EUROPEAN COMMISSION
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Technical manual on Owner-Occupied Housing and House Price Indices

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Introduction

Owner-occupied housing costs are the costs associated with purchasing, maintaining and living in an own home.

Owner-occupied housing costs pose a particular challenge to compilers of price indices. Some national CPIs include a proxy for the cost of shelter by owner-occupation in the form of estimates of the rent which would be payable if the property was rented rather than owned. This is known as *imputed rent* or *rental equivalence*. This is not permitted in the HICP on conceptual grounds, as there are no actual transactions and no money changes hands. Imputed rents are outside the scope of Household Final Monetary Consumption Expenditure (HFMCE), which represents the part of final consumption expenditure covered by the HICP according to the Framework Regulation (EU) 2016/792 on harmonised indices of consumer prices and the house price index ([1]).

A measure of owner-occupied housing cost according to the *net acquisition approach* would meet the requirement of being based on actual monetary transactions. Generally, under the net acquisition approach, prices are measured to reflect the change in the acquisition cost of the goods and services which are new to the household sector as a whole. As a consequence, homes purchased by households from other households (intra-sectoral transactions) are excluded although the associated on-going costs associated with living in these homes are included and the costs associated with the transfer of ownership such as legal fees and taxes ([2]).

An owner-occupied housing price index according to this approach has been developed as a stand-alone index in the EU, as provided for in the Commission Regulation (EU) No 93/2013 establishing owner-occupied housing price indices ([3]) and the articles 1, 2 and 3 of the Framework Regulation (EU) 2016/792. A decision on a possible integration into the HICP has not yet been taken ([4]).

This technical manual provides guidelines for the development of a price index on OOH under the net acquisition approach.

A significant element of OOH costs are those associated with the initial acquisition of the dwelling and by far the biggest element of the latter is the price of the property. Changes in the prices of dwellings are measured by the house price index (HPI), which is an important indicator in its own right. This manual also includes practical advice for the compilation of the HPI ([5]).

There is also a glossary of main terms together with a number of annexes giving more detailed explanations. Furthermore, some empirical examples are given.

([1]) Regulation (EU) 2016/792 of the European Parliament and of the Council of 11 May 2016 on harmonised indices of consumer prices and the house price index, and repealing Council Regulation (EC) No 2494/95, *OJ L 135, 24.5.2016, p. 11-38*.

([2]) In the present context, the coverage of 'owner occupancy' is wider than household dwellings purchased for owner-occupancy as the main residence. Vacation homes are included in the compilation of OOH indices and, under the 'domestic' concept followed by the HICP, the purchase of a vacation house by a non-resident would enter into the compilation of the OOH price index.

([3]) Commission Regulation (EU) No 93/2013 of 1 February 2013 laying down detailed rules for the implementation of Council Regulation (EC) No 2494/95 concerning harmonised indices of consumer prices, as regards establishing owner-occupied housing price indices; *OJ L 33, 2.2.2013, p. 14-16*.

([4]) The new Framework Regulation 2016/792 requests, by 31 December 2018, a report to be provided by the Commission to the European Parliament and the Council on the suitability of the OOH price index for integration into the HICP coverage.

([5]) Readers wanting a general overview of the conceptual and practical issues related to the compilation of an HPI can also refer to the 'Handbook on Residential Property Price Indices (RPPIs)', available from the Publications Office of the European Union, 2013.

1. Owner-occupied housing as part of a consumer price index

1.1. Owner-occupied housing as a measurement issue

A dwelling is a major durable, acquired at a certain point of time, used over many years and whose initial purchase is, in many situations, financed by means of credit or savings accrued over a long time period (e.g. through building and loan associations).

The distinction between the payment, acquisition and use of housing is the first and most fundamental measurement issue confronted by CPI compilers. The payment approach covers the expenditure incurred in occupying the house over a period of time. The net acquisition approach measures the price of purchasing owner-occupied housing and so follows the approach adopted for other parts of the HCIP and records the price at the time of the acquisition. The use, in practice the user cost and rental equivalence approaches, measures the changing cost of using owner-occupied dwelling and is normally accounted for by the rent the owner, as tenant, notionally pays himself i.e. the imputed rent when living in the dwelling — the rental equivalence approach. In presence of these temporal differences, when should the value of a house be recorded and on what basis?

A second issue relates to the durability of housing in the sense that each individual dwelling has a long life compared with other durables (although there is, of course, the issue of depreciation). The durability of housing implies that a flow of services will be provided to owner-occupiers after its acquisition ([6]). As these services are output produced by owner-occupiers for their own consumption, no market value exists. This raises a measurement problem. On what basis should the value of the services provided by the home be estimated? What approach should be followed?

These questions will be addressed in the next sections. At this stage, it suffices to say that no 'perfect' solution exists for the inclusion of OOH into a CPI. The answers to the aforesaid questions will ultimately depend on the purpose behind the computation of OOH costs and the associated indices which will determine the basic construction principle, most particularly, whether a consumption or expenditure approach is followed.

1.2. The national accounts perspective

In the national accounts framework ([7]), when a good other than housing is purchased by a household, all of the expenditure is attributed to the time of purchase, even though the use of it extends beyond the time of purchase. Housing, however, is treated in a different way because the benefit of using a house normally extends over many more years than other durables. Thus, it is considered inappropriate to charge the entire benefit given by the consumption of housing services to the initial point in time when the purchase is made. Consequently, in national accounts an imputation is made for the value of the housing services provided to the owner over the useful life of the dwelling. Also, the purchase of a dwelling is considered part consumable and part asset which in most circumstances will appreciate, the consumable component being represented by the cost of the building and the asset component being represented by the cost of the land.

National accountants tackle the OOH issue by separating acquisition from use; the former being an investment made by households and the latter consumption of housing services by owner-occupiers. More specifically:

- The benefits of using a house are defined as services provided by owner-occupied dwellings which are consumed by their owners (the households) over a period of time.
- The imputed values regarding the flow of benefits stemming from the use of the house

([6]) Durability, in this context, implies that the quality of the housing services provided would be subject to depreciation due to the effect of time which, in turn, can be tackled by repairs and renovation works.
([7]) United Nations System of National Accounts (SNA 2008) and in the European System of National Accounts (ESA 2010).

are characterised as owners' final consumption expenditures.

- The imputed value of the housing services provided to owner-occupiers can be estimated on the basis of the rentals that would be paid in the open market for accommodation of comparable size, quality, type and location.
- The acquisitions of dwellings or residential structures for own use are defined as Gross Fixed Capital Formation (GFCF).
- The dwellings are valued in the capital formation account on the basis of their acquisition value.

From the national accounts perspective, the inclusion of OOH in a price index measuring consumption is only conceptually attainable from a use perspective. According to this conceptual basis, dwellings are fixed assets and, as a result, their acquisition prices should not be included in a price index measuring consumption. Similarly, expenditures on major renovations or extensions are not characterized as household consumption expenditure and are treated by national accountants as GFCF ([8]).

From this viewpoint, the measurement of OOH in a CPI would ultimately imply imputing non-monetary values for the estimation of the cost of a service for which there is no market price. This is fully consistent with the national accounts framework, but, falls outside the scope of the HICP, as there are no actual transactions and no money changes hands.

1.3. Other approaches to the measurement of owner-occupied housing in a CPI

Several approaches are available for measuring the inflation faced by owner-occupiers in a CPI. The main alternatives are the (net) acquisition approach, the use approach (covering the user and rental equivalence approaches), and the payments approach. All these approaches to the measurement of OOH costs are conceptually sound, have a basis in economic theory and have associated strengths and weaknesses. The answer to the question of which method is most appropriate for inflation measurement depends on user need and the purpose of the index. For the HICP, the net acquisition method has been judged to be the most appropriate.

The following sections provide a brief explanation on each one of these possible approaches for dealing with OOH. Ideally the approach adopted in practice should align with the main purpose of the index and the underlying conceptual basis.

1.3.1. ACQUISITION

In the acquisitions approach, prices are recorded at full market price, ignoring the problem of distributing the initial cost of the durable over the useful life of the good. The total value of the acquisition is entirely allocated to the time of purchase, regardless of when its consumption starts and when and how it is paid for.

A system of price indices based on this approach should include the following information:

- Expenditures on the acquisition of dwellings.
- Local authority and other fees related with purchase or construction.
- Major repairs and maintenance ([9]).
- Insurance connected with dwellings.

([8]) On the other hand, ordinary maintenance, which can be divided into two main categories — (1) 'do-it-yourself' maintenance and (2) major, typically carried out by landlords/owners, repair works — is considered intermediate consumption in the production of housing services. Section 3.10 deals with repairs and maintenance in more detail.

([9]) Minor repairs and redecoration are already covered under another COICOP heading.

One of the advantages of this approach is that it treats all durables in the same manner so no special procedures need to be put in place for OOH costs. It is also internally consistent with other elements of a CPI. But there are complications associated with the treatment of land as an asset.

Another possible disadvantage of this approach is that if the base year corresponds to a boom or slump year then the base period expenditure weights may be unrepresentative of the underlying position. This problem can be minimised by calculating the base year weights as averages over several years. In addition, the use of chain-linked indices with systematic and regular revisions of the weighting scheme can reduce this potential problem.

In practice, the application of this approach takes the net form. The net principle, which is consistent with the approach adopted by national accounts, means that only transactions between the household sector (which is the target population of the index) and other sectors are in scope. Thus, a house purchased directly from another household is excluded, although the costs associated with transfer of ownership, such as legal fees and taxes are in scope.

The strengths of the net acquisition approach for the measurement of OOH can be summarised as follows:

- It measures prices as they are commonly understood by the general public (i.e. it follows price developments of the prices people actually face when purchasing a dwelling).
- It reflects changes in real transaction prices, something which is in line with the HICP as a measure of monetary inflation. An important aspect of an inflation measure is that it should only include actual purchaser prices.
- It is conceptually simple and identical to the treatment of other-durables a consumer price index calculation, including the HICP.

Conversely, the main disadvantages of the net acquisition approach are:

- The fact that in the National Accounts house purchases are regarded in part as an investment rather than a consumption purchase ([10]).
- The high initial cost of setting-up the necessary statistical infrastructure.
- The methodological challenge associated with the collection of prices for comparable dwellings over time, net of the land price component, on a regular and timely manner ([11]).
- Public perceptions, namely the expectation that if the outgoings of owner-occupiers increase, for instance increases in monthly mortgage payments as a result of rises in interest rates, this should be reflected in the index. Under the net acquisition costs approach this will not be the case.

The net acquisition costs approach will be explained in more detail in chapters 2 and 3 of this manual.

1.3.2. USE

The use (or consumption) approach is related to microeconomic theory and to the cost-of-living framework. Underlying this approach is the idea that the economic value of a house is based on the benefits that are extracted from using it and that these are, in turn, equal to the opportunity cost associated with the best alternative use of the expenditure incurred in the consumption of those same housing services ([12]). There are two basic approaches: user cost and rental equivalence (i.e. imputed rents).

([10]) Technically, this would not constitute a real disadvantage if the scope of the OOH index is extended to cover *total household expenditure* and is not restricted, as in the HICP, to cover only *household consumption expenditure*.

([11]) The land issue will be tackled latter on, notably in chapter 7 of this manual. The quality change issue (i.e. the need for comparable dwellings) is not, in itself, something specific of this approach but rather a general issue to all price indices. Quality change is addressed in chapters 3 and 6 of the manual.

([12]) Index weights of the use approach tend to be higher than the ones that are derived from the net acquisition approach because financing costs are excluded in the latter whereas they are explicitly or implicitly included in the use approach, depending on whether the user cost or rental equivalence option is followed. In addition, the use approach includes second-hand as well as new dwellings.

1.3.2.1. User cost

The user cost approach attempts to measure the changes in the cost to owner-occupiers of using the dwelling. In the user cost approach the initial purchase cost of the durable is decomposed into two parts; one that reflects the estimated recurring costs associated with the use of the services provided by the durable; and another (regarded as an investment), which must earn some exogenous rate of return to reflect the opportunity cost of capital.

In theory, a system based on this approach would include the following ([13]):

- Repairs and maintenance
- Insurance
- Local authority and other fees related with purchase or construction
- Mortgage interest
- Depreciation of dwellings
- Opportunity cost of alternative investments

but

- Less capital gains
- From the perspective of HICP standards, the user cost approach has some serious drawbacks:
- It is based on subjective judgements and theoretical assumptions on depreciation and opportunity costs which do not necessarily mirror the experiences of households.
- It uses imputed cost measures rather than actual transaction prices.
- It reflects changes in interest rates, making the index of limited value for monetary policy purposes, a key use of the HICP (interest rates being one of the tools to keep inflation in check).

1.3.2.2. Rental equivalence

Thus, the user cost approach suffers from a number of conceptual and methodological complexities: it is not an approach favoured by NSIs and the rental equivalence approach is more likely to be the adopted method. In the rental equivalence approach the rents for rented dwellings are taken as a measure of the costs of use. In this approach a price is imputed for the OOH dwelling which is equal to the rental price or leasing price of an equivalent dwelling for the same period of time ([14]).

The rental equivalence approach is the only one that does not require the compilation of an index on major repairs and maintenance. This is justified by the fact that major repairs and maintenance costs are normally paid by landlords and are thus reflected in the rentals paid by tenants. A practical drawback of this approach is that it may not be possible to implement in situations where the rental market is limited or lacks comparability with the owner-occupied housing market (e.g. by being heavily regulated or relating to one particular segment of the market, such as the lower-end). It also relies on a statistically reliable rents index.

Despite its attractions insofar as it relies only on the availability of a reliable and relevant rent index, the rental equivalence approach, like the user cost approach, has some serious disadvantages:

- It is a notional concept that uses imputed prices rather than actual transaction prices. As such it is inconsistent with HICP requirements, which state that the HICP shall follow purchaser prices of monetary transactions.
- It is not necessarily representative in countries with a small or structurally different rental market.

([13]) Statistics Iceland applies the user cost approach to OOH in their national CPI (Guðnason and Jónsdóttir, 2006).
([14]) Germany and Norway, for instance, apply the rental equivalence approach in their national CPIs.

1.3.3. PAYMENTS

The payments approach to OOH is a form of cash flow approach to the on-going costs of living in an owner-occupied dwelling. Under this approach, what is measured is the change in money outlays to be made by households in relation to the purchase of housing goods and services. Expenditure is defined as all payments for those goods and services involved, regardless of when they are actually consumed or acquired ([15]).

In principle, this variant does not require imputed or theoretical prices. A system of expenditures and price indices based on this approach would include the following items:

- Cash spent on the total or partial purchase of dwellings
- Local authority and other fees related with purchase or construction
- Insurance connected with dwellings
- Payments on repairs and maintenance
- Mortgage interest payments
- Mortgage repayments

As with the user cost approach, inclusion of mortgage interest payments would make the use of the payments approach in the HICP framework problematic due to the primary use of the HICP being for monetary policy. Also the index includes mortgage repayments, which are not consumption expenditures and therefore outside the scope of the HICP.

1.3.4. EXCLUSION OF OWNER-OCCUPIED HOUSING FROM THE CPI

The exclusion of OOH from the CPI is another option available to price index compilers ([16]). The justification for this option is essentially based on the national accounts perspective and on considerations about the scope of the CPI being computed.

As pointed out in section 1.2, in national accounts the acquisition of a dwelling by a household is considered investment in a fixed asset, not consumption of a durable good. This argument, together with the view that the scope of the index must essentially be restricted to household monetary expenditures, can justify the exclusion option ([17]).

With the exclusion of OOH costs an important component of the inflationary pressures faced by households is not covered in the CPI ([18]). In this case the OOH can still be used as a valuable 'satellite' self-standing indicator for monetary and economic policy making.

1.4. Relationship between CPI purpose and the choice of the OOH approach

The choice of the approach to OOH in a CPI fundamentally depends on the index purpose. For instance, if the primarily purpose of the index is, as in the case of the HICP, to measure monetary (or non-imputed) expenditures by households, then the acquisition approach is the right one to apply.

([15]) An example of a price index following this approach is provided by the Retail Price Index (RPI) published in the United Kingdom by the Office for National Statistics (ONS). This approach was introduced in 1975 in replacement of the rental equivalent approach to OOH (ONS, 2003).
([16]) Austria, France and Spain are among the countries that have chosen this option in their national CPIs.
([17]) It should also be borne in mind that the exclusion of OOH from CPI could also be made on practical grounds due to a lack of relevant data source. Problems associated with the possible data sources available for the compilation of a system of price indices is tackled in chapter 5.
([18]) This restriction could be overcome with the production of an additional indicator covering all monetary transactions made by households, encompassing all expenditures on all sorts of tangible assets (referred to as Household Expenditure Price Index).

On the other hand, if the purpose is to measure the value of current period consumption services, then the acquisition approach can only be regarded as an approximation to a more appropriate method (which would be either the rental equivalence or user cost approach). In the same vein, if the dominant purpose of a CPI is to evaluate money incomes or for indexation purposes, then the payments approach might be appropriate. Of course, the comparison of inflation across different countries can be confounded by the use of different approaches to OOH. The purchase of a dwelling by a household that is, by national accounts standards, considered an investment, may be covered together with the purchase of goods and services under the Household Expenditure Price Index (HEPI) ([19]) ([20]). Table 1 provides an overview of the relationship between CPI purpose and the choice of method for dealing with OOH costs.

Table 1: Relationship between the choice of the OOH approach and CPI purposes

Approaches to OOH	Primary purpose of CPI	OOH price definition underlying the approach	Comments
Acquisition	Measure the change through time of the total expenditure associated to *all monetary transactions* made by households for acquiring goods and services for consumption purposes	Acquisition cost of a dwelling made by a household for own occupancy	Approach more in accordance with the definition of an 'inflation index'. No need for imputed prices.
Use	Measure the change through time of the *total value of all goods and services* that were *actually consumed* by households	Opportunity cost associated with the use of a dwelling by a household for own purpose	Approach more in accordance with the 'Cost-Of-Living' Index (COLI) framework. Imputed prices are needed.
Payment	Measure the change through time of the *total payments* made for all goods and services by households	Cash outlays associated with the own-occupied dwelling	Approach more appropriate for the evaluation of money income. Also for a COLI. No need for imputations.
Exclusion of OOH	Measure the change through time of the total expenditure associated to *all monetary transactions of consumer goods and services* made by households	–	Can be seen as being too narrow in its scope; a problem that could be overcome by the construction of the HEPI index.

([19]) It is worth noting that the validity of the acquisition approach does not depend on an answer to the question on whether the OOH component should be excluded or included in a CPI. What really matters is that this approach is the best one to develop price indices encompassing all monetary transactions made by households.

([20]) It goes without saying that, under this approach, the idea of having an index covering all monetary transactions made by households would, in effect, encompass all expenditures on all sorts of valuable tangible assets. Examples of such assets include works of art, antiques or precious materials. These are household final expenditures but not, according to national accounts standards, household final *consumption* expenditures. Although not in the scope of this manual, it is nevertheless worthwhile pointing out that the question of whether these expenditures should be included or excluded in a HEPI is not a clear cut issue.

2. The net acquisition approach to OOH costs

In line with the HICP standards, the most appropriate OOH concept and approach, as outlined in the previous chapter, is the net acquisition approach.

For the definition of the scope of OOH costs when following HICP standards, it is necessary to recall that the HICP is designed to measure changes in consumer prices where:

- Imputed transactions are defined as non-monetary.
- Asset transactions are defined as non-consumption.
- Within household sector transactions are excluded (as they net to zero), apart from the associated transaction costs such as estate agent and legal fees.

These elements — monetary transactions, covering only consumption, net of household-to-household purchases — are of importance when the various costs associated with OOH are catalogued and measured according to HICP rules and principles.

Clearly, because the continuous OOH service flow is largely generated without actual transactions (such as rental agreements for rented properties), and because imputations are not generally acceptable in the HICP framework, the OOH price index (OOHPI) is computed by using directly observable household expenditures of dwelling purchases, major repairs and services related to dwelling ownership and their legal transfer; that is to say including all the transaction expenditure related to living in owner-occupied housing.

Excluding assets from the scope of the index poses a particular challenge in measuring OOH using the acquisition approach. Firstly, rented-out dwellings are by definition investment goods, whose purpose is to raise revenue for their owners and therefore whose purchase is out-of-scope. Secondly, and more importantly, even when lived in by their owners, dwellings are not always and entirely owned for just housing but also for storage of wealth, as a method of saving and for investment in anticipation of capital appreciation. Dwellings can also be used for purposes other than rendering housing services (e.g. used as offices for small service firms).

In principle, dwellings solely owned for investment purposes (i.e. for renting) are relatively easy to deal with by excluding them altogether from the coverage, subject to such purchases being separately identifiable. So, only transactions by households — whether it is a purchase, construction, renovation or another service related to dwellings — that are destined for owner-occupancy, are taken into consideration (thus leaving out not only purchases by institutional sectors, but also households when acting as landlords).

More problematic is to separate out and exclude the non-tangible, non-produced asset element from owner-occupied dwellings. The non-consumable part of the dwelling has been mainly identified to be represented by the land component on which the structure sits. The solution for the OOH price index would be to exclude the land component from the index weights and prices ([21]). In practice this can be very difficult.

In consumer price indices, a normal procedure is to account expenditures that are used in weighting in ‘net’ terms. For most products included in the index the difference between the gross and net expenditures is insignificant or non-existent. This is to say that, for those products the reference population is only making purchases, not sales. However, for some product groups the sales are almost as important as purchases. This happens, of course, with dwellings purchases, where the principle of netting out sales from purchases is of importance. The same can also apply to second-hand goods such as cars.

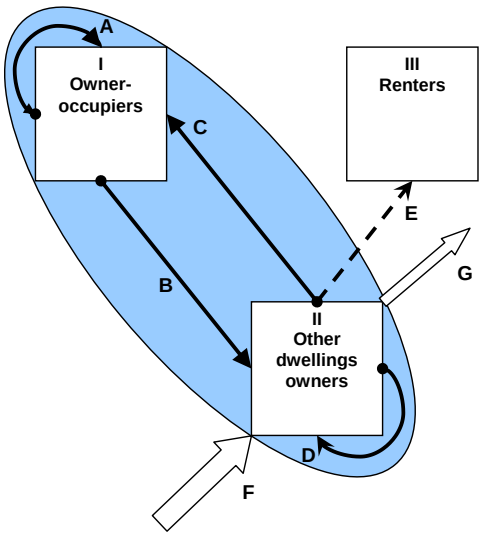
In the net acquisition approach, sales and purchases of dwellings by households are treated symmetrically, the former having a negative weight and the latter a positive weight. This procedure avoids double accounting problems. The HICP is based upon the application of the ‘net concept’ and this is explicitly mentioned in the HICP regulations for the following products:

([21]) More on the land issue is available in chapter 7.

