

**AN EMPIRICAL ANALYSIS OF THE DIFFERENT CONCEPTS FOR OWNED
ACCOMMODATION IN THE CANADIAN CPI:
THE CASE OF OTTAWA, 1996-2005¹**

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1. Introduction

1. The treatment of the price of owner occupied housing (OOH) in a consumer price index (CPI) is conceptually challenging. The characteristics of a house, considered as a commodity, permit and encourage a variety of treatments that lead to different estimates. Furthermore, a house is a consumer asset with a long useful life that is generally purchased on credit, with active resale and rental markets in which households participate as both buyers and sellers. A consumer price index for OOH services may be built around the cost of using a home, the cash outlays on a home, its assumed rental value or its purchase price. Commentary in the literature suggests that no one treatment is ideal for all of the complimentary (and at times rival) uses of the CPI and therefore there is no general consensus on the question as to how to best treat homeownership in the Consumer Price Index (CPI).
2. There is considerable variety in how OOH services are defined in the official CPI statistics for different nations. This is in striking contrast with the treatment of OOH services costs in the national accounts of most countries. In that case, most countries including Canada have agreed upon and apply a rental equivalence approach for the OOH component.
3. The CPI is sensitive to the measurement of price change for OOH services. This sensitivity results on one hand from the fact that in Canada, as in other nations, shelter is

¹ *Any views in this paper are those of the authors and do not necessarily represent the opinions of Prices Division or Statistics Canada.*

This paper builds and draws heavily on previous work done over the years by Andy Baldwin and other staff members of Prices Division.

by far the most important CPI component in terms of the share of household expenditure, and way more than half of the shelter expenditures are for OOH services. On the other hand, depending on the approach used for measuring shelter services, prices for some of its components can be somewhat volatile (e.g., such as mortgage interest costs), thus further compounding the effect of shelter on the overall CPI.

4. For most other durable commodities, the price information included in the CPI is simply based on the observed purchase prices and there is no need to measure with accurate precision the quantity of the services that are used up in a given time period. Many consumer durables share some of the characteristics of owner occupied housing, but to lesser degrees. For example, most motor vehicles, like houses, are purchased on credit, but these credit payments rarely last more than 5 years while the amortization period for a mortgage loan can sometimes extend 25 years. The various possible approaches for the treatment of OOH services in the CPI could also be applied to some other durables like motor vehicles, but the consequences for the official CPI of choosing some other concept would be far less significant mainly because they comprise much smaller portions of household expenditures.
5. The CPI is the most commonly referenced measure of inflation. It is widely used as an escalator to account for changes in the cost-of-living in wage and salary agreements, union contracts, the specifications of income tax brackets and exemptions, and government transfer payments such as Old Age Security and family allowances. For the purposes of escalation, deflation or indexation of income or payment figures, the content of those figures determines what concept is ideal for the price index.²
6. If the objective is a macroeconomic indicator of current inflationary trends, other criteria are relevant. From this perspective, the mortgage interest component of the current official Canadian CPI may pose special problems. As discussed below, this component indirectly reflects house prices over a span of 20 years or more and is sensitive as well to current changes in interest rates.

² For example, the personal income and personal disposable income estimates of the Canadian System of National Accounts (CSNA) include imputed rent for owner-occupied dwellings as a component, so a CPI incorporating the equivalent rent concept would be desirable as a deflator.

7. Different tradeoffs made among the differing needs for a measure of price level change have led different nations to incorporate different concepts of the price of OOH services into the CPI. Different nations have made different choices too because, among the alternative ways of conceptualizing the price of OOH services, some pose special measurement problems for some nations.
8. A common purpose of international comparisons is to evaluate the inflationary performance of one country versus others. How can we compare measured rates of inflation for countries that have made different choices about how to measure price level change?
9. Faced with this challenge, the Fourteenth International Conference of Labour Statistics adopted a resolution that asked countries to provide, in addition to the all-items CPI, an index that excludes shelter. However, given the importance of shelter costs in household expenditures, it is not fully satisfactory to base international comparisons of inflation rates on a price level change index that *excludes* shelter. A better alternative could be to take the CPI for each foreign country of interest and try to construct an analytical CPI for Canada that is based on that same concept. The OOH services component is key area of difference among the CPIs for different nations. There is also research interest in the behaviour of the resulting series for the OOH services component defined using alternative suggested concepts
10. This state of affairs led the Prices Division of Statistics Canada in December 1985 to start publishing analytical series as part of the CPI program.
11. An initial paper by DeVries and Baldwin (1985) focused on obtaining Canadian CPI series comparable in their methodology with the U.S. CPI, for the years before and after 1983 when the U.S. abandoned the net purchase including charges for interest approach (NP2) in favour of the rental equivalence approach. In Baldwin (1985), the analytical concepts were expanded from two to six, and since then there have been no changes except to discontinue the updating of the results for the NP2 series, since the U.S. is no longer using this approach. (Hence no update results for NP2 are shown in this report.)
12. The two money outlays concepts were added, building on the arguments presented in Turvey (1981). He outlined narrowly defined and broadly defined money outlays

concepts for use as escalators. The narrowly defined money outlays index is just the official Canadian CPI excluding the replacement cost component. The U.K., Ireland and Iceland formerly used this approach. However, the U.K. has since added a depreciation component to its OOH index, so the U.K. CPI is now more comparable with the Canadian CPI than any of the analytical series.

13. In this report, the Statistics Canada analytical indexes of consumer prices based on different treatments of owned accommodation are updated for the period of January 1996 to December 2005. More specifically, this paper presents six alternative homeownership series based on four different concepts, including one based on the concept used in the official CPI: a version of the user cost concept. A second series is based on the rental equivalence concept. Two more series are based on what is referred to by Statistics Canada as the money outlays approach. And a final two series are based on what is referred to by Statistics Canada as the net purchase approach. All-items level indexes embedding the various alternative homeownership series are also presented,³ so that the effects of the different OOH concepts on the overall CPI can be observed.
14. Furthermore, the present study differs from previous ones with regards to the geographic coverage. As opposed to what had been done in the past, the estimates of comparative shelter costs in this paper apply only for Ottawa. The motivation for the reduced coverage is explained by the desire to incorporate and measure, where applicable, the impact of hedonic price indexes for resale houses into the analysis. These data, which were obtained from a third party, were at the time of the study, only available for Ottawa.
15. The analytical series were created with the specific analytical needs of users for which the current treatment of housing is not met in the official Canadian CPI, including those who want to compare the movement of the Canadian CPI with that of other countries using different concepts for owned accommodation. For example, the homeownership component based on the rental equivalence approach would provide more reliable comparisons of inflation rates with the United States (since 1983), Japan, France and

³ All of these higher-level aggregates differ only in their owned accommodation components; for all aggregates, all other components are based on the official concept.

many others. The rental equivalence concept is also of value for understanding the differences in measured inflation between the Canadian CPI and the GDP deflator.

