Measuring Durable Goods and Housing Prices in the CPI: An Empirical Assessment

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- The treatment of owner-occupied housing in the consumer price index remains the object of intense debate, with no consensus emerging and different countries using different approaches.[2] Yet there is no so such debate for durable goods, which, like housing, also provide services well beyond their purchase date.

- The treatment of both durable goods and housing could be brought closer to that for a cost-of-living concept by focusing on the cost of the services that these assets provide over time.

- The official treatment of housing over the past 15 years, which is based on a partial user-cost approach, yields results that are relatively close to (and somewhat smoother than) the enhanced (more comprehensive) user-cost approach that we propose, thus offering an acceptable compromise in the current environment of low and stable inflation. For automobiles, the official approach, which is based on the price paid at the time of acquisition, also yields results that are very close to those obtained from a user-cost approach.

- Nonetheless, we suggest that it would be worthwhile to consider treating housing and durables in the same way and bringing the actual CPI closer to a cost-of-living index.

The goal of the Bank of Canada is to foster confidence in the value of money by maintaining an environment of low, stable and predictable inflation, where inflation is defined as a persistent increase in the average prices of consumer goods and services—in other words, a trend increase in the cost of living. To achieve this goal, the Bank has targeted inflation since 1991. The target is set in terms of the 12-month increase in the total consumer price index (CPI) because it is the most relevant estimate of the cost of living for the majority of Canadians (Bank of Canada 2011).

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1   Pierre Duguay served as a Deputy Governor of the Bank of Canada from January 2000 until his retirement from the Bank in July 2010. Special thanks to Richard Dion for his seminal contribution to this work.

2   Recent Canadian examples include F. Poschmann and A. Jacobs, "Improving on the CPI: A Proposal for a Better Inflation Indicator," C. D. Howe Institute E-Brief (2015); and P. Bergevin, "Housing Bubbles and the Consumer Price Index: A Proposal for a Better Inflation Indicator," C. D. Howe Institute Commentary No. 362 (2012). Both papers are available at www.cdhowe.org.

However, while the CPI is the most commonly used and a reasonably adequate measure of inflation, it is not fully consistent with a true cost-of-living index (COLI). The main advantage of a true COLI is that it is a welfare-oriented measure grounded in the theory of consumer substitution behaviour.[3] This approach is well suited to the Bank's mandate to promote the economic and financial welfare of Canada. For services and non-durable goods, quality-adjusted transaction prices tend to satisfy the requirements of a COLI, since they reflect the instantaneous utility derived from the purchase. This is not true of durable goods and housing, however, from which consumers derive utility well beyond the purchase date.[4, 5] When constructing the CPI, Statistics Canada uses purchase prices to measure the costs of durable goods and a partial user-cost approach to measure the cost of owner-occupied housing (also known as owned accommodation), but it omits two key elements of that approach: the cost of owner's equity and the expected rate of housing appreciation. This article explores ways to better capture changes in the cost of living by reviewing different approaches to measuring durable goods and housing prices in the CPI.[6] Implications for monetary policy are also discussed.

Statistics Canada uses purchase prices to measure the costs of durable goods and a partial user-cost approach to measure the cost of owner-occupied housing, but it omits the cost of owner's equity and the expected rate of housing appreciation

Measuring the Prices of Durable Goods and Housing

There are essentially three ways to measure the prices of durable goods and housing included in the CPI. The first simply takes the prices paid for durables and housing at the time of acquisition (the net acquisition approach). The second calculates the imputed cost of the services provided by the use of durable goods or housing; it can be implemented through either a rental-equivalence or a user-cost approach. The third measure (the payment approach) focuses on the out-of-pocket expenses required to use or acquire a durable good or a house. In this article, we will focus on the net acquisition, rental-equivalence and user-cost approaches.

Net acquisition

The net acquisition approach,[7] which uses the price paid for a good at the time of acquisition rather than the cost of the service flows arising from the purchase, is not strictly compatible with a COLI. The main advantage of the approach is that it relies solely on observed prices and costs for current transactions. However, its departure from a COLI makes the approach questionable for indexation purposes and, to a lesser extent, from a monetary policy perspective.

Because people purchase durable goods and housing at irregular intervals, only a small fraction of households purchase these goods in any given year. The amount spent collectively by households on durables and housing in a given year would thus be equivalent to the depreciation (or amortization) part of the user cost of consuming these goods plus the growth in the stock of such goods. If that growth is

The net acquisition approach focuses on prices related to the current production of durable goods and housing, which is meaningful for monetary policy

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3   For further details on the advantages of a COLI, see Triplett (2001).

4   In the CPI, durable goods include automobiles, furniture, appliances, household tools (e.g., snow removal equipment), and audio and video equipment. Non-durable goods include fresh food products, gasoline and natural gas.

5   Quality-adjusted transaction prices approximate the requirements of a COLI for semi-durable goods (e.g., clothing) because they depreciate rapidly enough.

6   The official CPI also differs from a true COLI because it is based on an asymmetric weighting (fixed-basket) formula (the Lowe index) rather than a symmetric weighting formula (such as a Fisher index), which would be required by a COLI to avoid a substitution bias. By updating the consumer basket every two years instead of every four and reducing the delay in introducing new weights into the CPI (from 18 to 13 months), Statistics Canada is striving to lower the size of such a bias. Ideally, Statistics Canada should endeavour to eliminate the bias by resorting to a symmetric weighting formula, although that would involve small revisions to the CPI when new basket weights become available.

