CoreLogic

CoreLogic Home Value Hedonic Indices FAQs

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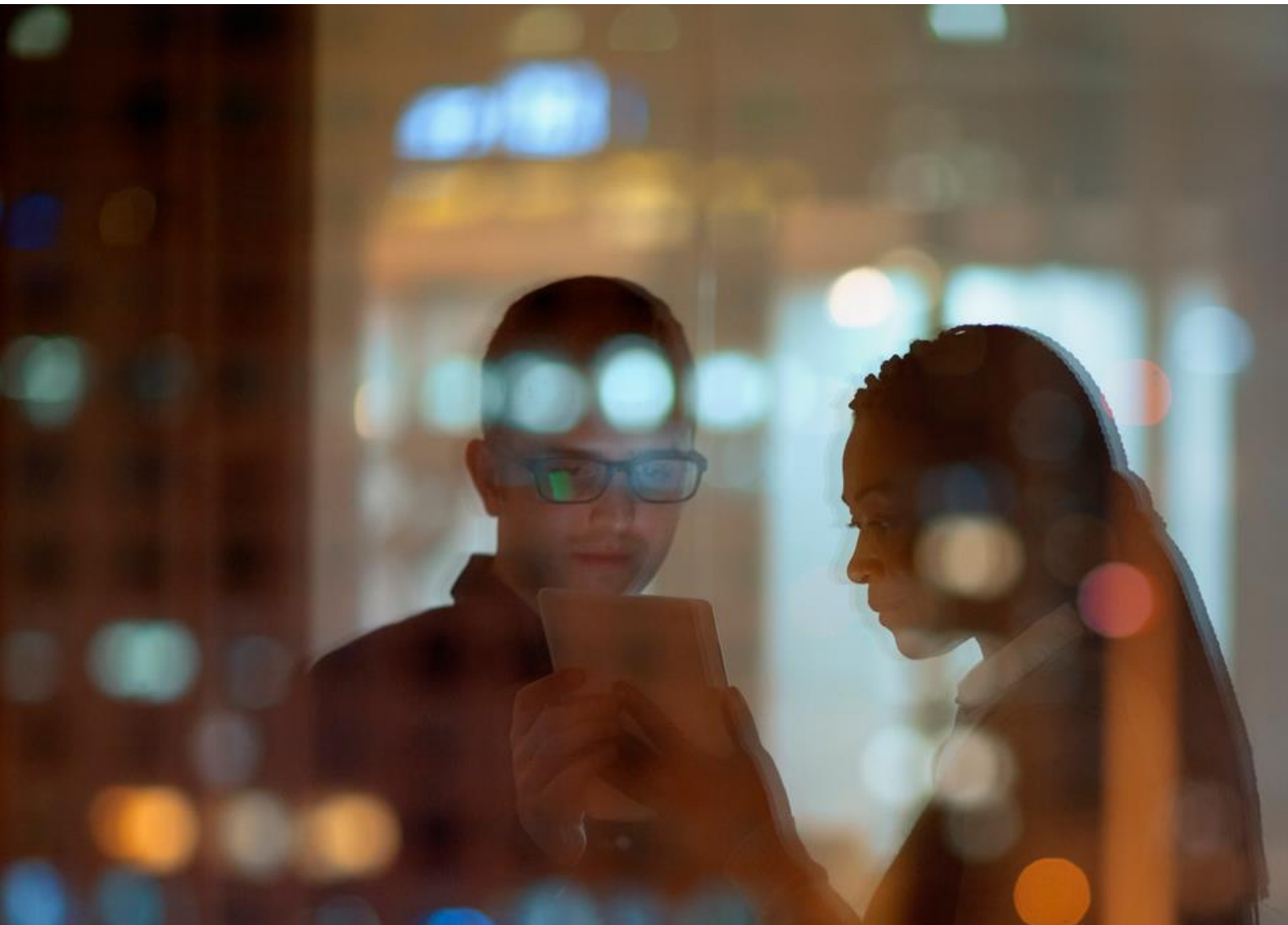

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1. Describing the index

1.1. What is an Index?

An index is a statistical device that summarises a particular underlying quantity (e.g. prices, values, or rental returns) for a given segment of the market in a single base figure. This figure is then used as a benchmark for measuring the change in the underlying quantity over time. The base figure is usually assigned an arbitrary value of 100 at a particular base date (all of CoreLogic's indices have a base date of 31/12/2009) and the values for all subsequent dates is expressed in relation to this base figure.