16. Before moving on to describe the Statistics Canada analytic series and discuss the updated values for these, in the following section we review Diewert's views on the proper treatment of OOH services in a CPI.

Alternative Conceptual Definitions

17. Diewert has been a prolific contributor to both the development and the analysis of alternative ways of treating the services of OOH and other durables in official statistics including the CPI.⁴ Diewert (2004) reviews four basic approaches that he terms the (1) payments, (2) acquisitions, (3) user cost, and (4) rental equivalence approaches. He describes these as follows:
18. If sufficiently active used or second hand markets for the given type of durable exist, then the going purchase price at the beginning of the period and selling price at the period's end could be ascertained. This information might be utilized to estimate the cost of using the durable during the period: the user cost.
- a. If rental or leasing markets for a comparable consumer durable exist, then market rental prices might be used to estimate and impute the one period cost of using an owned durable.⁵ This is the rental equivalence approach.
 - b. The payments approach deals with the cash flow costs of home ownership, including mortgage payments.
 - c. With the acquisitions approach, the entire cost of a product is charged to the period of purchase, just as with products that are not durable. Diewert notes that, in actual CPI practice, this approach is used for all durables other than owner occupied housing.

⁴ See Diewert (1974, 2004).

⁵ Another method for determining rental price equivalents for stocks of consumer durables is to ask households what they think their durables would rent for.

19. From Diewert's perspective, when the *payments approach* is implemented so that the opportunity cost of the equity tied up in an owner occupied dwelling and also the depreciation on the dwelling are ignored, or if nominal interest rates are used without an offset for inflation, then the approach is conceptually flawed.
20. Diewert acknowledges that if the purpose of the CPI is to measure price level change for period-by-period monetary expenditures by households, then the acquisitions approach has merit. However, if the CPI is intended as a measure of the cost-of-living (COLI), Diewert argues that the *acquisitions approach* to pricing durables fails to reflect the "consumption" of services in any one period. For instance, higher real interest rates in a country usually result in a drop in purchases of automobiles and houses and other long lived consumer durables, but consumers still nevertheless go on consuming the services of their existing stocks of these assets even under these economic circumstances.
21. Approaches that Diewert sees as superior are the rental equivalence and the user cost ones.
22. As defined by Diewert, the imputed *rental equivalent* for an owner occupied dwelling unit consists of three main costs: (1) the real opportunity cost of the financial capital tied up in the structure; (2) the real opportunity cost of the financial capital tied up in the land; and (3) the depreciation cost for the structure.
23. Finally, for the *user cost approach*, Diewert states that this begins with the (observed or inferred) cost of purchasing the dwelling at the beginning of the period, and then nets off the (observed or inferred) benefit that could be obtained by selling it at the end of the period. Since money received at the end of the period is not as valuable as money received at the beginning of the period, to convert the end of period value into a beginning of period equivalent value requires discounting the end of period selling price using the beginning of period interest rate. Alternatively, for the user cost approach, Diewert shows that the consumer can be regarded as purchasing the dwelling at the beginning of the period, and charging a self assessed rent equal to the user cost, with the rest of the purchase price treated as an investment earning the appropriate opportunity cost of capital.

24. Diewert shows how the user cost formula can also be transformed so that only the initial purchase price information is directly used together with an estimated or assumed depreciation rate and the asset inflation rate. Diewert (2004) dwells at length on the problems associated with estimating depreciation rates.
25. The user cost is usually expressed in terms of prices that are discounted to the beginning of the designated time period. However, Diewert also derives an expression for the user cost in terms of prices that are “discounted” to the end of the period. He explains that the end of period user cost can be viewed as an approximate rental cost. Taking this perspective, the rental cost (i.e., the rental equivalent) for the use of a consumer durable should equal the (real) opportunity cost of the capital tied up plus the decline in value of the asset over the period.
26. Diewert’s papers on this topic, especially including his 2004 study, provide helpful analytic frameworks and raise a wide assortment of issues that are relevant for assessing the strengths and weaknesses and for interpreting the movements of CPI series incorporating alternative concepts of OOH services.

3. The Statistics Canada Official and Analytical Owned Housing Series

27. We turn our attention now to analytical series of owned accommodation of Statistics Canada’s CPI program. The distribution of expenditures over the various components of the OOH services costs for the city of Ottawa are shown in Table 1 with these components evaluated using December 1994 prices, and in Table 2 with the same components evaluated using December 1997 prices. The appendix provides a more detailed look at how the indexes are calculated.

3.1 Canada’s official choice for the CPI

28. The official Canadian concept for the owned accommodation component of the CPI measures the changes in the cost of using a fixed dwelling stock. It includes six components: (1) mortgage interest costs; (2) property taxes; (3) homeowner’s insurance premiums; (4) homeowner’s repairs; (5) other homeownership costs including transaction

charges (e.g., real estate commissions and legal fees); condominium charges and mortgage insurance; and (6) replacement cost for that part of the housing structure assumed to be used up in the year in question.

29. The basic idea of the official concept is to treat homeowners as landlords who would be renting the dwelling unit to themselves. Whatever a landlord could expense is included in the index, including even imputed items (e.g., depreciation). Whatever cost items a landlord cannot expense for tax purposes are ignored by the index.
30. Thus, according to the official concept, homeownership costs exclude capital gains (a negative cost) and the foregone interest on the owner's capital invested in his home; these are excluded as expenses relating to investment rather than consumption. No country using this concept incorporates capital gains, but this exclusion does not rest on evidence that capital gains are unimportant. The potential importance of capital gains will hopefully be explored, in the future, by adding a new analytical series that would account for capital gains. Thus, although the official concept is often referred to as a user cost approach, it differs from the user cost concept defined by Diewert in his 2004 and other papers, and in the literature on which he builds. Dealing with the capital gains and foregone interest exclusions could be the objective of a new analytic series.
31. Because this approach specifically estimates the costs of using owned accommodation and not those faced by tenants, the measure does, however, include a "replacement cost" (or depreciation) component.⁶ Between 1949 and 1997, the annual housing depreciation rate used for the Canadian CPI was 2%. Statistics Canada adopted this rate based on a study that analysed U.S. Federal Housing Administration field appraisal data from 1939.
32. Kostenbauer (2001) argues that there is evidence that the 2% depreciation rate is probably too high. As a consequence of this study and results of others, the depreciation rate in the Canadian CPI was lowered to 1.5% effective January 1998. The CPI measures changes in the cost of purchasing a *fixed basket* of consumer goods and services over time. Each year, Statistics Canada carries out the Survey of Household Spending (formerly called the Family Expenditure Survey now called the Survey of household spending) to update the expenditure weights for most of the commodities in the basket.

⁶ Depreciation is the only component in the CPI that is not an out-of-pocket expense.

However, because depreciation is not an out-of-pocket expense, its share in the basket a notional amount (and weight) must be imputed.

