

Developing a Residential Property Price Index (RPPI) for Canada: Approach, Risks and Challenges

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Abstract

Statistics Canada's New Housing Price Index (NHPI) dates back to 1981. The index measures monthly price changes in the sale of new houses only. The resale market is not included, and some dwelling types such as condominiums and apartments are also not covered. Given the important contribution of the residential property market to overall economic activity, and its role in trend analysis and policy making, Statistics Canada is working to develop a more comprehensive and representative residential property price index which will address existing limitations and better align with user needs and international guidelines.

This paper outlines the risks and challenges Statistics Canada faces in the development of a residential property price index. These challenges range from methodological, such as coverage, collection and weighting, and the risks associated with potentially using data collected outside of Statistics Canada, to the difficulties of balancing internal data needs with international data requirements. The paper begins with a discussion of the current measures of housing prices in Canada, including the NHPI and indexes produced outside of Statistics Canada, and outlines how those measures could be strengthened, in terms of coverage, sampling, collection and the use of hedonically-enhanced price adjustments. The potential approaches to developing a residential property price index, or combination of indexes, are then explored, along with the associated risks and challenges.

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1. Introduction

Given the relatively large contribution of the housing sector to the overall economy, the monitoring of trends in residential housing prices is important for informing financial and monetary policy.

Statistics Canada's New Housing Price Index (NHPI) measures price changes in the sale of new dwellings. By definition, price movements of the existing housing stock are excluded from the measure, as are some dwelling types such as condominiums. In order to accurately measure changes in residential property prices, a comprehensive index should include all housing types, both new and those sold on the secondary market.

To this end, Statistics Canada is conducting a feasibility study for the development of a new Residential Property Price Index (RPPI). The index will include an enhanced NHPI, as well as an index for condominiums and the resale housing stock. This paper provides an overview of the challenges and ongoing work to consult potential users and identify data needs, evaluates the risks and benefits of using data collected outside of Statistics Canada, and proposes recommendations for data sources, methods and approaches towards developing a RPPI.

2. Existing indexes : strengths and limitations

2.1 New Housing Price Index

The New Housing Price Index (NHPI) is a monthly index that measures changes over time in contractors' selling prices of new residential houses for 21 geographic areas in Canada¹. The NHPI is based on a matched model, a variant of the repeat sales approach, using detailed specifications that remain the same between two consecutive months. The realities of the Canadian new housing market favour the use of a matched model approach. In Canada, new housing is typically developed by builders who construct entire subdivisions of homes that closely resemble one another in size, style and land features. Statistics Canada collects data on monthly selling prices (transaction prices) directly from a survey of contractors, together with contractors' estimation of the market value of minor variances between these homes.

¹ The geographic area represented is the Census Metropolitan Area (CMA), consisting of one or more neighbouring municipalities situated around a core. A CMA must have a total population of at least 100,000 of which 50,000 or more live in the core.

The NHPI has several advantages. It provides timely information on residential property market conditions and benefits from a broad coverage and high level of geographical detail. Moreover, the underlying survey collects contractors' estimates of the current cost of land, therefore allowing the calculation of an independent index for land prices. The residual (selling price less land) is also indexed independently and published as an NHPI house-only index².

Given its properties, the NHPI is widely used by policymakers in Canada, particularly the Bank of Canada and Finance Canada. It is also used as an input in the derivation of major economic indicators such as the Consumer Price Index (CPI) and national accounts estimates.³ The land/house split is particularly important for both Statistics Canada and other users; currently this estimate is not available elsewhere.

Despite the long history and extensive usage of the NHPI, it has become increasingly clear that a more comprehensive measure is required. First, the NHPI measures changes in the price of new houses only, as such it is not necessarily representative of resale prices of residential properties in Canada. The houses surveyed for the index are generally found in new developments in the suburbs which are not representative of all housing units and the movements over time in land prices in suburbs are generally different from price movements in the downtown core. The degree of representativeness is further reduced by the fact that not all types of housing are covered – most notably condominiums.

Moreover, the decomposition of price information into land and structure components, although highly desirable, can be difficult to estimate. The allocation of value to land or structure is a difficult task and contractors do not report lot prices uniformly, resulting in respondent bias. A particular concern is the reporting of the price paid to acquire the lot at its historic cost – the longer the time lag between the lot acquisition and the sale of the new property, the more likely the understatement of the reported land value.

