Market price approach to simple user cost

Rosmundur Gudnason
Statistics Iceland, Borgartúni 21a, IS - Reykjavík 150, Iceland
Tel.: +354 528 1201; Fax: +354 528 1099; E-mail: rosmundur.gudnason@statice.is

Abstract. There are two main approaches to measuring Owner Occupied Housing: the flow of services approach (covering rental equivalence and user cost) and the net acquisition. They use market price information for price measurement in the calculation of consumer's use of own housing. This paper describes these methods and treats extensively the simple user cost used for the calculation of owner occupied housing in Iceland. This method measures expenditure shares based on sticky real interest rate and depreciation. The price change of property is measured by a constant quality price index for all properties sold.

1. Introduction

Two main approaches exist for treating owner occupied housing in CPIs. One is based on the flow of services measurement and includes rental equivalence and user cost methods and the other one – on capitalizing the housing as a net cost. Both approaches use market prices to measure the price change of owner occupied housing but different methods are applied to estimate the weight of housing in the CPI.

When rental equivalence is used, some countries use information from the National Accounts as a source for weights and others use information collected directly from the owner who is asked what rent, in his opinion, he would get if he would have rented out his house. The simple user cost is based on annuity (imputed rent) of the average property value, with given long-term real interest rate and depreciation, to estimate the expenditure share. Capitalizing the new house gives the weight in the case of net acquisition.

Measurement of the price change is always based on market prices. In the case of rental equivalence the market rents for comparable housing are used. For the simple user cost approach the prices of all properties sold independent of whether they are old or new, are used. For the net method only the prices of new houses are included.

It should be noted that even if prices for old and new houses move in the same fashion, and therefore the OOH index based on both user cost and net acquisition approaches are the same, the effect on the total CPI would be different due to the use of different weights. Market prices are very significant element in these approaches and the development of good and reliable indices reflecting changes in market prices is important in the CPI calculation of housing.

2. Market price methods to calculate owner occupied housing in the CPI

The three market price methods used for these two approaches are rental equivalence, user cost and net acquisition.

Rental equivalence is often used where strong rental markets exist. The results for rented housing, that are comparable to the owner occupied ones, are used. The rental equivalence is therefore based on comparing the rent for similar apartments or houses and using that result for calculating the imputed rent. The primary assumption is that the rent market has an adequate coverage so market rent can be measured for comparable types and sizes of properties similar to the owned housing stock and the results can be used as equivalence to rent changes for own housing.

The precondition for using this method is that rent markets are not controlled and rent not subventioned by governments because that is a price setting mechanism not faced by the owners. It is also important that cost incurred by landlords but not by tenants or owners should not be taken into account in the price measurement [8,47]. This method is used in Denmark, Germany, Netherlands, Norway, USA, Switzerland and Japan [16]. It cannot be applied in Iceland because of the thin and underdeveloped rental market and the very dissimilar composition of the owner occupied housing stock and the rental market. In the years 2000–2002 about 80 per cent of Icelanders lived in own houses according to the yearly Households Expenditure Survey.

User cost is suitable in cases when the rental markets are small. This method is used in the Icelandic CPI where the service of living in own house is measured. The annuity (imputed rent) is derived from the market price of the house, using certain assumptions about the real interest rate and depreciation. The real interest rate is based on the required rate of return (opportunity cost) on the capital bound in the property, independent on whether it is own capital or a loan. The wear of the property (depreciation) is taken into account and is calculated on the base of the expected lifetime of the house. In addition minor repairs are taken into consideration and public tariffs connected to the house, such as sewerage, garbage and water.