Title	The official CPI concept for Canada	Rental equivalence concept	Money outlays concept		Net purchase concept	
			Excluding equity payments (MO1)	Including equity payments (MO2)	Based on purchases (NP1)	Based on down payments and discounted mortgage payments (NP3)
Maintenance and Repairs	8.4	1.2	10.9	7.6	9.1	8.7
Condominium Charges	1.4		1.7	1.2	1.5	1.4
Property Taxes (Including Special Charges)	20.9		27.0	18.9	22.6	21.5
Insurance Premiums	4.7	1.0	6.1	4.3	5.1	4.9
Mortgage Insurance	0.8		1.0	0.7		0.8
Mortgage Interest Cost	35.8		46.2	32.3		
Replacement Cost	22.5					
Real Estate Commissions	2.6		3.4	2.4	2.8	2.7
Legal Fees	1.2		1.6	1.1	1.3	1.2
Other Shelter Services	1.6		2.1	1.5	1.8	1.7
Equivalent Rent		97.8				
Down payments				37.1		23.5
Principal Portion of Mortgage Payments				37.0		
Sale of Home				-44.0		
Home Purchase					55.9	
Discounted Mortgage Payments						33.6
Owned accommodation	100.0	100.0	100.0	100.0	100.0	100.0

* Basket shares shown in this table may not exactly sum to 100 due to rounding.

Title	The official CPI concept for Canada	Rental equivalence concept	Money outlays concept		Net purchase concept	
			Excluding equity payments (MO1)	Including equity payments (MO2)	Based on purchases (NP1)	Based on down payments and discounted mortgage payments (NP3)
Homeowners' Maintenance and Repairs	10.6	1.6	12.8	8.4	9.9	9.3
Condominium Charges	1.7		2.1	1.3	1.6	1.5
Property Taxes (Including Special Charges)	22.7		27.5	17.9	21.3	20.0
Homeowners' Insurance Premiums	5.4	1.1	6.6	4.3	5.1	4.8
Mortgage Insurance	1.3		1.6	1.1		1.2
Mortgage Interest Cost	31.3		37.8	24.7		
Replacement Cost	17.3					
Real Estate Commissions	1.8		2.1	1.4	1.7	1.6
Legal Fees	1.0		1.2	0.8	1.0	0.9
Other Shelter Services	6.9		8.3	5.4	6.5	6.1
Equivalent Rent		97.2				
Down payments				43.1		29.6
Principal Portion of Mortgage Payments				31.7		
Sale of Home				-40.1		
Home Purchase					53.0	
Discounted Mortgage Payments						25.0
Owned accommodation	100.0	100.0	100.0	100.0	100.0	100.0

Basket shares shown in this table may not exactly sum to 100 due to rounding.

33. The replacement cost incurred by homeowners is derived using average price data for residential properties obtained from the Survey of Household Spending and based on homeowner appraisals of the values of their properties at the end of the survey year. The average price data for residential properties is multiplied by the “house-to-property ratio”, estimated by Statistics Canada, to obtain estimates of the average price of residential houses (exclusive of land). The average price of residential houses is multiplied by the depreciation rate of 1.5% to obtain an estimate of the replacement cost. The national replacement cost index is a weighted aggregate of individual area indexes. The weights reflect relative shares of the total value of the national owner-occupied housing stock, which is compiled from the Survey of Household Spending. The replacement cost index is updated every month by applying the movements of the New Housing Price Index (NHPI), for which a variant exclusive of land is published.
34. Statistics Canada defines housing depreciation as “the hypothetical amount of money that would be necessary to replace the used-up portion of the stock of dwellings owned and occupied by the target population at the end of a year”.
35. Until 1997 when Statistics Canada changed the depreciation formula for the purposes of the CPI, it had used for the past 40 years a declining-balance method with an annual depreciation rate of 2%.⁷ According to *The Consumer Price Index Reference Paper*

⁷ The modern housing stock is on average 28–29 years old, which would validate a depreciation rate of 2% using a declining balance depreciation method. A 1968 report, entitled “Estimates of Residential Capital Stock and Flows”, explains that Statistics Canada adopted the rate from Grebler *et al.* (1956), who analysed U.S. Federal Housing Administration (FHA) field appraisal data from 1939. Using a sample of 1500 owner-occupied single-family houses, on average 20 years old, the authors estimated an average depreciation rate for a number of dwelling vintages and found that it followed an approximate declining-balance profile. Houses lost an average of 18% of their initial value over the first four years of their construction. Depreciation slowed sharply after that period. The authors of the FHA study did not explicitly show or explain how they arrived at a constant 2% depreciation rate, or why they chose it, but the rate does correspond well to a housing stock that is on average more than 27 years old. The study was seminal for its time, and applying the results to the Canadian CPI certainly made sense. The most important limitation of the study today is its age. Obviously, the composition of the current Canadian housing stock is different from that of the United States in 1939. Construction machinery and equipment, building materials, weatherproofing techniques, roofing materials and heating systems have all changed. (The average age of the Canadian housing stock can be calculated from Statistics Canada’s **Homeowner Repair and Renovation Expenditure**, Catalogue No. 62-201-XPB, and from census data. As a note, the median age of Canadian houses is 20 years. However, the median is not the appropriate measure here because the median is insensitive to how data are distributed around it. Of course, if depreciation were straight-line or truly “constant” declining-balance, then the age of the housing stock would not matter.)

(Catalogue No. 62-553, p. 55), the 2% rate was consistent with the one used in the System of National Accounts (SNA), which has used a rate of 2% to calculate Net Residential Capital Formation. However, the SNA includes rental accommodations, which are thought to depreciate faster than owned housing, so presumably the SNA's depreciation rate should be higher than for the CPI. Statistics Canada changed the depreciation rate to 1.5% in 1997.

36. Simple depreciation methods such as straight-line and declining-balance are not adequate for houses because they are heterogeneous products. Vintage effects are also an important factor. If older houses were of inferior quality to today's houses, they would depreciate faster, independent of other effects. To control for the complexities of a heterogeneous housing stock, Kostenbauer (2001) and others including Diewert (2004) have recommended the use of hedonic methods.
37. Diewert (2004) examines the advantages and disadvantages of a general hedonic regression model compared to the repeat sales model or to the closely related time-dummy hedonic regression models of Aizcorbe, Corrado and Doms (2003). As Diewert sees it, the main advantage of the general hedonic regression model is that it uses all of the information on housing sales in each sample period in a nontrivial way. If the unmatched prices in the sample of housing prices behave differently than the matched prices, a general hedonic regression model can generate quite different price index values than models that rely only on matched prices. The disadvantages Diewert calls attention to include the difficulty in determining which characteristics to include and the appropriate functional form for the hedonic regression.
38. A house is the sum of its physical parts such as the building materials used and the method of heating, as well as of its "basic attributes" such as the size, age, type of roofing, number of rooms, and so on. Even a highly simplified hedonic approach to housing goes a long way in managing the heterogeneity problem. As Kostenbauer (2001) notes, in practice, the steps are to: (a) identify the basic attributes, (b) specify the regression equation that relates the price of houses to the basic attributes, and (c) estimate the parameters. Frequently, the regression is specified in a semi-logarithmic form; that is

the effect of each basic attribute on the house value is expressed as a percentage mark-up rather than in dollar terms.⁸

