SSC Annual Meeting, May 2009
Proceedings of the Survey Methods Section

THE RENT COMPONENT OF THE CONSUMER PRICE INDEX

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ABSTRACT

The Consumer Price Index (CPI) is one of Statistics Canada's key indicators. It represents the rate of price change for goods and services bought by Canadian consumers. The CPI measures price change by comparing, through time, the cost of a fixed basket of commodities. It is used in many ways, for example, in the indexing of private and public pension plans. Due to the importance of the CPI, Statistics Canada regularly reviews the quality of its components. In this paper, we discuss the rented accommodation of the Shelter component of the CPI, hereafter referred to as the Rent Index, which represents 5.5% of the CPI basket of commodities. The data underlying the Rent Index is collected through the Labour Force Survey (LFS) vehicle. In this presentation, we discuss the current methodology used to estimate the Rent Index and list potential future survey improvements.

KEY WORDS: Consumer Price Index, Labour Force Survey, Relative Price, Rent

RÉSUMÉ

Indicateur essentiel de Statistique Canada, l'indice des prix à la consommation (IPC) représente le taux de variation des prix des biens et services achetés par les consommateurs canadiens. L'IPC mesure la variation des prix en comparant, dans le temps, le coût d'un panier fixe de biens et de services. L'IPC a plusieurs usages : il sert, par exemple, à l'indexation des régimes de retraite privés et publics. Compte tenu de son importance, Statistique Canada procède régulièrement à l'assurance de la qualité de ses différentes composantes. Cet article porte sur la catégorie de produit logement en location de la composante loyer de l'IPC, référée ci-après comme l'indice des prix des loyers. Cet indice représente environ 5.5 % de l'IPC. Les données ayant trait aux prix des loyers payés par les locataires, intrant du calcul de l'indice, sont recueillies à partir de l'échantillon des locataires de l'Enquête sur la population active (EPA). Cette présentation s'intéresse à la méthodologie utilisée pour estimer l'indice des prix des loyers de l'IPC et aux améliorations qu'il serait possible d'y apporter.

MOTS CLÉS : ; Enquête sur la population active; indice des prix à la consommation; loyer; rapport de prix

1. INTRODUCTION

The Consumer Price Index (CPI) is the principal source of information concerning trends in consumer prices and inflation in Canada, and is one of the nation's most important economic indicators. It is obtained by comparing, through time, the cost of a fixed basket of commodities purchased by Canadian consumers. Since the basket contains commodities of unchanging or equivalent quantity, the index reflects pure price movements.

The CPI is used in many ways, for example in the indexing of private and public pension plans. The Bank of Canada uses the CPI to determine monetary policy and to measure the success of its policy to contain inflation within a targeted range. Since the purchasing power of money is affected by changes in prices, the CPI is of interest to virtually all Canadians.

The Rent Index represents 5.5% of the CPI basket of commodities. It measures the rate of change in the price paid for rental accommodation by a tenant. In general, the CPI price samples are chosen using criteria based on judgement, rather than probability sampling techniques. The Rent component is one of the exceptions. The data underlying the Rent Index is collected from the Labour Force Survey (LFS), a probability sampling monthly survey.

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This paper discusses the methodology currently used to estimate the Rent Index of the CPI and lists potential future survey improvements. Section 2 provides the reader with a general description of the CPI, while Section 3 describes the methodology of its the Rent component. Section 4 discusses potential future survey improvements, particularly for the imputation and estimation systems of the Rent component. Conclusions follow in Section 5.

2. CONSUMER PRICE INDEX (CPI)

Prices are collected mostly monthly for over 600 separate goods and services. The goods and services are organized into a hierarchical classification system. Three main levels of hierarchy are used. The lowest level is officially referred to as the "basic class" and contains 168 classes. The next level up is known as the major component level which encompasses eight major component classes. The highest level is the "All-items" level. The Rent component is a basic class within the major component class "Shelter" and represents 5.5 % of the CPI basket of commodities.

The calculation of the monthly All-items CPI index starts with the estimation of the price change for a particular product using an arithmetic or geometric average. Price indexes for the products are then aggregated following the hierarchy structure defined by the product classification code and weighted with the product's CPI weight. The CPI weights indicate the relative importance of a commodity in the CPI basket. The weights are derived from either the Survey of Household Spending or Food Expenditure Survey data. Average yearly expenditures per household are calculated for each commodity class by province or sub-provincial area. Then the average expenditures per household for each commodity class in province or sub-provincial area are multiplied by the estimated number of households. More explanations on the calculation of the CPI can be found in Statistics Canada (1995).