It is the use or the service of living in the house that is accounted for and capital gain is measured by the long-term real interest rate. The price change is estimated on the basis of information on all properties sold in the country and to some extent on the changes in the real interest rate. The consumer price index is a short time measurement tool for estimating price change and it is assumed that there is no substitution between living in own house and renting. In the short run it is not possible to sell the house and move into a rented one because of the small rental market. Some countries estimate their housing as a user cost but none of them except Iceland uses real interest rates in that calculation. In Iceland longer mortgages are usually indexed with the CPI. In some countries mortgage profiles are used but they only reflect the lifetime of the mortgage not the house and it is often very difficult to separate financing for housing from other financing. Some countries use market prices of houses to evaluate depreciation or the mortgage rate. The countries that apply this method are Finland, Sweden, Iceland, Ireland, United Kingdom and Canada.

Acquisition method capitalizes the house and measures the housing net. The net housing cost is the value of new houses in excess of depreciation of the stock. This method treats housing the same as other expenditures on durable goods included in the index such as cars or electrical equipment. These durable goods are capitalized when purchased and incorporated into the CPI. The price change should theoretically only be measured for new buildings. This covers houses that are built by consumers as well as properties that are bought from a construction company or real estate agents. In addition it's necessary to take into account properties that are bought directly from other sectors in the economy. This index has therefore many similar properties as the producer price index for buildings.

Each year there is a different amount of new houses built depending on the economic cycle in each country and the net change in housing can therefore be negative in a certain year. The net weight for housing must therefore be averaged over some years. The weights will be more volatile and cyclical when the net method is used compared to rental equivalence or user cost and the net weight will usually be lower [6,62]. The method was used by the Bureau of Labour Statistics in the USA prior to January 1983 and is now used in Australia and New Zeeland and has been under study for inclusion in the HICP.

3. Simple user cost in the CPI

Owner occupied housing has two aspects. A house is a place to live in and at the same time an investment. To separate the measurement of the use from that of investment is a difficult problem in CPI calculation, especially where rental market is thin. The flow of service of living in own house is calculated as imputed rent in the Icelandic consumer price index, but the buying of the house is an investment and therefore not taken into account directly in the calculation.

The user cost method converts a part of the expenditure on a durable (such as a house) into a flow of services by taking into consideration use of capital long-term financial (opportunity) cost (interest) and the use of durable (depreciation).

The method to calculate housing as simple user cost [6,621] [8, 28 and 53] and price update the results by the price changes of all properties sold was adopted in November 1992.[1] In the beginning the price measurement was conducted only in the capital area but in March 2000 it was extended to cover the whole country. The base for the calculation is the real estate value of the house (as estimated by the Land Registry). That information is collected in the yearly Household Expenditure Survey for each household participating.

The simple user cost is calculated in two steps. One is the calculation of the weight by using a real interest rate to measure the long-term financial cost and the use of the durable. The other part is the price adjustment of the user cost weight (expenditure) by a house price index. Technically it is done by calculating the cost as an annuity.[2] An annuity is a "sequence of equal payments made at equal intervals of time" [1,80]. In the index calculation the property value is calculated as an annuity and includes both the real interest rate and depreciation. The annuity formula has the general form:

$$\boldsymbol{P}_H = \boldsymbol{A}_{HV} * \left[\frac{(1+r)^N - 1}{r * (1+r)^N} \right] \tag{1}$$

where

P_H the present value of the house,
A_{HV} the annuity of the house value,
  r the real interest rate,
  N the life time of the durable (depreciation is given by an assumed lifetime of 80 years, and no scrap value in the end i.e. 1.25 per cent).

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[1] Similar user cost method was used in Iceland from 1980 to measure the profitability of the fishing fleet under high inflationary situation.

[2] This user cost method is in some ways similar as Steiner [29] suggested in the Stiegler report 1961. He uses in his user cost model the annuity method to measure depreciation and interest rates but does not use real interest rates.

The annuity formula (1) is derived from a geometric series and the interest is calculated over the lifetime of the durable and added to the durables value and then converted into equal payments (annuity). By using the property index to change the annuity both the interest rate and the depreciation are calculated on the same base and increase in the same way. In addition the rent amount is also calculated over the lifetime of the durable. Lower lifetime of the durable (higher depreciation) leads to lower total interest rate.