39. The interpretation of hedonic regressions is as follows. Assume that a sample includes a house constructed in 1981 and another in 1982. The price of the two houses differs because (a) the 1981 house is one year older than the 1982 house and (b) the 1982 house may have different attributes. If the regression successfully controls for differences in basic attributes, the coefficient corresponding to “age of the house” will give the implied premium of a 1982 house over a 1981 house. The rate of change of observed house prices with respect to age is interpreted as the net depreciation rate.
40. The mortgage interest component estimates price-induced changes in the amount of mortgage interest owed by the target population on outstanding mortgages. Statistics Canada practice is to hold the volume of mortgage loans, by age of mortgage, constant so that interest owed does not depend on the changes in lump-sum payments or changes in the loan-to-value ratios or amortization periods of the outstanding loans, but only on house prices and interest rates. The house price attached to an outstanding loan dates from the month of purchase. The interest rate dates from the month that the loan was last renegotiated, or the month of initiation if the loan has never been renegotiated. Thus, the interest owed on the stock of mortgages in the current month is a function of current and lagged house prices and interest rates, mixed according to the proportion of new and existing mortgages.⁹
41. When a price index is used for escalation, typically the paid cost of mortgagors on their mortgage debt is viewed as relevant. However, the inclusion in the price index domain of mortgage interest may render the index less suitable as an indicator of the core rate of inflation.
42. The Bank of Canada has been using a separate measure of core inflation.¹⁰ One of the Bank’s technical reports notes that:

⁸ Thus, the presence of a sunroom will have a greater impact on the price of an expensive house than on one of lower value. This is a reasonable assumption because the more expensive house is expected to have a larger, more expensive sunroom.

⁹ This issue is also taken up in *The Consumer Price Index Reference Paper*, pp. 113-117.

¹⁰ Until May 2001, the official measure of core inflation used by the Bank was CPIxFET (the CPI excluding food, energy and the effect of changes in indirect taxes), a measure that does not exclude the mortgage interest cost

“It may be useful, for example, to exclude changes in mortgage interest costs from a core measure used for policy purposes, since changes in interest rates by the monetary authorities will directly affect published inflation rates through corresponding changes in mortgage interest costs.”¹¹

43. And another Bank of Canada study states:

“Monetary policy no doubt plays a large role in fluctuations in mortgage interest costs. A tightening of monetary policy, for example, aimed at reducing the inflation rate, has a perverse short-term effect on inflation, since higher interest rates will cause a temporary rise in mortgage interest costs. This perverse effect explains why some countries, such as the United Kingdom and New Zealand, exclude this component from their core inflation measures.”¹²

44. Other concerns have also been raised about the replacement cost component of the official concept. The price component that pertains most directly to the replacement cost for owned housing component is for new dwellings, but new dwellings are seldom sold without lots. Thus, dwelling price estimates necessarily depend on the estimates of builders as to what their houses would sell for if only the house itself and not its serviced lot were on the market. This estimate is likely to be more approximate if a builder has held onto a lot quite a while before building on it, and if the market for residential land is volatile. There is reason to believe that the dwelling price series fails to entirely remove the impact of change in land prices, and hence that what is calculated is something between an index of dwelling prices and an index for dwelling and lot together.¹³

component. Since then, the official measure has been CPIX that does exclude mortgage interest cost altogether. In Bank of Canada materials discussing CPIX, the exclusion of mortgage interest cost is not stated to be based on the sensitivity of the mortgage interest component to changes in monetary policy, but rather on its volatility.

¹¹ See Seamus Hogan, Marianne Johnson and Thérèse Laflèche (2001), “Core Inflation”, Bank of Canada Technical Report No.89, p.10.

¹² See Allan Crawford, Jean-François Fillion and Thérèse Laflèche (1997), “Is the CPI a Suitable Measure for Defining Price Stability?” in *Price Stability, Inflation Targets and Monetary Policy: A 1997 Conference Held by the Bank of Canada*, p.57.

¹³ We note that for the Bank of Canada’s measure of core inflation termed meantsd, replacement cost was the 12th most frequently eliminated component because of its high variability; homeowners’ insurance premiums was the 13th, and it is also based on the new housing price index series for dwellings only.

3.2 The rental equivalence concept

45. An index based on the rental equivalence concept measures changes in the cost of consuming the dwelling services of a fixed stock of owner-occupied housing by imputing rents based on observations for the market rents for tenant-occupied dwellings. Tenants pay only for the shelter services provided by their dwellings; their rental payments do not have any investment component. A presumed advantage of the rental equivalence concept is that it guards against the possibility of treating part of the changing return on an investment in owned housing as a change in the cost of consumption of shelter services.
46. Also, however, landlords usually directly pay most of the expenses for tenant-occupied dwellings including property taxes, dwelling insurance, mortgage interest, depreciation, transaction costs and most repairs. They recover these expenses in the rent that they receive from the tenants. The tenants pay only their monthly rent, insurance premiums on their household effects, and the cost of those repairs performed at their own expense.
47. Most homes are rented with some appliances in them and the equivalent rental values for the owner-occupied stock of homes will incorporate their rental value. To prevent double counting, the weights in the CPI for these appliances could be correspondingly reduced,¹⁴ as is done by the BLS in calculating the American CPI.¹⁵ The adoption of a rental equivalence approach to homeownership services therefore has implications for the calculation of some of the consumer durable components of the CPI.

¹⁴ The alternative would be to deduct that portion of equivalent rental values representing the rental of household appliances in calculating equivalent rent weights, in which case the weights for these appliances could be left as they are without any double-counting, as far as weights are concerned. But with this alternative, appliances would still potentially have an undue impact on the movement of the All-items CPI since their price changes would inappropriately influence the equivalent rent series, to the extent that it is based on quotes for dwellings with appliances included in the rent.

¹⁵ See U.S. Bureau of Labor Statistics (1983).