These CPI weights ensure that a 10% price increase in rent, for example, would have a greater impact on the All-items CPI than a 10% increase in the price of milk. This is because Canadians as a whole spend a much larger share of their total expenditures on rent than on milk.

3. RENT COMPONENT OF THE CPI

3.1 General information

The Rent Index measures the rate of change in the price paid for rental accommodation by a tenant. The population targeted by the Rent component of the CPI consists of all renters excluding: rents subsidized by government, employers or relatives; rents for dwellings that are used for both living and business purposes and rents paid by tenants living in institutions[1]. The rent information is collected as part of the Labour Force Survey (LFS) questionnaire. The LFS's primary objective is to provide estimates of employment and unemployment; however, it also collects a number of additional individual and household attributes, one of which is the amount of rent paid by the portion of the sample identified as renters.

3.2 Sampling Design

The LFS monthly sample size is approximately 54,000 dwellings. The average number of LFS self-declared renters per month is roughly 14,000 dwellings.

In most strata, the LFS uses a two-stage sampling design. In the first stage, a sample of geographical regions is selected. These regions are called primary sampling units (PSUs). In each PSU selected, a sample of dwellings is drawn (second stage). The LFS uses a rotating panel sampling design so that selected dwellings remain in the LFS sample for six consecutive months. Each month about 1/6th of the LFS sampled dwellings are in their first month of the survey, 1/6th are in their second month, and so on. After being part of the survey for six months, dwellings rotated out are replaced by other dwellings. As a result, 5/6th of the dwellings overlap in any two consecutive months.

[1] Price Advisor Committee recently recommended that subsidized dwellings be included. This would better reflect cost-of-living changes and better accord with international best practices.

Rent Indexes are published for 16 cities across Canada. Thus, to construct the indexes, the Rent Survey records the price of rent in the same dwelling over six successive months.

3.3 Collection and Editing

The LFS is conducted using Computer Assisted Interviewing (CAI) by a staff of trained interviewers located across the country. The first interview with a member of the household living in the dwelling (also known as the birth interview) is usually conducted in person using CAPI (Computer Assisted Personal Interviewing) by a field interviewer. Interviews in subsequent months are conducted by telephone through regional office interviewers using Computer Assisted Telephone Interviewing (CATI) if the respondent has granted permission to be contacted by telephone ortherwise there are conducted by CAPI. Edit rules are incorporated in the application.

At the first Rent interview, general questions are asked related to the dwelling. For example, a question is asked to know which utilities and services are included as part of the monthly rent. This information is used later on for price quality adjustments.

3.4 Imputation

Each month, despite the best efforts of survey managers and operations staff to maximize response, some nonresponse will occur. The response data are then subject to further edit and imputation processes. Imputation in the Rent survey is a multi-step process, originally defined by Kovar (1984).

First, unreported rents are replaced by rents carried forward from the previous month; a common imputation method used for price indices. Since dwellings are in the sample for six consecutive months, a rent can be carried forward five times. If a dwelling does not report rent in the first month, it is not used in the estimation of the Rent Index until it reports a rent.

Next, a secondary imputation is performed for LFS rotating out dwellings with a carried forward rent. Other dwellings with a carried forward rent not rotating out of LFS could eventually report a rent value; therefore, only the rotating out dwellings with carried forward rents need to be examined further. Assuming that most rent prices change once a year, only rotating out dwellings for which no rent change was observed while they were in the sample are eligible for the second imputation part.

Given that a dwelling j is eligible for imputation, the first step consists of evaluating its probability imputation. This probability is based on the change rate p_i^t at month t in city i given by:

$$p_i^t = \frac{m_i^t}{n_i^t}$$

where m_i^t is the number of dwellings with a rent change in city i at month t and n_i^t is the overall number of dwellings in city i at month t. The monthly change rate is simply the proportion of dwellings that have a rent change in month t based on all reported rents in city i in month t.

The probability of imputation of the rent price for the dwelling j in city i is then estimated as:

$$\text{Prob}_{ij} = \left[\sum_{t=1}^{12} p_i^t\right] * \left(\frac{\sum_{t=2}^{6} p_i^t I_{ij}^t}{\sum_{t=1}^{12} p_i^t - \sum_{t=2}^{6} p_i^t \left(1 - I_{ij}^t\right)} \right)$$

The dichotomous variable I_{ij}^{t} takes the value of one if the rent price for dwelling *j* is carried forward for month *t*, and zero otherwise. The probability of imputation is the probability that a rent change occurred in one of the 'carried forward' months. The calculation of the probability is applied to the sample in order to remedy the problem that the measurement period of rent is much shorter (6 consecutive months) than the expected period of rent change (one change over a 12 month basis). The probability of imputation is the yearly change rate multiplied by a ratio. The yearly change rate is the sum of the monthly change rate for each month of the previous year. The ratio is the sum of the monthly change rate for each month where a rent value was carried divided by the yearly rate minus the sum of the monthly change rate for each month where the rent was not carried.