- Insurance ([22]), where HICP weights are to derived net of claims; and, of greater relevance.
- New and second-hand cars ([23]), where sales of second-hand vehicles between households are not covered. But note, the purchases of second-hand vehicles by households via a dealer are included, in principle at least, with a net weight reflecting the difference between the dealer's buying and selling price, and purchasers of second-hand vehicles directly from another sector are similarly included with a 'net' weight ([24]).

An OOH price index system should capture price movements of all household purchases intended for owner-occupancy net of sales of all owner-occupied dwellings to the non-household sector. The schematic picture (Figure 1) presents the situation of interest in a simplistic way.

Figure 1: Dwelling ownership flows between and within sectors



The arrows relate to flows of goods (dwellings)

In Figure 1, the boxes show the relevant players and the arrows all the flows that are relevant for housing. The 'blue/shadowed' oval delineates those transactions which are relevant to OOH. Box I shows the households belonging to the reference population. For completeness sake, another group of households — renter households — who rent dwellings owned by others are shown in Box III.

Owner-occupiers (I) and renters (III) can only be households, and they form the whole household sector. Moreover, all dwellings in use are occupied by them; otherwise they are kept vacant. On the other hand, the whole dwelling stock is owned by owner-occupiers (I) and other dwelling owners (II). This group of other dwelling owners consists not only of all institutional sectors other than households, but also households when acting as landlords or developers.

Flows A to D represent all dwelling transactions that are carried out within the period in question. Flow E portrays the service flow from dwelling owners to the renters, flow F depicts additions to the dwellings stock and flow G depicts disposals of dwellings. The flows include the following market transactions:

- Flow **A:** household purchases of dwellings for their own use, that were owner-occupied by the sellers.
- Flow **B:** non-household purchases of dwellings for renting or for other purposes that were owner-occupied by the sellers.

([22]) Commission Regulation (EC) No 1617/1999.
([23]) Commission Regulation (EC) No 1749/1999, Annex B, Group 07.1 (Purchase of vehicles).
([24]) Rents are also treated according to the net concept. Landlords, in this case, act as a market producer and do not belong to the household sector. This means that rents represent market transactions between the non-household sector (i.e. landlords) and the household sectors (tenants) and are, for this reason, covered in the HICP. The HICP excludes transactions related to housing that are done by households but that are not linked to OOH, for example, expenditures carried out by them as landlords.

- Flow **C:** household purchases of dwellings for their own use, from the non-household sector. These transactions include existing dwellings that were previously rented out and new dwellings stock (i.e., additions; flow F) that were constructed during the period. Examples of situations that could be covered by the index under flow C include; a never occupied, new dwelling that has just been purchased by a household; a dwelling, which was previously owned by a governmental institution, and that is sold to the household sector; a dwelling previously belonging to the rental market and that is sold to a household; an industrial or institutional building that has been converted to residential homes.
- Flow **D:** non-household purchases of dwellings from other non-household sector members. Also this flow includes both new and existing dwellings.

When defining the coverage and weights of the dwelling purchases in scope the net concept, all sales need to be deducted from the purchases to arrive at net purchases. From Figure 1 it can be easily seen that the net purchases for owner-occupiers is given by:

$$(A+C) - (A+B) = C - B \qquad (2.1)$$

In this presentation new dwellings always enter in the housing markets — to be used by their owners or to be rented out — via the 'other dwelling owner' sector. A special case occurs where a household self-builds a new dwelling for owner-occupation. Self-build houses are in scope of the HICP but the weight and price is, of necessity, generally based on the constructions costs.

It should be noted that in the net acquisition approach it is conceptually irrelevant whether a dwelling is new or old. The important factors to consider are whether the dwelling has been purchased by the household sector for own use and from what sector it has been purchased. The approach focuses on the purchases of dwellings from other sectors (i.e. inter-sector purchases) and 'self-build' homes by the household sector.

The application of the net instead of the gross concept has immediate practical implications that need to be tackled by price index compilers when constructing OOH indices and, most particularly, the corresponding HPI. These will be dealt with in the next chapters.

3. Practical implementation of the net acquisition approach

3.1. Classification issues

As referred at the beginning of this manual, two possibilities are offered for the extension of the scope of presently used inflation indicator. While the first one includes the OOH in the present scope of the HICP, the second option implies the production of a new indicator (the HEPI) combining the HICP and OOH price indices.

Whatever the approach to the treatment of OOH, a classification of sub-indices needs be adopted, which could be either the extension of the Classification of Individual Consumption by Purpose (COICOP) adapted to the needs of HICP ([25]) or, an autonomous, self-classification system for OOH price indices. It is possible to develop the two approaches so that a one-to-one mapping between them is established. In Table 2, a possible classification system separating expenditures that are carried out for the acquisition of a house and the expenditures incurred when an owner-occupied dwelling is in use is matched with a classification system based on an extension of the COICOP/HICP nomenclature. Thus the designations, i.e. the categorisation of the different expenditures, are identical in each case, only the codes themselves vary.

It should be noted that transactions and transfers within families, notably inheritances and gifts between family members but also transactions between one household member and another for tax reasons ([26]), for example, are outside the scope of owner-occupied housing costs.

3.1.1. A POSSIBLE EXTENSION OF COICOP

To apply the OOH net acquisition method in the HICP, its coverage should be extended within the current conceptual framework.

This extension of coverage is likely to have a significant impact in the contents and weighting structure of the HICP. For instance, major maintenance and repairs to owner-occupied dwelling units would be included. At present, only minor costs are specifically addressed in the HICP and its classification system.

An extension of the present COICOP/HICP classification would have to cover the following areas:

- *The acquisition of new dwellings*: the cost of purchases of newly built dwellings of various types (e.g. dwellings in blocks of flats, terraced houses, detached 'turn-key' ready houses built by developers);
- *Self-builds* where individuals build a dwelling on a plot of land, either through their own labour or by employing a professional builder;
- *Major improvements (renovations) to the dwelling* which go further than major repairs and maintenance (see below) and is likely to include new construction or major improvements to the fabric of the building;
- *The acquisition of existing dwellings new to the sector*: dwellings that were purchased for own-occupancy and that previously had another use and were classified as being in another sector (e.g. rented or formerly an industrial building);
- *Other services related to the purchase of a dwelling:* transaction costs connected to the purchase of a dwelling for own use, such as the payment of fees for legal services;

([25]) Hereafter referred as 'COICOP/HICP'.
([26]) In some countries it is advantageous to either give or sell a property to another household member to reduce income tax or inheritance tax liabilities. But it is not very common and is mentioned for completeness sake. Moreover, in practice it is likely that such sales will be difficult to identify.

- *Major repairs and maintenance:* inclusion of the expenditure on materials and for services engaged for major maintenance, repair and decoration to maintain the fabric of the dwelling;
- *Insurance connected with the dwelling:* the coverage of COICOP/HICP 12.5 heading needs to be extended to include service charges paid by owner-occupiers for buildings insurance as opposed to contents insurance covering personal belongings within the home such as furniture, electrical goods and clothes. Buildings insurance provides cover for the structure of a dwelling: walls, fences, gates, *etc.*).

It should be noted that, with regard to flats, any regular annual or monthly service charge owner-occupiers pay for the maintenance of common areas such as the entrance to the building and also, possibly, for external decoration should be included under HICP 04.4.4 (other services related to the dwelling n.e.c.) even though some of the service charge may relate to minor and major repairs. However, one-off irregular expenses occurring every 10-15 years, say, that owner-occupiers need to pay for painting the interior staircase of the block, painting and repairing the exterior façade, repairing the roof, repairing the central heating system of the block etc. and that are not covered by the usual annual or monthly service charges, should be included in OOH expenses for major renovations. The important point here is that for owner-occupiers living in multi-occupied buildings (blocks of flats), major repairs should include not only the expenses for repairing the flat itself, but also the expenses for repairs of the common parts of the building.

A summary with a proposal for an extended coverage of the COICOP/HICP classification, based on the present classification, is presented in the right hand side of Table 2. It should be emphasized that at this stage this is no more than a proposition, it is not part of the current version of ECOICOP.

The new areas of coverage will be dealt with in sections 3.8 to 3.11. Sections 3.3 to 3.7 clarify some particular issues relating to the implementation of the net acquisition approach (borderline cases, used price concept, the issue of timing, OOHPI weights, reliability and quality adjustment of OOH price indices).

3.1.2. A POSSIBLE SEPARATE CLASSIFICATION SYSTEM: NOT AN EXTENSION OF COICOP

If there is a requirement for OOH price indices to be distinct and separately identifiable from the HICP, then a classification system not based on an extension of COICOP may be more appropriate. This is shown in the left hand side of Table 2. This classification is based on the notion that different OOH expenditures can be grouped into two distinct groups: expenditures incurred for the acquisition of a dwelling and expenditures incurred during the period of own use of the dwelling.

3.2. The designations adopted in the classification system

As previously discussed OOH total expenditure is composed of two main components: the first component is connected with the initial one-off acquisition cost of a dwelling, which is based on market transactions and can be characterised as a flow; the second component focuses on the expenditure incurred by households in their capacity as occupiers of an owner-occupied dwelling and covers the ongoing costs associated with the whole stock of owner-occupied houses.

The classification system, adopted both for OOHPI and HPI and presented in Table 2, is briefly described below for each of these two components. Again we note that the designations between the two sets of codes — a separate autonomous classification system on the left hand side and the extension of COICOP on the right hand side of the table — are identical.

3.2.1. THE EXPENDITURE RELATED TO THE ACQUISITION OF DWELLINGS

Purchase of new dwellings corresponds to the acquisition of newly built dwellings of various types (e.g. dwellings in blocks of flats, terraced houses, detached 'turn-key' ready houses built by developers, etc.). Specific cases like housing co-operatives ([27]) and ready-built pre-fabricated houses (purchased turn-key) are included under this category. New dwellings can be classified under two main categories:

a) Flats owned by an owner-occupier that are self-contained housing units with their own entrances but taking up only part of an apartment building and sharing some common areas such as corridors and stairwells and a communal entrance to the block.

b) Houses which are free-standing self-contained residential buildings on their own plot of land. This category covers detached ([28]), terraced ([29]) and semi-detached ([30]) houses and may consist of one or many stories or floors. Most houses are built on plots of land larger than the structure itself, adding an area surrounding the house ([31]).

Self-build dwellings are built by the households themselves for their own occupation. The land will be purchased separately (either freehold or leasehold) ([32]) or will have been inherited, or possibly rented. In practice, self-builders can be divided into three main categories:

a) Step-by-step self-builders: where an owner organises the building of the dwelling themselves. For some aspects of the building work the household may undertake the work themselves and purchase only the materials. For other aspects, especially those requiring specialist skills such as plumbing, heating and electrical wiring, the services of a professional may be purchased. Although it might be obligatory or necessary to involve a company or a person with specialist skills for certain parts of the construction process, a major part of the work is done by the owners themselves;

b) Self-builders who employ a building firm to undertake much of the work often using the building firm to manage the project: in this case a professional builder, either self-employed or working to a building company, is responsible for the main part of the building work and undertakes the majority of the work. The household will be involved in all decision making regarding all aspects of the building;

c) Self-builders with prefabricated houses: in some countries, a significant share of the market is made up of prefabricated houses i.e. houses that are manufactured off-site ready to assemble. This category could be combined with the previous one but because of the different purchases involved will involve additional price collection even if construction indices already exist ([33]).

Major renovations covers new construction or enlargements to existing dwelling, significant transformations and major refurbishment or renovations that go beyond the routine maintenance that is needed to preserve the internal and external fabric of the building as the building depreciates. In the OOH they should be treated as an increase in the quality of the property. Money spent simply to keep a property functioning and usable, and to prevent its deterioration, or to do routine and ongoing

([27]) A housing co-operative is a form of ownership in which a non-profit corporation owns residential buildings and residents own shares in the corporation that correspond to their dwelling and a percentage of common areas. Check in Annex G more details about housing co-operatives.
([28]) A detached house is any house that stands alone and that is separated from its neighbours. It can then be characterized as a bungalow, a back split house, a two storey house, etc.
([29]) A terraced house is defined as a dwelling located in a row of houses built in a similar style and having common dividing walls.
([30]) A semi-detached house is a two unit row-house, often called a 'duplex' (but note that this term is sometimes used also to mean stacked apartments on two different floors).
([31]) Although this is not always the case and indeed there will be instances where the floor area extends beyond the boundary of the land e.g. where there is an over-hanging balcony.
([32]) There can also be instances where somebody owns land on a leasehold basis and then builds a dwelling on it for their own occupancy. The land and in consequence any structure reverts to the freeholder at the end of the lease. In these cases the lease will normally extend over many years and there might be an annual ground rent to pay.
([33]) The case of a landowner that buys a prefabricated house and purchases, in addition, excavation and other earthwork services should be considered similar to the purchase of a new flat or a family house and therefore classified under the newly built dwellings category. In this situation, however, some attention must be paid to the existence of possible incoherencies arising from the inclusion of prices of prefabricated houses, which exclude the land component, in the newly built dwellings aggregate covering prices of dwelling purchases including the land component. In situations where incoherencies are found to be relevant, the estimation of the price of the land component could be necessary to harmonise the compilation of the price index for newly built dwellings.

maintenance on a dwelling are everyday costs associated with living in a dwelling and should be classified as maintenance and repairs. There is a grey area between repair projects (which can be minor or major, and are described in the next section) and major renovations but they can be distinguished by the following two features:

(a) Major renovations are associated with permanent improvements that increase the intrinsic value of the dwelling from its original standard, or level of utility, or substantially lengthen its expected life.

(b) A major renovation will provide benefits to the owner of the dwelling in the long term and is sometimes an investment decision to enhance the investment value of the dwelling and may be undertaken even when the property is not in need of repair. Renovation work is distinct from minor and major repairs and maintenance in that it improves the quality of the dwelling and therefore increases its value.

Examples might include: the building of an extension thereby increasing the floor area of the property; the installation of central heating in a property for the first time; the replacement of single-glazed windows with double glazing; the fitting of external wall insulation (involving the fixing of insulation boards to the outside of a building, which is then covered with a mesh reinforcement, a base coat and a final decorative finish) or internal wall insulation (for example thermally insulating the inside of solid walled properties or cavity wall insulation where the cavity between the internal and external walls are in-filled with a high-performance insulation material). In the classification system major renovations are combined with self-build dwellings.

Purchase of existing dwellings new to the household sector corresponds to the acquisition of existing dwellings new to the household sector which relates in practice to the acquisition of existing dwellings that were previously owned and rented out by an individual ([34]) or an organisation, including government institutions, and to first purchase of dwellings that have been converted from other uses and have been sold to the household sector for the first time. Examples of the latter can include warehouses and other commercial buildings that have been converted into town apartments.

Other services related to the purchase of a dwelling covers all transaction costs connected to the purchase of a dwelling for own use whether existing ([35]) or new, and whether paid for by the buyer or the seller. It includes, for example: payments for the services of property agents and mortgage lenders or brokers such as a mortgage application fee and a property valuation fee; fees for arranging a mortgage (a charge by a mortgage broker)([36]); fees for legal services to ascertain that the seller is the legal owner of the property and that there are no outstanding claims or liens against the property; costs imposed by governments such as stamp duty, registration and transfer fees; other services, such as inspection costs asked by the buyer, such as testing for structural damage, water quality, and radon gas emissions, that are not yet included in the scope of the present HICP or are not included in the purchase price of new and existing dwellings ([37]). VAT and other sales taxes, if applicable, should be included in the transaction price. Financial services related to the purchase of the dwelling, most particularly the cost of financial intermediation services such as the cost of loans or mortgages (FISIM – COICOP 12.6.1), should not be included in this category.

3.2.2. THE EXPENDITURE RELATED WITH THE OWNERSHIP OF DWELLINGS

Major repairs and maintenance. It is important to distinguish between, on the one hand, repairs and maintenance (whether they be minor or major) and, on the other hand, major renovations — the latter including reconstructions or enlargements that go considerably beyond what is required simply to keep the property in good working order. The distinction is not always clear-cut and may require some judgment based on detailed enquiries by the price collector. Maintenance and repairs relate to

([34]) Dwellings bought by Households for investment purposes e.g. for putting in the rental market are considered new to the Household Owner-occupiers subsector when they are sold for future own occupancy. The opposite is also true. This affects only the weight computation: the first flow as a positive contribution and the second as a negative one.
([35]) It should be noted that for other services related with the acquisition of existing dwellings the net concept does not apply for those related with the transactions intra-households.
([36]) But, as explained in Section 3.2.2, a fee for later re-financing after the property has been purchased, i.e. a fee for re-mortgaging the property, is classified as 'Other services related to the ownership of the dwelling'.
([37]) According to the scope of OOHPI both seller and buyer must belong to the Household institutional sector as owner-occupiers.

the work required so that the property provides the same standard of accommodation over the expected life of the property as at the time the property was purchased. Such expenditure essentially relates to spending money simply to keep a property functioning and usable, and to prevent its deterioration.

Expenditure related to the ownership of dwellings which takes place routinely as part of ordinary repair and maintenance can be distinguished by two features ([38]):

a) The expenditure relates to activities that must be undertaken regularly in order to maintain the dwelling in working order over its expected service life. The owner or user of the asset has no choice about whether or not to undertake ordinary maintenance and repairs if the dwelling in question is to continue to provide the usual ongoing shelter service to the same standard;

b) Following on from (a) the maintenance and repairs undertaken do not result in an enhancement of the standard of accommodation or its expected service life. They simply maintain the property in good working order, by redecoration and putting right defects.

A further distinction needs to be made between major repairs and maintenance and minor repairs and maintenance ([39]). Minor repairs and maintenance, often referred to as ordinary or routine, are usually associated with a low volume of work and therefore linked to relatively low levels of expenditure over an extended period of time, relating to what are essentially very minor pieces of work. Minor repairs are already included in the HICP (COICOP 04.3) as a current expenditure incurred by households and for that reason, rather than on conceptual grounds, are not included in the scope of OOHPI; Similarly with minor or routine maintenance. The expenditures involved may consist of either payments to professional builders for services rendered or the purchase of materials for 'do-it-yourself' maintenance and repairs such as paint and paint brushes for redecoration.

On occasions, ordinary or routine maintenance and repairs can also be undertaken at the same time as major repairs required to preserve the expected life of the building and to uphold its value. The costs of these major repairs are in scope of OOHPI and are unlikely to be already included in the HICP. Examples include: repairing a leaking roof; carrying out remedial work to address subsidence; the treatment for woodworm or dry rot; replacing rotten window frames with like-with-like frames.

To summarise, in order to draw a line between repairs and maintenance and major home renovations and enlargements, the following questions can be put with regard to the expenditure involved:

a) Does it correspond to fixing something that is already in place, in order to bring the property back to the previous standard, to keep the property in good order and to preserve its expected life and maintain its value? or;

b) Does it increase the standard and quality of the property or extend its life, with the expectation that as a result the intrinsic monetary value of the property will increase?

If the answer is *b)* (increase in dwelling's performance and value) then the expenditure is classified as a major renovation or enlargement, and should be included under OOHPI code O1.1.1.2.

If the answer is *a)* then the expenditure is classified as maintenance and repair and its inclusion in the index of OOH costs (OOHPI) is determined by the answers to the following questions:

([38]) The delineation of repairs from renovations is made in SNA 6.228 using two criteria. For 'Ordinary maintenance and repairs the distinguishing two features are:

a. They are activities that owners or users of fixed assets are obliged to undertake periodically in order to be able to utilise such assets over their expected service lives. They are current costs that cannot be avoided if the fixed assets are to continue to be used. The owner or user cannot afford to neglect maintenance and repairs as the expected service life may be drastically shortened otherwise;

b. They do not change the fixed asset, but simply maintain it in good working order or restore it to its previous condition in the event of a breakdown. Defective parts are replaced by new parts of the same kind without changing the basic nature of the fixed asset.'

([39]) Within repairs, the SNA at paragraph 6.37 distinguishes between repairs commonly done by both tenants and owners and those commonly done by owners only, thus: 'In the case of dwellings, 'do-it-yourself' activities cover decoration, maintenance and small repairs, including repairs to fittings, of types that are commonly carried out by tenants as well as by owners. On the other hand, more substantial repairs, such as re-plastering walls or repairing roofs, carried out by owners, are essentially intermediate inputs into the production of housing services.' Note, however, the difference in terminology between the HICP and the SNA in that to help with interpretation the HICP refers to the repairs done by tenants as 'minor' and the repairs done by owners only as 'major'.

a(i) Is the repair associated to a low volume of routine work and therefore to a relatively low level of expenditure? or

a(ii) Does it involve a high volume of work and a significantly large one-off expenditure?

If it is *a(i)* then the expenditure is classified as a minor repair and should be covered by current expenditure already in the HICP under COICOP 04.3. On the other hand if it is *a(ii)*, then the expenditure is classified as a major repair and should be included under OOHPI code O1.2.1.

A useful analogy to explain the distinction between **minor and major repairs** is the type of work carried out by tenants and owners. Minor repairs and maintenance relates to the work a tenant might carry out on a rental property i.e. low volume work which **does not extend the life of the dwelling or improve the dwelling compared to its original state**. As these costs will already be included in the HICP they are not in the scope of OOH costs. Major repairs and maintenance, on the other hand, refer to the type of work only carried out by a property owner, i.e. works that bring the dwelling back to its original quality thereby helping **to extend the life of the dwelling** (but not to increase its value compared to its original state).

The most important point is to ensure that all OOH maintenance and renovation costs are accounted for and that there is no double counting.

Insurance connected with the dwelling relates to the premiums paid by owner occupiers for property insurance covering the basic building structure (walls, roof etc.), as typically taken out by landlords. Also in scope are the service charges relating to mortgage protection insurance which covers the re-payment of a loan in the event of the borrower's death, incapacity or loss of job ([40]). Contents insurance, e.g. where carpets and furniture need to be replaced due to water damage resulting from a leaking roof or theft where items are stolen as a result of a break-in are not in the scope of OOH costs — the service charge is already included in the HICP subheading 12.5.2. The OOH Price Index (OOHPI) should only cover what is excluded from HICP subheading 12.5.2.

Other services relate to the ownership of dwelling relates to costs which are in scope and are not covered elsewhere. Examples under this heading include:

a) On-going service charge by the bank to manage and administer the regular repayment of the mortgage ([41]), or a brokerage fee related to re-mortgaging a property;

b) Costs associated with the supply of legal certificates: e.g. a certificate on the 'energy efficiency' of the dwelling for owner-occupiers;

c) Any other cost associated with the provision of services to owners of dwellings that do not fit into the 'insurance' and 'major repair works' categories: e. g. professional evaluation of the value of a house for insurance purposes;

d) Municipal and/or local annual Property tax — taxes for property owners with the purpose of paying for local authority's investments and services such as street cleaning, mowing grass in areas between buildings, etc. ([42]);

e) Energy Efficiency Certificates and Gas Safety Certificates if needed only by owner-occupiers regardless of whether the dwelling is being sold.