7   This approach considers only newly produced goods and excludes goods exchanged among households (e.g., existing homes or used cars).

commensurate with the real financial opportunity cost component of the user cost (defined in **Box 1** on p. 29), the net acquisition approach would yield similar results to a COLI and thus could not be dismissed out of hand. Further, the approach focuses on prices related to the current production of these goods, which is also meaningful for monetary policy.[8]

Rental equivalence

The rental-equivalence approach seeks to capture the value of the services consumed. Conceptually, it is well suited to measuring the prices of durable goods and housing because it is fully compatible with a COLI. However, successfully implementing the approach greatly depends on the availability of a rental market and the degree of segmentation between the ownership and rental markets. Imputations must be made with this approach, using paid rents as a proxy for equivalent rents, which can be difficult if there is no active rental market or if the market is distorted (e.g., by rent controls).

The rental-equivalence approach seeks to capture the value of the services consumed

For most durable goods, a rental market is nearly non-existent, except for automobiles, some household equipment, and audio and video equipment. The leasing market for automobiles accounted for about one-fifth of motor vehicle purchases in 2014, and there is little segmentation between the purchase and leasing markets for cars .[9,10] A rental-equivalence approach to measuring automobile prices could therefore be justified in principle.[11]

With regard to housing, there is a relatively active rental market for multiple-unit dwellings such as apartments and condominiums, but not for single-family homes. Specifically, the rental and home-ownership markets are highly segmented because of the different demographic and socio-economic characteristics of tenants and owners, the various types and locations of housing (multiple-unit dwellings versus single-family homes), and rent controls.[12] This poses important challenges to implementing the rental-equivalence approach for the owned-accommodation (OA) category in the CPI and can lead to measurement errors for both weights and the component price index.

User cost

The limitations noted above may favour the user-cost approach, particularly for single-family housing. This approach involves pricing the inputs to durable (housing) services, including the financing cost (or financial opportunity cost if owned resources are used) and depreciation. Based on capital market theory,[13] the user-cost and rental-equivalence approaches should, in principle, yield similar results to, and be compatible with, a COLI. The main challenge with the user-cost approach is that it requires extensive information on the average return on

The user-cost and rental-equivalence approaches should, in principle, yield similar results to, and be compatible with, a cost-of-living index

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8   However, since purchases of durable goods (particularly houses) vary considerably over the business cycle, large weight changes can occur whenever the CPI basket is updated, which can be problematic.

9   This share is down from 45 per cent in 2005 (Ross Marowits, Canadian Press, 23 May 2014, available at www.moneysense.ca/spend/auto/car-leasing-regaining-traction-but-canadians-prefer-to-own-their-wheels).

10   In particular, similar models of cars are purchased and leased. However, car leases tend to be of shorter duration than the average life span of owned cars.

11   There could be challenges with this approach; for example, the car leasing market dried up during the 2008–09 financial crisis.

12   In addition, the utility generated from the house may not be the same for owners and renters: homeowner-occupiers may derive enjoyment from owning their living accommodation and tend to take better care of their homes than renters and their landlords.

13   Capital market theory implies that the price of an asset (e.g., a house) would be equal to the discounted value of the flow of income or services (e.g., rents) that it provides over the lifetime of the asset.

household financial assets and the expected future appreciation of housing to estimate the financial opportunity cost. As well, because the expected future appreciation of housing translates into a reduction in the opportunity cost of OA, the user cost can decline sharply at times of an accelerated increase in house prices, which could materially reduce inflation and increase its volatility. This could create problems for communicating monetary policy and for the public credibility of the CPI.[14]

Statistics Canada's approach

For durable goods such as motor vehicles, Statistics Canada uses the net acquisition approach. When accounting for car leases, for example, it converts the cost of leasing into an equivalent imputed purchase price. From a COLI perspective, a preferable approach would be to use price information from the car-leasing market to assess the cost of car services to car owners, following a rental-equivalence approach.

For housing, the official measure can be seen as a truncated version of the user-cost approach. It prices mortgage interest costs[15] and depreciation costs but excludes two defining elements of the capital theory foundation of the approach: the expected appreciation of owner-occupied dwellings and the financial opportunity cost of homeowner equity in these dwellings.

International practices

International statistical agencies have unanimously adopted the net acquisition approach for durables, but there is no consensus about the best approach to the treatment of OA in the CPI[16] (**Table 1**). Rental equivalence is the most popular approach among countries belonging to the Organisation for Economic Co-operation and Development.[17] Johnson's (2015) recent review of the U.K. CPI proposes using CPIH, which includes the costs of OA and is based on a rental-equivalence approach, as the U.K.'s main measure of inflation. Several countries in the European Union have refrained from incorporating OA into their CPI, although Eurostat is currently conducting a pilot study for the euro area based on the net acquisition approach. Australia and New Zealand use a net acquisition approach, while Sweden and Finland—like Canada—are using a partial user-cost approach. No country has adopted a full-fledged user-cost approach.

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14   More importantly, the user cost can become negative in such circumstances. To avoid this problem, Diewert, Nakamura and Nakamura (2009) propose that the opportunity cost of home ownership be the higher of the user cost and the rent that the premises could command; this would have to be estimated at the micro level.

15   In Statistics Canada's methodology, "mortgage interest costs" is the product of two indexes: an index (H) that captures the effects of changes in dwelling prices on the outstanding mortgage balance, assuming a fixed stock of dwellings and fixed financing conditions, and an index (I) that estimates the effect of changes in interest rates on the amount of mortgage interest owed, assuming a given amount of principal outstanding. For more details, see Statistics Canada (2009).

16   However, there is a consensus about using the rental-equivalence approach to measure consumption in the national accounts.

17   The decision to adopt a rental-equivalence approach in some European countries, such as Germany, likely has to do with the depth of their rental markets.

