dummy variables taking the value of 1 according to the region in which the property is located. Otherwise 0.
Road Charge Liability	ROADCHRG	Dummy variable taking the value of 1 if the property is liable to a road charge. Otherwise 0.
Number of habitable rooms	NOHABS	Actual number of habitable rooms.
Age of property	PROPAGE	Actual age of property in years.

Thus the index numbers we calculate represent the movement in average prices for houses possessing the same characteristics as those bought in 1983. The index numbers themselves are computed by comparing the weighted (i.e. mix-adjusted) prices in each current period with the weighted average price in the base period.

Before proceeding to the derivation of the index, there are several important matters regarding the reliability of the basic price-estimating equations worth noting.

1. **Explanatory Power**: it will be appreciated that it is not possible to measure all the characteristics that may influence prices or to measure them satisfactorily in every case. In particular, qualitative factors relating to the standards of repair of existing (non-new) houses, the quality of workmanship, the nature of fixtures and fittings, environmental quality of the neighbourhood etc., are not reflected in our equations except in so far as they may be correlated with the variables which are measured. 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 70 per cent of the variation in house prices at the UK level. Explanatory power of this order should be seen as very satisfactory.

2. **Independence of Variables**: it is necessary to ensure that the explanatory variables used in the equations are sufficiently independent of one another to allow their relative importance as determinants of prices to be reliably estimated. Although in principle it may be thought desirable to utilise information available about all explanatory variables, in practice certain variables may be correlated with each other to such an extent that it may be impossible to measure particular coefficients in any one set or sub-set of the data without the problems associated with "multicollinearity". Such issues include regression coefficients not being uniquely determined, these coefficients fluctuating markedly from one period to another and reduced reliability on the interpretation of the relative importance of variables according to their partial regression coefficients. While it is broadly inevitable that a degree of multicollinearity will exist, steps have been taken to minimize its influence such as conducting logical and statistical steps to remove redundant variables from the regression equations.

   In relation to the issues outlined above and where redundant variables have not been automatically removed from the hedonic regression specification in order to maintain the statistical quality of the model, the **Index Administrator** may use discretion to remove variables where, for example, insufficient observations have led to difficulties in identifying the partial coefficient reading, resulting in unstable and fluctuating influences of these variables on house price determination from one period to another.

3. Functional Form: a primary step in regression analysis is to determine an appropriate functional form for the price equation. A potentially serious source of bias in hedonic price and other regression-based studies may be associated with misspecification of the model. However, unfortunately there has been little theoretical guidance in the academic literature as to which functional form is the most appropriate. The problem therefore reduces to an empirical one and asks for the use of statistical procedures, such as a Box-Cox test, to best determine model form. The results from a number of studies led to the conclusion that the semi-logarithmic functional form (with the dependent variable measured in natural logarithms) is preferred. The specifications of the final regression equations used to generate the standardised index numbers are shown in Table 5: Regression Specification.

Table 5: Regression Specification

Final Regression Specification (*Dependent Variable* $\ln p_i$)						
	✓ denotes variables included.			✗ denotes variables excluded.		
	Table 2					
	Regression Equations For:					
Variables*	All Houses	Existing Houses	First Time Buyers	Former Owner Occupiers	EPRS+ All, FTB, FOO	EPRS+ Existing
DH^	*Omitted Dummy*					
SDH	✓	✓	✓	✓	✓	✓
TH	✓	✓	✓	✓	✓	✓
BUNG	✓	✓	✓	✓	✓	✓
FLAT	✓	✓	✓	✓	✓	✓
NOBATHS	✓	✓	✓	✓	✓	✓
NOTOILET	✓	✓	✓	✓	✓	✓
NOGARAGE	✓	✓	✓	✓	✓	✓
NOGSPACE	✓	✓	✓	✓	✓	✓
GARDEN	✓	✓	✓	✓	✗	✗
A1	✓	✓	✓	✓	✓	✓
CHF^	*Omitted Dummy*					
CHO	✓	✓	✓	✓	✓	✓
CHP	✓	✓	✓	✓	✓	✓
FH	✓	✓	✓	✓	✗	✗
EPR1	✓	✓	✓	✓	✗	✗
EPR2	✓	✓	✓	✓	✗	✗
EPR3	✓	✓	✓	✓	✗	✗
EPR4	✓	✓	✓	✓	✗	✗
EPR5	✓	✓	✓	✓	✗	✗
EPR6	✓	✓	✓	✓	✗	✗
EPR7	✓	✓	✓	✓	✗	✗
EPR8	✓	✓	✓	✓	✗	✗
EPR9^	*Omitted Dummy*					
EPR10	✓	✓	✓	✓	✗	✗
EPR11	✓	✓	✓	✓	✗	✗
EPR12	✓	✓	✓	✓	✗	✗
ROADCHRG	✓	✗	✓	✓	✓	✗
NOHABS	✓	✓	✓	✓	✓	✓
PROPAGE	✓	✓	✓	✓	✓	✓

* Variable code names are defined in Table 4: Definitions and Code Names of Variables Included in Index Determination

+ The Economic Planning Region (EPR) regressions for new and existing houses only include variables common to both the region and sub-sample specifications.