Examples can be rare and should be investigated on an individual country by country basis. There are, of course, many on-going costs common to both owner-occupiers and renters that are already included in the HICP.

([40]) Mortgage protection insurance as an insurance policy exclusively and explicitly repays any outstanding monies on a mortgage. Regular life insurance, not specifically related to the repayment of an outstanding mortgage, is covered in HICP COICOP 12.5.1.

([41]) This is contractually different to and not the same as the initial commission a Bank may charge for arranging the mortgage. It is not a contractual obligation related to the initial purchase per se, rather it is an ongoing cost determined by the current tariff of Bank charges.

([42]) Property taxes which are based on real/estimated dwelling capital or income value, only should be included in an OOH index if they are directly related to service provision & are only incurred by owner-occupiers (following HICP principles). Most commonly, the services referred to are those provided by local government e.g. for maintenance of roads, street lighting and other common infrastructure plus the provision of schools, social services & housing. Such taxes are included under OOHPI code O.1.2.3. Conversely, if they are not directly related to the provision of services i.e. they are a wealth tax going direct to government with no direct link to services provided, they are not consumption related, are considered a form of taxation (a distributive tax), and should be excluded from the OOH price index and also from the HICP.

Table 2: Classification system for price indices related to dwelling acquisition and ownership

OOH Code	HPI Code	Designation	COICOP_bis	Comments
O1	**H1**	**Owner-occupiers' housing expenditures**		OOH all-items price index
O1.1	**H.1.1**	**Acquisitions of dwellings**	**04.2**	See section 3.8
O1.1.1	**H.1.1**	New dwellings	04.2.1	
O1.1.1.1	**H.1.1**	*Purchases of new dwellings*	*04.2.1.1*	See section 3.8.1
O1.1.1.2	*excluded*	*Self-build dwellings and major renovations* (*)	*04.2.1.2*	
O1.1.1.2.1	*excluded*	*Self-build dwellings*	*04.2.1.2.1*	See section 3.8.2
O1.1.1.2.2	*excluded*	*Major renovations*	*04.2.1.2.1*	See section 3.10.1
O1.1.2	**H.1.2**(**)	Existing dwellings new to the households	04.2.2	
O1.1.3	*excluded*	Other services related to the acquisition of dwellings	12.7.2	See section 3.9
O1.2	*excluded*	**Ownership of dwellings**	**04.3**	
O1.2.1	*excluded*	Major repairs and maintenance (***)	04.3.3	See section 3.10
O1.2.1.1	*excluded*	*Materials for major repairs and maintenance*	*04.3.3.1*	
O1.2.1.2	*excluded*	*Services for major repairs and maintenance*	*04.3.3.2*	
O1.2.2	*excluded*	Insurance connected with dwellings	12.5.2	See section 3.11
O1.2.3	*excluded*	Other services related to ownership of dwellings	12.7.1	See section 3.9.6

(*) In practice the separation between indices for self-builders and major renovations may not be possible. This can occur if there are no separate indices compiled for these two sub-items in Construction Short Term Statistics. In these circumstances the price index compiler may need to use an overall index for self-building and major renovations without the split between these two components.
(**) OOHPI comprises only the existing dwellings that are new to the household sector. In contrast the HPI includes all existing dwellings.
(***) In some cases, the separation between services and materials used in major repairs and maintenance works may not be possible. This can happen when the service provided already includes, in its final price, the cost of materials and the latter is not explicitly shown in the contractor's final bill. In situations like these, the price index compiler may find it advisable to follow the provision cost of a number of typical major repairs and maintenance works and avoid, on grounds of practicality, to present a split between materials and services. See section 3.10.1.

3.3. Borderline cases between rental and owner-occupied housing

A number of special cases can occur which require particular consideration.

- **Housing co-operatives.** A housing co-operative is a legal entity that can provide to their shareholders an alternative to both renting and owning a home. This type of housing tenure differs from direct ownership in that real estate is owned by the legal entity and not by households themselves. Shares represent the right to occupy and use a certain housing unit in the co-operative and can be used as collateral for loans. Although co-operatives (co-ops) may restrict, at least to a certain degree, the freedom in which transactions are done ([43]), shares can be traded on the market for a price ([44]). Housing co-operatives where the accommodation is rented are not within the scope of OOHPI. A more detailed discussion of the treatment of co-operative housing is given in Annex G.
- **Leasehold purchases**. In some countries an owner of a flat may purchase the property 'leasehold' which gives ownership for a limited period of, say, 99 years, and where an annual 'ground rent' is paid. The purchaser only owns a leasehold property for a fixed period of time. They will have a legal agreement with the landlord (sometimes known as the 'freeholder') called a 'lease'. This tells the purchaser how many years they will own the property. Ownership of the property reverts to the landlord when the lease comes to an end. Leases can vary. In some cases the purchaser of the lease will need permission to make alterations and may have to pay an annual amount to maintain the property. The lease will also stipulate whether the purchaser or the landlord has responsibility for repairs and other issues such as dealing with noisy neighbours. In legal terms leasehold is a method of owning property (usually a flat) for a fixed term but not the land on which it stands. Possession of the property will be subject to the payment of an annual ground rent. When the lease expires, ownership of the land and in consequence the property reverts back to the freeholder. By way of example, nearly all flats in London are leasehold. These leasehold properties are treated conceptually in exactly the same way as dwellings purchased freehold where there is outright ownership of the property and land on which it stands. Freehold ownership of land (as opposed to leasehold) is where the owner of the land has no time limit to his period of ownership. The Ground Rent for leasehold property is a legitimate part of the on-going costs of home ownership being part of a package where the flat cannot be purchased without the lease and the stipulated ground rent. A similar situation applies where a household purchases a house but rents the ground on which it is built. The house cannot be purchased without renting the ground on which it stands. The treatment in the HICP and in owner-occupied housing costs of the cost of renting the land, i.e. the Ground Rent as opposed to the service charge, is not clear-cut. It is a difficult point and there are arguments both for its inclusion and for its exclusion and if it is included under what category of expenditure it should come is also a matter of debate. For example, it could be argued that as ground rent means that the land is not owned but rented then it has no place in owner-occupied housing costs although it should be included in the HICP. However, the counter-argument is that, from a buyer's perspective, leasehold properties are purchased in exactly the same way as freehold properties and that for properties with relatively long leases there is little distinction in the market place between the two forms of 'ownership'. A purchaser of a leasehold flat would describe themselves as 'owning' the flat and the right to use the land over the prescribed period of the lease.

([43]) Examples include reserving the right to admit a new member and limiting the price at transfer.
([44]) This price can be labelled as the 'commercial price'.

If the view is taken that ground rent is paid by owner-occupiers of leasehold property, and that they are tenants as far as the use of the land is concerned, then the ground rent should be included in the HICP under COICOP 4.1.2.2 (garage rentals and other rentals paid by tenants). The purchase price of the leasehold property would be included under COICOP 04.2 and the corresponding OOHPI code on the basis that the purchaser is buying the physical dwelling and an entitlement to the use of the land (subject to the ground rent). Thus, the purchase of a leasehold property is treated in the same way as the purchase of freehold property. Of course, if the leaseholder buys out the ground rent thereby making them a freeholder then arguably this is an acquisition cost incurred by owner-occupiers and should be treated accordingly and the purchase should come under OOHPI code O.1.1.3 (Other services related to the acquisition of dwellings). If the view is taken that leasehold properties are a form of ownership (the purchaser owns the lease) — and that in practice no distinction can be made between a building and the land it rests on — then the ground rent should be treated as an ongoing cost of home ownership under OOHPI code O1.2.3. In principle ground rent would be included in an HICP under either scenario ([45]).

It should be noted that the length of a lease can influence market price especially when the lease is coming towards its end ([46]).

- **Rent to Buy.** This relates to schemes designed in some countries for people who want to rent affordably now, save for a deposit, and then buy the dwelling, or a different dwelling, later. The schemes can vary in detail but generally come in the form of the Government facilitating sub-market rents for a minimum number of years to households who have never owned a home before. The tenants can then use this fixed period of support to achieve their aspiration of home ownership, either by buying the home they are renting or another one usually at market value having used the savings from the subsidised rent to build-up a deposit. Some schemes achieve this via a Rent to Buy Fund whereby Governments will offer low cost loans to providers (housing associations or builders) to build homes to be let at sub-market rents thereby increasing the housing stock. Others effectively provide subsidised rents on existing dwellings. The main attraction of Rent to Buy properties is the subsidised rent. Rent to Buy is not within the scope of OOHPI unless and until a dwelling is purchased. At this stage the purchase is treated like any other house sale. In this case, it is an example of the purchase of existing dwellings new to the household sector.
- **Shared ownership.** Shared ownership schemes are where the person occupying a dwelling part buys and part rents. Such schemes are most commonly provided through housing associations. As a general rule, if a dwelling is partly-owned by the occupier then only the occupiers share enters into the OOHPI weight relating to the acquisition cost. The corresponding weights relating to the costs associated with the ownership of the dwelling, such as repairs, insurance should relate to the actual costs incurred by the part-owner.
- **Buy to let.** This involves an individual purchasing a property, and typically taking out a mortgage, and then renting it out. As the owner does not live in the property such a purchase does not come within the scope of OOHPI.
- **Right to Buy.** In some countries a tenant with a minimum number of years' tenancy can be eligible to buy their home at a significant discount. For example, tenants renting accommodation supplied by central or local government and some housing association tenants may be eligible. This is another example of the purchase of an existing dwelling new to the household sector. On purchase it is the subsidised price that should enter the calculation of the acquisition costs as this is the actual

([45]) As a warning, it should also be mentioned that ESA 4.72 stipulates that rent on land is a property income transaction. That would make it difficult to include it as a consumption category.
([46]) Work undertaken by CSO Ireland indicates that leasehold properties command a lower price than the equivalent freehold properties. The effect of length of lease on market price is less clear but is most likely to be factor when the lease is relatively short-term.

transaction price ([47]).

- **Equity loan schemes.** This is where Government contributes part of the deposit for the purchase of a dwelling so that the aspiring home owner needs only to have a much smaller deposit. The Government has a share of the equity proportional to its contribution to the deposit and on sale reclaims its proportion of the value of the dwelling. This is a particular example of shared ownership.

Each special case should be considered on its merits taking into account the details — most particularly the legal aspects relating to ownership and how the schemes are applied in practice. Consideration should be given to how these schemes are treated by a country's national accountants. That said, some of the above cases can be difficult to identify in practice unless needed and recorded for legal reasons or for purposes of taxation.

If a borderline case between owner-occupancy and rental dwellings is deemed not to belong to the group of owner-occupied dwellings, actual rents paid by the occupier should be included in the HICP rents index.

3.4. **The price concept and the issue of timing**

The compilation of OOH price indices should be based on the full transaction prices that are paid by households for the purposes of purchasing and maintaining a dwelling for their own occupation or use ([48]).

At this point, two clarifications regarding the price concept and scope should be noted.

The first one has to do with the notion of full transaction price. The latter equates to the total price paid by households for the acquisition of a dwelling including VAT. However other taxes paid, such as stamp duty, should be included in OOHPI O.1.1.3 (see Section 3.9). The latter are not part of the purchase price and should not be included in HPI calculations.

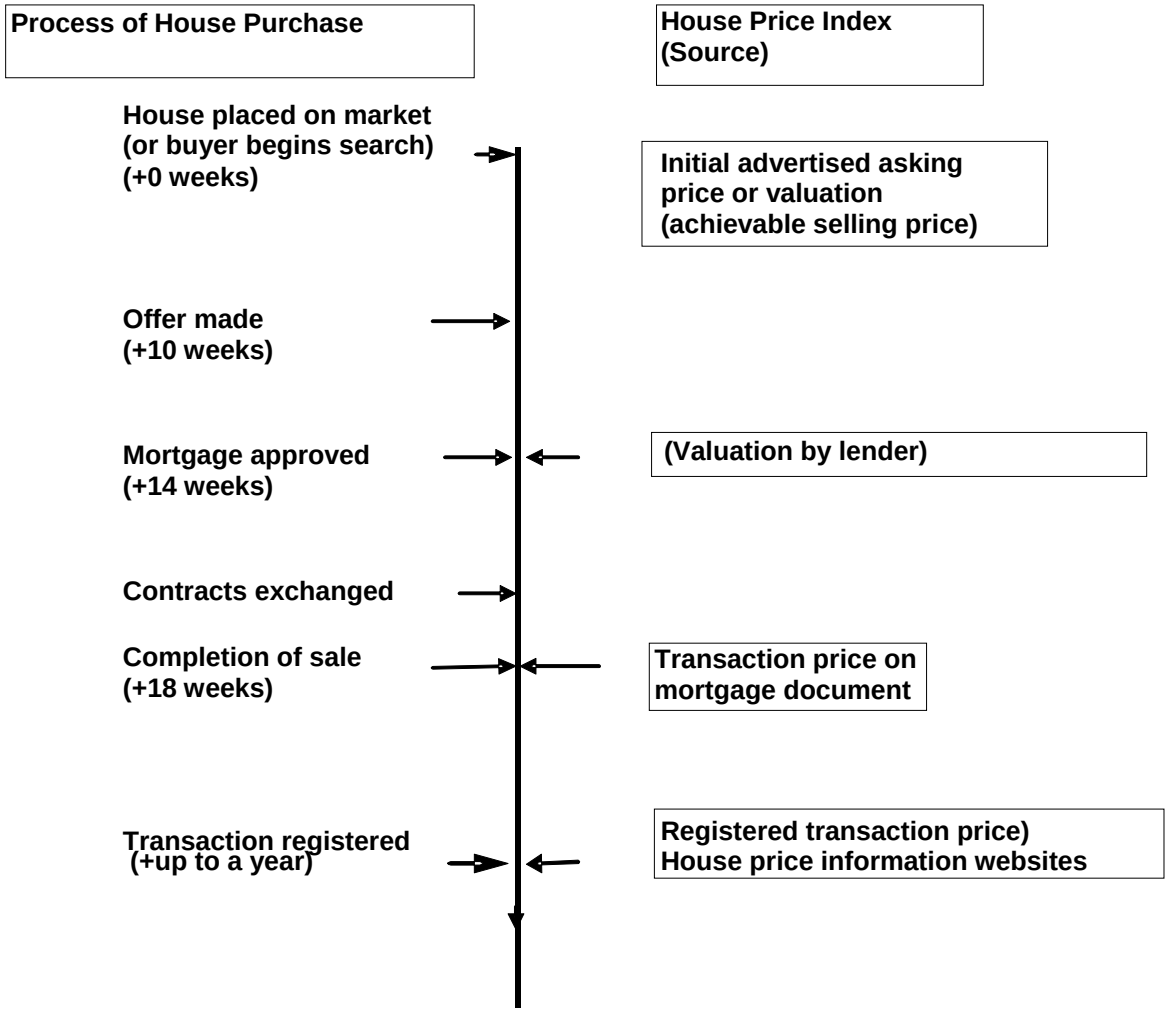
The second has to do with the separation between resident and non-resident households. Following HICP conventions and, in particular, the use of the domestic concept, the residential status of the purchaser is of no relevance in the compilation of an OOH price index. OOH costs cover all purchases of OOH taking place in the economic territory ([49]).

Concerning the issue of timing, this is made complicated by the fact that the acquisition of a dwelling can be a rather long and complicate process. It may consist of several steps and contracts and, for new houses, as the dwelling is being built, different payments to construction companies (or real estate brokers) at different stages of building and points in time. Moreover, it may include other activities such as official inspections, formal transfer of ownership and tax payments. Measuring the costs borne at these different stages may require the interrogation of different data sources. The time lag between the first binding contract (and typically the first payment representing a deposit) and the final stages of the process leading to the registration of change of ownership can be over a year. Illustrated below is a typical timeline taken from the UK experience.

([47]) Although 'Right to Buy' schemes involve subsidised prices which, in some cases, may strictly speaking take the form of discriminatory discounts as they are directed at and apply only to particularly groups of the population, this aspect should be ignored for the current purpose. However, for an HPI the inclusion of 'Non-market' prices represents a deviation from the target index.

([48]) Perhaps a clarification should be made here regarding the concept of 'own use/occupancy' in this manual. In the present context, 'own occupancy' should not be understood in the sense that only the purchase of main residences are of interest. Instead, it should be perceived in a broad way as all household dwelling purchases bought for own-occupancy, regardless of their final intended use (main or secondary residence). Vacation homes are, in this light, covered in the compilation of OOH indices.

([49]) This means that, for instance, a transaction of a vacation house by a foreigner would enter into the compilation of the OOH price index. As this type of transactions may have distinctively different characteristics from all the remaining dwelling purchases, it may be advisable to build a special price index aggregate to cover them. Likewise, as its relative importance may be quite high in some countries, it may be wise to isolate them in a particular elementary aggregate. Practical aggregation and compilation issues are dealt with later on in this manual.



For the purpose of OOH price indices the reference date for the purchase to enter the index is the point in time when the first binding contract between the seller and the purchaser is signed i.e. the point when the dwelling is no longer available on the market.

To summarise, OOH price indices should be based on real transaction prices set at the moment of signature of the first binding contract between the seller and the purchaser of a dwelling ([50]). This may be different from: the time the payment is made; the time when the transaction and change of ownership appears in the official register; or the moment when use starts.

This is an issue that is also confronted in the compilation of an HPI. The indices so constructed and the resulting index numbers can vary according to the point in the house purchasing process at which the price is measured (for instance, whether the final transaction price or the earlier valuation used for securing a loan is taken) and according to the amount of detailed information available on the characteristics of the houses being sold. Such issues can dictate the detailed methodology for index construction. The process of purchasing a dwelling and the amount of information given in the associated documentation can often act as a constraint on the techniques available to quality adjust for houses of different sizes and locations in order to produce a Lowe or 'Laspeyres-type' fixed-

([50]) Real transaction prices should be the basis of OOH price index compilation. 'Non-market' and notional/'abstract' prices should be considered a deviation from the desired first-best solution and its inclusion analysed with great care. An example of a notional or 'abstract' price is a price quote derived from a model project home. An example of non-market prices is bank appraisals data.

basket price index. The inability to quality adjust is particularly problematic where there is a lack of homogeneity, as in the case of the residential property market. In practice the derivation of data from different data sets and a high incidence in the use of administrative and other readily available data on the transaction of dwellings can result in a deviation from the target measure or, at the very least, methodological compromises or imperfect application of the recommended methodology. In these cases, the reasonableness regarding the deviation should be assessed in light of a country's house market characteristics and available databases. This assessment should include an evaluation of the impact of a departure from the target principles.

It should be noted that the price concept in some cases can be more complicated and this can generate difficulties for index construction as the 'price' to be taken is far from straightforward. We can take the situation of cooperative housing in Denmark. In Denmark the purchaser buys a share in a cooperative which reflects the assets and liabilities such as financial savings and outstanding mortgage of the cooperative as well as the price of the dwelling. In work undertaken by Statistics Denmark, four pricing concepts were adopted to compute a house price index. The difference is not academic as it can lead to different challenges relating to the practical calculation of the index and to different estimates of house price inflation. Also the different concepts represent departures to varying degrees to the price concept for dwellings that are not part of cooperatives ([51]). Further references to the situation in Denmark are made in Annex G on the treatment of housing co-operatives in the HPI and OOHPI.

3.5. Some issues on the derivation of owner-occupied housing weights

The volume of houses being transacted for own-occupancy varies between countries. Clearly, the quality of the OOH sub-indices becomes more critical the larger the index weights.

For OOH costs, the appropriate weights for the net acquisition are the net value of purchases of the household sector of new dwellings and of dwellings from other institutional sectors in the base period and not the value of the total housing stock ([52]).

To apply the net acquisition approach to OOH, the weights for the purchase of dwellings should cover purchases less sales in the same way as purchases of consumer durables are included in the HICP, most particularly the treatment of second-hand cars. Gross fixed capital formation in dwellings is defined in the ESA 2010 as the value of acquisitions (purchases plus own account construction and transfers in kind) less disposals (sales plus transfers in kind) of dwellings. If purchases less sales of dwellings are negative, then a zero weight should be used. Weights have to be updated according to HICP weighting rules.

As most of the second-hand transactions are done between households (i.e. are intra-sector transactions), the sales and the purchases of these dwellings tend to cancel out with the exception of the transfer costs which, it has been noted, are in scope. This means that, in practice, the net acquisition approach is heavily weighted towards transactions of new dwellings as household purchases of second-hand dwellings for own use from other sectors (e.g., a local government may sell rental dwellings to owner-occupiers or a rented house can be sold by the owner to the tenant and some industrial buildings are converted into flat) tend to be relatively infrequent and insignificant.

Looking at housing markets from the households' point of view, the situation may be somewhat different. For example, in some countries more than three-quarters of all transactions on the housing markets deal with existing dwellings.

The relationship between housing markets of newly built and existing dwellings may naturally be different across Member States but it can be reasonably assumed that the markets for existing dwellings tend to be larger than the markets for newly built dwellings.

Weights will be dealt with in more detail in Sections 3.12 and 5.1.4: Section 3.12 tackles the issue of OOH weights derivation & section 5.1.4 focuses on data sources.

([51]) For more details see *Price concepts for Housing Cooperatives in a House Price Index*, Jakob Holmgaard, May 2015.
([52]) Alternatively, if the purpose of an HPI is to track the price change of the housing stock then stock-weights — the stock value shares of the strata — should be used.

3.6. **The quality adjustment issue**

It is important to ensure that the changes in the characteristics of the dwellings being sold are controlled for in OOH price indices, most particularly in the acquisition of dwellings and the deployment of the House Price Index (HPI) ([53]).

For anyone acquainted with the crucial role of quality adjustment in price index compilation, trying to compare like with like, or, to put it differently, to make price comparisons of products of 'equal quality', is not a trivial issue.

In the case of the compilation of OOH price indices, and in particular the HPI, the comparison over time of prices of 'dwelling of equal quality' is a concept that is difficult to follow in practice because of the change in the composition of purchased dwellings in each period. In this context, the application of the more conventional matched model approach to quality adjustment is not possible and price measurement problems stemming from changes in the mix of purchased dwellings need to be taken into account Thus, the degree to which house price indices are able to eliminate the effect of *quality differences* between different dwellings compared over time, such as the condition of the property, whether it has central heating and a fully-fitted kitchen and bathroom and the mix-adjustment for differences in size of plot, size of house, type of property (flat, house, semi-detached or detached), location etc. are critical and challenging issues.