A dwelling eligible for imputation will have its rent imputed if its probability of imputation is greater than or equal to a generated uniform random number. Finally, given that the price of rent is to be imputed, the procedure multiplies the carried rent by a factor that represents the average rent increase experienced by dwellings in a particular city. The factor is an average of the monthly movements calculated using only dwellings for which an actual rent change was observed in the given month. The imputation factor for dwelling *j* in city *i* is given as:

$$\text{Factor}_{ij} = \frac{\sum_{t=2}^{6} R_i^t p_i^t \left(1 - I_{ij}^t\right)}{\sum_{t=2}^{6} p_i^t \left(1 - I_{ij}^t\right)}$$

where R_i^t is the observed change in rent between month *t* and *t*-1 based on all reported rents in a city *i* and is given by:

$$R_i^t = \frac{\sum_{j \in m_i^t} r_{ij}^t}{\sum_{j \in m_i^t} r_{ij}^{t-1}}$$

where r_{ij}^t and r_{ij}^{t-1} are the rent prices for dwelling *j* belonging to city *i* at month *t* and month *t*-1 respectively and m_i^t is the subset of dwellings in city *i* that experience a rent change at month *t*.

3.5 Estimation

Indexes should reflect pure price movement, that is, the movement that is not attributable to changes in either the quality or the quantity of a given good or service in both compared months. As specified above, five of the six LFS rotation groups are the same from month to month. The Rent Index is thus calculated using the matched sample of rental dwellings.

LFS sampling weights are not used to produce the estimates. The Rent price relative is estimated as the ratio of average rent prices in the current and previous month periods. Rent price averages and month-to-month price index ratios are produced at the national, provincial and city levels.

Each province is divided into two strata. Stratum *h1* contains cities fewer than 30,000 in population and stratum *h2* contains cities over 30,000 in population. At the stratum level, the unweighted arithmetic means are used for all cities. Above the provincial level, the weighted (with CPI weights[1]) arithmetic average of the two stratum means is calculated for each province. In addition, the Rent Index for Canada can be computed as a weighted arithmetic average of the corresponding indexes for the ten provinces and Whitehorse and Yellowknife. For example, the Rent Index at the provincial level is given as:

$$\text{Rent Index} = \frac{\sum_{i \in h1} \sum_{j \in sr} \frac{r_{h1ij}^t}{n_{h1i}} * \omega_{h1} + \sum_{i \in h2} \sum_{j \in sr} \frac{r_{h2ij}^t}{n_{h2i}} * \omega_{h2}}{\sum_{i \in h1} \sum_{j \in sr} \frac{r_{h1ij}^{t-1}}{n_{h1i}} * \omega_{h1} + \sum_{i \in h2} \sum_{j \in sr} \frac{r_{h2ij}^{t-1}}{n_{h2i}} * \omega_{h2}}$$

[1] These CPI weights are derived from 1991 Census data.

where $r_{h1ij}^{t}, r_{h2ij}^{t}$ and $r_{h1ij}^{t-1}, r_{h2ij}^{t-1}$ are the rent prices in the observed month period t and the previous month period t-1 respectively for dwelling j included in s_r in city i and in stratum *h1, h2*. Note that s_r is the subset of sampled dwellings responding in both the observed month and the previous month. The quantities ω_{h1} and ω_{h2} are the CPI weights for strata *h1* and *h2* that indicate the relative importance of the strata in the province, and n_{h1i} and n_{h2i} are the city sample sizes within each stratum.

4. POTENTIAL IMPROVEMENTS

In the pursuit of ongoing quality assurance, the Rent Index methodology is being reviewed to see whether improvements could be made. For now, the focus has been on data processing, particularly on the imputation and estimation processes.

4.1 Imputation

The rent component of the CPI makes assumptions about the way the rental market operates. These assumptions include the frequency of rent increases (or decreases). The current imputation strategy assumes that rent changes occur once a year on average. Statistics Canada initiated in yearly 2009 a consultation in major Canadian cities. The results of the consultation confirmed the accuracy of the majority of the working assumptions.

However, an analysis of nonresponse should be undertaken to verify the existence of nonresponse bias. Nonresponse bias would exist if nonresponse does not occur at random but occurs at different rates for some groups of dwellings. If a bias is found, the construction of bias-free imputation classes using relevant auxiliary variables might be deemed necessary (e.g. using the score method). More details about this score method can be found in the Haziza and Beaumont (2007).