^ Variables omitted for computational purposes. Where more than one dummy variable describes a particular characteristic (e.g. House type = DH, SDH, TH, BUNG or FLAT) then exactly one of them must be excluded in order to avoid the problem of indeterminacy of the ordinary least squares normal equations (also known as the "dummy variable trap").

We are now in a position to apply the methodology to derive index numbers. The methodology is applied here to produce base-weighted standardised house-price index numbers, whereby a weighted average of the estimated regression coefficients is calculated (each coefficient being regarded as an implicit characteristics-price). It will be appreciated that weights other than those appropriate to the base period may be adopted.

The steps involved may be summarised as follows:

- Calculate the weights, $Q_{j,1983}$: the proportions of the qualitative variables and the means of the quantitative variables presenting the chosen base period (i.e. 1983).
- With price transformed to natural logarithmic form, use the technique of ordinary least squares to estimate the regression coefficients β_j for the explanatory variables, in both the base period (i.e. $\beta_{j,1983}$) and for every subsequent time period.
- Calculate a base-weighted (Laspeyres type) index for the current period (I_t) as follows:

$$I_t = \frac{exp \sum \beta_{j,t} Q_{j,1983}}{exp \sum \beta_{j,1983} Q_{j,1983}} \times 100$$

Summation is carried out, of course, over all variables included in each regression (although note these will vary from index to index and the number of explanatory variables can vary too e.g. $n = 14$ for a headline regional index.

Finally, the standardized house price (SHP) for time is simply the 1983 SHP multiplied by the index value for time divided by 100:

$$SHP_t = SHP_{1983} \times \frac{I_t}{100}$$

4) Governance and Regulatory Compliance

IHS Markit Benchmark Administration Limited (IMBA UK) is the Administrator of HHPI 2019 Index family. Information on IMBA UK's governance and compliance approach can be found here. This document covers:

- Governance arrangements, including external committees
- Input data integrity
- Conflicts of interest management
- Market disruption and Force Majeure
- Methodology changes and cessations
- Complaints
- Errors and restatements
- Reporting of infringements and misconduct
- Methodology reviews
- Business continuity

More details about IMBA UK can be found on the Administrator's website.

5) Construction of this Index Manual

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For any general index enquiries, please contact the IHS Markit Index Administration support group at support@ihsmarkit.com.

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A) Glossary

Term	Definition
HHPI	means Halifax House Price Index (HHPI) family.
IHS Markit Benchmark Administration Limited (IMBA UK)	means the Administrator of the HHPI 1983 index family.
IHS Markit Website	means the following website: http://www.markit.com/Product/Halifax-House-Price-Index .
Index Base Date	is the date of the initial level of the index. See Table 1: Index Administration Events.
Index Commencement Date	is the date the index level was first published. See Table 1: Index Administration Events.
Index Manual	means this document, as amended, replaced or substituted, from time to time.
Index Owner	means IHS Markit.

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Please refer to the methodology for the Index for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations.

Information presented prior to an index's launch date is hypothetical back-tested performance, not actual performance, and is based on the index methodology in effect on the launch date. However, when creating back-tested history for periods of market anomalies or other periods that do not reflect the general current market environment, index methodology rules may be relaxed to capture a large enough universe of securities to simulate the target market the index is designed to measure or strategy the index is designed to capture. For example, market capitalization and liquidity thresholds may be reduced. In addition, forks have not been factored into the back-test data with respect to the S&P Cryptocurrency Indices. For the S&P Cryptocurrency Top 5 & 10 Equal Weight Indices, the custody element of the methodology was not considered; the back-test history is based on the index constituents that meet the custody element as of the Launch Date. Back-tested performance reflects application of an index methodology and selection of index constituents with the benefit of hindsight and knowledge of factors that may have positively affected its performance, cannot account for all financial risk that may affect results and may be considered to reflect survivor/look ahead bias. Actual returns may differ significantly from, and be lower than, back-tested returns. Past performance is not an indication or guarantee of future results.

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