² The NHPI is comprised of both elemental and aggregate calculations. The elemental index is calculated using the Jevons formula (equally weighted geometric mean) combining housing models quotes across builders. The aggregate NHPI is the weighted combination of city estimates to national totals for each series component (house, land, total). The index used for this calculation is a fixed weighted Laspeyres type (Lowe) formula.

³ The NHPI house-only index is used in the estimation of certain shelter components of the CPI (replacement cost index and homeowners' insurance for owned accommodations). The total NHPI is an input in the compilation of mortgage interest for owned accommodation and real estate commissions. Within the SNA, the NHPI is used in the estimation of the value of the national housing stock in the national balance sheet program. The NHPI house-only serves as a deflator for the value of new residential business construction.

Several improvements are already underway and plans for other enhancements to address the limitations identified above are in progress:

2.1.1 Sample increase

Over the last few years, the NHPI sample has been increased by about 60 builders in order to optimize representativeness. Most of the sample increase has been implemented into the regular production process, and this has improved the quality of index. As new builders and more house models are added to the sample, the impact of outliers is reduced and the number of observations for the purpose of hedonically-enhanced regressions is augmented.

2.1.2 Hedonically-enhanced price quotes

Accounting for quality change can be a challenge and this is particularly true for housing prices. The NHPI uses a matched model approach and links in new models in such a way that a model replacement is treated like a new good and the index is calculated with a missing price quote in the link month(s). Nonetheless, a potential new-goods bias in the index may remain. To address this issue, and more importantly to address data collection issues that may have led to index bias, hedonic models have been created and an 'hedonically-enhanced' approach has been proposed. Hedonically-enhanced indexes are those where another methodology (such as matched models) is used, and hedonics is used solely to impute a price movement between the discontinued model and its replacement. Hedonically-enhanced models are being used to produce price indexes in Canada's largest cities, where the sample size is sufficient to produce reliable results: Toronto, Montréal, Vancouver and Calgary.

2.1.3 Condominiums

Currently the NHPI comprises only single family dwellings. It has become increasingly apparent however, that condominiums represent a growing portion of the new housing market, particularly in urban areas, and their omission from the NHPI is viewed as a significant data gap⁴. Furthermore, provincial governments and the various players in the real estate market are interested in having an index that would track changes in the new condominium market in their respective areas. The final recommendation of a feasibility study on including condominiums in the NHPI, conducted by Statistics

⁴ In 2010, 26% of dwellings were apartments; 28.7% in 2011. According to the description of Statistics Canada's Building Permits Survey, apartments include almost all the condominiums in Canada (Statistics Canada, Building Permits Data).

Canada in 2011, is that the new condominium index be based on data collected from a survey of condominium builders and estimated by the matched sample method with hedonically-enhanced price adjustments when there are model changes. It was also recommended that the new condominium index be calculated as a separate index from the NHPI. Coverage would include nine geographic areas, covering close to 90% of the condominium market in Canada.

2.2 Private sector resale price indexes

There are two existing indexes produced outside of Statistics Canada, which cover the resale housing market in Canada. The Multiple Listing – Home Price Index (MLS-HPI) and the Teranet - National Bank House Price Index (TNB-HPI) are presented below. Together, the enhanced NHPI and an index of resale housing prices could potentially provide a new measure of residential property prices. This approach is being carefully considered by Statistics Canada, in an effort to minimize duplication of work and response burden. As a part of this initiative the strengths and limitations of each of the two existing indexes are being reviewed.

The methods used to derive the TNB-HPI, as with the MLS-HPI, have not been fully evaluated by Statistics Canada, which makes it difficult at this stage to make any assessment of their quality. Statistics Canada would also have to assess the potential for changes to index methodology and coverage. The continuity of the time series may be at risk if the indexes were to be used by Statistics Canada in conjunction with the NHPI.