Table 1: Treatment of owned accommodation in the CPI: International practices

	Simplified user-cost approach	Rental-equivalence approach	Net acquisition approach	Excludes OA
Australia	-	-	x	-
Belgium	-	-	-	x
Canada	x	-	-	-
Denmark	-	x	-	-
Euro area (HICP)	-	-	Pilot study	x
Finland	x (until 2005)	-	x	-
France	-	-	-	x
Germany	-	x	-	-
Italy	-	-	-	x
Japan	-	x	-	-
Netherlands	-	x	-	-
New Zealand	-	-	x	-
Norway	-	x	-	-
Spain	-	-	-	x
Sweden	x	-	-	-
Switzerland	-	-	-	x
United Kingdom	x (RPI)	X CPIH	-	-
United States	-	x	-	-

Note: HICP = Harmonised Index of Consumer Prices; RPI = Retail Prices Index; CPIH = consumer price index including costs of owner-occupied housing

Source: Bank of Canada

The remainder of this article presents specific suggestions to make the CPI more like a COLI with respect to its treatment of housing and automobiles. Our empirical estimations are only approximate, however, since they are calculated from Canada-wide aggregates rather than from the geographically disaggregated data used in the construction of the official CPI.

Improving the CPI as an Approximation of a Cost-of-Living Index: The Case of Owned Accommodation

To obtain a more comprehensive measure of user costs, the mortgage interest cost (MIC) has to be replaced with the financial opportunity cost (FINOC) of living in one's own dwelling.

The overall user cost combines the measure of the FINOC (**Box 1**) with other operating expenses related to OA costs embedded in the CPI. These include replacement-cost depreciation (*rc*), property taxes (*pt*), maintenance and repairs (*mrp*), property insurance (*ins*), and other housing services such as condominium fees (*oth*). Their relative weights in OA correspond to those in the current CPI, adjusted for the fact that the specific dollar amount of the FINOC is different from, and often lower than, the dollar value of the MIC component that it replaces.[18] Consequently, the size of the total basket diminishes, and the relative weights of

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18   This is because, in those cases, the negative contribution of the house appreciation term to the cost of owning a house exceeds the contribution of the average return on household financial assets.

the other operating-cost components in both OA and total CPI increase. A chain-weighted user-cost index is constructed using the Survey of Household Spending (SHS) for 2001, 2005, 2009 and 2011. For illustrative purposes, using the 2005 and 2009 weights, the user-cost index for OA is, respectively defined as

$$uc_t^{oa2005} = 0.22 * IFINOC_t + 0.24 * rc_t + 0.24 * pt_t + 0.11 * mrp_t + 0.08 * ins_t + 0.11 * oth_t$$

and

$$uc_t^{oa2009} = 0.24 * IFINOC_t + 0.28 * rc_t + 0.22 * pt_t + 0.09 * mrp_t + 0.08 * ins_t + 0.09 * oth_t.$$

Box 1

Measuring Financial Opportunity Cost

Financial opportunity cost ($FINOC$) has three elements: the interest rate paid on the mortgaged portion of the house (r_t^d), the average return on household financial assets (r_t^a) as the opportunity cost of the equity portion of the house, and the expected future appreciation of the dwelling ($(E[H_{t+1}] - H_t)/H_t$):

$$FINOC_t = r_t^d D_t + r_t^a (1 - D_t) - \frac{(E[H_{t+1}] - H_t)}{H_t},$$

where D_t, the mortgaged portion of the house, is approximated by the ratio of residential mortgages to the value at current prices of residential dwellings and land held by the personal sector, taken from the national accounts. This ratio has been relatively stable at about 30 per cent, which is consistent with the Canadian Association of Accredited Mortgage Professionals' estimate of 26 per cent (CAAMP 2014).

The financial opportunity cost in current dollars ($FINOC\$_t$) associated with a fixed (base-period) stock of residential owner-occupied properties is calculated as

$$FINOC\$_t = Res_{base} * P_t^{res} * FINOC_t,$$

where P_t^{res} is measured by the index of resale housing prices from the Royal LePage House Price Survey, and Res_{base} is the base-period volume of residential stock for owner-occupied housing.[1] The index (base = 100) of the financial opportunity cost component of the CPI ($IFINOC$) is calculated as

$$IFINOC_t = \frac{FINOC\$_t}{FINOC\$_{base}} * 100,$$

where FINOC\$$_{base}$ is the base-period value of FINOC\$.

One challenge in building a user-cost measure of owned accommodation is to come up with appropriate measures for the three elements of the financial opportunity cost: the average mortgage interest rate (r_t^d), the average return on household financial assets (r_t^a) and the expected future appreciation of the dwelling ($(E[H_{t+1}] - H_t)/H_t$.

(continued…)

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1 Not all residential dwellings are owner-occupied. Data on paid and imputed rents from the national accounts suggest that owner-occupied dwellings account for about 75 per cent of the value of residential dwellings.

Box 1 *(continued)*

The average mortgage interest rate (r_t^d) is approximated by a 20-quarter weighted moving average of the posted 5-year mortgage rate less a discount rate,[2] with the weights corresponding to the value of the net change in the number of mortgages in each quarter. For simplicity, the implicit assumption is that all mortgages are renewed at or within five-year intervals. We estimate that r_t^d averaged 3.4 per cent over the second half of 2014, much lower than the average of 6.5 per cent in 2001.

For the average return on household financial assets (r_t^a), we used the ratio of the investment income of the personal and unincorporated business sector to the market value of that sector's financial assets at quarter-end, as provided by the National Balance Sheet Accounts. Investment income includes interest, dividends, miscellaneous investment income of the personal and unincorporated business sector, and capital gains.[3]

The nominal return on household financial assets has averaged about 4.5 per cent since 2000, ranging from a peak of 5.0 per cent in the first quarter of 2000 to a trough of about 4.0 per cent in the fourth quarter of 2014 and displaying a distinct downward trend.