For example, an index value of 110 two years after the base date means that the underlying quantity has increased by 10% over the intervening two years.

1.2. What does the index value mean?

The index value itself has no intrinsic meaning – it simply serves as a means of benchmarking the changes in the underlying quantity. What's important to understand is how one index value relates to another index value as at a different point in time. The difference between these values expresses how much the underlying quantity has changed between the two points in time.

1.3. Why are there multiple price indices in the market?

Unlike shares on the ASX, bonds or commodities, there are two key characteristics of the property market that makes it difficult to create an accurate read of growth in the market:

1. Residential property as an asset class is not homogeneous – one property may not be a direct substitute for another property. This means that the agreement to purchase a specific property does not mean a separate property may be offered up for settlement.

   Additionally, existing properties are constantly evolving independently with new properties being constructed, changing the composition of the residential property market on a continuous basis.

2. Property markets exhibit much lower liquidity and turnover where only ~5% of all residential properties across Australia are transacted in any given 12-month period.

As a result, multiple methodologies exist to try and combat these inherent pitfalls, creating different readings that can be interpreted differently. Additionally, because there is no centrally managed source of property transactions, the underlying data used by different providers will be different and hence the resulting outputs will also be different.

1.4. What is meant by a 'market segment'?

The market segment is simply a collection of properties that share a common underlying attribute for which we are attempting to summarise (all the detached dwellings in a particular suburb, or all apartments in a capital city are examples of a market segment).

1.5. What constitutes a house or a unit?

From CoreLogic's perspective, a house is any property that is on a Torrens Title, where the title holder claims ownership upon the land which the property resides on. This includes property types such as semi-detached dwellings, terraces and duplexes.

A unit is any property that is on a strata title, where the title holders own a shared claim to common land that multiple properties may reside on. This includes property types such as villas and townhouses.

Both of these only refer to properties which have been deemed by regulatory bodies to be for residential purposes only.

2. Describing the hedonic regression

2.1. What is the Hedonic Index?

A hedonic index is an index that uses the Hedonic Regression methodology for estimating the underlying value of a particular quantity (e.g., prices, rents). The Hedonic Regression assumes that the quantity itself can be broken down into its constituent characteristics to obtain estimates of the contributory value of each individual characteristic. Within the real estate world, this means that the sale value or rental value of a particular property can be attributed to characteristics such as number of bedrooms, number of bathrooms, land size, floor area, location, etc.

By understanding the contributory value of each characteristic, we are able to infer the value of every property in the country and subsequently index the change in property values over time without requiring an actual transaction to be observed.

2.2. Why Hedonic methodology?

The two fundamental aspects of the property market explored in section 1.3 create a number of issues that need to be addressed when trying to identify the growth in a given market:

1. Observing only transacted properties creates a compositional bias – due to the homogeneity of property assets, the distribution of properties transacted do not accurately reflect or represent the entire underlying stock and you risk creating a view of the market that is informed by a small sample of the population due to the low turnover rate in the property market.
   For example, when the first home buyer's policy came out, a significantly larger proportion of properties transacted were made up of properties on the cheaper end of the spectrum resulting in a significant decrease in the average price of transacted properties.
2. Older transactions inform current views of market prices – due to the low turnover rate in the property market, prices from transactions dated many months prior are often used in order to produce enough observations to make sure there is a sufficiently representative sample of transactions being used to infer market prices.
3. Capital works factors significantly into the overall change in the property market – as properties constantly evolve and in particular, new properties are introduced to the market, there is often a premium paid for the generally higher quality of the new stock that does not accurately reflect the organic growth attributed to existing stock.
   For example, when large unit developments hit the market all at the same time, the spike in volumes combined with the low turnover rate can result in average prices being skewed towards the new builds, which may exaggerate the perceived growth of property prices.

The Hedonic method has been designed in part to combat each of these issues to create a more robust reading of the property market.

2.2.1. How does the Hedonic method account for compositional bias?

By estimating the values of all properties irrespective of whether they have transacted or not, the hedonic index creates a consistent apples-to-apples comparison when determining change, ensuring that all properties are included in the indexation process.