There are four basic methods for compiling constant-quality house price indices: stratification or 'mix-adjustment'; hedonic regression techniques; repeat sales; and appraisal-based methods (notably the Sales Price Appraisal Ratio — SPAR-method). Each method attempts to adjust for the change in the 'quality mix' of the houses whose prices are observed and combined to construct the index. The different methods of index construction used by statistical agencies reflect the differing local solutions used to meet the above challenges and reflect country circumstances.

Stratification or mix-adjustment is the most straightforward way to control for changes in the composition or quality mix of the properties sold but its effectiveness will depend upon the stratification variables used because a mix-adjusted measure only controls for compositional change across the various groups — a mix-adjusted index does not account for changes in the mix of properties sold *within* each subgroup or stratum. In theory, the more detailed the stratification, the more the index controls for changes in the characteristics of the properties covered by the index but increasing the number of strata reduces the average number of price observations per stratum and, in fact, can quickly lead to empty strata. Similarly, reliance on repeat sales in the repeat sales method, which observes the price development of a specific house over a period of time by reference to the selling price each time it is sold, can lead to too few data points to compute an index. Also as a dwelling must be sold at least twice, newly built dwelling units are excluded and further sample selection bias can arise from the restriction to properties that have been sold more than once during the sample period. It is for the above reasons that many statistical offices look to hedonic regression techniques and the SPAR method ([54]).

The subject of quality adjustment is tackled in more detail in Chapter 6 of this manual.

3.7. **Frequency of the indices**

In some Member States, general activity in the housing market and the acquisition of new dwellings may be subject to seasonal variation. Moreover, in all Member States the number of transacted dwellings (and in particular of new dwellings) will vary significantly according to the economic cycle. This can accentuate problems in getting a sufficient number of price quotes for the production of a monthly index, particularly in smaller countries. For an HPI a quarterly frequency is sufficient. For OOH price indices monthly production (directly compiled or estimated results) with publication within 15 days of the reference period would be required to meet the HICP publication timetable.

([53]) Examples of such characteristics that need to be catered for in an HPI include e.g. location, type of dwelling, living area and number of rooms.
([54]) See also the *Handbook on Residential Property Price Indices*, Eurostat 2013.

Monthly indices can be either directly computed from monthly prices or computed from quarterly data using model-based estimates ([55]) that deliver monthly indices consistent with quarterly indices.

A regular revision of the OOHPI/HPI weighting scheme is required. Every year a set of weights should be compiled. The time lag between the year of the index and the reference year for the weights should not exceed 2 years

3.8. **Price index for the acquisition of dwellings**

As mentioned in chapter 2, only the dwellings that are acquired by households for own use and that are new to the household sector should be taken into account in the construction of an OOH price index following a net acquisition approach. According to Figure 1 of chapter 2, flow C represents these transactions. For practical reasons, C can be divided into three flows as in Table 3 below — C1, C2 and C3 — from which B then needs to be deducted. C1 refers to new dwellings constructed by self-builders. C2 refers to new dwellings constructed other than by self-builders. C3 includes all existing dwellings sold to households by non-households.

Table 3: Definition of the relevant scope of dwelling transactions

		SELLER	
	BUYER	Households	Others
NEW DWELLINGS	Households	-	C1+C2
	Others	-	D1
EXISTING DWELLINGS	Households	A	C3
	Others	B	D2

In light of the classification presented in Table **3**, a price index for the acquisition of dwellings following a net acquisition approach (${}_{Ac}I_0^t$) would comprise of the following elementary indices:

$$ {}_{Ac}I_0^t = {}_{C1}w \cdot {}_{C1}I_0^t + {}_{C2}w \cdot {}_{C2}I_0^t + \left({}_{C3}w - {}_{B}w\right) \cdot {}_{C3}I_0^t \qquad (3.1) $$

where,

${}_{x}I_0^t$ = price index of aggregate '*x*' in period *t*;

${}_{x}w$ = expenditure weight of aggregate '*x*'.

$\left({}_{B}w\right)$ = non-household purchases of dwellings for renting or for other purposes, that were owner-occupied by the sellers.

The index that is being built does not cover cell A because transactions between households cancel out in the net acquisition approach. Moreover, non-household purchases (i.e., B, D1 and D2) are out of the scope of the net acquisition approach.

As equation (3.1) highlights, each one of the cells included in Table 3 is a potential source for the derivation of an elementary index. These will be described in the next sections.

Even where one of the transaction categories in Table 3 is in scope, the derivation of a corresponding price index for that category may not be required if the weight of the transactions is insignificant. In these circumstances the weight should be re-allocated across all transactions in scope in proportion to the relative weights of the remaining cells.

([55]) An adequate estimation procedure can rely on available proxy variables. The wisdom of such an approach should be assessed. Econometric approaches can be used to identify the best proxies for the estimation procedure to be applied.

3.8.1. ELEMENTARY PRICE INDEX FOR NEWLY BUILT DWELLINGS

Household purchases of newly built houses directly from the non-household sector (e.g. from a building firm or a selling agent) are identified by cell C2 in Table 3. Thus, we have:

$$_{ND}I_0^t = {}_{C2}I_0^t \tag{3.2}$$

At this point, it should be stressed that the acquisition of newly built dwellings comprises not only of purchases of entirely new dwellings (i.e. 'brand new homes') but also of all existent dwellings that have been subject to major improvements or renovations (see Table 2). As highlighted again in section 3.10.1, the latter should be regarded as expenditures on the acquisition of a completely new dwelling and should be covered by this elementary aggregate. Major renovations are works that increase the capacity and/or performance of the dwelling stock, and for this reason are considered together with the self-built in aggregate C1 in Table 3.

Dwelling types (flats, detached houses, row houses, housing cooperatives, pre-fabricated houses, etc.) could constitute a candidate for a further breakdown of equation (3.2) depending on the relative importance of each dwelling type, the statistical needs for further stratification and on user needs for sub-indices.

3.8.2. ELEMENTARY INDEX FOR SELF-BUILT DWELLINGS

A self-builder can be characterised as someone who acts as his own developer. In most economies, it is expected that only a small percentage of all self-builders get directly involved in the building work themselves. It is thus expected that most self-builders will administer the building process either by contracting out to a single builder/company or by making use of several subcontractors, who will be employed in different phases and aspects of the building work.

Although the characteristics of a self-built dwelling will ultimately vary from country to country, they will typically consist of detached dwellings built on a plot of land already owned by the self-builder.

The essential difference compared to other newly built dwellings is that the land is generally not purchased with a building structure or is purchased with the intention of knocking down whatever structure is on the site with the implication that the purchase price represents the value of the land. Of course, in some instances the land or building site might have been inherited and therefore does not constitute an acquisition via a monetary transaction ([56]).

For the construction of an index self-builders can be divided into three main types:

- *Step-by-step self-builders;*
- *Self-builders who involve a building firm; and*
- *Self-builders with prefabricated houses* ([57])*.*

Thus, taking into account the basic framework set out in Table 3, it is possible to define the OOH price index for self-builds as

([56]) The treatment of 'land' is elaborated on in chapter 7.
([57]) Excludes those who purchase a package that covers the cost of a prefabricated house and the cost of installation (including excavation and other earthwork services). Such a purchase should be considered similar to the purchase of a new flat or a family house and therefore classified under the newly built dwellings category. The category 'Self-builders with prefabricated houses' should only include cases where the buyer manages the steps needed for assembling the house, i.e. project manages the use of different specialised companies and associated contracts and transactions.

$$ {}_{SB}I_0^t = \left({}_{SBS}w_{\cdot SBS}I_0^t\right) + \left({}_{BF}w_{\cdot BF}I_0^t\right) + \left({}_{PFH}w_{\cdot PFH}I_0^t\right) \quad (3.3) $$

where,

$ {}_{SB}I_0^t = {}_{C1}I_0^t $

SBS stands for the 'step-by-step self-builder case';

BF stands for the 'building firm case'; and

PFH stands for the 'prefabricated case'.

For the three categories of self-builders, a number of price series have to be calculated ([58]). This can be particularly challenging for the ${}_{SBS}I$ and ${}_{BF}I$ indices, as the measurement of construction prices can be extremely difficult. Not only because these may be part of the grey economy, but also because the output of the activity in any period includes a great variety of structures and types of work.

One possible way to circumvent this difficulty is to use readily available statistics on the construction sector even if some of the data may be of limited relevance to self-builds so detailed investigations may be required. These statistics follow a common framework ([59]) and include input price statistics, based on construction costs indices ([60]) and output price indices.

Figure 2: Input- and Output-indices

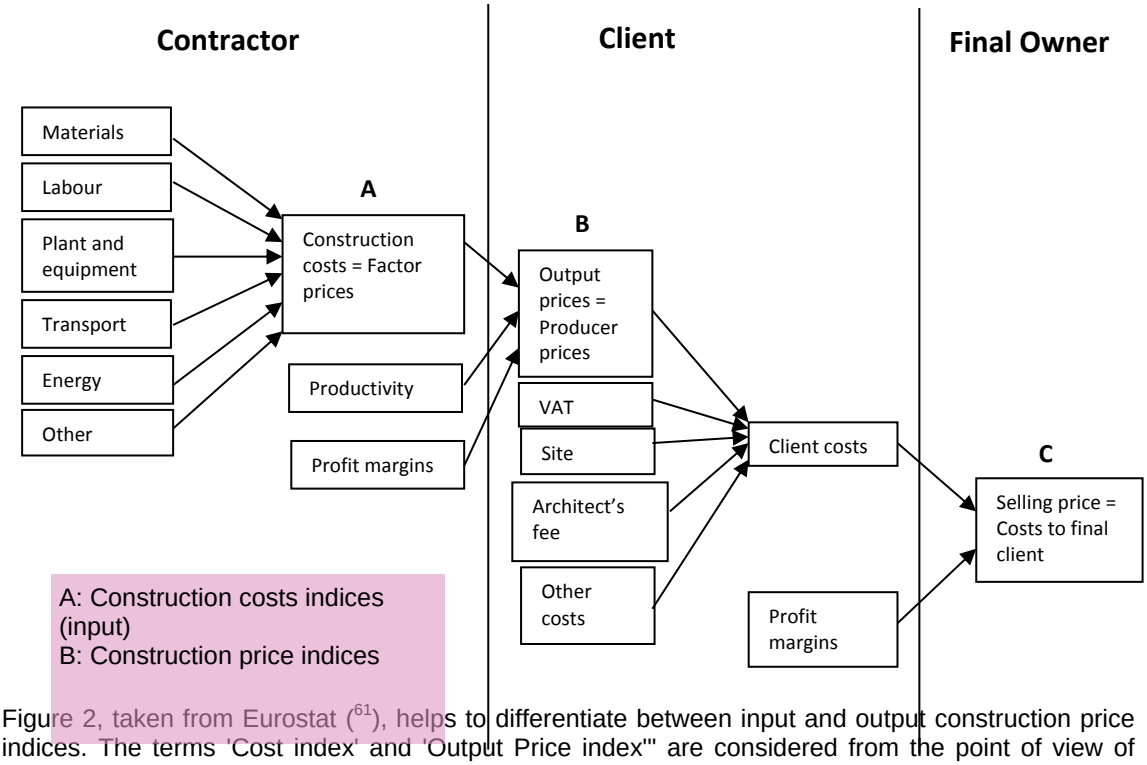


Figure 2, taken from Eurostat ([61]), helps to differentiate between input and output construction price indices. The terms 'Cost index' and 'Output Price index'" are considered from the point of view of contractors (building firms). The pertinent columns are the first relating to the contractor and the

([58]) This is also true for major repairs and maintenance as well as for the construction of elementary aggregates covering renovations, extensions, conversions or reconstructions of the dwelling. All these are tackled in section 3.10.

([59]) Set out by Council Regulation No 1165/1998 concerning the development of Short-Term Statistics (STS-R). The STS-R requires short-term statistics on input prices, material costs and labour costs. It also foresees output price index.

([60]) Construction cost indices can also be used for modelling purposes to differentiate the cost of the structure from the cost of the land using the cost of production approach to model the price of the building, using an hedonic approach where the functional form for the hedonic price function is assumed to be determined by the supply side of the market, i.e., by independent contractors (see *Handbook on Residential Property Price Indices*, Chapter 8, Eurostat 2013).

([61]) Eurostat (2006b), *Methodology of short-term business Statistics*..

middle one relating to client costs. As for any self-build there will be no sale and therefore no profit margin on the sale of the dwelling. For step-by-step self-builders, information relating to the first column is likely to be the most relevant whilst for self-builders who involve building firms it is the middle column which is likely to generate the most relevant information. The choice of appropriate indices is important as different costs will be subject to different inflationary pressures. For instance, labour costs may well rise at a different rate to the cost of materials.

The input price index can be considered as a combination of component costs indices (material costs and labour costs) and provides a picture of the price developments of the main production factors of construction.

The price series provided by this index and its sub-indices can be used as *proxies* for the construction of price indices for step-by-step self-builds and for those who use a building firm for all or part of the construction.

At this point, a note on the term 'input price index' should be made so as to avoid confusion and hence clarify the use of the term in this manual. The term 'input' is used here because self-builders are seen as developers/constructors as well as future users of the self-built dwelling. The inputs included in an input price index are, therefore, important for the development of $_{SBS}I$. For instance, the cost of materials will be a major part of the construction costs of a self-built dwelling and may be represented by contractors' material costs, possibly with some modification to allow, for example, for any changes in VAT rates applicable to self-builders but not to contractors input price, (which may be exempt from VAT), and for changes in the average discounts given to contractors by building suppliers.

The *construction cost price index* needs to take account of the type of house under consideration, most particularly when used as a proxy for step-by-step builders. The list of available property characteristics and construction indices need to be sufficiently detailed to reflect the mix of self-built dwellings.

It should be noted that according to national accounts, workers engaged in production undertaken entirely for their own final consumption or own capital formation, either individually or collectively, are self-employed and unwaged. Although in theory a value could be imputed for the output of own-account production based on costs, including estimated labour costs, no imputation is made for the wages of workers engaged in such production, even in the case of collective, or communal, projects undertaken by groups of persons working together voluntarily. SNA (2008) states that when work on own account occurs either for intermediate consumption for housing services (repairs) or for GFCF (renovations) only the cost of the materials should be included ([62]).

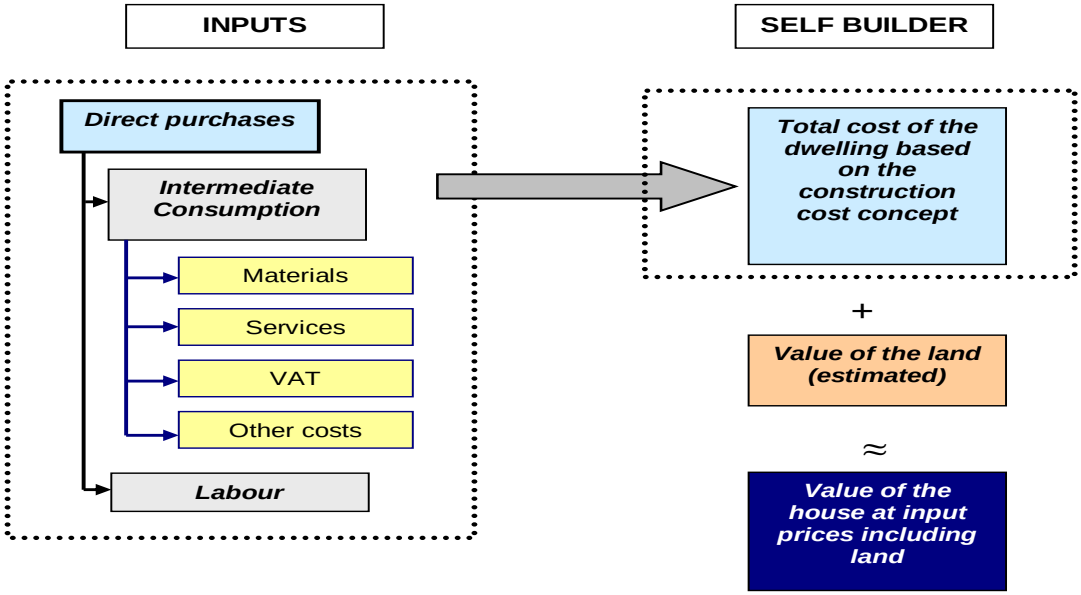
3.8.3. SOME CLARIFICATIONS REGARDING THE COMPILATION OF AN INDEX FOR SELF-BUILT DWELLINGS

Figure 3 is taken from Eurostat (2006b).

Its aim is to describe the phenomenon of self-builders, to better define the contours of this activity in the overall economic activity and to establish the distinction between input and output prices so that the relevant components of an index for self-builders can be identified in accordance with the best compilation approach based on input prices.

([62]) SNA 24.51: *All dwellings require regular maintenance. The production account for an owner-occupied dwelling treats as intermediate consumption only the goods and services necessary to undertake the sort of repairs that are typically the responsibility of the landlord in the case of rented buildings. These may include payment to specialists in the building trade, for example plumbers or painters, and the cost of these specialists will include their compensation of employees. However, when work is undertaken by the owner himself only the cost of the materials is included in intermediate consumption with no estimate made for the value of the owner's time. If labour costs were to be imputed to the owner undertaking repairs, this would be recorded as income accruing to the household but the income from the rental on the house would be reduced by an exactly offsetting amount.)* and SNA 24.53: *When renovations are undertaken, these are treated as gross fixed capital formation but the same conventions apply concerning the recording of compensation of employees*. Note also that, putting the SNA to one side, it can be argued, on the basis of the HICP concepts and methods the imputed cost of freely given labour should not be included in the OOH as the OOHPI, like the HICP, is a monetary index based referenced to transactions.

Figure 3: Self-builder index based on inputs



First, one should take into account the following key points:

1. a self-builder is a producer for own account and with a non-market output;
2. production can be described in general terms as an activity in which a producer unit (in this case a self-builder) uses inputs to produce an output;
3. these inputs comprise the purchase of materials and services (intermediate consumption) and other elements such as labour;
4. from the self-builder's point of view, all their purchases are considered as inputs, therefore the self-builders index is a price index based on a weighted input prices approach. Of course, from the perspective of the self-builder, what for him is an input price corresponds to an output price of the supplier (e.g. a unit who sells the self-builder a given material or service);
5. in addition, as the self-builder is a household, generally he cannot deduct VAT on purchases of materials and services. In this case VAT on input acquisitions should be included as a real cost;
6. the output value of a self-builder is valued according to the construction costs index (with no profit margins or productivity effect);

The same principles apply in connection with the computation of a price index for prefabricated houses (i.e. $_{PFH}I$). The index should be based on the price of the prefabricated building plus the price of any construction works purchased by the self-builder, such as the laying of foundations and electricity and water services plus the cost of erecting the building. As with all self-builds, delivery costs and VAT should be included where applicable.

Self-builders who involve a building firm may include appropriate elements of input and output price indices ([63]). This will ultimately depend on the type of construction being targeted by the index. However, care should be taken to ensure that price series derived from output price series are based on actual prices paid by the self-builder ([64]).

([63]) Needless to say, from the self-builder's point of view, these prices are always considered input prices. Output prices are referred here as the prices charged by one (or more) input supplier to a self-builder.

([64]) Let us recall that the methodology for STS suggests three methods for the compilation of output prices: (a) actual prices; (b) model pricing based on a theoretical model project using tender price data from standard price lists; and (c) by means of the hedonic regression method (Eurostat, 2006b: 79). In light of the approach to OOH followed in this manual, preference should be given to option (a) above.

Estimates of equation (3.3) can be based on a probability sample of goods and of observation units taking into account the types of buildings constructed and materials used.

Lacking a suitable sampling frame, it may be necessary to use a purposive sample of representative goods, based on the advice of construction experts and referenced to a representative sample of self-builds.

A possible sample of representative goods for the index for self-built dwellings. Could include amongst other things the following categories ([65]):

- Earthwork:
  - excavation works
  - base frame for concrete
- Foundation:
  - base concrete, 12 cm
- Building Shell:
  - ground floor: brickwork
  - construction of roof
- Carpenter work:
  - construction of dormer
- Installation of sewage and water services:
  - Ground pipes for drinking water and connection to mains
  - Sewer pipes and connection to public sewage system or cesspit
- Electricity installation:
  - electricity, switchers, fuses
- Heating installation:
  - floor heating
- Painter:
  - painting of timber set
- Office work:
  - construction management.

Much of the work that an index compiler has to do regarding the development of an index for self-builders could also be used to help construct indices covering major improvements, renovations, reconstruction and enlargement of existing dwellings and indices relating to major repairs and maintenance.

3.8.4. ELEMENTARY PRICE INDEX FOR EXISTING DWELLINGS

In addition to newly built dwellings and self-builders, a household may also acquire an existing house that had not been occupied by the previous owner for his or her own use ([66]). These transactions contribute to the increase in the number of the housing units that are owner-occupied and should be covered in an OOH price index following the net acquisition approach ([67]).

([65]) Annex B offers a list of the elements that might be considered for an index of self-built dwellings (and also for major renovations).
([66]) An example of a transaction falling into this category would be the purchase by a former tenant of a flat from his landlord.
([67]) Conversely, all transactions of opposite direction should be regarded as a decrease in the number of own-occupied housing units. The net effect of all these transactions of opposite signs in the base period should be taken into account when deriving the weights for this index category. Weight derivation is going to be tackled in another section of this manual.

These purchases are represented by C3 in Table 3. Thus,

$$_{ED}I_0^t = {}_{C3}I_0^t \tag{3.4}$$

In Table 2, these acquisitions are covered by heading O1.1.2 (Existing dwellings new to the household sector). To reiterate, the exchanges of ownership of existing dwellings for own-occupancy between households, are not covered in an OOH price index following the net acquisition approach ([68]).

In some countries, the purchase of existing dwellings may be negligible and therefore excluded from the calculation of an OOH price index following a net acquisition approach.

An example of the acquisition of existing dwellings new to the sector would be purchases of properties previously rented out. A particularly challenging case arises when a tenant purchases a flat, say, from their landlord. The price is often discounted and where this is so might be treated as a discriminatory price reduction depending on the details of how the discounting is applied. Discriminatory price reductions should be excluded from the index calculation, in line with Regulation 2602/2000, Article 2(b) so as not to misrepresent price changes. Article 2(b) states that discounts should be 'available to all potential consumers with no special conditions attached'. The main challenge is to identify these separately from other transactions and to identify the factors relating to the offering of a discount, as details of the status of the seller and the pre-sale status of the property are rarely recorded in documents and no details of the particular discounting scheme will be available without further enquiry. This might be easier where the seller is a company or institution rather than a private individual or household. But as it can be notoriously difficult to record discriminatory discounts in house purchases this complication is often disregarded on grounds of practicality. It can also be argued that transactions relating to the sale and purchase of dwellings are a rather special case as in most instances the price is negotiated. As noted earlier, the discounts offered to 'Right to Buy' purchasers should not be treated as discriminatory discounts as they are available to all who enter into a 'Right to Buy' arrangement.