The advantage of this macro measure of return on equity r_t^a is its comprehensive coverage. The list of assets covered includes various types of deposits, short-term paper, bonds, Canada Savings Bonds, mortgages, life insurance and pension funds, shares in mutual funds and companies, and foreign investment. By construction, the evolution of r_t^a reflects changes in both the returns on individual assets and the composition of the asset portfolio of households.[4]

The expected rate of housing appreciation can exhibit extreme volatility from one period to the next. However, given the costs involved in moving, finding and selling property, households do not reassess their decision to own or to rent every period. Based on the view that households take a long-run perspective on the prospects for future appreciation, housing price expectations are assumed to be constant over time[5] at the average annual rate of change of house prices over the period of the inflation-targeting regime (1992–2014) (i.e., at about 4.0 per cent).[6]

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2 The discount rate, measured as the difference between the actual and the posted rate for a 5-year term, has risen significantly over time, reaching about 1.9 percentage points in the fourth quarter of 2014.

3 Capital gains are measured as the difference between the market value and the book value of the financial assets at quarter-end. To avoid excessive volatility, capital gains are assumed to be constant over time, at the average since 1992 (i.e., about 1.0 per cent).

4 To obtain a pure price effect, it would have been preferable to measure the return of an invariant portfolio in terms of risks, but this is not possible, owing to a lack of data. Our measure of the average return on household financial assets would also not be available on a timely basis. It could be used to measure the weight of FINOC, but for computation of the monthly CPI, a risk-free rate of return, which, by arbitrage, should be a reasonable approximation of risk-adjusted returns on household portfolios, could be used as a price index.

5 The housing price expectations measured with a 5- or 10-year moving average significantly increase the volatility of the FINOC index and do not adequately represent expected future house price movements.

6 The rate of appreciation is measured from the Royal LePage House Price Survey of existing houses, the only index available over a sufficiently long time period. Over the past 15 years, its trend growth has closely tracked that of other measures of existing house prices, such as the Teranet-National Bank House Price Index.

Pricing Owned Accommodation: An Empirical Comparison of the Approaches

Synthetic measures of OA based on the net acquisition and rental-equivalence approaches were also constructed using simple assumptions and procedures. They are calculated as chain-weighted averages of the components in each index (**Table 2** and **Table 3**). The weights for the net acquisition measure are based on the SHS and correspond to the total value of houses bought by the household sector minus the value sold in a given survey period.[19] The key price component, net home purchases, is captured by Statistics Canada's New Housing Price Index. As observed in footnote 8, above, the weight of OA in the net acquisition approach varies considerably from one basket to the next. For the rental-equivalence measure, the weights are taken from the national accounts and correspond to the personal expenditure values for imputed rent.[20] As well, the key price component, equivalent rent, is proxied by the index of paid rent in the CPI. All the other price components of these two measures are taken directly from the CPI.

Table 2: Weights for the components of indexes of owned accommodation

	Weights for each Index[a]			
	Official index	Net acquisition index	Rental-equivalence index	User-cost index
Maintenance and repairs	9.8	11.2	3.2	10.9
Property taxes	21.0	24.0	-	23.8
Insurance premiums	6.9	6.3	1.7	8.3
Mortgage interest cost	33.2	-	-	-
Replacement depreciation cost	19.5	-	-	23.6
Other owned-accommodation expenses	9.6	11.0	-	11.4
Equivalent rent	-	-	95.1	-
Home purchase cost	-	47.5	-	-
Financial opportunity cost	-	-	-	22.0

a.   All weights are based on the 2005 Survey of Household Spending except for equivalent rent, home purchase cost and financial opportunity cost.

Source: Bank of Canada

19   The total value is for new or existing houses and includes both structure and land.

20   The weights may be upwardly biased since most rented homes include appliances. Therefore, the estimated rental values for OA also likely include the rental of some appliances provided with the houses.

Table 3: Weights of rented housing and owned accommodation in the CPI using various approaches

Approaches	2001		2005		2009		2011	
	Rented housing	Owned accommodation	Rented housing	Owned accommodation	Rented housing	Owned accommodation	Rented housing	Owned accommodation
Official	6.3	15.5	5.5	15.6	6.2	16.8	5.9	15.5
Net acquisition	6.5	13.1	5.6	13.9	6.3	15.8	5.5	20.8
Rental-equivalence	6.1	18.7	5.3	18.4	6.0	19.4	5.7	19.2
User-cost	6.1	17.1	5.6	13.9	6.2	16.0	6.0	14.7

Source: Bank of Canada

The levels and year-over-year growth rates of the indexes of OA from 2000 to 2014 are plotted in charts 1 to 3. In level terms, the very gradual profile of the rental-equivalence index stands in sharp contrast to the rapid escalation of the net acquisition index. The user-cost measure, however, follows a path broadly similar to the official measure, although they diverge in recent years because of falling returns on financial assets and the use of a moving average of mortgage interest costs in the official measure. In both the user-cost and the official indexes, the effect of the rise in house prices on OA (and the cost of living) is tempered by the decline in financing costs, but the user-cost index is more sensitive to fluctuations in interest rates (**Chart 1**). This greater sensitivity adds volatility to the measure of user-cost inflation (**Chart 2**). In terms of yearly growth rates, the rental-equivalence measure shows exceptional stability around 1.5 per cent (a rate slightly below the average overall inflation rate),[21] whereas both the official and the net acquisition measures track the changes in house prices (**Chart 3**).[22]

In both the user-cost and the official indexes, the effect of the rise in house prices on owned accommodation (and the cost of living) is tempered by the decline in financing costs, but the user-cost index is more sensitive to fluctuations in interest rates