3.3 The money (or cash) outlays, or payments, concept

48. An index based on the money outlays concept measures the price-induced changes in the consumption-related cash outlays on owner-occupied homes. Imputed costs are excluded by definition, as are investment-related outlays.
49. Most of the components of owned accommodation using the official concept represent cash disbursements, and are in scope under a money outlays concept; this includes repairs, property taxes, insurance premiums and mortgage interest. The important omission from the preceding list is the replacement cost of depreciation, which is included with the user cost approach, but excluded as an imputed item for the money outlays concept.
50. In this report, two variants of the money outlays concept are shown, one including and one excluding net equity payments (MO1 and MO2, respectively). Net equity payments consist of down payments on owner-occupied homes, plus the principal portion of loan repayments when those houses are purchased on credit, less sales of owner-occupied homes. If net equity payments are considered to be primarily investment outlays then they are excluded from the owned accommodation measures, and such is the practice in all official consumer price series based on the money outlays concept, including those of Iceland, Ireland, and, until 1995, the U.K.
51. However, if net equity payments are considered to be primarily consumption outlays, then they should be included, as advocated by Turvey (1981), as part of a money outlays measure. This variant of the money outlays concept is that it is more consistent with the net purchase approach to consumer durables in the CPI. Indeed, in the special case where all owner occupied houses are purchased with cash, this variant of the money outlays approach reduces to a net purchase approach (discussed below).
52. However, the house prices associated with the reported repayments of mortgage principal in the money outlays series would, like those for mortgage interest payments, cover a multi-year span, raising possible problems if this approach is to be used as part of the official CPI or some other indicator of the rate of current price change. Also, the actual

amounts of equity payments are extremely variable from year to year, and the estimated amounts, if they derive from family expenditure survey data, are even more variable. For this reason, it does not seem feasible to include net equity payments in a money outlays series without some kind of smoothing of the data.

3.4 The net purchase (or acquisitions) concept

53. A series based on the net purchase concept measures changes in current transaction prices for owned accommodation. Net purchases of owner-occupied dwellings consist of all purchases of new as well as existing owner-occupied dwellings by the household sector less sales of such dwellings, that is, purchases of new dwellings by the household sector plus net household sector purchases of existing dwellings by the from sellers outside the household sector. When net purchases of existing dwellings are unimportant, net purchases closely approximate new purchases for owner-occupied dwellings.
54. The simplest variant of a net purchase series for owned accommodation (labelled NP1) includes a home purchase component whose weight is based on net purchases but excludes mortgage interest.¹⁶
55. This variant is consistent with the treatment of consumer durables in the official CPI, being based entirely on actual (i.e., not hypothetical) prices. For owned housing, the net purchase index is based on the actual prices of dwelling and lot together.¹⁷
56. However, the scope of the net purchase approach can be extended to include mortgage interest payments, as for the second Statistics Canada net purchase series (NP2). From 1953 to 1984, the homeownership component of the U.S. CPI for urban wage earners and clerical employees was based on net purchases including mortgage interest. Under this

¹⁶ This approach is recommended by some for judging the effectiveness of monetary policy in meeting its price stability targets. It measures the change in current transaction prices but does not reflect interest rate hikes that might be a concomitant of a tight monetary policy intended to reduce the inflation rate.

¹⁷ As was mentioned in the previous section, a replacement cost index for homes is necessarily based on a hypothetical index for dwellings. The term "hypothetical" applies because this index must be derived from a hypothetical question about what the dwelling or serviced lot would sell for separately, when in reality they are sold as a package.

concept, mortgage interest comprises those negotiated interest payments that are likely to be made.¹⁸

57. Under this second variant of the net purchase approach, the net purchase weight may vary dramatically for a given volume of home purchases depending on the degree to which those purchases are credit financed. If a member of the target population purchases a \$100,000 home using cash that purchase will increase the home purchase weight by \$100,000. If the same home is purchased with a \$75,000 mortgage loan at 13% interest, the interest contracted for over the first 10 years of a 20-year amortization period would be about \$87,000 so that this purchase will have almost double the weight in the owned accommodation index as the first purchase, although the purchase price is the same.
58. Blinder (1981) suggested that the weight attached to a home purchase should be the same whether it is purchased on credit or not.¹⁹ If it is purchased on credit, the loan-to-value ratio will dictate a division of home purchases. The index for the loan portion of the home purchase will then represent the discounted value of the stream of future mortgage payments for a home purchased in the given period compared to the discounted value of the stream of future mortgage payments on a home purchased in the base year, where the base year mortgage interest rate is the discount rate.
59. This alternative net purchase concept (NP3) provides a measure of the change in current consumer prices that takes account of changes in interest rates, but without exaggerating their impact.²⁰
60. Such a measure would properly measure changes in prices of current transactions, including interest-related transactions. Hence central bankers and their political masters

¹⁸ The qualification is necessary because so many mortgages are terminated before the end of their original amortization period due to renegotiations of the mortgage or the sale of the home.

¹⁹ A net purchase series based on down payments and discounted mortgage payments is similar to the outlays series on an acquisition basis proposed by Turvey (1981), but Turvey considers allowing changes in terms of credit, including the loan-to-value ratio, to be reflected in his proposed index. In this implementation, it is not possible to accommodate changes in the loan-to-value ratio since down payments and mortgage payments are treated as separate basic groupings with fixed basket shares. However, it would be possible to accommodate such changes if the down payment and discounted mortgage payments were treated as a single basic group.

²⁰ This type of measure has not yet aroused much interest among official statisticians. For example, in a survey of alternatives for pricing of loan-related items in which its authors set the goal of exploring all reasonable possibilities, Woodhouse and Hanson pay no attention to such an index. The only concept they discussed that would bring into play both good prices and interest rates was something resembling the mortgage interest component in the official CPI. See Woodhouse and Hanson (1987).

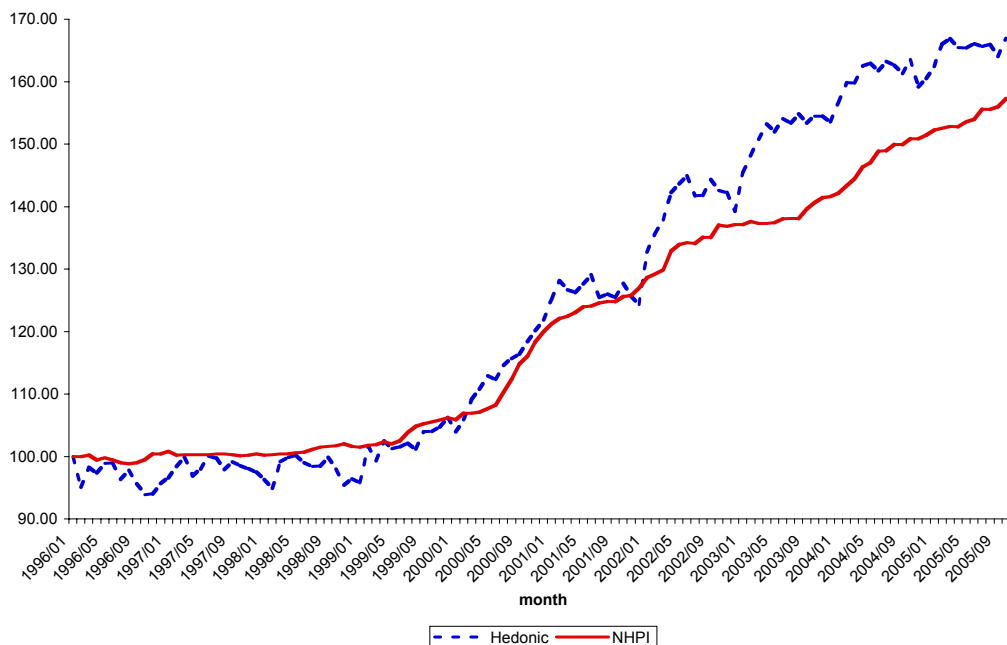
might find such a measure useful for dealing with claims that interest rate changes can provoke.