3.9. Price index for other services related to the purchase of a dwelling

3.9.1. SCOPE AND BASIC APPROACH

The acquisition of a dwelling normally results in the payment for other services related to the purchase of a dwelling, whether existing or new, for own use. Examples include commissions, service charges, fees and taxes ([69]).

In Table 2, these costs are categorised under heading O.1.1.3 'Other services related to the acquisition of dwellings'. The expenditure can be significant and should be explicitly covered in the OOHPI, unless the weight is below one part per hundred of the total OOH expenditure (which is unlikely).

The costs of **both buyers and sellers,** who belong to the Household institutional sector as owner-occupiers, should be included, as the costs borne all relate to the costs associated with home ownership. Most particularly, **the costs of services relating to sales between households should be included — the net concept does not apply to services related to intra-household transactions of existing dwellings.** Again, all such costs are associated with home ownership.

The costs associated with the process of buying and selling a home, sometimes paid by the buyer and sometimes paid by the seller, include: the payment for the services of property agents and lenders or brokers (an application fee, appraisal fee, etc.); fees for legal services (to assure that the seller is the legal owner of the property and that there are no outstanding claims or liens against the

([68]) They are, however, covered by the House Price Index, which is going to be treated in chapter 4 of this manual.
([69]) It is perhaps worthwhile to make a technical distinction between a fee and a tax. In principle, a fee is something that has a visible counterpart on account of the cost incurred by the purchaser. A counterpart could be, for instance, the issue of a certificate or a licence. Taxes do not require the existence of this counterpart component. However, one should bear in mind that the division line separating taxes from fees is not always clear-cut.

property plus the contract of sale), the costs of drawing up the contract of sale; stamp duty; Government recording and transfer fees; costs associated with a host of other services such as structural surveys, the testing of water quality and radon gas emissions. The costs of these services are not included in the purchasing price of the dwelling and are also not included elsewhere in the HICP. **Annex H** provides more detailed examples.

The above services are part of the full transaction costs of a dwelling, as per equation

$$TC_{i;t} = DP_{i;t} + Services_{i;t} \tag{3.5}$$

where,

$TC_{i;t}$ refers to the total transaction cost;

$DP_{i;t}$ refers to the price of the *ith* dwelling in period *t*; and

$Services_{i;t}$ refers to 'other services' associated to the purchase of the *ith* dwelling in period *t.*

When developing an index aimed at covering other services related to the purchase of a dwelling, price index compilers have first to understand the buying process that underlines the purchase of a dwelling and the various costs involved. This is extremely important as it is this process that determines the fees, taxes, commissions, etc. that should be covered by the index ([70]).

The buying process varies from country to country and it is therefore up to each NSI to identify the various steps taxes and other charges included in a typical process of purchasing a dwelling.

It should also be noted that the buying process for a purchase based on a mortgage can be very different from that of a cash sale and often involves the payment of additional fees. Similarly, with a direct sale between households compared with using an estate agent to market a house. While in some countries dwellings are essentially purchased through the assistance of real estate agent, in other countries the services of real estate agents are very rarely used and the pricing of real estate commissions may not be necessary because of the low expenditure weights attached to them.

It is up to each NSI to identify the buying processes, evaluate the most significant costs for inclusion in the 'other services' index.

([70]) For ease of exposition, the set of taxes, fees, commissions and other costs relevant to this OOH index will be hereafter denominated as 'taxes' in the sections dealing with other costs.

Table 4 gives an illustrative example of how relevant these expenditures can be for an OOHPI. It is based on the experience of one Member State.

Table 4: Expenditure in services related with the acquisition

	% fee	Euros
Mortgage arrangement fee	*0,2%*	*0.002 x*
Notary fee + VAT (20%)	*1,0%*	*0.012x*
Land registry	*0,5%*	*0.005x*
Legal fees (Lawyer or solicitor) + VAT (20%)	*1,5%*	*0.018x*
Real Estate Broker + VAT (20%)	*5%*	*0.060x*
Transfer tax or VAT	*7,0%*	*0.070x*
Stamp duty	*0,5%*	*0.005x*
Total expenditure with the purchase		*1.172x*
Weight for new dwellings' purchase		85.5%
Weight for other services related with the purchase		14.5%

When constructing the index for heading O.1.1.3, it is important to identify two basic categories of other services costs ([71]):

- Costs that are proportional to the transaction value of the dwelling;
- Costs that are fixed and independent of value of the transaction.

As the price behaviour of each of these categories is different, it may be advisable to use them as a stratification variable. The next few sections develop this approach in more detail.

3.9.2. TREATMENT OF COSTS PROPORTIONAL TO THE TRANSACTION VALUE

The compilation of an index dealing with taxes that are proportional to dwelling transaction values should be done in line with the existing HICP framework on the treatment of service charges proportional to transaction values ([72]). Where charges are a proportion of the transaction value, such as can be the case with stamp duty and the fees charged by an estate agent which are sometimes charged as a percentage of the purchase value or achieved price of a property, a transaction price is not directly observable. Such charges should be treated like any other charge proportional to the transaction value. They should be valued using representative units of transactions from the reference period, for example the fees for a representative sample of house sales. The change in the monetary values of the representative unit transactions, in this example the change in the purchase prices of the representative basket of house sales, should be estimated by the change in a price index which represents appropriately the unit transactions concerned i.e. the House Price Index (HPI). The HPI is used for taking into account house price inflation in the index.

Thus, following the HICP framework, it is possible to define an index representing the evolution of the costs associated with the payment of a particular tax *i* between the base period *0* and period *t* as:

$$_{PCosts}I^{t}_{i;0} = \frac{r_{i;t} \cdot e_{i;t}}{r_{i;0} \cdot e_{i;0}} \qquad (3.6)$$

where,

([71]) Complex tax schemes, involving a mix of the two basic categories of other services, are dealt with in more detail in the next sections of the manual.
([72]) Framework laid down in Commission Regulation (EC) No 1920/2001.

$_{CostsP}I^{t}_{i;0}$ is the index associated with tax *i* in period *t*, based on period *0*;

r^{i}_{0} is the percentage rate of the tax *i* applied in period 0;

r^{i}_{t} is the percentage rate of the tax *i* applied in period *t*;

$e_{i;0} = \sum p_{i;0} q_{i;0}$ is the total expenditure on the acquisition of dwellings in period *0* to which the tax *i* is associated with;

$e_{i;t} = \sum p_{i;t} q_{i;0}$ is the total expenditure on the acquisition of dwellings in period *0* at prices from period *t*, to which the tax *i* is associated with. {{{in the end what is important here for a compiler is that the ratio of $e_{i;t}$ and $e_{i;0}$ is the HPI, see next page.}}}

The numerator of equation (3.6) can be developed to include the evolution of total expenditure between period *0* and *t*.

$$r_{i;t} \,.\, e_{i;t} = \left(r_{i;t} \,.\, I^{t}_{i;0}\right).\frac{e_{i;t}}{I^{t}_{i;0}} \tag{3.7}$$

where,

$$I^{t}_{i;0} = \frac{e_{i;t}}{e_{i;0}}$$

which can be developed in the following manner

$$r_{i;t} \,.\, e_{i;t} = \left(r_{i;t} \,.\, I^{t}_{i;0}\right).e_{i;0} \tag{3.8}$$

Replacing the numerator of equation (3.6) by equation (3.8) and taking the summation over the *n* relevant costs proportional to transaction value, yields the desired Laspeyres-type index for other costs:

$$_{PCosts}I^{t}_{0} = \frac{\sum_{i=1}^{n}\left(r_{i;t} \,.\, I^{t}_{i;0}\right)e_{i;0}}{\sum_{i=1}^{n}\left(r_{i;0} \,.\, e_{i;0}\right)} \tag{3.9}$$

Equation (3.9) can be easily transformed into

$$_{PCosts}I^{t}_{0} = \sum_{n}\left[\left(\frac{r_{i;t}}{r_{i;0}}\right).I^{t}_{i;0} \,.\, w_{i}\right] \tag{3.10}$$

With the weight associated with tax *i* defined as

$$w_i = \frac{r_{i;0} \cdot e_{i;0}}{\sum_n \left(r_{i;0} \cdot e_{i;0} \right)} \tag{3.11}$$

It can be seen from equation (3.10) that the price index for other costs proportional to a dwelling transaction value is not merely a function of the tax rate. In fact, it is a product of two elements:

- $\frac{r_{i;t}}{r_{i;0}}$, the ratio between the tax rates available in period *t* and *0*; and
- $I_{i;0}^{t}$, an index that reflects the price evolution of the total expenditure of the dwellings between period *0* and *t*.

At this point, it is worthwhile spending some time defining the characteristics of an appropriate index for $I_{i;0}^{t}$. Two important requirements should be met:

- the index should cover the services and costs related to representative transactions of ***all*** types dwelling; and
- the index should be adjusted for quality changes in the dwelling transacted and compiled according to HICP rules.

It should be noted that the first requirement implies that both new and existing dwellings are taken into account. As mentioned earlier these are services associated with the transaction of a dwelling whenever a transaction is carried out and the inclusions of these services in an OOHPI is independent of the categorisation of the dwelling as existing ([73]) or new. Thus, both type of dwelling transactions need to be covered by the OOH other services index ([74]).

The House Price Index (HPI), which is described in more detail in chapter 6, fulfils these requirements. Thus, replacing $I_{i;0}^{t}$ by the HPI in equation (3.10) yields the final expression for the index for other services costs proportional to the transaction value of a dwelling.

$$_{PCosts}I_0^t = \sum_n \left[\left(\frac{r_{i;t}}{r_{i;0}} \right) \cdot \ _{HPI}I_{i;0}^{t} \cdot w_i \right] \tag{3.12}$$

Through equation (3.11), it is clear that the HPI, comprising of both new and *all* existing dwellings, is an important building block of the OOH price index system.

It should be noted that in some countries stamp duty does not apply to co-operative housing.

3.9.2.1. Example with two taxes where both are proportional to transaction values

In this situation we have two taxes, r_1 and r_2; both of them are proportional to the transaction values p_t and p_0. The *q's* represent the number of transactions.

([73]) Even if a dwelling is transacted between households, the payment of these costs represents another transaction that is carried out between the household and the non-household sector (such as the public sector).
([74]) Referring back to table 2, this means that both headings under the aggregate on existing dwellings would be included.

$$_{PCosts}I_0^t = \frac{r_{1;t}p_{1;t}q_{1;0}+r_{2;t}p_{2;t}q_{2;0}}{r_{1;0}p_{1;0}q_{1;0}+r_{2;0}p_{2;0}q_{2;0}} \quad (3.13)$$

Developing the right-hand side of equation (3.13) we have, successively

$$\frac{r_{1;t}.p_{1;t}.q_{1;0}}{r_{1;0}.p_{1;0}.q_{1;0}+r_{2;0}.p_{2;0}.q_{2;0}}+\frac{r_{2;t}.p_{2;t}.q_{2;0}}{r_{1;0}.p_{1;0}.q_{1;0}+r_{2;0}.p_{2;0}.q_{2;0}}$$

and

$$\underbrace{\frac{r_{1;t}.p_{1;t}.q_{1;0}}{r_{1;0}.p_{1;0}.q_{1;0}}.\left[\frac{r_{1;0}.p_{1;0}.q_{1;0}}{r_{1;0}.p_{1;0}.q_{1;0}+r_{2;0}.p_{2;0}.q_{2;0}}\right]}_{\text{Expenditure weight in the base period related to the } \textbf{\textit{first}} \textbf{ proportional tax}}+\underbrace{\frac{r_{2;t}.p_{2;t}.q_{2;0}}{r_{2;0}.p_{2;0}.q_{2;0}}.\left[\frac{r_{2;0}.p_{2;0}.q_{2;0}}{r_{1;0}.p_{1;0}.q_{1;0}+r_{2;0}.p_{2;0}.q_{2;0}}\right]}_{\text{Expenditure weight in the base period related to the } \textbf{\textit{second}} \textbf{ proportional tax}}$$

The last formula can be written in parallel with equation (3.11) above. If we proceed in this manner, we will arrive at the following formulation.

$$\frac{r_{1;t}.}{r_{1;0}}._{HPI}I_{1;0}^t.w_{1;0}+\frac{r_{2;t}}{r_{2;0}.}._{HPI}I_{2;0}^t.w_{2;0} \quad (3.14)$$

Thus, the weight structure of the different taxes in base period (i.e. the *w*) forms the essential building blocks used to calculate a weighted average of the change in the rates of the different taxes since the base period. This is essentially no different from the price relatives used in the HICP.

3.9.3. TREATMENT OF FIXED TAXES

Fixed taxes should be treated in the same way as the price of any other good or service in the HICP, HPI or OOHPI.

Defining $f_{i;t}$ as the fixed tax *i* charged in period *t*, it is possible to define the index covering these taxes as

$$_{FCosts}I_0^t = \sum\nolimits_m \left[\left(\frac{f_{i;t}}{f_{i;0}}\right).w_i\right] \quad (3.15)$$

Summation is done over the *m* relevant fixed taxes. The weight is here defined as

$$w_i = \frac{f_{i;0} \cdot q_{i;0}}{\sum_m (f_{i;0} \cdot q_{i;0})}$$

Where w_i refers to the expenditure weight associated with the *ith* fixed tax.

3.9.4. DEALING WITH COMPLEX TAX SCHEMES

Sections 3.9.2 and 3.9.3 show how simple fixed and proportional tax structures can be treated when compiling an index for other services.

The treatment of more complex tax structures that combine fixed and proportional components will vary from case to case but can be tackled following the same overall framework that was used to deal with the simple fixed and proportional tax cases.

This section highlights the case where for a particular tax there is a combination of a fixed and a variable component. It is not unusual to come across this in practice.

Following the previous framework an index covering *n* proportional and *n* fixed taxes would be,

$$_{PCosts+FCosts}I_0^t = \sum_{i=1}^{n} \left[\left(\frac{r_{i;t}}{r_{i;0}} . I_{i;0}^t . w_{ri;0} \right) + \left(\frac{f_{i;t}}{f_{i;0}} . w_{Fi;0} \right) \right] \quad (3.16)([75])$$

With $w_{ri;0}$ and $w_{Fi;0}$ identified as weights for the proportional and fixed parts of the tax, defined respectively as:

$$w_{ri;0} = \frac{r_{i;0} e_{i;0}}{\sum_{i=1}^{n} r_{i;0} e_{i;0} + f_{i;0} q_{i;0}}$$

$$w_{Fi;0} = \frac{f_{i;0} q_{i;0}}{\sum_{i=1}^{n} r_{i;0} e_{i;0} + f_{i;0} q_{i;0}}$$

3.9.4.1. Example with two taxes where one is a proportional rate and the other a fixed lump sum

As in the previous section, we start by expressing the tax scheme structure. This time tax 1 is a proportional rate and tax 2 is a fixed amount of money. Thus:

$$_{PCosts+F}I_0^t = \frac{r_{1;t} . p_{1;t} . q_{1;0} + f_{2;t} . q_{2;0}}{r_{1;0} . p_{1;0} . q_{1;0} + f_{2;0} . q_{2;0}} \quad (3.17)$$

Where $f_{2;t}$ and $f_{2;0}$ are the fixed amounts paid in periods *t* and *0*, respectively.

([75]) Examples for calculations of indices according to formulas (3.10), (3.15) and (3.16) are given in annex C.

Developing the right-hand side of the equation we have:

$$\frac{r_{1;t}.p_{1;t}.q_{1;0}}{r_{1;0}.p_{1;0}.q_{1;0}+f_{2;0}.q_{2;0}}+\frac{f_{2;t}.q_{2;0}}{r_{1;0}.p_{1;0}.q_{1;0}+f_{2;0}.q_{2;0}}$$

Which is equal to

$$\frac{r_{1;t}.p_{1;t}.q_{1;0}}{r_{1;0}.p_{1;0}.q_{1;0}}.\underbrace{\left[\frac{r_{1;0}.p_{1;0}.q_{1;0}}{r_{1;0}.p_{1;0}.q_{1;0}+f_{2;0}.q_{2;0}}\right]}_{\text{Expenditure weight in the base period related to the } \textbf{proportional} \text{ part of the tax}}+\frac{f_{2;t}.q_{2;0}}{f_{2;0}.q_{2;0}}.\underbrace{\left[\frac{f_{2;0}.q_{2;0}}{r_{1;0}.p_{1;0}.q_{1;0}+f_{2;0}.q_{2;0}}\right]}_{\text{Expenditure weight in the base period related to the } \textbf{fixed} \text{ part of the tax}}$$

The above expression can be made more readable by introducing the HPI:

$$\frac{r_{1;t}}{r_{1;0}}.{}_{HPI}I^{t}_{1;0}\cdot w_{1;0}+\frac{f_{2;t}\cdot q_{2;0}}{f_{2;0}\cdot q_{2;0}}\cdot w_{2;0} \qquad (3.18)$$

3.9.5. AGGREGATION OF THE INDEX FOR OTHER SERVICES

In practice, the construction of the OOH price index for other services will depend on the number and on the complexity of the relevant taxes, which may depend on the type of dwelling, the value of the transaction and the socio-economic characteristics of the buyer or seller. Compilers should refer to the previous section as a working basis when addressing the specificities of other services components found relevant in their countries.

The index for other services related to the purchase of a dwelling is defined as the weighted sum of all relevant services cost components associated with the purchase of a dwelling. If these fall into the three already mentioned categories, then it can be defined as:

$${}_{Costs}I^{t}_{0}=\left[{}_{PCosts}w\cdot{}_{PCosts}I^{t}_{o}\right]+\left[{}_{FCosts}w\cdot{}_{FCosts}I^{t}_{o}\right]+\left[{}_{Complex}w\cdot{}_{Complex}I^{t}_{o}\right] \qquad (3.19)$$

In general, costs proportional to the transaction value usually outweigh fixed costs. In this context, the index for other services related to the purchase of a dwelling is expected to be essentially driven by proportional costs.

A simple exemplification of the construction of this index is shown in section 3.9.6.1.

3.9.6. OTHER SERVICES NOT ELSEWHERE COVERED (N.E.C).

This category, already existent in the HICP, has a very broad scope that has included the payment of services provided by real estate and housing agents, but up until now only in connection with rental transactions (which are excluded from OOHPI). Although covering more services than the ones

related to the purchase of a dwelling ([76]), its scope, if not well defined, can confusingly overlap the scope of other services related to the purchase of the dwelling.

Although a final decision on each particular expenditure should be set on a case-by-case basis, the division line between the two index headings can be established in accordance with the identification of the type of expenditure being analysed.

Thus, if a certain expenditure item is perceived as being a service that is part of the acquisition process of a dwelling, then it should be included under O.1.1.3 'Other services related to the acquisition of dwellings'. On the other hand, if it is considered a cost that is incurred by someone that is already an owner of a dwelling, then it should be classified under O.1.2.3 'Other services related to ownership of dwellings' Examples of services (not elsewhere covered) specifically identified with the ownership of a dwelling as opposed to acquisition might include: Energy Efficiency Certificates and Gas Safety Certificates if needed by owner-occupiers regardless of whether the dwelling is being sold. These should be investigated on an individual country by country basis and should exclude on-going costs common to both owner-occupiers and renters that are already included in the HICP (see section 3.2.2).

It should be noted that following HICP standards, annual property taxes which are calculated based on real or estimated dwelling capital or income value, only should be included in an OOH price index if they are directly related to the provision of services ([77]) and are only incurred by owner-occupiers i.e. they are incurred specifically due to home ownership. Such taxes are included under OOHPI code O.1.2.3 (see also footnote 42). Conversely, if they are not directly related to the provision of services i.e. they are a form of wealth tax with the money going direct to government with no direct link to services provided, they are not consumption related, are considered a form of taxation, and should be excluded from the OOH price index and also from the HICP. If the property taxes are directly related to the provision of services and are paid as the result of occupying rather than owning a dwelling (and therefore are not unique to owner-occupiers) they fall under the COICOP heading 0.4.4.4.9 (other services related to dwellings), unless it is possible to apportion them to the various sub-headings of COICOP 04.4 according to how the taxes are spent on the services provided: 04.4.1 – Water supply; 04.4.2 – Refuse collection; 04.4.3 – Sewage collection; 04.4.4 – Other services relating to the dwelling not elsewhere covered (including road cleaning). Nonetheless, in practice it might be difficult to distinguish the different expenditures in which case the COICOP heading 0.4.4.4.9 should be used.

Annex H lists some examples of other services (not elsewhere covered) related to the acquisition of a dwelling.

The construction of the index covering the provision of these services follows the same procedures set out in the previous sections.

3.9.6.1. Example of calculation of costs relating to other services associated with the purchase of a dwelling

Assume that the analysis of the buying process in a certain country has provided the following information on relevant taxes/fees related to the purchase of a dwelling:

- Land registry fee of EUR 525;
- Stamp duty tax of 2%;
- Property transfer tax of 3%.

The information is related to year base. At the beginning of year two, the land registry fee increased to EUR 530. This tax registered another increase to EUR 540 in the last three months of year two. In the second month of year two the property transfer tax increased to 3.5%. The stamp duty tax remained the same throughout the considered period.

([76]) HICP category 12.7.0 covers, for instance. Fees for employment agencies, fees for the issue of birth, marriage and death certificates.
([77]) Most commonly, services provided by local government e.g. for maintenance of roads, street lighting and other common infrastructure plus the provision of schools, social services and housing, etc.

Moreover, the HPI registered the following behavior:

Year 1		Year 2	
month	HPI	month	HPI
1	100	1	102.35
2	100.5	2	102.5
3	101.2	3	102.67
4	101.1	4	102.9
5	101.15	5	103.01
6	101.3	6	102.6
7	100.9	7	102.56
8	101.3	8	103.02
9	102	9	103.4
10	101.75	10	103.46
11	102.2	11	103.8
12	102.44	12	103.93

For simplicity, we keep constant the associated weighting structure.