2.2.1 MLS Home Price Index

The Multiple Listing Service – Home Price Index (MLS-HPI) is the newest addition to the set of indexes covering the resale market in Canada. Released by the Canadian Real Estate Association (CREA), the MLS-HPI uses a hybrid model, combining repeat sales and hedonic components. The index is produced monthly for six major housing markets. Separate indexes are produced for each geographic area and for different property types including condominiums, along with an aggregate composite.⁵

The MLS-HPI relies on benchmarking to allow for easy comparison between areas and types of housing

⁵ The metropolitan areas covered are the Greater Vancouver, Fraser Valley, Calgary, Regina, Greater Toronto and Greater Montreal, representing the local real estate boards that have worked in association with CREA on developing the MLS-HPI. Current plans see coverage expanded to 19 markets over the next two years as additional real estate boards join the project.

units. It uses a defined 'benchmark home', a house whose price-determining characteristics are typical for properties traded in that particular location. The index makes use of the significant resale price data collected through the CREA's multiple listing service (MLS) system, and attempts to control for quality changes over time that distort average or median property prices. The MLS-HPI uses data as of the transaction date - the date upon which a contract is signed without conditions. The geographical coverage of the MLS data, although extensive, is skewed towards mostly major metropolitan areas. CREA has already stated its intention to negotiate with additional real estate boards to join the MLS-HPI project. Another limitation of this approach is , the absence of data on private transactions, that is, properties marketed outside the MLS system. Venues available for private transactions have increased in importance in recent years, currently accounting for anywhere between 10% and 30% of the total residential properties sold in Canada.⁶

2.2.2 Teranet – National Bank Composite House Price Index

The Teranet-National Bank House Price Index (TNB-HPI) covers independently developed measures of changes in residential property prices in eleven metropolitan areas, which are aggregated into a composite national index.⁷

The TNB-HPI is a repeat sales index with monthly frequency and a two-month lag release. It has the advantage of reflecting actual transaction prices on the resale market, including condominiums.

Although the TNB-HPI attempts to adjust for quality changes of the individual housing units by adjusting for the effect of renovations and additions, depreciation of the properties that are resold is neglected causing some difficulty in comparing one sample period to another. Specifically, the omission of housing depreciation results in a downward bias for the Teranet Index. The data used in the derivation of TNB-HPI are prices at registration, taken from government land registry databases. Therefore, the reference date for a given transaction (and the associated price) is the closing date. This will likely turn into a weakness during rapid and substantial market movements, as the index will identify market turning points with a few months' lag (i.e., the average lag between the transaction date and the closing date). In conjunction with other measures of price changes, TNB-HPI data is used for real estate market analysis

⁶ Accurate estimates for transactions through non-MLS (private) venues are difficult to come by – the most cited estimate is around 30%, however, MLS sources argue that it is more in the 10% range.

⁷ The initial coverage of the TNB-HPI was six major metropolitan areas (Ottawa, Toronto, Calgary, Vancouver, Montreal and Halifax). Recently, five additional areas were added: Victoria, Edmonton, Quebec City, Winnipeg and Hamilton.

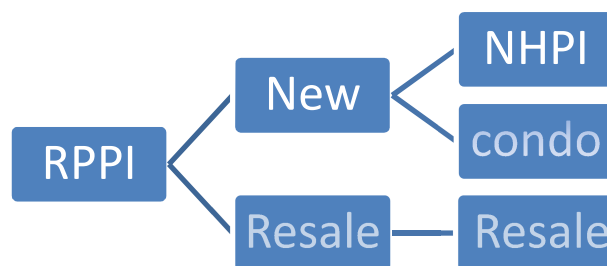
and general economic analysis. It is also used by Statistics Canada as part of the estimation process for the value of residential properties in the national balance sheet program of the System of National Accounts (SNA).

3. Framework and approach for a Canadian RPPI

Although there are a number of residential property price indexes for Canada, arguably none is fully representative of the broader Canadian housing market. The purpose of this section is to discuss the framework and possible approaches to developing a Canadian RPPI as an official indicator of residential property prices.

The proposed framework for a RPPI shows both the new and resale housing markets (Figure 1). The new component includes the existing NHPI with all of the enhancements mentioned in the previous section, as well as an additional index covering new condominiums. The resale component requires data from an existing source or the development of a new survey program to capture housing prices of the existing stock.⁸ The resulting RPPI would be a comprehensive measure which can be disaggregated into its component indexes, at the required levels of geography.

Figure 1.