4. Real interest rate

Nominal interest rates reflect inflation, the higher the inflation, the higher the interest rates get. The fact that a part of the price of using capital is due to factors other than the service price for the use of money makes the use of interest rates a quality adjustment issue. The quality issue in this case is that inflation is embedded in the interest rates and distorts the real interest value, making a quality adjustment necessary. The real interest rate from this point of view is the quality adjusted nominal interest rate. The quality adjustment is necessary as in the case of every good and service that has a better or worse quality reflected in its price.

The method applied for this correction is based on the connection between nominal and real interest rate as expressed by Fisher (1896) identity [7,21]. The nominal interest rate is designated r_t, the real interest rate as $r*$ and the general inflation rate as p_t. The expression is:

$$r_t = (1 + r*)(1 + p_t) - 1 \tag{2}$$

It means that the real interest rate, when not known, is the difference between the change in the nominal interest rate and the change in consumer inflation and the quality adjustment is expressed as follows:

$$r* = (1 + r_t)/(1 + p_t) - 1 \tag{3}$$

There could be a problem in the case of short-term movements. There are indications that the Fisher effect is not very strong in the short term even if it is so in the longer run [27]. If this is right the use of this method should probably be extended to some kind of average over a longer period of time.

The real interest rates in Iceland are preset and indexed by the CPI. The nominal interest rate is found by adjusting each month the real rate by the change in the CPI in accordance with Fishers formula.[3] The long-term real interest rate used in the simple user cost model shows the return on investment over the lifetime of the durable. In this way the real rate measures the capital gain. At periods it can be lower or higher than the rate of return but it is approximated by the average long-term real interest rate. User cost methods that do not use quality adjusted interest rates and in addition include all short term movements in house prices into the measure of capital gain will be exaggerating the price changes and are not taking into acount the development of prices over the lifetime of the durable. Therefore the results will also be very volatile [10,11,20,32].

The real interest rates used in the calculation of the simplified user cost are sticky over the lifetime of the durable but are partly kept variable to reflect short term trends in interest rates. When consumers buy property they finance it with equity and mortgages and the average long-term real interest rate in the model takes into account these two main types of financing. In the simple user cost model the division

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[3]Indexation of this kind in Iceland refers only to mortages covering a period of five years or longer.

between these two forms of finance is mainly based on information from the sales contracts used for the house price measurement. As a result the opportunity financial cost covering the lifetime of the durable is estimated by keeping the equity rate fixed but allowing the mortgage real interest share to vary.

Part of the price of the house represents buyers' equity,[4] which is estimated to be half of the house price. The real interest applied to approximate the rate on equity is the long-term real rate used to evaluate the assets of pensions funds in Iceland and are kept fixed over the durable's lifetime. When this calculation method was adopted the long time real interest rate of the pension funds was estimated at 3 per cent and has been kept unchanged since.[5] Other long-term real interest rates used fluctuate over time usually covering new or old mortgages. They vary in the range of 4.0% to nearly 9.0%. These are mainly mortgages from the Housing Fund or old loans from the old State Housing Board. Other financing is originating predominantly from the pensions funds or the banks of which most are loans with fixed real interest rates that have been unchanged for the past decade. Hence, the variability of the long-term real interest rates has been relatively small over time.

The average real interest rate measured monthly in this way has been around 4% since 1992. The interest rates of the House Fund mortgages have bee relatively stable over the last years. In July 2004 this changed and the rates are now set monthly and will probably fluctuate more than before. Therefore the method changed going over to a moving five-year average. The motivation was published in a press release on 12 August 2004. "This practice should ensure that the short term changes in the real interest rates of housing mortages will not cause significant volatility in the monthly measurement of the CPI. On the other hand, it also secures that long term changes in the real interest rates are taken into consideration" [28].