4.2 Estimation

As specified earlier, the LFS sampling weights are not currently used in the index calculation. Sampling weights are not commonly used for price indices. Work has been initiated to see whether the estimation process could benefit from using the LFS sampling weights. The LFS sampling weight is derived in three steps. First, the design weight is calculated by weighting each dwelling by the inverse of its probability of inclusion in the sample. Then a nonresponse weight adjustment is applied to compensate for the dwelling nonresponse. The new weight obtained is called the subweight. Lastly, the final weight is calculated using calibration and composite calibration along with the integrated method of weighting. This process makes the estimates agree with known totals such as Census estimates and the previous month's estimates.

Calibration is a technique that finds final weights w_{ij} as close as possible to the subweight according to some distance function, and such that calibration-weighted estimates for a vector of auxiliary variables x, $\hat{t}_x = \sum_{i \in h1,h2} \sum_{j \in s_r} w_{ij} x_{ij}$ are exactly equal to the vector of known population totals, $t_x = \sum_{i \in h1,h2} \sum_{j \in P} x_{ij}$, where P denotes the population. In the LFS, these known population totals, often called control totals, are the Census estimates projected to the current month for the number of people aged 15 and over in geographical regions and for the number of people in age-sex groups by province; see Statistics Canada (2008). Composite calibration is essentially the same as calibration, except that some control totals are estimates from the previous month, and that the auxiliary variables associated with these estimated control totals are not known for all responding dwellings and are thus imputed. These control totals and auxiliary variables are called composite control totals and composite auxiliary variables, respectively. In the LFS, each province has 25 composite auxiliary variables (such as employment in previous month by industry), all of which are defined with respect to the previous month.

To account for undercoverage and improve the efficiency of the estimates, auxiliary variables used in calibration must be correlated with the main variables of interest. Auxiliary variables are identified by modelling the variables of interest. Estimates produced for the Rent survey could benefit from using LFS sampling weights calibrated for variables related to the Rent Index. An explanatory data analysis seems to show correlation between the rent price and some collected variables such as the building age, apartment floor number and number of bedrooms in the dwelling. These dwelling characteristics and other socio-demographic LFS variables could potentially be used for calibration or composite calibration. Long Census questionnaire asked if the respondent is a renter, the rent price, the age of the dwelling, the number of rooms and bedrooms in the dwelling. These variables could be used as known totals to derive rent sampling weights.

If LFS sampling weights are used, the Rent Index for a given province could be estimated by

$$\text{Rent Index} = \frac{\sum_{i \in h1,h2} \sum_{j \in s_r} w_{ij}^{t} r_{ij}^{t} \Big/ \sum_{i \in h1,h2} \sum_{j \in s_r} w_{ij}^{t}}{\sum_{i \in h1,h2} \sum_{j \in s_r} w_{ij}^{t-1} r_{ij}^{t-1} \Big/ \sum_{i \in h1,h2} \sum_{j \in s_r} w_{ij}^{t-1}}$$

where w_{ij}^{t} and w_{ij}^{t-1} are the final sampling weights, after rent calibration, attached to each responding dwelling of the sample, and r_{ij}^{t} and r_{ij}^{t-1} are the rent prices in the observed month period and the previous month period, respectively.

The advantages of using calibration are i) to ensure consistency with external estimates of a population, ii) to account for undercoverage and iii) to improve the efficiency of the estimates. Composite calibration estimator improve the efficiency of the estimates, especially for estimates of change.

5. CONCLUSION

The Consumer Price Index (CPI) is one of Statistics Canada's key indicators of Canada's economic wellbeing. Because of the importance of the CPI, Statistics Canada regularly reviews the quality of the CPI's components, including the rental accommodation portion of the Shelter component. Potential future improvements could be achieved by investigating alternative imputation and estimation strategies. For example, sampling weights are not currently used in the calculation of the Rent Index. While this approach is consistent with existing practices in the CPI, the use of LFS sampling weights or weights calibrated for variables related to the Rent Index could prove to be beneficial for the quality of the Rent Index.

6. ACKNOWLEDGEMENTS

The authors would like to thank the following people for their comments and suggestions, as their contributions improved greatly the final version of this paper: Jean-François Beaumont, Susie Fortier, Zdenek Patak, Eric Rancourt and Lucie Veilleux. The authors would also like to thank Justin Hume for his help in interpreting the imputation methodology used in the Rent survey. The views expressed in the paper are those of the authors and do not necessarily reflect the official position of Statistics Canada. All remaining errors are those of the authors.

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