One approach currently being explored uses one (or both) of the existing indexes to measure the 'Resale' component of the RPPI. This would involve a thorough review of the data collection, quality and index methodology processes. The risks of relying on private sector data and indexes are being carefully considered and will be discussed in more detail in the next section. Both the risks and the advantages of

⁸ Since the two existing indexes under consideration (MLS-HPI and TNB-HPI) already include condominiums, the 'Resale' component in Figure 1 includes all the relevant dwelling types, while a new condominium index will need to be added to the 'New' component.

this approach will be weighed against the alternative, which is for Statistics Canada to develop its own price index for resale housing. The latter approach would draw heavily on the Agency's resources, both in terms of cost and expertise required to run the new index program. It also has implications for response burden, which is carefully reviewed and evaluated by senior managers at Statistics Canada where decisions regarding new survey programs are concerned. This is part of a government wide initiative to reduce red tape. Regardless of which approach is used to construct the RPPI, a comprehensive consultation process is underway to better understand the current uses of the NHPI, and potential uses of a RPPI.

3.1 International reporting and uses

International practices are guiding Statistics Canada's approach to developing a RPPI. The significant role of accurate and reliable residential property price statistics in policy making has been increasingly recognized by the international community. Real estate price indices are a fundamental part of the G-20 Data Gaps Initiative, and international organizations led by the International Monetary Fund (IMF) have set the basis for a coordinated effort to improve the availability of such statistics in most countries. In particular, the IMF is strongly encouraging countries to collect and compile property price indices, and has solicited the cooperation of national statistical agencies and central banks. Although the difficulties in constructing property price indices are recognized, there is increasing demand for RPPIs for G-20 countries.

Indices of residential and commercial real estate prices are already a component of the IMF's set of 'encouraged financial soundness indicators (FSIs) for real estate markets', but the reporting on this indicator has been limited. Canada participates in the FSI program via a joint submission by the Bank of Canada and Statistics Canada, however, no indicator of residential property prices is included in this submission since an official indicator does not exist in Canada.

Linked to these efforts, G-20 countries are encouraged to adhere to a new and broadened Special Data Dissemination Standard SDDS Plus. SDDS Plus is an upper tier of the IMF's Data Dissemination Standards, designed to help address data gaps identified following the global financial crisis. It covers what is considered to be a number of the G-20 Data Gaps with established conceptual and data

frameworks, and includes residential property price indices.⁹

In addition, the need for property price indexes that are fit-for-purpose was recognised at a conference organised jointly by the IMF and the Bank for International Settlements (BIS) in Washington DC, in October 2003. It was determined that monitoring the development of house prices is important and two separate types of RPPI can be distinguished: a constant quality price index for the stock of residential housing at a particular moment in time and a constant quality price index for residential property sales taking place during a particular period of time. The construction of these two types of indexes would be different; most particularly the weighting method associated with each of the two types.

3.2 User consultations

In addition to the need for a more comprehensive measure of housing prices to fulfill international reporting requirements, a number of Statistics Canada programs would benefit from the development of a RPPI. An extensive consultation process is underway with potential users of a RPPI, as well as external users and clients who depend on the main economic indicators produced by Statistics Canada.

The most important internal users of a RPPI would be the Consumer Price Division (CPD) and the System of National Accounts (SNA). A RPPI would significantly improve the derivation of the Consumer Price Index (CPI). Just as the NHPI is currently used to estimate the effect of changes in the prices of dwellings on outstanding mortgage loans (Mortgage Interest Cost Index), a RPPI would also factor in the prices of resale dwellings. The same is true for the Real Estate Commissions Index component of the CPI, which is currently tied to movements in the prices of new homes. A house price index for these purposes should ideally include both new and used dwellings. Similarly, a RPPI would improve the measurement of aggregate wealth in the economy in the SNA. Residential properties constitute a major asset class on the balance sheets of households. A corresponding price index is an essential input into the derivation of improved estimates of household wealth, for the deflation of the value of residential building construction and the estimation of the value of the national housing stock in the SNA.

In addition, the development of a RPPI would be of interest to many external users, including the Bank of

⁹ Canada is a subscriber to the IMF's Special Data Dissemination Standard (SDDS), which prescribes the dissemination, advance release dates, timeliness and associated metadata for a number of key economic variables.