61. The net purchase approach (excluding interest) has been recommended by some as the best approach for measuring inflation, and was chosen for this reason, rather than for international comparability. However the New Zealand CPI's homeownership component almost follows this net purchase approach, and if their statistical agency or ours stripped their index of its mortgage interest component it would be fully comparable with our analytical series based on net purchases. Blinder's paper, written when the US still had its old net purchase including interest concept, makes a short term reform proposal that is essentially to adopt the New Zealand approach. The net purchase approach including interest approach was inspired by Blinder's article, and was calculated for the first time as an analytical series by Prices Division in 1985 (NP3). Without such an indicator any critic of a CPI defined as an inflation measure (i.e. a CPI based on net purchases) could claim that by ignoring mortgage rate hikes it is grossly underestimating the actual rate of inflation, and might find an audience; with it, one can readily demonstrate that the differences are seldom all that great.

4. Hedonics

62. There is a large body of literature, which applies the hedonic approach to the measurement of house prices. Bailey *et al.* (1963), Case *et al.* (1991), Meese and Wallace (1997), Nolan (1979), and Sheppard (1999) are but a very small sample of the applied research in this area.

Chart 1. NHPI vs. Hedonic Price Index, Ottawa, Jan 1996 to Dec. 2005 (Jan 1996 = 100)



63. It is almost universally accepted that a hedonic price index for housing will yield, albeit not a perfect measure, the best available measure of trends in house prices. In contrast, the New House Price Index (NHPI), which is used as a proxy for house price inflation in the analytical series of this study, is imperfect in a few ways. First, the quality differences that occur in time for new houses in the sample are adjusted using the “link-to-show-no-change” method, which as is well known, will likely underestimate (or overestimate) true price increases (or decreases). Second, new houses are not necessarily representative of the housing market as a whole. For instance, the construction of new homes mainly occurs outside the core area of the city where land is more readily available and where prices are thus cheaper. However, most housing transactions are occurring in the resale market and nearer to the city core and can therefore exhibit somewhat different behaviour than the new house market. Chart 1 illustrates the difference between the NHPI and a hedonic price index for the Ottawa area.

64. Over the January 1996 to December 2005 period the NHPI increased 57% compared to 75% for the hedonic price index. The inherent weakness in the NHPI is what motivated the use of the hedonic price index in this study as an alternative to the NHPI.
65. A complete description of the hedonic model and a discussion of its results are beyond the scope of this paper.²¹ The Hedonic price index used for this study uses data from Multiple Listing Services. Data are available for most physical characteristics associated with a house. The data are available for the period January 1996 to December 2005. There are over 100 000 observations in the database. The hedonic model uses adjacent years time dummy variables with a semi-logarithmic functional form.

5. Results

66. Table 3 shows the growth rates over the 1996 to 2005 period that are obtained using the various measures of home ownership and its impact on components of the CPI at various levels of aggregation. In this case, the estimates use the NHPI as the measure for house price movements. Based on the results from the hedonic index, it can be ascertained that in all cases except for the NHPI, the various measures of owned accommodation would yield slightly higher values. Only in the case of both Net purchases approaches is the effect of the hedonic regression applied with any precision.
67. Not surprisingly, at the level of Owned accommodation, the results vary according to the approach used. The Money Outlays version 1 (MO1) approach generates here the lowest rate of house inflation for owned accommodation (12.5%). In contrast, version 1 of the Net Purchase (NP1) approach provides the highest (44.7%). That MO1 generates the lowest rate of increase is not at all surprising. The dominant component of the measure are mortgage interest rates (53.2% of owned accommodation) and mortgage interest rates have been historically low during at times during the period of the study. MO2 increased 6 percentage points higher than its MO1 counterpart over the period. Recall that MO2 differs from MO1 inasmuch as it includes the net value of the down payment, the

²¹ For more information on the hedonic model used in this study, please consult Prud'Homme, Sanga, and Shum (2004).

principal portion of the mortgage payment and the receipts from the sale of the home. Therefore, the housing bubble that Ottawa has been experiencing over the last decade should translate into higher increases in a measure of owned accommodation that includes equity prices such as MO2 compared to a measure that does not, such as MO1.

68. The rental equivalence (RE) approach also recorded, not surprisingly, a relatively slower rate of increase. The rental market in Ottawa (and for most large cities in Canada) was, until recently, highly regulated. Rent increases were therefore capped. Given that the rental equivalence approach uses rents as the basis for its movements, then this measure will most likely provide rates of increase that do not reflect current market conditions.
69. The rate of increase for owned accommodation based on both Net Purchase concepts over the period contrasts sharply with the other measures. The relatively high weight given to home purchases couple with the rapidly rising prices of real estate in Ottawa explain this phenomenon. House prices have appreciated rapidly in Ottawa over this period and the NP1 and NP2 are faithful reflections of this.
70. For completeness of presentation, Table 3 also shows the impact of the various measures of owned accommodation on the Shelter component of the CPI, the next level up in the chain of aggregation in the Canadian CPI.
71. The range of differences once the various measures are aggregated to the All-items is also presented in Table 3. Note the slightly less than six percentage point difference between the growth rate in the CPI between the MO1 and the NP1 approaches (21.4% vs. 27%). On a monthly basis the differences are 0.16% vs. 0.20%.
72. Table 4, shows the impact of using hedonically produced prices for housing on both of the NP approaches. Given that the hedonic prices for houses were trending higher than the NHPI over this period, the expected result appears, the NP1 and NP2 (hedonic) is higher than NP1 (NHPI). Furthermore, the spread between NP1 and NP2 is greater once the higher rate of price increase of the hedonic index is used compared to when the NHPI is used.
73. Charts 2 through 7 show trends for different index series for the various treatments of owned accommodation in the Canadian CPI.

6. Conclusion

74. This research has shown that the Consumer Price Index is indeed sensitive to the choice of the concept of homeownership that is used in the CPI. Although there is no single correct concept, there is an appropriate one depending on the concept of the CPI one is attempting to measure. Of all the analytical series that Statistics Canada has calculated relating to the CPI, the analytical owned accommodation series are potentially the most interesting and useful to policymakers, analysts and the general public. Ideally, these series would be updated every month, and published along with the official CPI concept.