Chart 1: The user-cost index of owned accommodation versus the official measure

Index: 2002Q2 = 100

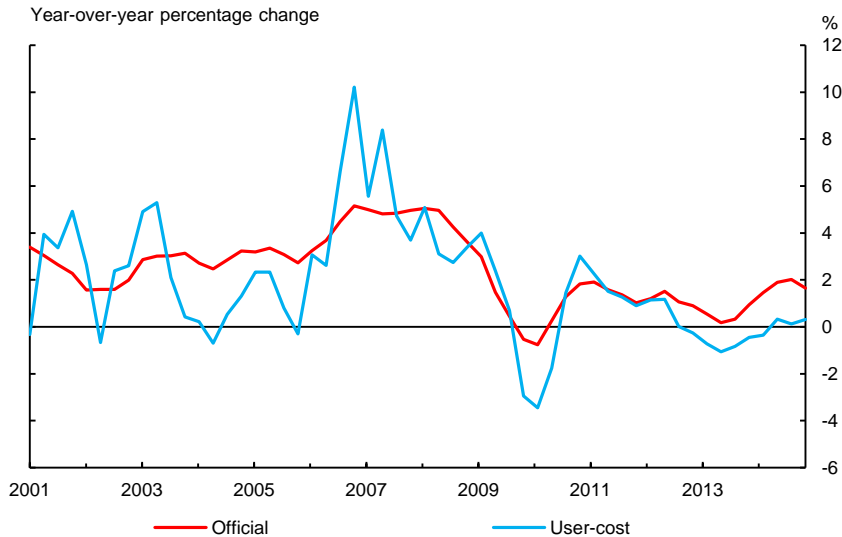Note: Both indexes are buffered from house price increases by declining financing costs.

Sources: Statistics Canada and Bank of Canada calculations

Last observation: 2014Q4

21   The use of paid rent for tenants as a proxy for imputed rent could account for such smoothness and the large divergence from the user-cost approach. This might not be the case if rents were appropriately imputed at a micro level, based on a composite of owner-occupied dwellings.

22   In the official measure, however, the link with house prices is lagged. This is because, by construction, the new house price index (excluding the land) used to measure the depreciation costs in the official CPI is entered with a one-month lag.
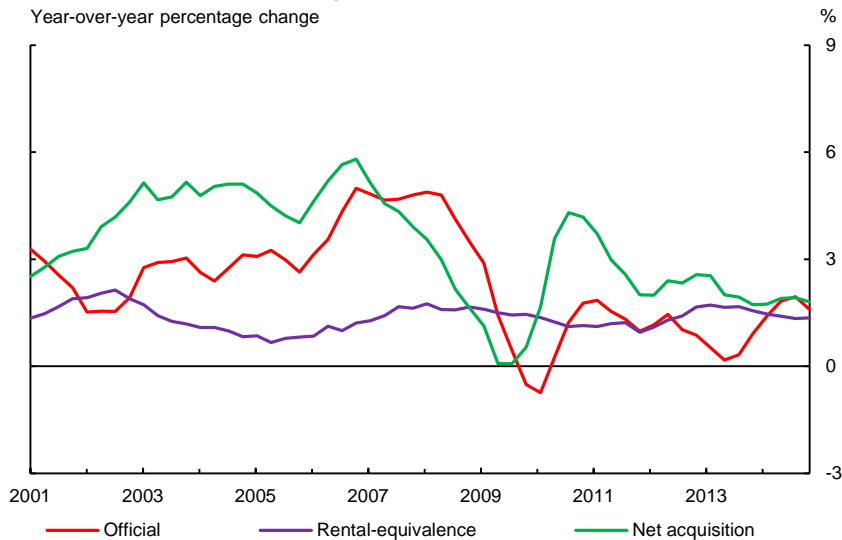
Chart 2: **User-cost inflation is significantly more volatile than the official measure of owned accommodation**

Year-over-year percentage change

Sources: Statistics Canada and Bank of Canada calculations   Last observation: 2014Q4

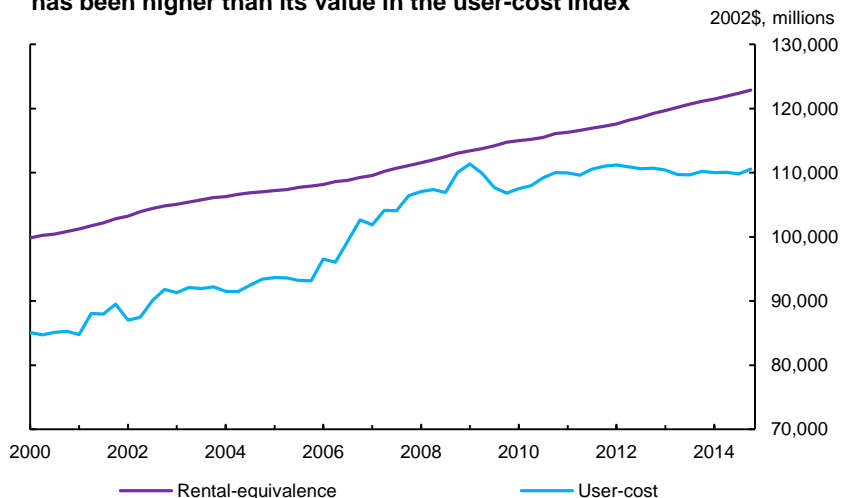**Chart 3:** **The official inflation rate of owned accommodation reflects house price movements with a lag**

Year-over-year percentage change

Sources: Statistics Canada and Bank of Canada calculations   Last observation: 2014Q4

As shown in **Chart 4**, despite the slower progression of the rental-equivalence index, the imputed value of rents has constantly exceeded the value of the user cost.[23] The potential upward bias in the weights for the rental-equivalence measure mentioned in footnote 20 may partly explain this result. Alternatively, this finding may suggest that rents are elevated relative to the cost of home ownership and could explain why, in Canada, home ownership grew from about 64 per cent in 2000 to 69 per cent in 2011, while the rent component of shelter fell in real terms (i.e., relative to the overall CPI).