Canada (monetary policy and financial stability) and Finance Canada (fiscal and regulatory policy), as well as federal government agencies, such as the Canada Mortgage and Housing Corporation (CMHC), the financial industry, real estate and construction industries and associations, market analysts, academics and the general public as a reliable and timely indicator of real estate market conditions.

Consultations have been ongoing with both internal and external users to ensure that all data requirements, uses and impacts are taken into consideration. Taken together, the international guidelines and user consultations will be an important part of the evaluation phase of this work.

4. Risks and challenges

As mentioned earlier, two private sector indexes already measure the Canadian resale housing market, thus it makes good sense to explore the possibility of using one or both of these indexes, which covers a much broader sample than we would expect from a direct measure approach by Statistics Canada.

However it should be noted that using data from the private sector is not a frequently used approach for Statistics Canada and the logistics of this type of arrangement need to be carefully navigated. Complete reliance on a private provider for the resale component of a RPPI data may expose Statistics Canada to new risks with respect to data quality, reliability, potential for index manipulation, index longevity and changes or revisions to index methodology. There are few precedents for use of data from a private source and navigating this new territory has implications for the agency's reputation as a credible national statistical organization.

Although the methodologies for both existing indexes are available, the details of the methods are not and the micro data are protected under confidentiality agreements. Thus, it has not yet been possible for Statistics Canada to certify the quality of the data or the resulting indexes. Given Statistics Canada's high standards for quality assurance and its policy on informing users of data quality and methodology, as well as the fact that a RPPI would be used in components of the CPI - which cannot be revised – the financial and policy implications of error or manipulation could have serious consequences and damage the credibility of both the CPI and Statistics Canada. There must be some provisions made for evaluation where Statistics Canada could be afforded periodic access to the microdata and the methods used to produce the indexes.

Uncertainty regarding the longevity of the index and the lack of control over the geographic coverage are

also concerns; if the index chosen was no longer produced for some geographical areas or was discontinued, Statistics Canada would be left with very limited options. Any partnership with a third-party should include negotiating elements to cover potential risks to index maintenance, continuity and comparability over time, all essential to Statistics Canada's RPPI initiative. In addition, Statistics Canada would need to be informed, in a timely manner, of any changes to the methodology or composition of the index.

If Statistics Canada produced its own resale house price index, detailed micro data would need to be collected or obtained from administrative data, and analysts would be required to produce the index in-house. Of course, this approach would ensure full control over confidentiality, data quality and the methods used, however it would also require a considerable amount of resources and costs, in addition to implications for response burden measurement initiatives.

Ultimately, Statistics Canada must determine how much is an appropriate level of risk and whether the risks outweigh the implications of creating its own resale index program. Any risks would have to be considered against the substantial advantages of human resource and cost efficiencies as well as the reduced response burden.

In addition to the risks mentioned above, several technical challenges are discussed below:

4.1 Weighting

Based on user consultations, in order to produce a RPPI that can be used in different ways by the SNA, CPI and other statistical programs, the 'constant quality price index for residential property sales that took place during a particular period of time' is considered the preferred RPPI. As mentioned in an earlier section, this is one of the two types of RPPIs outlined in the Eurostat handbook. Using this method would require Statistics Canada to choose weights that represent the aggregate dollar value of dwellings sold (new and resale). To build the RPPI structure and assign the proper weights, the choice of dataset will need to be based on factors such as frequency, geography, type of dwellings, land/structure split, and the extent to which the dataset covers the residential market, all constrained by database availability.

Frequency

Annual data are needed to calculate weights, as the housing market changes and adapts to the dynamics of the population (migration or ageing of the population) and to economic issues (boom or recession).

Geography

Canada is vast and diverse and each housing market region adjusts at a different pace to internal or external factors. The geographical delimitation of Canada is complex and not equally distributed. In 2013, a total of ten provinces and three territories were the basic geography levels. Moreover, Statistics Canada uses standard Census Metropolitan Areas (see footnote 1) to cover the urban centres of most interest. Each of those geographical entities could adjust differently in terms of timing to a shock or to the presence of factors creating stimulus to a specific region. The geographical level chosen for the weights will depend on the availability of the data and the type of data holdings.