2.2.2. How does the Hedonic method account for property market illiquidity and delays in property transaction information?

By estimating the values of all properties irrespective of whether they have transacted or not, it fills the gaps for any information that is missing based on the available

information. This allows it to create a contemporary view of the state of the entire population despite only a small sample of observations being available. This process is improved by giving more weighting to newer records when determining the price contribution of the various hedonic attributes. This helps the index to produce accurate trends in real time in spite of data delays.

Additionally, the index is revised for 12 months following each release. This allows for the delayed transactions to be received and improves the historical accuracy of the index.

2.2.3. How does the Hedonic method account for changes in underlying stock?

By re-valuing all properties across the country based on their constituent characteristics, we are also able to account for any injection of capital (e.g., adding new bedrooms, expanding the land size or building new properties) that may artificially increase the overall value of properties. This is done during the indexation process when we compare the total value of properties in one period to the next, but only include properties that have not changed in characteristics between the two periods (i.e., only properties whose constituent characteristics have remained the same and existed in both periods are included in the comparison).

Effectively we are able to mathematically isolate the change in value associated with the passing of time as opposed to the changes in attributes.

2.3. What are some shortcomings of the hedonic method?

Inferred, not strictly factual – the hedonic method uses an estimate of the underlying quantity for every indexation point using observed transactions. The small number of observed transactions relative to the population of properties means that the majority of the indexation is driven by the model's ability to estimate the contributory value of underlying characteristics of residential properties.

Heavily dependent on data coverage – as the method relies on a model to breakdown the contribution of underlying characteristics to estimate values, significant breadth and depth of data is required to accurately and consistently compute the estimates. The model relies on the abundance of detailed property level information to make up for the absence of sufficient transaction observations.

2.4. How is this connected to Automated Valuation Models (AVMs) produced by CoreLogic?

The AVMs produced by CoreLogic is a completely different analytical solution and should not be confused with the Hedonic Index. Although both solutions leverage the

hedonic methodology in some way to impute an estimated value for every property in Australia, they do so with different objectives and as such are optimised differently.

CoreLogic's AVMs are produced for the sole purpose of gaining insight into an individual property as at a particular point in time, and therefore is optimised for estimating the likely sale value of the given property right now based on all available information. It takes into account more sources and additional algorithmic enhancements for this sole purpose.

CoreLogic's Indices are produced for the purpose of measuring market movement and therefore is less concerned about being optimised for estimation accuracy and more concerned with optimising for consistency in order to better understand how the portfolio value of properties change over time.

2.5. Where can I find a detailed technical documentation of the model implementation?

All technical documentation and methodology white papers can be found on our website at https://www.corelogic.com.au/our-data/corelogic-indices#methodology.

3. Changes to CoreLogic's Hedonic methodology from October 2023

From October 2023 the index methodology was overhauled to make the index revisionary. The rest of this section covers questions that may arise regarding this implementation. This section will often refer to the 'Prior Index' and 'New Index' which are the hedonic indices before and after implementing these changes.

3.1. What key changes were made to the CoreLogic Hedonic Methodology?

The underlying methodology itself is not a significant departure from the original Rismark International methodology published in 2011. In 2017, a major update was implemented to improve the model in a number of ways such as reducing volatility through a longer regression window and dynamic filtering method. In 2023 the hedonic index was updated again to allow revision in a rolling 12-month window in order to improve historical performance. The new hedonic methodology is documented in Section 2.5 – some of the important changes in the new index are highlighted below:

3.1.1. Revising the index in a 12-month window

CoreLogic's Hedonic Index benefits from receiving the majority of transactions through an agent's advice pipeline. In the 12 months to August 2023, CoreLogic

recorded 68.3% of sales prior to official notification of sales by the relevant Valuer General. By securing the early disclosure of the overwhelming majority of transactions, CoreLogic ensures more accurate representation of the underlying quantity of house price movements that it measures.

However, it is not possible to capture all relevant transactions before each index value is initially reported. As a result of these unobserved transactions, each publication of the index will show slight variance in monthly growth over time, which can produce more substantial discrepancies over extended periods.