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23   This is also expressed by the higher weights of OA in total CPI for rental equivalence compared with the user cost for each basket update.

Chart 4: **The value of owned accommodation in the rental-equivalence index has been higher than its value in the user-cost index**
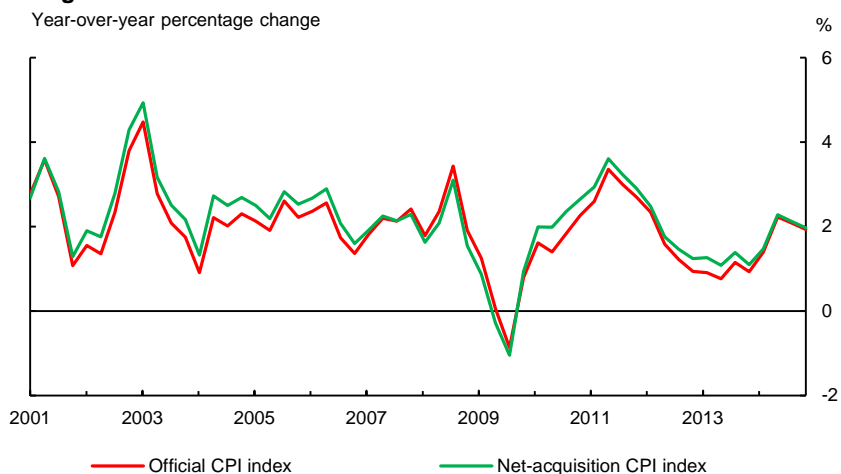
2002$, millions

Sources: Statistics Canada and Bank of Canada calculations   Last observation: 2014Q4

For each synthetic index of OA, the corresponding measure of total CPI is based on the weights of each OA measure in the overall basket (**Table 3** and charts 5 to 7).[24] The acquisition-based CPI would have registered the fastest inflation rate since the early 2000s (**Chart 5**), particularly during the period of peak yearly growth in housing prices, from the first quarter of 2006 to the second quarter of 2007, when total inflation would have been 0.4 percentage points above the inflation target instead of being on target, as officially recorded. Conversely, the inflation rate of a rental-equivalence-based CPI would have been significantly lower than the official one, particularly during the same period of rapid increases in house prices (**Chart 6**). For total CPI, the user-cost index is broadly in line with the official measure, albeit exhibiting less inflationary pressure since 2012 as a result of declining financial opportunity costs (**Chart 7**).

◄ *For total CPI, the user-cost index is broadly in line with the official measure, albeit exhibiting less inflationary pressure since 2012, as a result of declining financial opportunity costs*
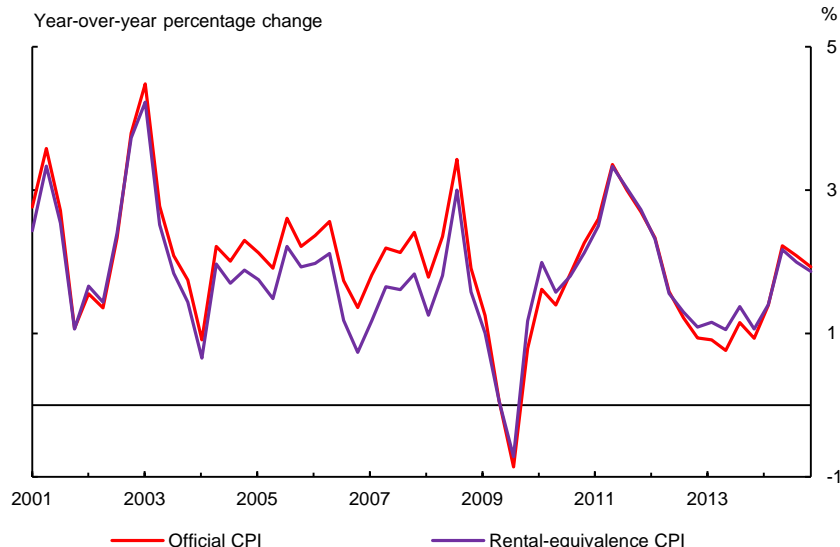
Chart 5: **The net acquisition version of the CPI shows the fastest rate of growth in total inflation**

Year-over-year percentage change

%

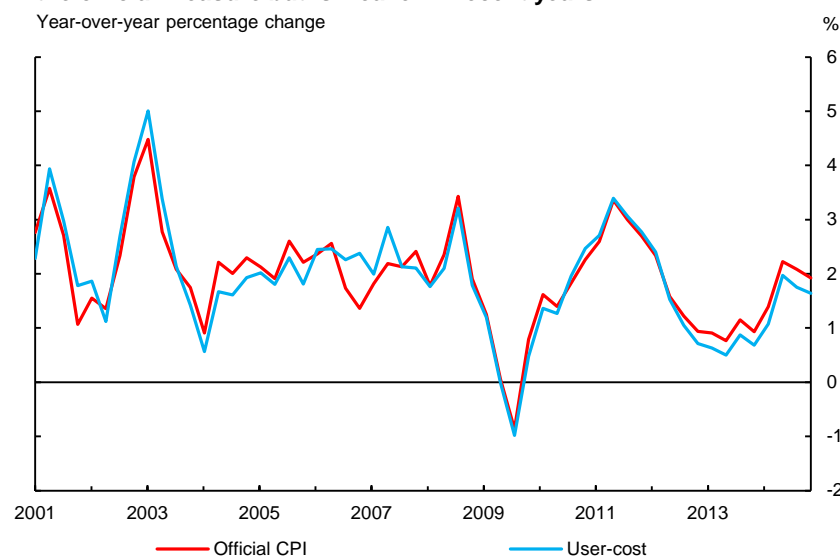Sources: Statistics Canada and Bank of Canada calculations   Last observation: 2014Q4