	Owned accommodation	Shelter	All-items
Official	20.5	23.4	23.6
RE	17.4	21.3	22.1
MO1	12.5	18.8	21.4
MO2	18.5	21.7	22.2
NP1	44.7	38.8	27.0
NP2	32.5	31.1	24.9

	Owned accommodation
NP1	50.6
NP2	34.3

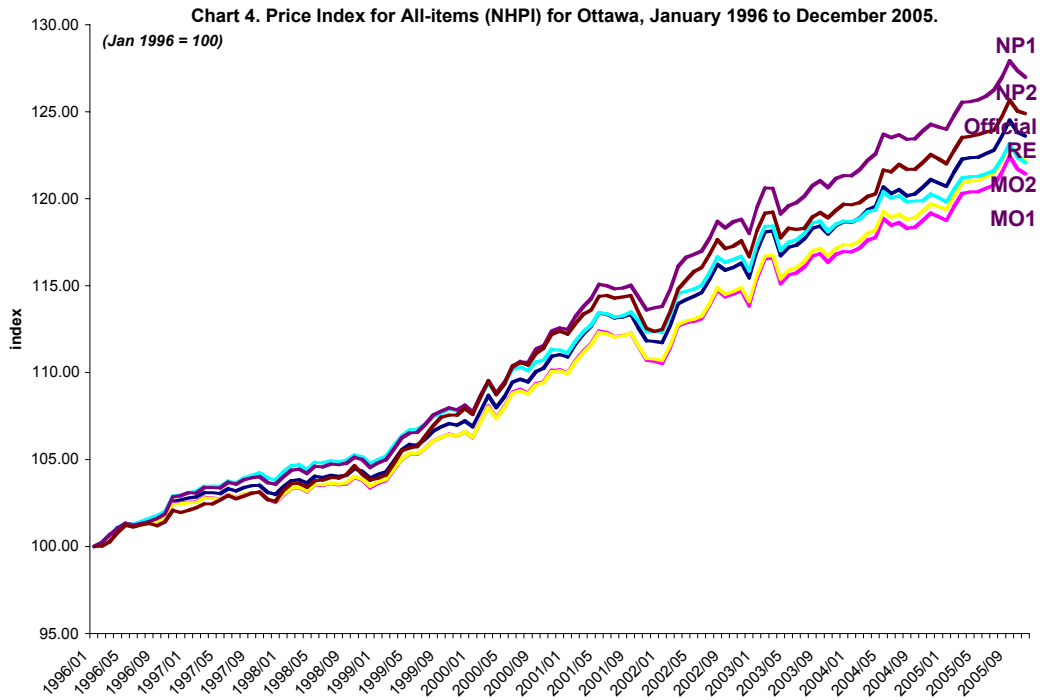


Chart 5. Price Index Series for Owned Accommodation using Hedonic Resale Prices for Ottawa, January 1996 to September 2005

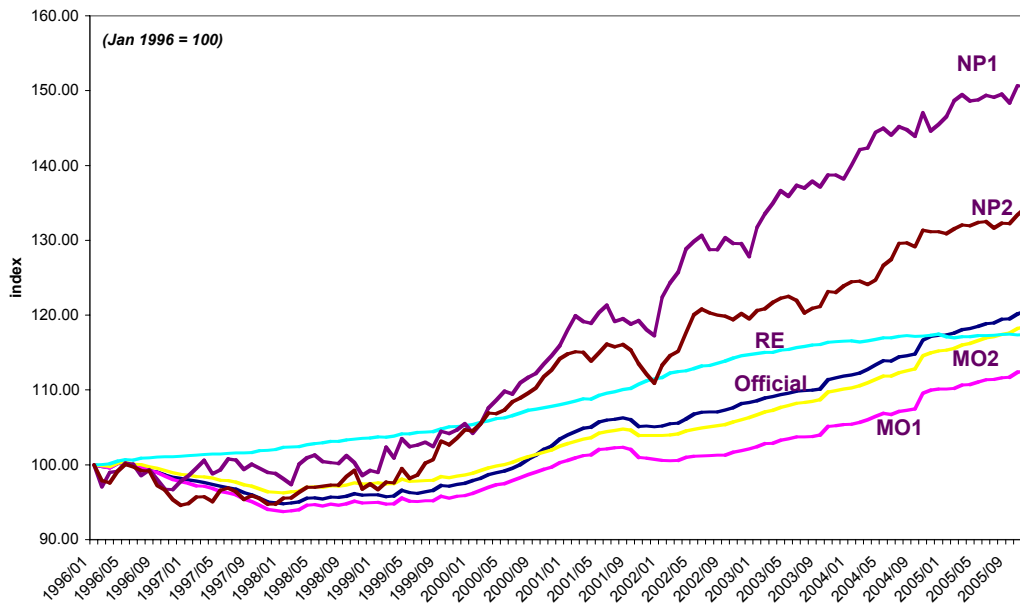


Chart 6. Price Index Series for Shelter using Hedonic Resale Prices for Ottawa, January 1996 to September 2005

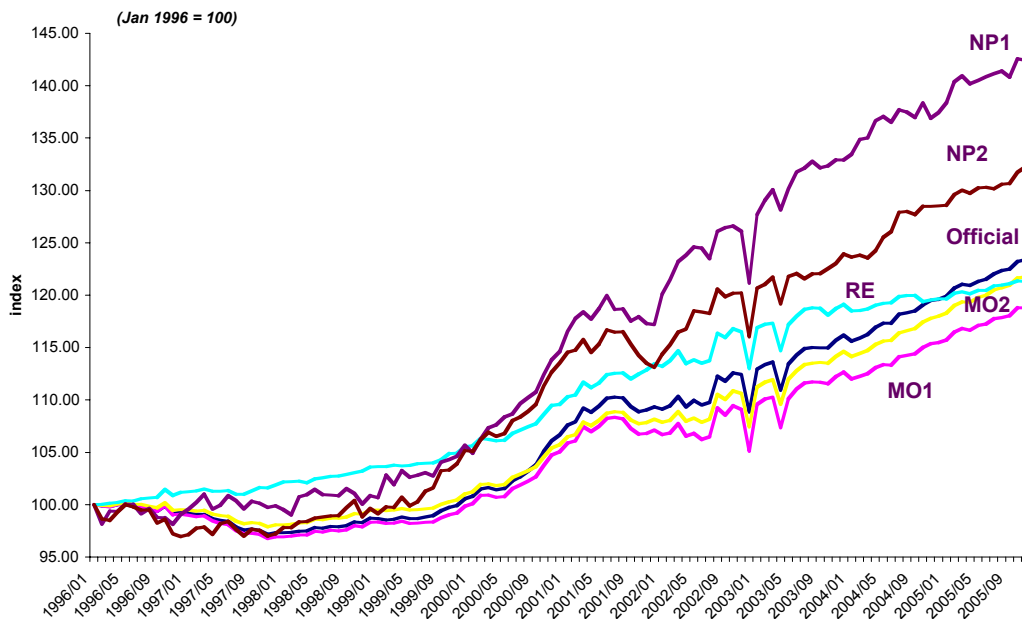
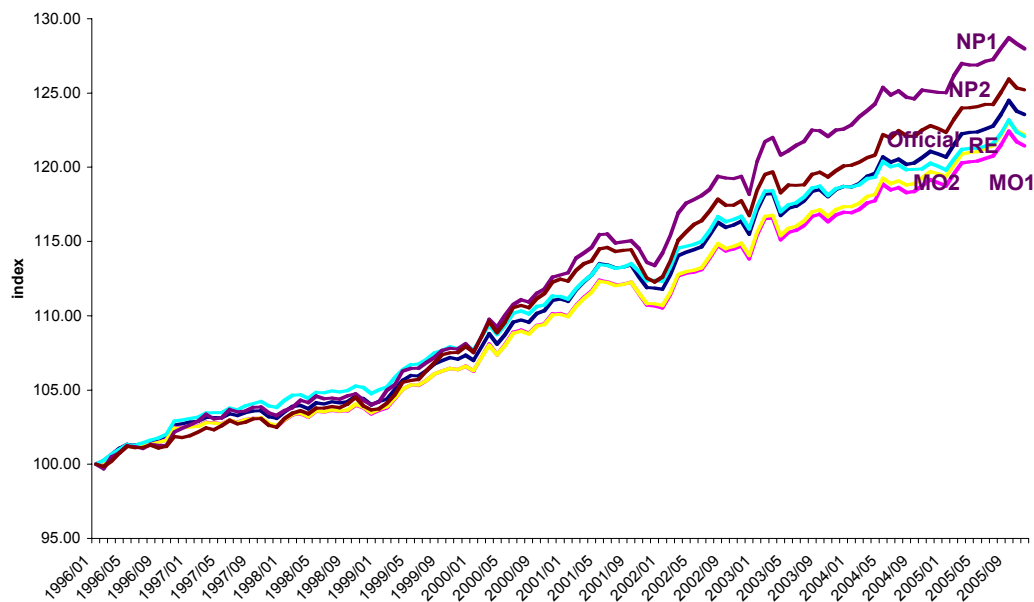