Weights		
Fixed Taxes	Land registry	9.5%
Proportional taxes	Stamp duty tax	36.2%
	Property transfer tax	54.3%

The indices for costs proportional to the transaction value and for fixed taxes can be obtained through the application of equations (3.12) and (3.13), respectively. The overall index for the total of 'other costs' can be obtained through equation (3.19). The following exemplifies the derivation of these indices for month 3 of the second year (note: base 100 = month 1 of year 1). Thus,

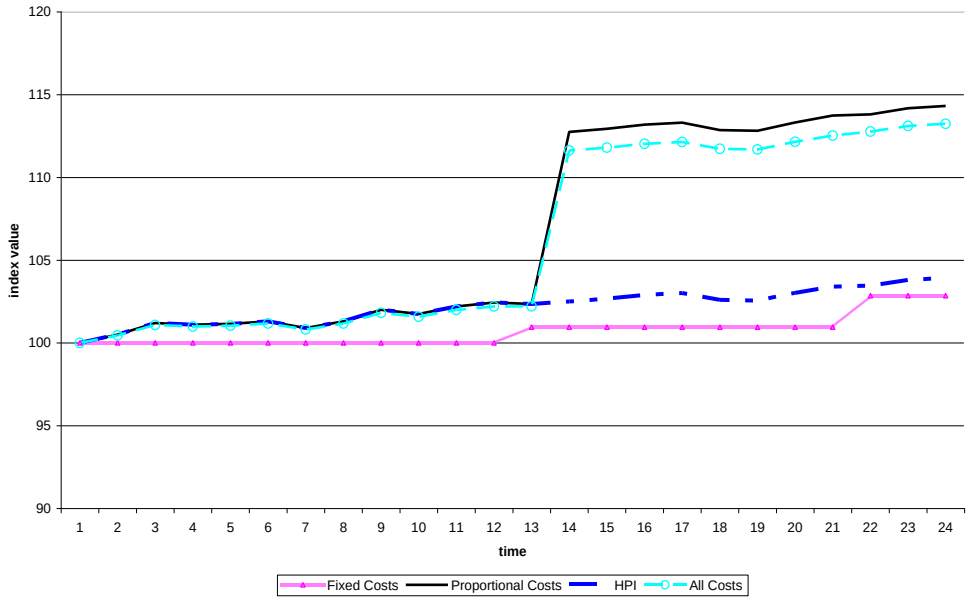
(1) $${}_{PCosts}I_{Y1;M1}^{Y2;M3} =$$

$$\left[\left(\frac{2}{2}\cdot\frac{36.2}{36.2+54.3}\right)+\left(\frac{3.5}{3}\cdot\frac{54.3}{36.2+54.3}\right)\right].102.67=112.94$$

(2) $${}_{FCosts}I_{Y1;M1}^{Y2;M3}=\frac{530}{525}.100=100.95$$

(3) $${}_{COSTS}I_{Y1;M1}^{Y2;M3}=\frac{36.2+54.3}{100}.112.94+\frac{9.5}{100}.100.95=111.80$$

Figure 4: The HPI, fixed, proportional and 'other costs' index



The above graph depicts the HPI, the indices for fixed and proportional costs and the index for 'other costs'. The 'All costs' index and the index for proportional costs follow the HPI in the first year due to the fact that the property transfer tax only changes in the second month of year two. The 'jump' that is visible in the 14th month (the second month of year 2) is caused by the increase in the property transfer tax from 3% to 3.5%. The impact of the fixed costs is almost negligible due to its very small weight.

3.10. Price index for major repairs and maintenance

3.10.1. DEFINITION AND DIFFERENCE BETWEEN ROUTINE MINOR REPAIRS AND MAJOR REPAIRS AND MAJOR RENOVATIONS

As mentioned in section 3.2.2, the maintenance and repair of dwellings, whether minor or major, is distinguished by two main characteristics. First, they represent activities that have to be taken regularly in order to maintain the dwelling in good working order. Second, they do not change the dwelling's underlying standard of accommodation, capacity or expected service life.

Examples of expenditures on such activities include, amongst other things, the acquisition of the following materials and services:

- *Materials:* paints, wallpaper, plaster, tiles and small plumbing items;
- *Services*: fees to plumbers, electricians, carpenters, glaziers, decorators, *etc*.

Major renovations, improvements, reconstruction and enlargement of existing dwellings should not be confused with maintenance and repair. Unlike the latter these expenditures will improve the underlying standard of the dwelling or prolong its expected life and for this reason should not be treated as routine expenditures ([78]). **Instead, they should be regarded as expenditures on the acquisition of a completely new dwelling,** which, for all purposes, was 'purchased' through its

([78]) In national accounts, they are treated as gross-fixed capital formation.

extension, conversion or reconstruction. Additional explanation of the difference between categories 1.1.1.2 and 1.2.1 (major renovations versus major repairs) is given in Sections 3.2.1 and 3.2.2.

The distinction between repairs and maintenance, on the one hand, and conversions, extensions or reconstructions, on the other, may not be crystal-clear in some cases and will need to be done by each NSI according to what the market perceives as a new addition to the stock of dwellings.

It should be noted that the HICP already takes into account minor maintenance and repair of the dwelling (under the COICOP/HICP 04.3.1 and 04.3.2 headings). Care should be taken to ensure that there is no double counting e.g. in some countries major repairs and maintenance are included in the national CPI based on the prices of a sample of construction goods and services.

Major repairs and maintenance are covered by heading O.1.2.1 of the nomenclature presented in Table 2 ([79]). As noted earlier, for owner-occupiers living in multi-occupied buildings (blocks of flats), major repairs should include not only the expenses for repairing the flat itself, but also the expenses for repairs of the common parts of the building where not covered by the usual annual or monthly service charges.

Home maintenance is the process of maintaining the dwelling. For example, in order to maintain the dwelling there is need to replace some roof tiles if they become worn or damaged or to paint the interior and exterior to protect the dwelling from the elements. Home repairs are also part of the home maintenance process whether simple 'do-it-yourself' repairs or repairs requiring the services of a professional contractor. Specialised public and private entities (some of them linked to the standards of practice for inspecting the conditions of residential properties) and other experts have developed studies on the life expectancy of housing components:

- National Association of Home Builders/ Bank of America Home Equity
  Study of Life Expectancy of Home Components
  http://www.nahb.org/fileUpload_details.aspx?contentID=99359
- Just Shelter, Realty Services, Inc Brokerage.
  Life Expectancies of Various Components of a Residential Structure
  http://www.justshelter.com/realestate/renovating/lifecycle.htm
- CSIRO Building Construction and Engineering
  McFallan & Tucker, Probability Of A Dwelling Surviving Or Failing
  http://www.irbdirekt.de/daten/iconda/CIB10064.pdf
- Government Office for the East Midlands
  Decent And Safe Homes
  http://www.eastmidlandsdash.org.uk/docs/DASHLLDecentHomesStandard.pdf

Some indicative component lifetimes are illustrated in Table 5.

([79]) Major tools and equipment used for maintenance and repair work would have to be covered, at least in principle, by the OOH price index, in addition to the inclusion of major repairs and maintenance. Under the national accounts framework, expenditure on these tools is considered intermediate consumption. One possible solution would be to include them in the current COICOP/HICP 05.5.1/2 heading ('Tools and equipment for house and garden'). Examples of such tools include electric drills, hedge cutters and chain saws.

Table 5: Indicative component lifetimes used in the disrepair criterion

Building components (key components marked*)	Houses and bungalows	All flats in blocks of below 6 storeys	All flats in blocks of 6 or more storeys
Wall structure*	80	80	80
Lintels*	60	60	60
Brickwork (spalling)*	30	30	30
Wall finish*	60	60	30
Roof structure*	50	30	30
Roof finish*	50	30	30
Chimney*	50	50	N/A
Windows*	40	30	30
External doors*	40	30	30
Kitchen	30	30	30
Bathrooms	40	40	40
Heating - central heating boiler*	15	15	15
Heating - central heating distribution system	40	40	40
Heating other*	30	30	30
Electrical systems*	30	30	30

Source: Department for Social Development, Northern Ireland

http://www.dsdni.gov.uk/print/index/hsdiv-housing/ha_guide/haghm-contents/haghm-housing-maintenance-contents/haghm-housing-maintenance-decent-homes-standard/haghm-housing-maintenance-reasonable-state-of-repair.htm

In line with what is already in use in HICP for minor maintenance and repairs, a further breakdown into 'materials' and 'services' could be applied as well for major repairs. However, in some cases this separation may be almost impossible to do because the service provided already includes, in its final price, the cost of materials. In situations like these, where a distinction between materials and services can be seen as almost artificial in light of the specific characteristics of the market, the price index compiler may find it advisable to follow the cost of providing a number of typical major repairs and maintenance works and avoid, for practical reasons, making a distinction between materials and services.

Expenditure on repairs and maintenance may be significant in a net acquisition context. This can be shown by looking at the illustrative example in Table 6, which gives for two countries the expenditure shares for the OOH component according to the net acquisition approach.

Table 6: Expenditure shares for house ownership components as a percentage of the total expenditure in a CPI (in parenthesis the shares in total OOH expenditure)

CPI	House Purchase	Repairs and maintenance	Property Rates and charges
Australia (*)	7.9% (69.9%)	2.2% (19.5%)	1.2% (10.6%)
New Zealand (+)	4.7% (50.5%)	2.2% (23.7%)	2.4% (25.8%)

(*) 6430.0 - Consumer Price Index: 15th Series Weighting Pattern (Reissue), Sep 2005, available at www.abs.gov.au

(+) Consumers Price Index Review September 2006 (revised), available at www.stats.govt.nz

As can be seen, expenditure spent on maintenance and repairs can be relatively large in relation to total OOH expenditure. Moreover, its importance relative to final monetary household expenditure is

also relevant, reaching, in both countries, to about 2.2% of the total (past the HICP threshold for explicit inclusion). That said, it should be noted that it is difficult to make generalisations due to the significant differences in the housing markets between and across countries.

3.10.2. SEPARATION BETWEEN MAJOR AND MINOR REPAIRS

Although well established in theory, the practical delineation between major and minor repairs can be problematic. Current COICOP distinguishes between major and minor repairs in the following way: *Minor repairs are activities, such as interior decoration and repairs to fittings, which are commonly carried out by both tenants and owners, whereas major repairs are those which would not normally be carried out in rented properties by the tenant (and are carried out by owners only). Examples of the latter repairs include re-plastering walls and repairing roofs.*

The distinction between the two types of expenditure is based on what is perceived as maintenance and repairs typically carried out by owners only. In this light, background on the rental market and the identification of the typical maintenance and repairs works that are carried out by landlords is useful, at the same time noting that this is likely to vary between countries. In some countries this separation may be regulated by legislation, something which can assist price index compilers in developing the index for major repairs and maintenance.

Using a monetary threshold could help to make the distinction between minor and major repairs. It has been argued that this solution would facilitate greater harmonisation but it suffers from the fact that the expenditure related to the same kind of repair can vary across countries. Each Member State will need to consider the most appropriate practical methodology to follow, taking into account local circumstances including perceptions of what are minor and what are major repairs with reference to the rental market.

Some illustrative examples of what could be considered as major repair and maintenance works, depending on country circumstances, include:

- external painting of a house;
- replacement of a central-heating system;

improved insulation, with the installation of, say, double glazed windows (but if the insulation works are applied to the entire building i.e. involve the walls, the roof and the windrows this could qualify as renovations and hence be included in O.1.1.1.2);

- updating of the electrical wiring;
- the installation of a new kitchen;
- the total or partial replacement of roofs, chimneys, drains and gutters.

Because the intention when constructing the HICP is to follow as closely as possible concepts that are consistent with the SNA/ESA, countries should also check what National Accounts are including in repairs and maintenance and what goes to renovations. It has to be accepted that some cases may not be clear cut as in the above case involving insulation works.

3.11. Extension of the price index for insurance

As mentioned in section 3.2.2., service charges paid by owner occupiers for the kinds of insurance for the dwelling which are typically also taken out by landlords for rented property, should be covered in an OOH price index following a net acquisition approach.

This type of insurance will typically cover:

- the dwelling structure and, in some cases, the walls, fences, hedges, gates, footpaths, etc.;
- fixtures and fittings of the dwelling such as fitted kitchen units and fitted wardrobes and internal decoration;
- outbuildings such as garages and sheds;

The insurance will typically provide protection of all the above elements against fire, storm and flood, theft and vandalism.

It should be noted that 'insurance connected with the dwelling' relates to building insurance and does not include 'contents insurance' which is treated separately and is already covered by the HICP ([80]). The latter provides cover for fire, theft and damage of the contents of the house, whilst building insurance covers the building structure and immovable elements.

Although building insurance is presently excluded from the scope of the HICP ([81]), its treatment should be in accordance with the existing rules and regulations on the treatment of contents insurance. According to Table 2, building insurance ($_{Ins}I_{0;t}$) would be included under heading O.1.2.2 of the proposed classification system.

As already mentioned in section 3.2.2, the service charge for insurance covering the re-payment of a mortgage where death or incapability of the borrower occurs is also in the scope of the OOHPI.

3.12. Derivation of the owner-occupied housing weights

3.12.1. BASIC APPROACH: NATIONAL ACCOUNTS

When deriving OOHPI weights the logical starting point is the mapping of OOHPI headings in the existing COICOP/HICP nomenclature with the additional headings referred to in section 3.2.2 in Table 2. According to the classification in Table 2, depending on the availability of weights and the ability to compute the relevant price indices, compilers may breakdown the cost of major repairs (04.3.3) into: materials for the maintenance and repair of the dwelling (04.3.3.1) and services for the repair and maintenance of the dwelling (04.3.3.2) with the purpose of compiling two sub-indices to be weighted together to produce an index for 04.3.3. Similarly weights may be computed from bottom to top, depending on data sources, even if separate indices are not compiled.

Table 7 presents the nomenclature in Table 2 mapped to a hypothetical extended COICOP/HICP classification that would include OOH.

From this table it cans be seen that the integration of OOH would require the construction of three entirely new indices:

- Acquisitions of dwellings ($_{Ac}I$ – equation (3.1));
- Other costs related to acquisition ($_{Costs}I$ – equation (3.19)); and
- Major repairs and maintenance (covered in section 3.10).

In addition the following item indices, already included in the HICP, would increase in scope:

- Insurance connected with the dwelling (i.e. 'building insurance', covered in section 3.11);
- Financial services n.e.c. (see footnote 82);
- Other services n.e.c. (covered in section 3.9.6).

Thus, at the present level of detail, whilst additional expenditure would have to be identified in line with the broadening in scope of the index — at least for *insurance connected with the dwelling* — no extra expenditure headings are needed under insurance and other services unless required for elementary aggregate indices.

Several data sources can be used for estimating the new weights. The best method depends on the availability and quality of the available sources of expenditure information. The use of National

([80]) COICOP/HICP 12.5.2. Commission Regulation (EC) No 1617/1999.
([81]) Mainly on the grounds that it is intermediate consumption used in the production of housing services and not a part of Household Final Monetary Consumption Expenditure (HFMCE).
([82]) An example of an item falling into this index category would be, for instance, a fee charged by a bank which is associated with the financing process of a house purchase. However, financial intermediation services indirectly measured – FISIM – COICOP 12.6.1, should not be included.

Accounts data is usually the preferred primary source of information because it is exhaustive, internally consistent and comparable across Member States.

Table 7: OOH in a possible extension/adaptation of the COICOP/HICP nomenclature

04. Housing, water, electricity, gas and other fuels
04.1. Actual rentals for housing
04.2. Acquisitions of dwellings
04.2.1. New dwellings
04.2.1.1. Purchase of new dwellings
04.2.1.2. Self-build dwellings and major renovations
04.2.1.2.1 Self-build dwellings
04.2.1.2.2 Major renovations
04.2.2. Existing dwellings new to the household sector
04.3. Costs of ownership of dwellings
04.3.1. Materials for the maintenance and repair of the dwelling
04.3.2. Services for the maintenance and repair of the dwelling
04.3.3. Major repairs and maintenance (*)
04.3.3.1 Materials for major repairs and maintenance
04.3.3.2 Services for major repairs and maintenance
04.4. Water supply and miscellaneous services relating to the dwelling
04.4.1. Water supply
04.4.2. Refuse collection
04.4.3. Sewerage collection
04.4.4. Other services relating to the dwelling n.e.c.
04.5. Electricity, gas and other fuels
04.5.1. Electricity
04.5.2. Gas
04.5.3. Liquid fuels
04.5.4. Solid fuels
04.5.5. Heat energy
12.5. Insurance
12.5.2. Insurance connected with the dwelling
12.6. Financial services n.e.c.
12.6.2. Other financial services n.e.c.
12.6.2.1. Financial services related to the acquisition of a dwelling
12.7. Other services n.e.c.
12.7.1. Other services related to the ownership of dwellings
12.7.2. Other services related to the acquisition of dwellings
12.7.1.1. Taxes
12.7.1.2. Professional charges or commissions

(*) see note in table 2.

The remainder of this section explores the use of national accounts data as the primary source for the derivation of weights, complemented with information from other statistical sources where desirable and feasible.

Expenditure weights covering *new dwellings* (NA) (04.2.1) and Major repairs and maintenance (MR) (04.3.3) should be based on item P.511 of the Gross Capital Formation account (i.e. acquisitions less disposals of tangible fixed assets). In this item it is possible to get Household Expenditure on Residential Fixed Capital Formation (ERFCF).

A workable solution to estimating the weight of the *new dwellings* and *major repairs* and maintenance aggregates would be to reflect in HICP weight for actual rentals the relationship between the expenditure on actual rentals and ERFCF. Expression (3.20) shows this ([83]):

([83]) It should be noted that in principle, according to SNA 6.228, major repairs should not be part of ERFCF, but should be considered as intermediate consumption (see also footnote 33). Nonetheless, the situation in each country should be clarified with the national accounts.

$$ {}_{(NA+MR)}w = \frac{ERFCF}{EXPR} \cdot {}_{Rents}w \qquad (3.20) $$

where:

EXPR is the national accounts estimate for the expenditure on actual rentals for housing;

${}_{Rents}w$ is the HICP weight for actual rentals (expressed in ‰).

In order to minimise volatility problems associated with the ERFCF and EXPR figures, an average of up to three years of national accounts aggregates may needed to estimate the combined weight $(NA+MR)^w$ although this will contribute to the aging of the weights.

$(NA+MR)^w$ should be divided into two components: one reflecting the expenditure on the purchase of dwellings and the other on major repairs and maintenance. National accounts should again be used as the source for this partitioning.

Additional information will also be needed to separate the weight for new dwellings into newly built dwellings and self-builds. Price index compilers should seek information in their national accounts systems regarding these expenditures.

It is, of course, an estimate of the expenditure on owner-occupied residential dwellings that is needed – not total expenditure on all residential property, which will include expenditure on residential dwellings that are part of the rental market. Clearly, the compilation of OOH weights should be estimated net of this last expenditure. To do this equation (3.20) becomes:

$$ {}_{(NA+MR)}w = \frac{ERFCF.(1-\alpha)}{EXPR} \cdot {}_{Rents}w \qquad (3.21) $$

where:

α = proportion of expenditure on residential dwellings devoted to the rental market (buy to let) ([84])

Estimates of the expenditure weights relating to other costs and other OOH item groups can also be produced based on national accounts inputs, essentially following the same approach as shown in equations (3.20) and (3.21).

3.12.2. ALTERNATIVE SOURCES OF EXPENDITURE INFORMATION TO NATIONAL ACCOUNTS

If no reliable, up-to-date or sufficiently detailed national accounts data is available, alternative data sources will have to be exploited, possibly in conjunction with whatever national accounts data is available, to provide estimates of OOHPI weights.

One possible approach would be to estimate relevant expenditure weights from general housing market statistics. For instance, where no information is obtainable separately on detached old dwellings and detached new dwellings except in terms of total number of transactions, the weight for the acquisition of detached new dwellings could be approximated using the following equation:

([84]) $0<\alpha<1$. The dimension of α would naturally vary from country to country and will be dependent on existing relationships between alternative uses of dwellings and the attractiveness of the housing rental market relative to other markets in terms of anticipated returns. Official building statistics may provide some information on α. If a clear distinction cannot be made between owner-occupier purchases and buy-to-let purchases in the source data, and if national accounts cannot provide a better estimate, it is reasonable to use census information on the tenure of the stock of dwellings to estimate the proportion of buy-to-let. If the rented (buy-to-let) proportion varies significantly with the type of dwelling (family houses vs. block of flats), α can be estimated as a weighted average of the proportions for each type of dwelling.

$$_{NA}w = [n(1-\beta)].[price.(1-\delta)].area.\theta \quad (3.22)$$

where,

n = total number of new dwelling transactions carried out within the relevant period;

β = estimated proportion of transactions carried out by the business sector;

Price = overall price per square meter of all market transactions;

δ = estimated proportion of the price of the land in total market price;

area = average floor area;

θ = the price of new dwelling flats divided by the price of second-hand dwelling flats ([85]).

Equation (3.22) aims at obtaining net acquisition weights, the parameters β and δ attempt to eliminate transactions which are irrelevant to the household sector and exclude the price of land ([86]).

The accuracy of the estimates obtained through equation (3.22) depends on the existence of relevant statistics on the housing market (e.g. price per square meter, number of transacted dwellings, etc.) and on the quality of the parameters/assumptions made (i.e., β, δ and θ). For instance, the quality of the estimates provided by equation (3.22), would be seriously undermined if the coefficients are affected by extreme values and/or δ is found to be completely unrealistic.

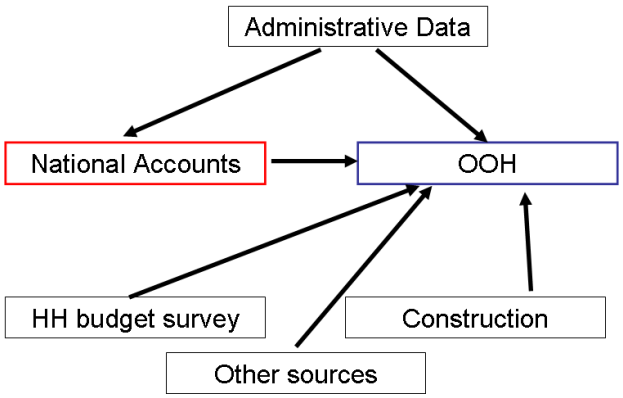
In the absence of relevant national accounts data, this approach can be of worth to OOHPI compilers and, realistically, may be the only choice available to them ([87]).

The same approach could also be used to estimate other OOH expenditure groups. Sources of information would include, for instance, official building statistics (such as information of building permits), special surveys on construction sector economic activity and information taken from national supervisory authorities (for insurance figures).

Each NSI needs to devise the best approach to OOHPI weight derivation taking into account the data sources at hand and their inherent quality ([88]). Figure 5 summarises possible data sources. A more detailed illustration of possible sources for the weights is presented in Annex D.

([85]) The assumption being made here is that the new versus old flats ratio is the same (or approximately the same) as the one that could be found for detached houses.
([86]) This is not needed when national accounts data is being used as, in principle, the data found under P.511 has already been estimated net of land prices.
([87]) Weight estimates using this approach could also be of worth in validating estimates based on national accounts data.
([88]) Data source weights are dealt with later in section 5.1.4 of this manual.