Type of dwelling

If prices for each type of dwelling (single, semi-detached, multiple) move differently and the price factors responsible for those price movements are different, this would indicate that the RPPI needs to be decomposed by type of dwelling. Given the potential to decompose the RPPI by type of dwelling, Statistics Canada would need a source of weights (i.e., the aggregate value of transactions) for each housing type.

Land /Structure Split

Through the consultative process, it has become clear that having a land/structure split is an important element of any housing price index. It would be possible to add such a question to a condominium survey; however it is a difficult concept to define for condominiums. While the value of the land for the whole development is fairly easy to define, there is some debate on associating land value with a particular unit. The most logical and consistent method may well be to divide the land value by the number of units, as each occupant has equal access to the land. It is harder to develop a 'matched model' for condominiums than for standard detached homes. There are characteristics that affect the price of condominiums over and above those that make determine price for standard detached homes (land and house size, location, etc.). Particularly, in a condo building, units with a desirable view or higher up or facing a particular direction command substantial premiums or discounts compared to units in the same building that otherwise have the same layout and size. As part of the RPPI feasibility study,

Statistics Canada will be consulting with building associations in order to gain some insight into this question. Industry information will also be used to assess the pricing strategy for condominiums. Determining which characteristics influence price will help us design the questionnaire and ultimately conduct hedonics and/or a matched model.

The conceptual issues of how to split property prices into their 'land' and 'structure' components is not limited to condos. The private-sector indices (CREA, Teranet) under consideration provide no separate land and structure components. A method would have to be developed to approximate such a split, possibly by adoption of a hedonic method as outlined by "The decomposition of a House Price Index into Land Structures Components: A Hedonic Regression Approach" (Erwin Diewert, 2010).

5. Conclusions

Statistics Canada recognizes the need to develop a more comprehensive housing price index. This need stems from both international reporting requirements and the need for a more accurate measure of housing prices. Enhancements to the current measure (NHPI) are well underway, including increasing the sample size, improved data quality through the use of hedonics and the expansion of dwelling types to include condominiums. In addition, the ongoing project to assess the feasibility of a RPPI for both new and resale housing prices is progressing, with a report and recommendations planned for the fall of 2013. Despite the potential risks and challenges with this work, Statistics Canada, in consultation with key external users and guided by international commitments, is laying the ground work for an accurate and reliable residential property price index. The biggest challenge to developing a RPPI will be the balance between optimizing quality and efficiency, and minimizing response burden, cost and risk.

Glossary¹⁰

Aggregate

A set of transactions (or their total value) such as the total purchases made by households on residential property in a certain period.

Aggregation

Combining, or adding, different sets of transactions to obtain larger sets of transactions. The larger set is described as having a higher *level* of aggregation than the (sub-)sets of which it is composed. The term “aggregation” is also used to mean the process of adding the values of the lower-level aggregates to obtain higher-level aggregates. In the case of price indexes, it means the process by which price indexes for lower-level aggregates are averaged to obtain price indexes for higher-level aggregates.

Consumer price index (CPI)

A monthly or quarterly price index compiled and published by an official statistical agency that measures changes in the prices of consumption goods and services acquired or used by households. Its exact definition, including the treatment of *owner-occupied housing*, may vary from country to country. In Europe, the Harmonised Index of Consumer Prices (HICP) currently excludes owner-occupied housing.

Coverage

The set of properties of which the prices are actually included in a price index. For practical reasons, coverage may have to be less than the ideal scope of the index. That is, the types of property actually priced may not cover all of the types that are sold or belong to the housing stock.

Deflating

The division of the current value of some aggregate by a price index (in this context referred to as a *deflator*), in order to revalue its quantities at the prices of the price reference period.

Elementary aggregate

Usually defined as the lowest aggregate for which expenditure data are available and used for index construction purposes. Elementary aggregates also serve as strata for the sampling of items to be priced. The values of the elementary aggregates are used to weight the price indexes for elementary aggregates to obtain higher-level indexes. In the context of a sales-based residential property price index, the term elementary aggregate is less appropriate. As every property is basically unique, the quantities are equal to 1, so that weights are available at the most detailed level.

Existing dwellings

The term “existing dwellings” is sometimes used to distinguish them from dwellings that are newly built (and added to the housing stock).

Fisher price index

The geometric average of the Laspeyres price index and the Paasche price index. The Fisher index is *symmetric* and *superlative*. Sales based residential property price indexes can always be computed using the Fisher formula because the quantities are equal to 1 (as each dwelling is essentially a unique good).