24   The total CPI is calculated using a Lowe index formula.

Chart 6: The rental-equivalence version of the CPI is showing the lowest rate of inflation

Year-over-year percentage change

Official CPI   Rental-equivalence CPI

Sources: Statistics Canada and Bank of Canada calculations   Last observation: 2014Q4

Chart 7: The user-cost version of the CPI follows a broadly similar path to the official measure but is weaker in recent years

Year-over-year percentage change

Official CPI   User-cost

Sources: Statistics Canada and Bank of Canada calculations   Last observation: 2014Q4

Volatility in the alternative measures of the cost of owned-accommodation and implications for the CPI

Volatility is defined as the standard deviation of the year-over-year growth rates in the OA indexes and the associated total CPI over the 2001–14 period (**Table 4**). The rental-equivalence index is by far the smoothest, while both the net acquisition and the user-cost indexes generate more volatility than the official measure. The greater volatility of the user-cost index relative to the official measure of OA comes from the higher standard deviation of the year-over-year growth in the measure of financial opportunity cost relative to the mortgage interest cost in the CPI. In terms of the implied volatility in CPI inflation, the net acquisition and user-cost indexes show slightly more volatility than the official measure, while the rental-equivalence index produces an overall CPI inflation that is somewhat smoother.

◀ *The net acquisition and user-cost indexes show slightly more volatility than the official measure*

Table 4: Volatility in indexes of owned accommodation and total CPI
Standard deviation of year-over-year growth rates, 2001–14

	Official	Net acquisition	Rental-equivalence	User-cost
Owned-accommodation indexes	1.48	1.52	0.35	2.86
Total CPI	0.90	0.96	0.84	0.97

Source: Bank of Canada

Improving the CPI as a Cost-of-Living Index: The Case of Motor Vehicles

As mentioned above, information from car leasing could readily be used to assess the cost of car services, given the virtual absence of market segmentation between car purchases and car leasing.[25] An alternative way to help the CPI approximate a COLI could be to replace the purchase price of motor vehicles and the remaining private transportation components with the costs of owning, maintaining and using cars. Cost information is divided between operating and fixed costs. Operating costs include gasoline and other fuel (gas) and maintenance (e.g., changing tires) (mrp_t). Fixed costs include driver's licences, car registration and parking fees (fee), and insurance premiums (ins), as well as depreciation (rc) and financial opportunity costs ($IFINOC_t$).[26] Using the SHS for 2005, the user-cost index for private transportation is defined as[27]

$$uc_t^{pt2005} = 0.06 * IFINOC_t + 0.37 * rc_t + 0.28 * gas_t + 0.10 * mrp_t + 0.16 * ins_t + 0.03 * fee_t.$$

The index for private transportation using this very rough proxy for the user-cost approach is similar to the official CPI index (**Chart 8** and **Chart 9**).[28] This is not surprising, given that the weights for the price of new motor vehicles are very similar in the two approaches and the weight for the financing costs is relatively small. These costs are nonetheless driving the divergence between the two indexes, with the user-cost measure showing less inflationary pressure in early 2000, but more in 2006–08, a period characterized by higher financial costs. After 2012, the inflation rate suggested by the user-cost measure is lower than the official measure (0.6 per cent versus 0.9 per cent, on average) because of declining interest rates on personal loans, including for automobiles.

◄ *An alternative way to help the CPI approximate a COLI could be to replace the purchase price of motor vehicles and the remaining private transportation components with the costs of owning, maintaining and using cars*

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25   We did not calculate a rental-equivalence measure for automobiles because we did not have access to leasing data.

26   The CPI weights for the depreciation of motor vehicles and for the FINOC were derived from Ray Barton, VPP and Mohammadian's (2006) estimates of the average depreciation over a five-year period and the average finance charges relative to automobile insurance premiums and other fixed costs, multiplied by the weight of these fixed costs (including insurance premiums) in the CPI. The resulting estimated CPI weight for depreciation is about 6.5 per cent (based on the 2011 SHS), slightly lower than the weight for the purchase and leasing of motor vehicles (7.6 per cent), and the weight of the FINOC is estimated at 0.9 per cent. The CPI price for the purchase of new motor vehicles is used as the price index of the replacement depreciation cost and, multiplied by an index of the interest rate on personal consumer loans, as the price index of the financial opportunity cost (IFINOC). The expected future rate of change of car prices is assumed to be zero.

27   Given the lack of access to data, the user-cost index for private transportation is computed using a fixed-weight approach, based on the 2005 SHS.

28   The two indexes show similar volatility over the historical period (2000–14).

Chart 8: The user-cost index for private transportation is similar to the official CPI index
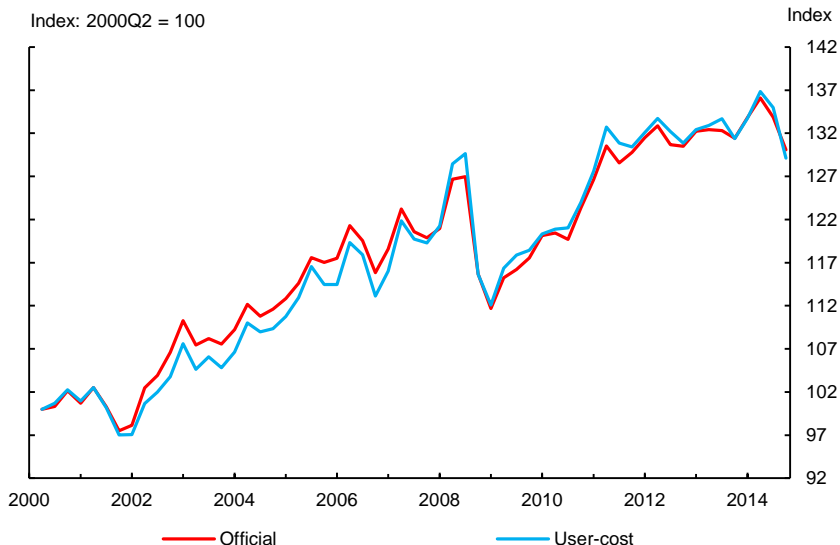
Index: 2000Q2 = 100