There are three parts that influence the results of the calculation of the annuity: house prices, interest rates and depreciation. The formula for the annuity is:

$$\boldsymbol{A}_{HV} = \boldsymbol{P}_H * \left[\frac{r * (1 + r)^N}{(1 + r)^N - 1} \right] \tag{4}$$

Dividing through it by $(1 + r)^N$ gives the equation:

$$\boldsymbol{A}_{HV} = \boldsymbol{P}_H * \left[\frac{r}{1 - (1 + r)^{-N}} \right] \tag{5}$$

According to formula Eq. (5) the real interest rate has a direct influence on the annuity. The annuity (imputed rent) increases by almost the same amount as the real rate when the rate is not very small (in this case 4%) and the lifetime long (80 years). The user cost is therefore very vulnerable to real interest rate changes.

The real interest rate also influences the value of the property used as the base for calculating the annuity as lower interest rates normally lead to a higher house prices. In calculating the present value of the sale contracts the loans with fixed interest rates are discounted by rate of return reflecting the change in the real interest rate. A rise in the real interest rate lowers the present value of the property. This fact is in accordance with the economic reality that a higher real interest rate leads to less demand and lower price of housing.

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[4]This share could partly be financed by loans.

[5]The long time rate of return for the pensions funds is now in the range of 2.0–3.5 per cent. Long time rate of return according to the liability law is 3.5 per cent.

5. Depreciation

It is difficult to measure depreciation that should reflect the wear and tear of property and that measurement is always very uncertain. There are generally three methods used to obtain the rate at which structures depreciate. The first method is to make a rough estimate of the life of the durable "by assuming depreciation model that seems most appropriate" [8,23]. The second method is to use cross sectional information to set the depreciation rate and the third method is to use information on rental or leasing prices. In deciding the depreciation rate used in the simple user cost calculation the first method was used. "The first and simplest method is to impose a particular depreciation pattern on the average observed life of structures to derive a depreciation rate" [23,373].

The depreciation rate was obtained mainly by considering the age of the housing stock. According to the Real Estate Registry the stock at the end of 2001 [31,261] has the following age structure: 90 per cent of all property is constructed after the year 1940, more than one third in the period 1960–1980 and one third is constructed later. The depreciation rate seems therefore to be in accordance with age structure.

The user cost covers both the structure and the land it is built on. The depreciation for the construction is 1.5 per cent setting the lifetime at approximately 67 years. Land does not wear over time and is therefore not depreciated. The depreciation is calculated on the value of the building. The price information used to calculate the house price index does not show separately the price of land. It is therefore convenient to calculate the depreciation of the whole value of the housing stock, both structure and land. The depreciation rate used in the index is 1.25 per cent of the real estate value. The value of land is separated in the real estate value calculated by the Land Registry and is approximately 15% of the total value of the house. In the future Statistics Iceland will consider separation of the value of land from the house value in the calculation of the user cost.

There are three most common depreciation methods: i) straight line depreciation when the depreciation is divided into equal shares, ii) one hoss shay or light bulb depreciation when the durable is depreciated when it falls apart and iii) geometric depreciation when the durables value declines by constant percentage rate. The depreciation is usually in the form $(1 - \delta)^N$, where d is the depreciation rate and N the lifetime of the durable (number of payments). It means that the depreciation is largest in the beginning. According to the geometric method the durable is never fully depreciated.

The form of the annuity formula is an inverted geometric depreciation of the type $(1-\delta)^{-N}$. Therefore it differs from the usual geometric depreciation in that it is small in the beginning but increases as the years go on.

The depreciation measured as amortization of the principal (sinking fund), where $N = 80$, reaches the 50 per cent level in the 64th year. In the year 73 it covers two thirds of the total depreciation. The interest payment equals the depreciation amount in the 64th year and after that the depreciation amount is larger than the interest. The yearly depreciation measured this way is nearly 0.2 per cent in the beginning and around 4 per cent in the end.