Figure 5: Data for weights



3.12.3. CHECKING THE IMPACT OF OWNER-OCCUPIED HOUSING IN THE WEIGHTS OF AN EXTENDED HICP

Clearly the inclusion of the OOH component in the HICP requires a re-calibration of the weights of all COICOP/HICP item groups so that they sum to 1000. This is achieved by dividing all item group weights by a correction factor, calculated in the following manner:

$$CF = \frac{1000 + {}_{OOH}w}{1000} \tag{3.23}$$

In equation (3.21), ${}_{OOH}w$ includes the weights of all relevant new OOH components in the HICP. The final item group weight is found by dividing the existing HICP weight by cf.

$${}_{HICP/OOH}w = \frac{{}_{HICP}w}{cf} \tag{3.24}$$

3.13. Aggregating the indices

After OOHPI weights have been estimated, a weighted aggregation of the OOH component indices, presented in Sections 3.8 to 3.11, into one single index for OOH costs following the net acquisition approach, is calculated in the usual way as follows:

$${}_{OOH}I_0^t = \left({}_{Ac}w \cdot {}_{Ac}I_0^t\right) + \left({}_{Costs}w \cdot {}_{Costs}I_0^t\right) + \left({}_{MR}w \cdot {}_{MR}I_0^t\right) + \left({}_{Ins}w \cdot {}_{Ins}I_{0;t}\right) \tag{3.25}$$

${}_{Ac}I_0^t$ defined by equation (3.1); and

${}_{COSTS}I_0^t$, defined by equation (3.19).

The number of OOH component indices will vary from country to country and will depend on the individual relevance of each of them in the OOHPI of the country concerned ([89]). Other price components that might enter in the compilation of OOHPI include major tools and equipment used for maintenance and repairs works, other services and financial services (see Table 7). The compilation of an extended HICP including the OOH component would be straightforward, the weights included in the construction of this index being those described by the previous sections and, in particular, by equation (3.22).

3.14. **Targeted index**

Table 8 gives the set of characteristics that index compilers should see as their ideal target or first-best solutions when developing net acquisition OOH price indices. Lack of appropriate data sources can, of course, limit the choices available to price index compilers and oblige them to adopt second-best solutions. Chapter 5 addresses this issue.

Table 8: Summary of desired characteristics of OOHPI

	Desired target	Observations and remarks
Definition and aim of the index	Provide a measure of price inflation for the household sector as a whole.	Index chained annually with December or the fourth quarter as the link period (see 'base period' below).
Geographical coverage	All country	-
Weight concept	Value of transactions	Index weights should reflect the value of the additions to the stock of owner-occupied dwellings which was available to households in the base period.
Prices		
Relevant price concept	Monetary transactions between the household sector and other institutional sectors	Real market transactions. No imputations or stated guesses/estimates. Full acquisition price.
Sources	Covering all relevant transactions	-
Timing	Price at the time of the first (binding) contract	-
Treatment of land prices	Excluded	This exclusion is made on the grounds that the cost of land grasps the investment element and the cost of structure represents the consumption motivation of purchasing a dwelling (but rarely excluded in practice).
Adjustment for quality change	Indices unaffected by changes in the quality of the dwellings	The quality issue in the OOHPI/HICP context has much to do with changes in the compositional basket of available transactions.
Periodicity	Monthly	Quarterly indices may be regarded as a suitable 'second-best' solution and monthly indices can be interpolated.

([89]) This raises the question of which rule should be used to define what is 'relevant' or 'irrelevant' in this context. A possible rule of thumb could be drawn from already existent rules on HICP coverage. These rules basically define a 'relevant' expenditure component as an expenditure category accounting for more than one part in a thousand of the total expenditure covered by all other relevant categories.

	Desired target	Observations and remarks
Base period:		
for the weights	one to two years	The choice should be made in accordance with the volatility of the net transactions of the base period
for the index	As specified by Eurostat	The same as the HICP
for the prices	December of each year	In the case of a quarterly index, the fourth quarter should be used
Publication of results	With a month of delay in relation to the reference period.	The same as the HICP
Reliability	Unbiased results	-

Whatever the final decision on the treatment of OOH, a classification of sub-indices needs be adopted, which could be either the extension of the Classification of Individual Consumption by Purpose (COICOP) adapted to the needs of the HICP ([90]) or, an autonomous, self-classification system for OOH price indices. It is possible to develop the two approaches so that a mapping between them is established. In Table 2, a classification system separating expenditures that are carried out for the acquisition of a house and the expenditures incurred when an owner-occupied dwelling is in use is matched with a classification system based on an extension of the COICOP/HICP nomenclature. Thus, the designations i.e. the categorisation of the different expenditures, are identical in each case, only the codes themselves vary.

It should be noted that transactions and transfers within families, including inheritances and gifts, etc., are outside the scope of owner-occupied housing costs.

([90]) Hereafter referred as 'COICOP/HICP'.

4. The House Price Index

4.1. Definition and scope

The House Price Index (HPI) measures the change in market prices of all residential properties that are purchased by households ([91]). In contrast with the OOH price index, the HPI does not follow the net acquisition concept and the price of land is included in both prices and weights.

In practice, the application of this concept means that:

- all dwelling acquisitions by households are covered by the HPI, all purchases of existing dwellings are included in the index, not just those purchased from other sectors;
- since the aim is to measure price developments of all residential properties purchased by households, the distinction between properties bought by households for their own use or for renting out to other households has no relevance to defining the HPI's scope;
- since the emphasis is on the market prices of residential properties, non-market prices are ruled out of scope of the HPI ([92]);
- since the HPI measures the price of the property itself, and not the total cost of acquiring, owning and maintaining a residential property, other costs related to the full cost of acquisition and ownership of the property, such as legal fees and repairs and maintenance (such as re-decoration or the replacement of a roof) are ruled out of scope.

Applying the same terminology as in 3.8, the HPI would be calculated as:

$$_{HPI}I_0^t = {}_{C2'}w_{\cdot C2'}I_0^t + {}_{C3'}w_{\cdot C3'}I_0^t + {}_{A}w_{\cdot A}I_0^t \qquad (4.1)$$

where:

$_{HPI}I^t_0$	is the HPI index in period t
$_{A}^{W}$	is the weight of existing dwellings sold by households to households
$_{A}I^{t}$	is the index of existing dwellings sold by households to households
$_{C2'}^{W}$	is the weight of 'other' new dwellings sold by non-households to households
$_{C3'}^{W}$	is the weight of all existing dwellings sold by non-households to households
$_{C2'}^{It}$	is the index of new dwellings sold by non-households to households
$_{C3'}^{It}$	is the index of all existing dwellings sold by non-households to households

The weights shown in equation 4.1 are based on households' gross transactions and include the price of land ([93]).

([91]) In this manual, the HPI does not mean the same thing as what could be called an 'all dwellings index'. Such an index would consider *all* dwelling purchases, including those made by the non-household sector.
([92]) An example of a non-market price would be the final price derived for a dwelling that was developed by a step-by-step self-builder or one that has been purchased by a sitting tenant at a discounted price.
([93]) The weights C2' and C3' shown in equation (4.1) should not be confused with C2 and C3 OOH weights. The prime symbol is here used to signal that the former were compiled using a gross concept and that the latter were based on a net concept.

The following sections give an overview of the compilation of HPIs. More detail can be found in the *Handbook on Residential Property Price Indices (RPPIs)*, published by Eurostat in 2013.

4.2. **Compilation requirements**

The construction of the HPI follows basic HICP requirements insofar as it is compiled using a Laspeyres-type annually chained index formula using final market prices that are paid by households, including VAT and other taxes related to the transaction. The HPI should also be quality-adjusted in order to reflect only the pure price movements of residential properties. More details of quality adjustment are given in Section 3.6 and in Chapter 6 which discusses index compilation. The reader should also refer to the above mentioned handbook.

4.3. **Comparison between the HPI and OOH price indices**

From Table 2, it is clear that the HPI covers market transactions of residential properties, regardless of which institutional sector they were bought from and the purpose of the purchase (dwellings purchased by households for investment purposes - e.g. for renting, are also covered). The two categories of 'new dwellings purchased' and 'purchase of existing dwellings' (HPI categories H1.1 and H1.2) enter into the compilation and should conceptually be more or less comparable with the OOHPI categories O.1.1.1.1 and O.1.1.2 respectively.

Major repairs and other services related to the purchase of a dwelling, which are covered in the OOHPI, are ruled out from the HPI since the emphasis given in this indicator is on the price of a dwelling and not on the total cost of acquiring, owning and maintaining it. Likewise, self-builds could be excluded in the HPI on the grounds that no market price exists.

4.4. **Uses of the House Price Index**

The HPI should be seen as an independent indicator, important in its own right. Its most pertinent function relates to its use as a macro-economic indicator: in particular, its role in monetary policy and inflation targeting and also, in conjunction with other statistics, as financial stability indicator. There is a general interest in monitoring household property prices: rising prices are often associated with economic growth, while falling or even static dwelling prices are often associated with an economic downturn. In addition, many central banks have *inflation targets* which can directly or indirectly involve indices of property prices. The European Central Bank (ECB) — in co-operation with the central banks of the individual countries of the euro area and the European Union — has an interest in the comparative measurement of changes in dwelling prices between different countries. Movements in the prices of dwellings will directly affect measured inflation when a CPI includes owner-occupier housing costs, and measured inflation is also indirectly affected if dwelling prices influence other prices such as rents.

The HPI can also help to explain the movements of OOH price indices.

An additional, and highly important use of the HPI, referred to earlier, lies in its function as a vital part of the input to the construction of the OOH price index (categories O.1.1.1.1. and O.1.1.2) including indirectly through, for example, the inclusion of transaction costs, such as legal fees, that are often proportional to the price of dwellings.

5. Data sources for House Price Indices

5.1. The choice of the most appropriate data source

In principle, there are a number of sources available to Member States for the compilation of HPIs, each of which has pros and cons that need to be evaluated carefully. In this context, at least four data sources can be mentioned here:

- real estate agents;
- construction companies;
- financial institutions;
- administrative sources.

Because of the high cost of undertaking purpose-designed surveys of house prices, the methods adopted by statistical agencies and others to construct residential property price indices have mainly made use of readily available administrative data, the latter usually being a function of the house price data generated by a country's legal and administrative processes associated with buying dwellings. Potential sources are the land registry, fiscal authorities, municipalities and notaries. In addition, it may be possible to obtain information from individual sales contracts that are kept by public authorities. Relevant information may also be found in banks or other financial institution dealing with mortgage loans for the acquisition of dwellings.

The following sections highlight some of the potential advantages and disadvantages of most common data sources, including administrative sources.

5.1.1. ADMINISTRATIVE SOURCES

Data gathered for administrative purposes containing information that can be used in the compilation of OOH price indices include, amongst others, registers of property sales, appraisal information held by banks following valuations made when prospective buyers apply for mortgages, and information held by estate agents and property developers.

Administrative registers created to support compliance with legislation on ownership and taxation of private dwellings include:

- land registry offices and/or notaries: information on dwelling transaction prices and changes of ownership;
- tax authorities: information on the value of dwellings for income tax or wealth tax purposes;
- municipalities: information used for tax purposes or for the issue of building permits.

Administrative data sources can have a number of advantages:

- exhaustiveness: are likely to include all relevant transactions;
- detailed information: a price or valuation will be recorded, plus, generally speaking, dwelling-type and location (but the valuation may differ from the price paid);
- data quality: the quality of the data should be good when registers are part of a legal framework, but may suffer from some miss-reporting if the purchaser of the dwelling has an incentive to record a lower price than that actually achieved.;
- cost: the use of administrative data is generally cost-efficient because it is readily available having already been collected for other purposes. It is often available to the statistical agency at marginal cost.

The disadvantages of administrative data stem from the fact that its existence primarily responds to administrative needs, not to the specific requirements of a price index. Potential disadvantages include:

- data needed for the construction of a constant quality mix-adjusted HPI, which are not relevant for the administrative purposes of the register, may not be available. The most common example of this is information on the characteristics of the dwelling. The latter are necessary for dealing with quality changes in the profile of dwellings that have been sold so that indices give the price change of a fixed 'basket' of dwellings ([94]);
- more generally, the variables defined for administrative purposes may not meet statistical objectives;
- there can be legal and bureaucratic restrictions to accessing the data;
- the data may suffer from under-reporting bias;
- changes in legislation or in taxation rules affecting administrative processes may lead to serious breaks or discontinuities in the data series;
- timeliness can be a problem compared with survey data. Delays are common in the registration of transactions.

5.1.2. CUSTOM-DESIGNED SURVEYS

Surveys of estate agents or property developers and house builders can be an alternative source of information to administrative records when the latter are inaccessible or prove inadequate. In order to ensure the quality of the results, the design of a survey should generate a representative sample of estate agents or, for newly-built homes, construction companies/developers and the questionnaire should cover all relevant price-determining characteristics needed for measuring the change in prices of properties of constant quality over time. The survey should also cover real transactions referenced to the date they occurred. As with OOH, the reference date for the purchase to enter the index is the time when the first binding contract between the seller and the purchaser is signed.

Annex A provides one example of a questionnaire. The questionnaire is divided into two parts: the first part is focused on quantitative variables (e.g. price and living area) and the second part on qualitative variables (e.g. the desirability of the neighbourhood). The design of the questionnaire will, of course, depend on the market characteristics of each country.

The most common methods used for capturing data based on surveys are:

- telephone surveys;
- face-to-face interviews;
- surveys sent by mail;
- E-mail surveys.

The main advantages of custom-designed surveys are:

- the design of the survey can be determined by the needs of the index compiler;
- the NSI has control over the data collection and validation processes.

The disadvantages associated with such surveys include:

- they can be expensive, particularly the fieldwork;
- they are a burden on respondents;
- they may suffer from low response rates; and
- the responses are not always totally reliable, particularly the answers to questions relating to the property characteristics such as floor area.

([94]) Quality issues are dealt in chapter 6.

5.1.3. PRICE DEFINITION

The process of buying and selling a property can take several months or more and involve a lot of negotiation. Moreover, price data may be recorded at different stages of the selling process depending on the administrative source used or the survey methodology followed. This has consequences for what prices are being measured and can affect the relevance of the computed index and its comparability with other HPIs.

In theory, price data for a residential property price index may be recorded:

- As soon as the property is on the market (the advertised asking price, may or may not be the estate agents valuation). Typical data sources: newspapers and estate agents.

From mortgage applications (initial price agreed between seller and buyer). Typical data source: mortgage lenders. But cash purchases will not be covered.

- From mortgage approvals (the estimated value by lender). Typical data source: mortgage lenders. Again, cash purchases will not be covered.
- Signing of binding contract (actual transaction price). Typical data source: lawyers, notaries.
- Transaction completed (transaction price). Typical data sources: land registries, tax authorities.

Each source of price data has its advantages and disadvantages. The target measure is the free market acquisition price. The disadvantage of advertised prices and prices on mortgage applications and approvals is that not all of the advertised prices will end in transactions, and the price may differ from the final negotiated transaction price. But these prices are likely to be available sometime before the final transaction price. Indices that measure the price earlier in the purchasing process can sometimes provide early detection of changes in house price inflation but they are not necessarily based on transaction prices because prices can be renegotiated before the deal is finalised.

It should be noted that the availability of different sources of price information at different points in the buying and selling process can be an advantage. For instance, as mentioned above, changes in the relationship between asking price and selling price may provide an early indication of a change in the state of the housing market.

5.1.4. DATA SOURCES FOR WEIGHTS

A sales-weighting is appropriate for a CPI, such as the HICP, that follows an acquisition approach and, likewise, for an index monitoring and measuring house price inflation. It is also appropriate for use as a deflator in measuring the *real output* of the residential real estate construction industry ([95]). A sales-weighted index needs estimates of expenditure relating to sales.

The expenditure weights for an HPI can be derived from a number of sources. Most particularly, from: national accounts data; periodic national censuses which collect information on the housing stock; information from banks on loans taken out for house purchase (but these records will exclude cash purchases); construction statistics (for new dwellings only); official registers recording ownership. As with prices, there can be a lack of coherence between these different data sources resulting from the long and involved processes associated with buying and selling a house and the fact that a valuation or offer price associated with an application for a mortgage will not necessarily lead to a sale and change of ownership and may not reflect the prices paid and price trends for cash purchases. Other issues also arise, such as the distinction, for new homes, between what is being built for selling and what is being built for renting out. This sort of information is not often readily available from one statistical source. It is for this reason that the construction of weights may need to draw on several different sources even though in principle national accounts should be the main

([95]) A price index which is required to measure the *wealth* associated with the ownership of residential property should be *stock-weighted*. A *stock-weighted* index is also appropriate for a financial stability indicator, in particular for an index which is being used to identify property price bubbles.

reference source, especially for the weights used to aggregate the elementary aggregate indices to produce the overall HPI. Other sources can be used to complement national accounts data, particularly at a lower and more detailed level, including different sources of construction statistics, official registers, etc.

The expenditure incurred by self-builders is not included in administrative records of house sales or ownership, nor in regular surveys of house prices. Consequently, special data collection tools are needed by the very nature of the activity of self-building. These expenses are classified as investment in the national accounts and are generally not covered in household budget surveys or, even if they are, are usually so infrequent that the HBS does not generate any useful estimate of the expenditures involved. Thus, to meet the measurement requirements of OOH it may be necessary to extend or amalgamate HBS data over several years (as may also be required for estimating the expenditure on major repairs and renovation). An alternative approach is to carry out special surveys of companies providing goods and services related to self-building to produce construction costs based, for instance, on model pricing and to combine this with broad-based figures from the HBS, Census or other source, on the number of self-builds. For construction price indices based on input prices, the use of bills to estimate weights has proved useful. As self-builders have the same role in respect of their own house, as does a construction company in respect of the houses the construction company builds, a common approach to practical index construction can be used. Annex D presents a summary illustration of possible sources for the weights.

5.1.4.1. Example of weights estimation

The estimation of weights can involve drawing on a number of different data sources with the potential for some issues arising over the coherence of the overall weighting structure due to differences in definitions and coverage between the different sources. This is illustrated in Table 9 where weights are grouped according to the Eurostat classification for OOH price indices measuring the different aspects of OOH costs: those relating to the acquisition of a dwelling and those relating to the ownership of a dwelling.

HICP does not cover investment spending ([96]), therefore one of the major measurement challenges is the separation of the capital investment element of a house purchase — the land — from the consumption expenditure element — the structure.

From a conceptual point of view, the ideal method for excluding the land may be the net/net approach, whereby prices and weights both exclude the land component. However, as many member states are unable to implement the net/net approach, due to a lack of available data particularly with respect to the breakdown of the price of a dwelling into its building and land components, Eurostat requires all member states to use the net/gross (net weight, gross price) approach even if a net/net approach is feasible. This clearly introduces a lack of coherence between weights and prices, albeit an unavoidable inconsistency.

The following example, is based on one countries experiences as is given for illustrative purposes. The source of component expenditure weights used to compile OOHPI (NA) are derived from GFCF and HFMCE. The national accounts data relate to two years prior to the current year and are price-updated to the December of the previous year using the relevant OOH sub-indices.

([96]) Investment spending is another elements of Final Demand and would be covered by an Index of Investment Prices (IIP).

Table 9: Source of weights data

	Acquisition of dwellings				Ownership of dwellings	
OOH(NA) Indices	Acquisition of New Dwellings (exc. Land)	Self Builds & Renovations	Existing Dwellings new to the OOH Sector	Services Related to Acquisition	Major Repairs & Maintenance	Insurance Connected with the Dwelling
Source of Weight data	Gross Fixed Capital Formation	Gross Fixed Capital Formation	No weight currently exists	Household Final Consumption Expenditure & Gross Fixed Capital Formation	Household Final Consumption Expenditure	Household Final Consumption Expenditure

An estimate of each component of the weights data is derived as follows.

1. Acquisition of Dwellings.

    a. New Dwellings.

        i. Purchase of New Dwellings.

        Data are provided by National Accounts from a Monthly Business Survey (for Construction and Allied Trades). This is based on one question in the housing work section: 'what was the total value of new work carried out for the private sector excluding repair and maintenance, housing improvements and major alterations'. This ensures that the value of the land is not included. However, this data is not based on sales transactions and so only takes into account the value of the houses built and not the value of the houses that have actually been sold. The data also include new builds heading to all sectors; it does not separate out those entering the OOH sector. If a large proportion of new builds are heading to other sectors, such as renting, then this will mean that the data will become less representative of sales to the OOH sector.

        ii. Self-build dwellings and major renovations.

        This information is supplied directly by National Accounts. Estimates for self-builds by both enterprises and household is modelled using a sum-of-costs approach as described in National Accounts. Self-builders can claim back VAT on self-build expenditure, so VAT returns are a proxy for the growth of self-builds.
        Estimates for major renovations are based on two areas.

        - *Expenditure on contractors' charges for improvements (inc. VAT).* This is an estimate of private sector expenditure on contractors charges for improvements (excluding VAT) grossed up by an allowance for VAT. The estimate is made by subtracting the estimate of expenditure on 'contractors' charges for 'repairs' from the estimate of 'expenditure on repair and improvements', the data source for which is output measured in the Construction Industry which excludes VAT. The 'contractors charges estimate' is based on a LCI (Living Cost Index).
        - *Estimated private sector expenditure on DIY goods for improvement work (inc. VAT).* This estimate covers private sector expenditure on do-it-yourself goods for improvement work. In this case a figure of 14% is used to represent the total amount estimated for household consumption on DIY goods and materials. The household consumption figure is based on data from the Annual Business Survey.

Within the self-builds and renovations index there are two sub-indices: materials and services. The materials items are weighted together by their Producer Price Index (PPI) base sale value, this is based on all material sales, regardless of which industry they have been sold to. The information is updated every 5 years. The services items are weighted together based on their CPI item weights. These two sub-indices are then weighted together based on their CPI class weights.

iii. Existing dwellings new to households.

This is currently given a zero weight as in this example there is no way of measuring it.

iv. Other costs related to the acquisitions of dwellings.

This consists of transfer costs and stamp duty. These are weighted together based on their relative values.

Data on transfer costs come from the National Accounts. This is based on expenditure for all legal costs, not just those related to house purchase. There is no accurate estimate available of what proportion of transfer costs are accounted for by legal costs. Within the transfer cost index items are weighted together based on CPI weights.

Within the stamp duty index, weights are based on dwelling sales by price band from Land Registry, and stamp duty land tax rates from the tax authority.