By revising the index in a 12-month rolling window, the final growth reported for each period incorporates a complete view of all relevant transactions. This ensures the historical validity of the index without jeopardising its integrity in real time. The number of transactions recorded more than 12 months after each index publication is low, so it is not necessary to revise beyond this time.

3.1.2. Weighting the hedonic regression

Exponential weighting has been added to the hedonic regression component of the new index to help it adapt to trends in the market. Previously, the regression treated all transactions within a 12-month window as being of equal importance when establishing the value of the various hedonic attributes that make up a residential property. In practice, the significance of transactions correlates with their recency. By prioritising newer transactions, the index is more agile in identifying emerging trends. While this approach does heighten the sensitivity of the index to the natural volatility of housing prices, empirical tests confirm its overarching effectiveness. The impact of weighting is not ubiquitous across Australia, however as an overall mechanism it has been effective in improving the performance of the new index.

3.1.3. Alignment to new ABS standard geographies

All new index outputs will align with the ABS' 2021 Australian Statistical Geography Standard. This will ensure the index series published by CoreLogic are comparable with other metrics aligned with the latest ABS geographical boundaries.

3.2. How does the most recent publication of the index incorporating these changes compare with the previous results published by CoreLogic?

As part of the release from October 2023, the new index incorporates a completely revised back series incorporating all available data. The previous index had a similar back series generated in 2018, which means that the period from 1980-2018 is very similar between the two series. Beyond 2018, the indices experience increasing divergence as the new index benefits from a complete view of all relevant

transactions that were not available when the prior index was run. Consequently, the two series should not be directly compared. Going forward, the new index will continue to revise in a 12-month rolling window which is distinct from the initial back series that was created.

3.3. How have the changes been validated?

There are two stages of validation for changes of this magnitude to ensure that they represent a genuine improvement to the model. To begin with, all models were compared against the prior model in a dedicated testing environment. The ratio between valuations produced through these models and genuine observed sales from an out of time sample can be used to test the performance of the underlying hedonic regression. The preliminary results from this testing stage demonstrated the efficacy of both the revision and the weighting within the new index.

Secondly, linear models can provide an analytical estimate of confidence that serves as a measure of overall performance. The confidence in the new model back series is greater than in the prior model, demonstrating the improved accuracy of the hedonic model.

4. Other index construction methodologies

4.1. What other methods of index construction are traditionally used?

There are multiple other approaches used across the industry for measuring prices, each with its own strengths and weaknesses due to the way in which it tries to get around the heterogeneous and illiquid nature of the property market. There are various formulations of other hedonic indices, as well as non-hedonic methods – for the most part these alternative methods are selected due to simplicity, ease of implementation, and insufficient data. These methods include:

1. Hedonic time dummy indices
2. Median and stratified median indices
3. Repeat sales indices

4.1.1. What is the hedonic time dummy method?

A hedonic time dummy method works similarly to hedonic imputation in that the value of hedonic attributes is learned based on observed transactions. However, the time dummy index uses the entire history of transactions to train one model, where the 'period' each transaction occurred in is included as a binary hedonic attribute. Consequently, the model can learn the coefficient for each period to establish growth. This method is typically not preferred to hedonic imputation, because it assumes that the hedonic coefficients are fixed across time.

4.1.2. What is the median/stratified median method?

The simple median method simply looks at all the transactions in a particular time frame (e.g., typically one month, three months or 12 months) and takes the middle (median) value. It is the simplest approach to generalise prices for a given market and observing how it changes over time to indicate growth and progression within a market. A mean index is a similar index that is created by taking the average price instead.

The stratified median method goes through a process of stratification which creates subsets of properties which are qualitatively similar. Unique prices series are created for each individual subset then aggregated to estimate composition-adjusted price movements in the overall market.

The stratified median price index deployed by CoreLogic creates the subsets based on the median prices of individual suburbs. All properties are then grouped into stratum based on the median price growth of the suburb they reside in. A median price is then calculated for each strata, and the overall index result is calculated as the average across the growth in median prices for each strata.

4.1.3. What is the repeat sales method?

The repeat sales, or repeat observations, method estimates the performance of the market by analysing the returns on individual properties where there are at least two observed transactions, each at different points in time. These observation pairs are then aggregated together and generalised to estimate the contribution to growth of adjacent time periods.