Chart 7. Price Index Series for All-items using Hedonic Resale Prices for Ottawa, January 1996 to September 2005



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Appendix A

Linking of the 1992=100 Series

The unlinked 1992=100 series with a 1992 basket was calculated from January 1992 to December 1997 and linked to these rebased series for the period 1995 to 1997:

$$P_{t/92}^{ch} = P_{Dec94/92}^{ch} \times P_{t/Dec94}^{(92)}; t = Jan95, \dots, Dec97 \quad (1)$$

where $P_{t/Dec94}^{(92)}$ denotes a series with a 1992 basket for which December 1994=1.0. *

Formula (1) should be calculated as:

$$P_{t/92}^{ch} = P_{Dec94/92}^{ch} \times \left(P_{t/92}^{(92)} / P_{dec94/92}^{(92)} \right) \quad (2)$$

where $P_{t/92}^{(92)}$ is the unlinked index for month t with 1992=100. That is, the index should be calculated from the unlinked indexes for the month t and link period December 1994. This is similar to the way linking actually takes place in the official CPI, and the differences need not concern us here.

Alternatively it could be calculated directly from component series rebased to December 1994=1.0 aggregated with weights representing a 1992 basket at December 1994 prices:

$$P_{t/92}^{ch} = P_{Dec94/92}^{ch} \times \sum_i W_{Dec94}^{(92)i} P_{t/Dec94}^i \quad (2)$$

where

$$W_{Dec94}^{(92)i} = W_{92}^{(92)i} P_{Dec94/92}^i / \sum_j W_{92}^{(92)j} P_{Dec94/92}^j \cdot$$

The weights for 1986 at December 1994 prices are given by:

$$W_{Dec94}^{(86)i} = W_{86}^{(86)i} P_{Dec94/86}^i / \sum_j W_{86}^{(86)j} P_{Dec94/86}^j \cdot$$

Linking of the 1996=100 Series

The unlinked 1996=100 series with a 1996 basket calculated from January 1996 forward was then linked to the chain series for the period from 1998 forward:

$$P_{t/92}^{ch} = P_{Dec97/92}^{ch} \times P_{t/Dec97}^{(96)}; t = Jan98, \dots$$

The method of calculation is analogous to that shown in formula (2) for the linking of the 1992 series:

$$P_{t/92}^{ch} = P_{Dec97/92}^{ch} \times \left(P_{t/96}^{(96)} / P_{dec97/96}^{(96)} \right).$$

As before, a set of hybrid weights were calculated for the 1992 and 1996 baskets at December 1997 prices.

Calculation of special aggregates for the analytical series for owned accommodation (1992 basket)

Besides the owned accommodation indexes themselves, the analytical series require higher level aggregates for shelter, housing and All-items. There is no longer an aggregate for principal accommodation or housing, so these are two aggregates less to be calculated. (It had been calculated in earlier rounds for the analytical owned accommodation indexes.) [NOTE: It may not be anything to worry about, but I thought I should tell you that someone like me doesn't understand the preceding parenthetical remark and the sentence before that: There is no longer...] In order to calculate these special aggregates it is first necessary to derive unlinked aggregate series based on the official concept that represent each of shelter, housing and All-items excluding owned accommodation. These series are building blocks for the special aggregates of all of the different concepts: rental equivalence, money outlays and net purchase:

45 (Hereafter, the discussion will refer exclusively to the calculation of the special aggregate for All-, since the calculation for the other aggregates follows exactly the same set of steps.)

We subtract the owned accommodation index (based on the official concept) from the CPI All-items.

$$P_{t/92}^{(92)AI-OA} = (P_{t/92}^{(92)AI} - W_{92}^{92OA} \cdot P_{t/92}^{(92)OA}) / (1 - W_{92}^{92OA}) \quad (0.1)$$

where

AI	refers to All-items
OA	refers to Owned Accommodation
t	refers to the observed period.
$P_{t/92}^{(92)AI-OA}$	is the unlinked price index for All-items excluding owned accommodation based on a 1992 basket (1992 is the base period).
$P_{t/92}^{(92)AI}$	is the unlinked All-items index based on a 1992 basket (1992 is the base period).
W_{92}^{92OA}	is the basket share of owned accommodation in the 1992 basket at 1992 prices.
$P_{t/92}^{(92)OA}$	is the unlinked owned accommodation price index based on the official concept based on a 1992 basket

To calculate the All-items index based on the rental equivalence, the money outlays and the net purchase concepts, we add the unlinked series based on each of these concepts to the unlinked price index for All-items excluding owned accommodation calculated in formula (1.1):

$$P_{t/92}^{(92)AI(RE)} = (W_{92}^{92AI-OA} \cdot P_{t/92}^{(92)AI-OA} + W_{92}^{92AO(RE)} \cdot P_{t/92}^{(92)OA(RE)}) / (W_{92}^{92AI-OA} + W_{92}^{92AO(RE)}) \quad (0.2)$$

where $W_{92}^{92AI-OA} = W_{92}^{92AI} - W_{92}^{92OA}$

Also, the hybrid value-weight for shelter or housing based on the 1992 basket at December 1994 prices will be needed (the same steps would be followed when producing special aggregates for 1996, we just have to replace 92 with a 96).