It should be added that unlike the usual geometric depreciation the durable is fully depreciated. It is similar to the one hoss shay method as the depreciation is largest at the end of the durables lifetime and that the durable is fully depreciated but contrary to the one hoss shay method it depreciates over the whole lifetime of the durable.

6. Measurement of property prices in the CPI

The Land Registry of Iceland calculates real estate value for all the property in the country. In the middle of the year 2001 the Land Registry revised the estimation method after extensive research, using

hedonic regression. The base for the analysis was the capital area and the estimates for other parts of the country were calculated with regional coefficients [9,17–22] [31, 259–270]. The value of all properties in the country is measured in a harmonised way based on information about properties sold. This is done with a reference to the law as "the law about the measurement of the real estate value says that it should be based on the market price of the property. According the first paragraph of the law no. 6/2001 the estimated value shall be the discounted market value as estimated last November" [31, 260]. This basic information is the same as the one used for the price measurement of housing in the CPI and therefore the real estate value is very suitable for the user cost calculation.

Sales contracts are the base for calculation of the index of property prices. One of their advantages is the fact that the contracts are standardised for the whole country. Each contract contains information about the property and owners, the sales amount and also complete information about the form of payment. Each property has a standardised identity number that is used in the property database that the Land Registry maintains. This very detailed information is the foundation for the valuation of property sales.

The sales information is collected through the Distnict commissoners. The formal registration of the ownership change is done by the Land Registry who require the sales contract to be available. Between 8–10 thousand sales contracts are collected each year covering 8–10% of all properties in the country and it gives the same results to use the number of sales or values.

The Land Registry of Iceland has collected the sales contracts over a long period of time. The information on market prices of properties received from them is used by the Land Registry as the base for their evaluation of all houses' real estate value. It is also used in the calculation of the simple user cost in the CPI.

The price concept used in the CPI is cash price. There are different forms of payments when a house is bought. As money received today is not the same as money received at a future point of time it is needed to calculate the present value of each contract. According to the market information the discount rate varies depending on the type of payment. The discount rate is measured monthly and if the change exceeds a certain minimum it is changed. When the discount rate is lowered, the present value of the property increases and vice versa. Changes in the market prices and the discount rate influence the price measurement. The present value of the contract is used for the price updating of properties in the CPI. The price measurement concept is the same as in other parts of the CPI and the prices taken into account are those that the consumer pays in reality. In the long run the nominal and cash house prices follow each other but within shorter interval they can divert temporarily.

The house price index is calculated based on the change in the property prices as obtained from the sale contracts. The imputed rent is estimated using the price information from all the sales. The prices used are the average prices for the whole country.

The combination of the house's size in square meters is kept fixed for the purposes of the calculation. The weight is based on three years data of the sale's volume in four size categories. The calculation is based on three month's moving average with one month's time lag but contracts from places outside the capital area arrive with two months timelag. The sales contracts in April refer to the period January to March and in May for the period February to April etc.. The main indices are four, for houses and apartments inside and outside the capital area. The price change is measured for following type of housing. Houses (13 per cent weight share) and apartments (59), for the capital area (total 72), houses (15) and apartments (13) outside the capital area (28). The emphasis is on the price change within groups of properties not between types of properties or between regions and the quantity weight between regions is kept constant.

Acknowlegements

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Rósmundur Gudnason is the head of price statistics at Statistics Iceland since 1991. He is active in international cooperation about price indices and price measurement problems as a member of the International Working Group on Price Indices, the Ottawa Group (since 1995) and the Eurostat Working Party on Harmonisation of Consumer Price Indices, HICP (since its founding in 1992 to 2001). He is currently a member of the LIN ECE Steering group on CPI. Fil Kand, 1976, University of Gothenbourg, Sweden, in economics, statistics, economic history and contemporary history. Price statistician at The National Economic Institute, Iceland 1976–1985. Independent consultancy in economics and financing for private and public companies 1985–1991.