4.2. What are the pros and cons of other methods?

These other methods are typically less timely and less robust at assessing more granular segments of the market when compared to the hedonic imputation method.

However, they can still provide an additional point of reference due to the unique angles through which they address the heterogeneous and illiquid nature of the property market.

4.2.1. What are the pros and cons of a hedonic dummy method?

The hedonic time dummy method is a simpler method relative to the hedonic imputation method, as one regression can account for the entire time period of the index.

The benefits of a hedonic dummy index are:

1. The hedonic regression compositionally adjusts based on observed attributes.
2. The model can revise the entire time series each calculation.

The disadvantage of a hedonic dummy index is:

1. The model relies on the assumption that hedonic coefficients are invariant over time.

4.2.2. What are the pros and cons of a stratified median method or a simple median method?

The stratified median method tries to overcome the heterogeneous and illiquid nature of the property market by grouping together similar properties into stratum. Each stratum is large enough to have sufficient volumes of observations while being small enough to delineate unique aspects of the property market.

The benefits of a stratified median price index are:

1. It is a direct summary of the prices observed in real settled transactions and does not try to computationally fill in the gaps.
2. It is able to control sufficiently for compositional bias at high levels of geography.

The disadvantages of a stratified median price index are:

1. It is not as timely as it depends on the availability of actual transaction results which can be up to three months delayed.
2. The approach cannot be applied consistently at more granular levels of geography.
3. It does not separate growth attributed to the construction of superior quality properties from the organic growth of existing properties.

The simple median (or mean) method has similar pros and cons. The benefit of a simple median method is it is a straight forward way to understand pricing relativity for affordability measures. It is not a great method for obtaining an accurate read on the change in prices over time due to the heterogeneous and illiquid nature of the property market (refer to section 2.2).

4.2.3. What are the pros and cons of a repeat sales method?

The repeat sales, or repeat observations, method tries to overcome the heterogeneous nature of the property market by looking at only properties that have transacted at two points in time to directly observe the growth between two distinct periods.

The benefits of a repeat observations price index are:

1. It provides an accurate indication of price changes in existing stock.
2. It is a direct summary of the prices observed in real settled transactions and does not try to computationally fill in the gaps.
3. It is also more accurate in the absence of sufficient coverage of underlying transactions – the method isn't influenced by the individual price levels of underlying stock.

The disadvantages of a repeat observations price index are:

1. It takes longer to take into account the impact of new stock on the market – there won't be many repeat observations for new stock in the short term.
2. It doesn't control for improvements or renovations done on existing properties.

4.3. How do the different methods' results compare to each other?

Generally speaking, the Hedonic index is much less volatile than other series and can be seen to identify the turning points in the market much earlier than the other methodologies. The hedonic methodology benefits from utilising all data to assess price movements, whereas simpler median indices (stratified or not) and especially repeat sales indices use a subset of available property data.

5. What can I obtain as a subscriber?

5.1. What indices are available?

Our CoreLogic Indices - Research Pack offering includes the following:

Type	Metric	History
Price Indices	- Hedonic Home Value Index - Seasonally adjusted Hedonic Home Value Index - Stratified Median Sales Price Index - Repeat Sales Price Index - Median Sales AVM Value - Median Sales Price - Mean Sales Price - Hedonic Listings Index - Hedonic Tiered Home Value Index - Low/Mid/High	- From 1980 onwards
Rental Indices	- Hedonic Rental Value Index - Hedonic Rental Yields - Median Rental Rate	- From 2005 onwards
Total Return	- Hedonic Total Return Index	- From 2005 onwards
Supporting Measures	- Preliminary Sales Volumes - Modelled Sales Volumes - Median Time on Market - Median Vendor Discounting	- From 1980 onwards - From 2005 onwards

5.2. How far back does the historical timeseries go?

See 5.1 above.

5.3. What geographies are available?

The Full Research Indices suite covers results for all of the following across Australia:

1. National
2. States
3. Combined Capital Cities
4. Combined Rest of State regions
5. Capital Cities and Rest of State regions.

All of these are in line with the Australian Bureau of Statistics' definitions of the Capital Cities and Rest of State regions as part of the 2021 Australian Statistical Geography Standard (ASGS). The indices are also aggregated to a number of Geographies smaller than those provided within the standard suites, down to the level of Statistical Area 2 and Suburb.