¹⁰ European Commission, EUROSTAT. November 2011. *Draft - Handbook on Residential Property Price Indices (chapters)*. The Netherlands. Chapter 13.

Geometric Laspeyres index

A weighted geometric average of the price relatives using the expenditure shares of the price reference period as weights.

Hedonic regression

The estimation of a hedonic model, using regression techniques, that explains the price of the property as a function of its characteristics (relating to the structures as well as the location). See also *hedonic imputation approach* and *time dummy variable hedonic approach*.

Hedonic imputation approach

An approach to estimating a quality-adjusted residential property price index where “missing” prices are imputed using a hedonic regression model. The model parameters are re-estimated in each time period, which makes this approach more flexible than the time dummy variable hedonic approach.

Housing stock

The total number of residential units available for nontransient occupancy. Depending on the particular definition used, the housing stock may or may not include mobile homes, etc.

Jevons price index

An elementary price index defined as the unweighted geometric average of the sample price relatives.

Laspeyres price index

A price index in which the quantities of the goods and services refer to the earlier of the two periods compared, the price reference period. The Laspeyres index can also be expressed as a weighted arithmetic average of the price relatives with the expenditure shares in the earlier period as weights. The earlier period serves as both the weight reference period and the price reference period.

Lowe price index

A price index that measures the change between periods 0 and t in the total value of a set of goods and services at fixed quantities. The quantities do not necessarily have to consist of the actual quantities in some period. The class of indexes covered by this definition is very broad and includes, by appropriate specification of the quantity terms, the Laspeyres and Paasche indexes.

Matched models approach

The practice of pricing exactly the same product, or model, in two or more consecutive periods. It is designed to ensure that the observed price changes are not affected by quality change. The change in price between two perfectly matched products is sometimes described as a pure price change.

Paasche price index

A price index in which the quantities of the goods and services considered refers to the later of the two periods compared. The later period serves as the weight reference period and the earlier period as the price reference period. The Paasche index can also be expressed as a weighted harmonic average of the price relatives that uses the actual expenditure shares in the later period as weights.

Price relative

The ratio of the price of an individual product in one period to the price of that same product in some other period.

Pure price change

The change in the price of a property of which the characteristics are unchanged or the change in the property price after adjusting for any change in quality (due to renovations, extensions and depreciation).

Owner-occupied housing

Dwellings owned by the households that live in them. The dwellings are fixed assets that their owners use to

produce housing services for their own consumption, these services being usually included within the scope of a CPI. The rents may be imputed by the rents payable on the market for equivalent accommodation or by user costs.

Quality change

A change in the (quality determining) characteristics of a good or service. In the case of a residential property this includes both depreciation of the structure and renovations, such as the modernisation of kitchens and bathrooms, the introduction of improved insulation and central heating or air conditioning systems.

Quality adjustment

An adjustment to the change in the price of a property of which the characteristics change over time that is designed to remove the contribution of the change in the characteristics to the observed price change. In practice, the required adjustment can only be estimated. Different methods of estimation, including hedonic methods, may be used in different circumstances. These methods can also be used to control for compositional or quality mix changes over time in the samples of properties sold.

Repeat sales method

A method to compile a residential property price index which compares properties that were sold twice or more in the data set at hand. It is a regression-based approach that only includes time dummy variables.

Representative property

A property, or category of properties, that accounts for a significant proportion of the total expenditures within some aggregate, and/or for which the average price change is expected to be close to the average for all properties within the aggregate.

Superlative index

Superlative indexes are generally symmetric and have good properties from an index number theoretic point of view. Examples are the (arithmetic) Fisher and the (geometric) Törnqvist index.

System of National Accounts (SNA)

A coherent, consistent and integrated set of macroeconomic accounts, balance sheets and tables based on internationally agreed concepts, definitions, classifications and accounting rules. Household income and consumption expenditure accounts form part of the SNA.

Time dummy variable (hedonic) approach

One of the main hedonic regression approaches to constructing a (residential property) price index. In the standard log-linear time dummy variable model, the characteristics coefficients are constrained to be fixed over time, and the price index numbers can be directly computed from the time dummy coefficients (through exponentiation).

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