Unified Approach to Statistics Canada's Residential Property Price Index

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Accounting for quality differences between goods is a concern when constructing a price index, in particular for very heterogeneous goods like residential properties. The goal of a price index is to capture a pure price movement across two periods, but if there are systematic differences in the goods being compared over time that also affect price—so called differences in quality—then a pure price movement cannot be captured using transaction prices.

Statistics Canada publishes a New Housing Price Index (NHPI), an Experimental New Condominium Apartment Price Index (NCAPI), and is developing a Resale Residential Property Price Index (rRPPI) to capture these three distinct markets. Each of these sectors have their own unique dynamics that require individualized approaches to index methodology and quality adjustment. Statistics Canada will be combining the NHPI, NCAPI and rRPPI into one Residential Property Price Index (RPPI) in order to capture the price inflation in the residential property market. Bringing these unique markets together into one price index requires a unified approach to the concepts of constant quality indexes.

New Housing Price Index

Matched Model

Hedonically Enhanced New Housing Price Index

Hedonics for Model Replacement New Condominium Apartment Price Index

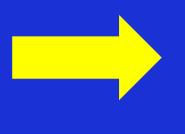
Stratification

Resale Residential Property
Price Index

Repeat Sales

Potential Outcomes Framework

A constant-quality index averages price relatives based on potential prices so that quality is held fixed over time.



What a property i at a point in time t would sell for in period τ , $p_{it}(\tau)$, compared to period 0, $p_{it}(0)$, irrespective of when it actually sells,

$$\log I_{0:\tau}^{C} = E[\log p_{it}(\tau)] - E[\log p_{it}(0)].$$

In practice potential prices are not observable; all that can be observed are transaction price:

$$p_{it} = p_{it}(0) + 1[t = \tau][p_{it}(\tau) - p_{it}(0)].$$

 X_{it} is a vector of characteristics for a property; the following assumptions can identify a constant-quality index with transaction prices.



Conditional independence: the distribution of potential prices is independent of time, conditional on X_{it} , so that $\{p_{it}(\tau), p_{it}(0)\} \perp t | X_{it}$.

Overlap: there are properties that sell in both periods, conditional on X_{it} , so that $0 < P(t = \tau | X_{it}) < 1$.

With overlap and conditional independence, the constant-quality index can be written as a function of transaction prices:

$$\log I_{0:\tau}^{\mathcal{C}} = E[\log p_{it}(\tau)] - E[\log p_{it}(0)]$$
$$= \sum_{i=0}^{\infty} (E[\log p_{it}|X_{it} = x, t = \tau])$$

A matched-model, hedonic, stratified, and repeat-sales indexes are all special cases of a constant-quality index that attempt to operationalize an assumption of conditional independence while satisfying the overlap condition.

Matched Model

- A model must sell in both periods for the overlap condition to be satisfied.
- This is the finest partitioning of properties and gives the best chance for conditional independence to hold, but demands a lot from the overlap condition.

Hedonics

- If overlap fails then a hedonic index specifies a linear model for prices so that
 - $E[\log p_{it}|X_{it},t] = \alpha_t + X_{it}\beta_t.$
- This relaxes overlap at the expense of using a parametric model for prices.

Stratification

- A coarser partitioning of properties by the characteristics X_{it} gives a stratified index.
- This relaxes the overlap condition, but requires conditional independence to hold within each strata.
- This is similar to a hedonic index, but is fully non-parametric.

Repeat Sales

- If properties sell over many periods, a matched model can be generalized as a repeat-sales index.
- Like a matched-model index, time-invariant characteristics are held fixed.
- Repeat-sales solves the overlap problem by allowing all transactions in a period to be used in the index, but now conditional independence has to hold over a longer time period.

Residential Property Price Index

References

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