5.4. Why do you use the ABS ASGS boundaries?

We understand the need from all users of our Property Market Indices to compare it with other macro-economic indicators and data sets published by other providers. By keeping in line with the ABS definitions, we allow our users to make direct comparisons with all ABS statistics without having to worry about the impact of compositional differences due to having different geography definitions.

5.5. What will change for existing subscribers?

On October 2nd 2023, all existing subscribers will get the new index results, which include a:

1. change in geographic boundaries from the previous 2016 ASGS definitions of various ABS geographies to the 2021 version;
2. fully revised historical back series;
3. new weighting method that places greater importance on recent sales; and
4. revisionary index where the historical back-series will be updated and the most recent 12 months of index results will be revised each month.

All existing products will be moved to the new model including the Research and Economist packs. These changes will affect all of the indices and metrics with a hedonic component. Other indices such as our repeat sales index are only impacted in terms of geographical boundaries changing.

5.6. Can I have custom indices?

Yes – these can and will be produced on a bespoke basis. Please consult your account manager or reach out to the CoreLogic sales team to understand the process and pricing for the production of bespoke series.

5.7. What is the plan and timeline for future index releases?

CoreLogic is passionate about providing market-leading property research and analytic solutions. As part of our commitment to innovation and excellence, we are continuously looking for ways to enhance our data and solutions. Should future improvements be identified, customers will be notified prior to implementation. Smaller changes may be introduced as required.

6. Why should I use CoreLogic's Indices?

CoreLogic Indices are built upon one of the most comprehensive property databases in Australia, with deep coverage across the entire property lifecycle. This breadth and depth of data combined with over 40 years' of experience aggregating and managing property data, allows us to create Australia's only Hedonic Imputation Index suite.

Through CoreLogic's extensive relationship with the Real Estate Industry, we also have access to one of the timeliest datasets.

The original RP Data-Rismark Hedonic Home Value Index was one of the most sophisticated and trusted property value measures in Australia, had broad industry acceptance and was relied upon by economists, policy makers and a broad range of stakeholders across the real estate, banking and finance sectors. We continue to stay close to all property market participants to consistently improve upon our data and analytical methods to better support their needs in assessing the property market and servicing their clients.

6.1. How can I trust the results being published?

CoreLogic is committed to ensuring a high standard of quality when it comes to our analytical processes, and we put all our models through an extensive governance process that includes both internal and external audits:

1. We have multiple tiers of internal governance to review the model performance by applying rigorous out of sample testing before it is assessed against global best practice by our overseas counterparts.
2. In 2017 we also commissioned audits from KPMG and Academics from the University of Sydney and Macquarie University to assess whether the:
    a. technical methodology adheres to global industry best practice;
    b. performance of the model meets benchmarking standards; and
    c. technical methodology is implemented as documented within CoreLogic's whitepaper.

3. The technical implementation of the model itself is also aligned to the methodology published by Eurostat (the ABS equivalent of the European Union) legislated for use by the European Commission and endorsed as best practice by the Internal Monetary Fund and Bank for International Settlements.

Since the time of publication for both the Eurostat report and the audits, the field of index theory has not shifted significantly. As a result, the new model has only received small changes beyond being made revisionary, and still aligns with industry best practises.

The whitepapers and reference documents can all be found on our website (https://www.corelogic.com.au/our-data/corelogic-indices)

6.2. Why don't other providers publish a hedonic index?

In order to create a Hedonic Index, there are a number of requirements from a data and processing perspective:

1. It requires timely data – the absence of timely data means the results will be volatile and less accurate when you try to estimate the values of properties at a point in time.
2. Depth of data – because the hedonic approach is underpinned by the ability to assign contributory value to underlying characteristics of the property, a shallow coverage of property characteristics greatly limits the ability to leverage the hedonic methodology.
3. Analytical rigour – the computational complexity of a hedonic approach means that simple difference in data or implementation can require significant theoretical assessments to understand the mathematical implications, the absence of which can result in inaccurate readings of the market.
4. Significant infrastructural requirements – the estimation of values for every property in the country every day is a very computationally intensive process that would require significant investment in the underlying production environments in order to maintain.

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