Index

Sources: Statistics Canada and Bank of Canada calculations   Last observation: 2014Q4

Chart 9: The recent inflation rate for user-cost private transportation is somewhat weaker than in the official CPI index

Year-over-year percentage change

%
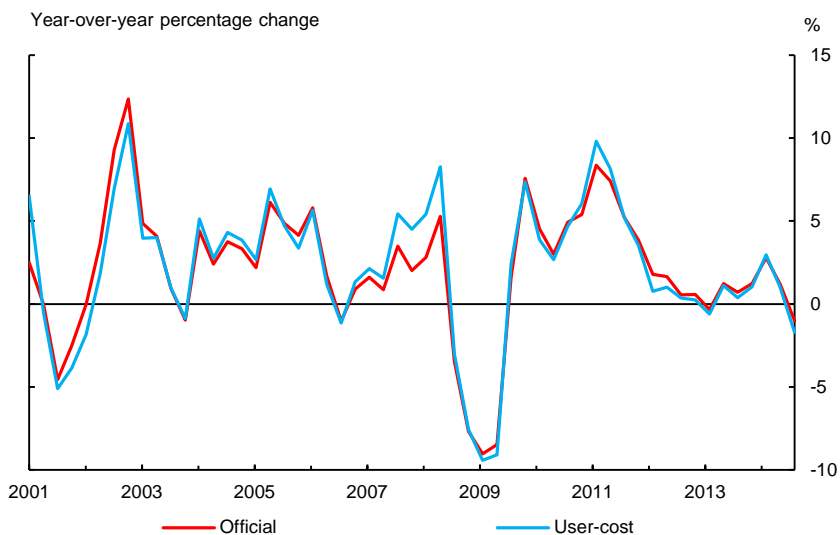
Sources: Statistics Canada and Bank of Canada calculations   Last observation: 2014Q4

Conclusion

We have argued that making the CPI more like a cost-of-living index can be accomplished by pricing the service flows from durable goods and housing rather than the acquisition cost. This type of index can be implemented through either a rental-equivalence approach (where a comparable rental market exists) or an enhanced user-cost approach. Both approaches pose considerable conceptual and practical difficulties, however, particularly for owner-occupied housing.

The rental-equivalence approach could be usefully considered for automobiles, given the prevalence of the car-leasing market and the virtual absence of segment-ation between the markets for car purchases and car leasing. But, for housing, the high degree of segmentation between the rental and home-ownership markets

raises important questions about the adequacy and cost of the information needed to support a high-quality rental-equivalence measure of owned accommodation in a Canadian context. The user-cost approach requires assumptions about the financial opportunity cost, particularly the expected future appreciation of housing. It can also produce excessive volatility.

Our rough attempt to produce rental-equivalence and user-cost measures of owner-occupied housing for the Canadian CPI shows that there is a lack of sensitivity to housing prices in our synthetic rental-equivalence index compared with the user-cost and official indexes. This could be problematic for monetary policy and could mean that, if a rental-equivalence measure were to be adopted for the official CPI, serious consideration might have to be given to a subsidiary indicator of inflation based on a net acquisition approach to owner-occupied housing.

For housing, our enhanced user-cost index of owned accommodation (based on extensive smoothing of the expected housing appreciation term) yields results that are relatively close to (though still somewhat more volatile than) the official measure throughout most of the past 15 years. For automobiles, this user-cost approach again yields results that are very close to the official (net acquisition) approach. One conclusion that could be drawn is that the actual practice thus represents an acceptable compromise in the current environment of low and stable inflation.[29] Another is that it would be worthwhile to pursue the work of trying to treat housing and durables in the same way and to bring the actual CPI closer to a COLI. Finally, it is reassuring to find that the contemplated changes would not alter the broad CPI story over history.

Literature Cited

Bank of Canada. 2011. *Renewal of the Inflation-Control Target: Background Information—November 2011.*

Ray Barton Associates Ltd. in association with Victoria Public Policy Institute and K. Mohammadian. 2006. "Estimation of Costs of Cars and Light Trucks Use per Vehicle-Kilometre in Canada." Final Report (Ottawa: Transport Canada, 30 March).

Canadian Association of Accredited Mortgage Professionals (CAAMP). 2014. "Annual State of the Residential Mortgage Market in Canada. " Prepared by W. Dunning, November.

Diewert, W. E., A. O. Nakamura and L. I. Nakamura. 2009. "The Housing Bubbles and a New Approach to Accounting for Housing in a CPI." *Journal of Housing Economics* 18 (3): 156–71.

Johnson, P. 2015. "UK Consumer Price Statistics: A Review." UK Statistics Authority, 8 January.

Statistics Canada. 2009."Canadian Consumer Price Index Reference Paper."

Triplett, J. E. 2001. "Should the Cost-of-Living Index Provide the Conceptual Framework for a Consumer Price Index?" *The Economic Journal* 111 (472): 311–43.

[29] This would not be true in a higher inflation environment with a larger and more variable difference between nominal and real interest rates.