2. Ownership of Dwellings.

a. Major repairs and maintenance

Expenditure information is derived by estimating spending on DIY goods from an Annual Business Survey (ABS), and from data from a Living Costs and Food survey (LCF). This is done by:

i. Estimating spending on materials for both major and minor repairs to dwellings as a proportion of turnover, using ABS estimates for the relevant construction-related industries.

ii. Estimating total spending on materials for major and minor repairs to dwellings, using output (turnover) in the construction industry for repairs and maintenance, which includes both intermediate consumption and GFCF.

iii. Estimating the proportion of total spending on major repairs and improvements, how much is paid for by householders rather than contractors (15%).

Thus, the following components are estimated.

iv. HFMCE on repairs and maintenance of a type done by tenants – 10%.

v. GFCF (major repairs) – 14%.

vi. Intermediate Consumption by owner-occupiers in the production of dwellings services – 76%.

b. Insurance connected with the dwelling.

This data is provided by National Accounts from the LCF survey already mentioned. It is already used in the CPI and it is regarded as reliable.

c. Other services related to ownership of dwellings.

Eurostat guidelines state that when the expenditure in a section is less than 0.5% it may be given a weight of zero; this is the case here.

It can be seen from the above that the estimation of weights relies heavily not only on the availability of data from different sources but also on the statistical integration of different surveys and an effective reconciliation of the different sources when apparent inconsistencies occur. HICP compilers often rely on National Accountants to undertake these tasks as these activities need to be carried out for the compilation of national accounts. In some cases, calculations rely on assumptions about the allocation of expenditure across different sub-headings.

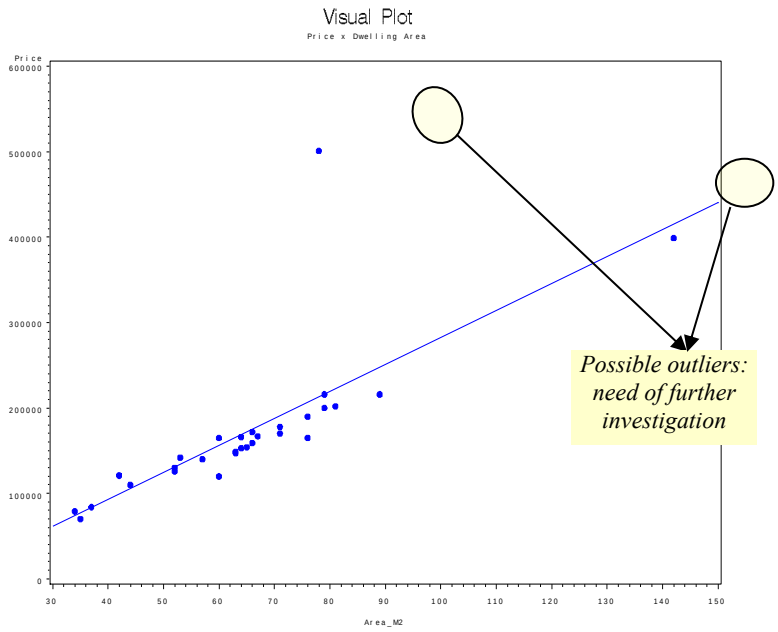
Limitations to the computation of weights include the weight for 'Acquisition of New Dwellings', which includes expenditure on all newly constructed dwellings and not those specifically destined for the OOH sector as per the methodology outlined by Eurostat and a zero weight for 'Existing Dwellings New to the OOH Sector' where no figure is available so a zero weight is currently applied.
In situations such as those described above, national statistical offices should attempt to gauge the potential inaccuracies arising from the unavoidable estimation processes and look to developing further data sources and estimation techniques where warranted.

5.2. **Data quality checks**

Good quality price indices require good quality data. Thus, it is important that data control checks are implemented at early phases of price index production. The choice of the specific procedures for this task will partly depend on the data sources that are used in the compilation of the indices.

One good practice is to visualise the raw data and test some reasonable pre-defined assumptions about the relationships between variables. The visual inspection of the data can prove to be a very powerful ally in the identification of outliers. Figure 6 below is an example of such a procedure.

Figure 6: Visual inspection of 'raw' data



In this example, the relationship between the transaction prices of flats in a given district is plotted against living area. In addition, a regression line is drawn to help to identify possible outliers in the data. As the figure signals, there are two observations that stand out from the remaining observations, suggesting that the index compiler should investigate them before the data are accepted as valid.

During this stage, it may be seen that some of the information was not correctly inserted in the database. If it turns out that this is the case, some sort of judgment has to be made regarding its correction, rejection or imputation. However, price index compilers should bear in mind that the outcome of data quality checks do not necessarily imply an automatic rejection of the information that has been signalled as outliers as they may hide important information on the phenomenon that is being analysed. An outlier may not be an incorrect observation. The impact of rejecting or imputing observations should be assessed.

Finally, it should be noted that, when dealing with missing and rejected observations, price index compilers should follow already established HICP minimum standards and guidelines ([97]) ([98]).

([97]) Namely, by developing a strategy to deal with missing information that keeps the use of price imputation techniques to a minimum.
([98]) The minimum standards regarding the treatment of missing observations, imputation and replacement procedures in the HICP can be found in Article 6 of Regulation (EC) No 1749/96. Guidelines on the treatment of rejected price observations can be found in Eurostat (2001b).

6. Compilation of House Price Indices

6.1. Foundations of the hedonic approach

6.1.1. SOME PRELIMINARIES

Hedonic house price indices (HPIs) should be computed at the level of:

(i) The whole market (i.e., all transacted dwellings).

(ii) Newly built dwellings.

(iii) Second-hand dwellings.

Hence three separate HPIs are required for each country. There are big variations amongst European countries regarding the relative size or weights of each sector. In some cases, the housing market is dominated by the second-hand segment. In other countries the market is more evenly balanced. Furthermore, it is recommended that separate hedonic models are estimated for houses and flats for each of (i), (ii), and (iii) above. The reason for treating houses and flats separately is that it is generally not possible to satisfactorily represent both with a single set of characteristics and shadow prices. For example, land area is more important for houses than flats, and whether a dwelling is located on the ground floor is only relevant for flats. More generally, the use of strata also allows the functional form of the hedonic model to be tailored to each stratum. Additional breakdowns (e.g. by urban/rural, region, type of buyer, etc.) may be relevant, depending on user needs in each country.

The price indices for houses and flats can then be combined in the same way as other subaggregates in the HICP as discussed in section 5. In a housing context, however, it is not clear whether the house and flat indices should be weighted by expenditure shares or by the number of housing transaction of each type. A case can be made that weighting by number of transactions generates an aggregate index that is more representative of the overall housing market. See chapter 5 of the Handbook on Residential Property Price Indices (RPPI) (2013), published by Eurostat for more on the issue of stratification.

6.1.2. THE NEED FOR A HEDONIC APPROACH

The compilation of HPIs raises many practical problems, mainly because houses are heterogeneous goods with negotiable prices that can only be observed when they are sold. House price indices should not be constructed simply by comparing the average price of houses sold in each time period, since the result would be dependent on the particular mix of dwellings that happened to be sold in that period. Instead, the heterogeneity of dwellings and the changing profile of houses sold in successive periods need to be taken into account in order to separate the influences of mix and quality changes of dwellings sold from pure price movements.

The relevance of controlling for quality changes can be illustrated, for example, by a situation where in a given period the great majority of dwelling purchases are of relatively cheap and low quality houses compared with the previous period. A price index based on the simple average of sale prices will show a drop in the overall level of prices. However, this gives the wrong signal since the drop in average price reflects a change in the mix of transacted dwellings. An HPI so constructed does not take into account the change in the composition of the quality mix of the dwellings purchased in that period.

When enough data on house prices and characteristics are available, the best way of quality adjusting a house price index is using hedonic methods. Other methods are briefly considered in section 6.5. Hedonic price indices are relatively versatile and can be used both in the computation of an owner-occupied housing price index (OOHPI) and an HPI. The principle is the same in each case: demand and supply determine the willingness of a buyer to purchase a property with a distinctive set

of characteristics at a given price and hedonics establishes the implicit marginal contribution of each characteristic to the value of the property.

Hedonic pricing methodology builds upon the idea that each characteristic of a good or service contributes differently to the valuation of the good or service by consumers. Thus, the first stage of this methodology consists of specifying a hedonic price function (i.e., a function relating transaction prices to the relevant characteristics of the good or service). In hedonic analyses of the housing market, those characteristics typically correspond to individual dwelling and location-related features. Using regression techniques, it is then possible to estimate the parameters in the hedonic price function, which can be interpreted as the implicit marginal prices for each characteristic. Based on the estimated marginal prices, housing prices can then be adjusted to remove the influence of those sources of heterogeneity and quality change. The particular adjustment carried out depends on the form of the hedonic price function (e.g. linear, log-linear), on the type of price index (e.g., Laspeyres, Paasche or Fisher) and on the selected hedonic method (e.g. hedonic imputation, time-dummy, rolling time dummy, re-pricing, or average characteristics). Section 6.1.3 takes a closer look at how a hedonic regression model is formulated. The different methods for constructing hedonic price indices from the hedonic model are considered in Section 6.2.

6.1.3. THE FUNCTIONAL FORM OF THE HEDONIC MODEL

The most widely used hedonic functional form is log-linear. An example of the log-linear functional form estimated for a single period t is provided in (6.1).

$$\ln(p_{t,h}) = Xb_t + u_{t,h},$$

(6.1)

where $p_{t,h}$ denotes the price of house h sold in period t, X is the matrix of characteristics, and the random error term $u_{t,h}$ captures the unexplained part of house prices. It is assumed that the list of characteristics (e.g., number of bedrooms, number of bathrooms and land area) in the matrix X remains the same from one period to the next. Each home, however, has its own particular mix of characteristics (e.g., 3 bedrooms, 2 bathrooms and 1000 square metres of land). The issue of which characteristics should be included in the hedonic model is discussed later in this chapter.

The log-linear form models the natural logarithm of price as a linear function of the explanatory variables. The log-linear functional form has a number of advantages in a hedonic context (see Diewert 2003 and Malpezzi 2003). These include, first, the ease of interpretation of the characteristic shadow prices. For example if the estimated shadow price on a characteristic equals 0.1, then this indicates that a one unit increase in the quantity of this characteristic increases a house's price by about 10 percent (note this simple interpretation does not hold for dummy variables). Second, taking the log of prices reduces the impact of skewness in the price distribution and heteroscedasticity (i.e., a changing variance in the error term). Third, as will be shown, price indices in the time-dummy case can easily be computed when the functional form is log-linear. One disadvantage is that what is estimated by the hedonic model is the log of price. Simply exponentiating this estimate produces a biased price index. This bias is generally assumed to be small and hence of little consequence (although this is not necessarily always the case). A number of corrections for this bias have been proposed in the literature (see Hill 2013).

If one wants to compute separate indices for land and structures, then it may be better to use a linear functional form as shown in (6.2):

$$p_{t,h} = Xb_t + u_{t,h}.$$

(6.2)

In this case the value of a property can be expressed as the sum of the value of the land and the value of the structure (see chapter 8 of the RPPI Handbook 2013). But by using the linear model the advantages of the log-linear model are sacrificed.

The characteristic shadow prices represented by the vector b in (6.1) and (6.2) are typically estimated by ordinary least squares (OLS), although weighted least squares (WLS) is also sometimes used (see for example Goodman and Thibodeau 1995, 1997). One reason for using WLS would be if some of the characteristics are missing for some houses. One approach for handling missing characteristics is to impute values prior to estimating the hedonic model. For example, suppose a particular house has two bedrooms, but the number of bathrooms is missing. In this case, the bathroom count could be set equal to the median bathroom count in the data set of houses with two bedrooms. However, given that one of the characteristics of this house is now imputed, one may want to give this house less weight in the hedonic regression. There still remains the question then of how the weights should be determined under WLS. This issue is not addressed here.

The squares of some specific variables are also sometimes added to the hedonic function when there is evidence to suggest that the effect of the variable on the dwelling price is not constant for all possible values of the dwelling characteristics. More complicated functions such as splines are also used to model variables where the relationship between price and the level of the characteristic is uncertain and perhaps non-monotonic (e.g., new and very old dwellings may be more highly valued than dwellings built in the 1960s and 1970s), see for example, Grether and Mieszkowski (1974) and Malpezzi, Ozanne and Thibodeau (1987). Similarly, Fletcher, Gallimore and Mangan (2000) report that as the size of the dwelling increases, its price while monotonic increases but at a decreasing rate. Moreover, many house attributes have a qualitative nature and are included in the regression model as dummy variables. It is also possible to construct interaction variables in order to reflect the joint influence of a qualitative attribute and other discrete or continuous characteristics, allowing the effect of those characteristics to shift according to the presence or not of that attribute. For example, let AGE be the number of years since the house was constructed and REGION_A be a dummy variable which equals unity if the dwelling is located in Region A and zero otherwise. By considering the interaction variable AGE*REGION_A it is possible to differentiate the effects of age in region A relative to other regions: for Region A, the effect of an unit increment in the house age is given by summing up the coefficients associated to the variables AGE and AGE*REGION_A, while for other regions that effect is given directly by the coefficient of the variable AGE.

6.2. Methods for constructing hedonic house price indices

Five hedonic methods — time dummy, rolling time dummy, imputation, characteristics, and re-pricing — are considered below. The assumptions required by each method and the similarities and differences between the different methods are discussed. More details on the hedonic methods described in this chapter can be found in Hill (2013), the RPPI Handbook (2013) and Holmgaard (2016).

6.2.1. THE TIME DUMMY METHOD

The time-dummy method adds time dummy variables for every period in the comparison to the log-linear hedonic model in (6.1). A single hedonic model is then estimated for the whole pooled data set. The shadow price vector b therefore represents the average shadow prices of the characteristics across the whole time horizon of the data set.

More formally, let the matrix of time dummy variables be denoted by D. The objective now is to estimate both the vector b of shadow prices on the characteristics, and the vector of time dummy characteristics denoted here by d.

$$\ln(p_{t,h}) = Xb + Dd + u_{t,h} \qquad (6.3)$$

One advantage of this approach is its simplicity. The price indices are derived immediately from the estimated pooled time dummy regression equation by simply exponentiating the estimated time dummy coefficients. The price index for period t is given by $P_t = \exp(d_t^*)$, where an asterisk is used to indicate the estimated value of d_t in (6.3). No dummy variable is included for the base period. Hence by construction the price index in the base period is normalised to 1. It should be noted that the

characteristic shadow price vector b is now no longer time dependent. The reasonableness of this assumption can be tested using a Chow test — see Annex E.

The time dummy method has two main attractions. First it provides an easy way to compute hedonic house price indices. Second, it works well with smaller data sets. This is because all the available data are used to estimate the hedonic model, thus increasing statistical significance and robustness.

The assumption of fixed characteristics parameters however is a disadvantage of the time dummy hedonic method as it can represent a departure from the reality of the market place, although for housing this is likely to be less of an issue than for some other items in the HICP basket as the relative valuation of different housing characteristics should not change that much over a short period of time. The time-dummy method also has the disadvantage that all the time dummy variables are re-calculated each successive period leading to the potential for backward revisions for a CPI which by definition is not revisable. Both these problems are dealt with by the rolling-time-dummy (RTD) variant on the basic time-dummy method that is discussed next.

6.2.2. THE ROLLING TIME DUMMY (RTD) METHOD

The RTD method is a variant on the time-dummy method first proposed by Shimizu, Takatsuji, Ono and Nishimura (2010). The method is explained by Diewert (2010) as follows:

> *First, one chooses a 'suitable' number of periods (equal to or greater than two) where it is thought that the hedonic regression model will yield 'reasonable' results; this will be the window length (say M periods) for the sequence of regression models which will be estimated. Secondly, an initial regression model is estimated and the appropriate indexes are calculated using data pertaining to the first M periods in the data set. Next, a second regression model is estimated where the data consist of the initial data less the data for period 1 but adding the data for period M+1. Appropriate price indexes are calculated for this new regression model but only the rate of increase of the index going from period M to M+1 is used to update the previous sequence of M index values. This procedure is continued with each successive regression dropping the data of the previous earliest period and adding the data for the next period, with one new update factor being added with each regression.*

More concretely, suppose the objective is to construct a hedonic house price index at a quarterly frequency, and that we focus on the case of a rolling window that consists of five consecutive quarters.

$$\ln(P_{\tau,h}) = Xb + D_{t+1}d_{t+1} + D_{t+2}d_{t+2} + D_{t+3}d_{t+3} + D_{t+4}d_{t+4} + u_{\tau,h}$$

(6.4)

The hedonic model is estimated using only the data for the five periods (τ=t,t+1,t+2,t+3,t+4). No time dummy variable is included in (6.4) for the first period – here period t. Hence the price index for period t is by construction 1 (i.e., $\tilde{P}_t = 1$), while the price indices for the subsequent four periods are: $\tilde{P}t+1 = \exp(dt+1^*)$, $\tilde{P}t+2 = \exp(dt+2^*)$, $\tilde{P}t+3 = \exp(dt+3^*)$, $\tilde{P}t+4 = \exp(dt+4^*)$. Tildes are placed above the price indices to denote that they are preliminary. The estimates $\exp(dt+1^*)$ and $\exp(dt+2^*)$ are discarded, and only $\exp(dt+3^*)$ and $\exp(dt+4^*)$ are used. This is because the objective when estimating (6.4) is to compute only the change in the price index from period t+3 to t+4.

$$\frac{P_{t+4}}{P_{t+3}} = \frac{\exp(d^*_{t+4})}{\exp(d^*_{t+3})}$$

(8.5)

The overall price index is then obtained by chaining together comparisons like (6.5) between adjacent periods. This approach ensures that the overall price index is not subject to revision (a key weakness of the time-dummy method discussed above).

An important second advantage of RTD over time-dummy is that it allows the characteristic shadow price vector b to be continually updated. At the same time it shares the advantages of time-dummy in

that it is simple to compute and works well with smaller data sets. Like time-dummy it also generates standard errors on the logs of the price indices.

The length of the rolling window must be chosen by the index provider. In one sense this is an advantage in that it gives the provider some flexibility to experiment with different window lengths and see which seems to perform best. In another sense it is a disadvantage as no consensus has yet emerged on the ideal length of the rolling window. This is largely because the RTD method was only first proposed by Shimizu et al. in 2010 (actually slightly earlier in working paper form), and NSIs have not yet had enough time to explore the impact of alternative window lengths. The issue of optimal window length in the RTD method is currently being investigated by Hill, Scholz, and Shimizu (2016).

O'Hanlon (2011) explains how Ireland has implemented the RTD method to construct its official HPI. He recommends setting M=12. In other words the rolling window includes 12 months (i.e., one year). If it is only possible to compute the HPI on a quarterly basis, a good starting point is probably a rolling five quarter window.

Two factors must be traded off when choosing the window length. A shorter window has the advantage that it ensures that the estimated characteristic shadow price vector b is up to date and relevant to the time periods being considered. On the other hand a longer window has the advantage that it allows more data to be used thus increasing the robustness of the estimated hedonic model. Hence the optimal window length may be shorter for larger countries with more data than for smaller countries with less data.

If the price index starts exhibiting short-term volatility this may indicate that the sample sizes in the estimation of each hedonic model are too small (and hence the window is too short). Insignificant coefficients on the time-dummy coefficients may also be an indication of a too short window. However, one must be careful here. An insignificant time dummy coefficient may arise in periods of relative price stability even if the hedonic model is performing well, since in this case the 'true' underlying coefficient is close to zero anyway. Later in the chapter an empirical example based on real housing data is provided that compares time-dummy and different versions of RTD. In conclusion, the RTD method is a safe, reliable and robust method for constructing hedonic house price indices. It is particularly well suited to smaller countries that do not have that much data in each period. It is nevertheless recommended that NSIs using RTD experiment with different window lengths.

6.2.3. THE HEDONIC IMPUTATION METHOD

The hedonic imputation method estimates a separate hedonic model for each period, and hence allows the characteristic shadow prices to reflect the situation observed in that particular period. If there are not enough data to do this, then multiple periods can be included in each hedonic model along with period dummy variables. The hedonic model is then used to impute prices for each dwelling. For example, let $p_{t,h}$ denote a dwelling h sold in period t. Suppose further and quite plausibly that this same dwelling does not sell in period t+1. An imputed price for dwelling h in period t+1 can be obtained from the hedonic model estimated for period t+1, denoted here by $\hat{p}_{t+1,h,}(x_{t,h})$, where $x_{t,h}$ is the vector of characteristics of house h sold in period t. A price relative for house i can now be obtained using either single imputation $(\hat{p}_{t+1,h}(x_{t,h})/\ p_{t,h})$ or double imputation $(\hat{p}t+1,h(xt,h)/\ \hat{p}t,h(xt.h))$. Double imputation implies throwing away the actual transaction price of house h in period t and replacing it in the denominator with an imputed price. While at first glance this might seem like a strange thing to do, double imputation has the advantage that it produces price relatives that are less sensitive to omitted variables when the omitted variables are stable over time (see Hill and Melser 2008). This is typically the case in a housing context. For example, a house that is located next to a busy road in period t is very likely to be also located next to a busy road in period t+1.

Focusing on the case of double imputation, a Laspeyres-type imputations price index can be obtained by taking a geometric mean of the price relatives for homes actually sold in period x_{th} as follows:

$$\frac{P_{t+1}}{P_t} = \prod_{h=1}^{n(t)} \left[\frac{\hat{\mathrm{p}}_{t+1,h}(x_{t,h})}{\hat{\mathrm{p}}_{t,h}(x_{t,h})} \right]^{1/n(t)} = \exp\left[\frac{1}{n(t)} \sum_{h=1}^{n(t)} \sum_{c=1}^{C} \left(\hat{\mathrm{b}}_{t+1,c} - \hat{\mathrm{b}}_{t,c} \right) x_{t,h,c} \right],$$

(6.6)

where n(t) in (6.6) denotes the number of homes sold in period t. Also, the last term in (6.6) presupposes that the underlying hedonic model has a log-linear functional form. It is assumed here that the price index is being computed directly from the data on individual houses, rather than from strata. In other words, each house is treated as its own strata. A Paasche-type equivalent price index is obtained by instead focusing on the homes sold in period t+1 ($x_{t+1,h}$):

$$\frac{P_{t+1}}{P_t} = \prod_{h=1}^{n(t+1)} \left[\frac{\hat{\mathrm{p}}_{t+1,h}(x_{t+1,h})}{\hat{\mathrm{p}}_{t,h}(x_{t+1,h})} \right]^{1/n(t+1)} = \exp\left[\frac{1}{n(t+1)} \sum_{h=1}^{n(t+1)} \sum_{c=1}^{C} \left(\hat{\mathrm{b}}_{t+1,c} - \hat{\mathrm{b}}_{t,c} \right) x_{t+1,h,c} \right].$$

(6.7)

Again, the last term in (6.7) presupposes a log-linear functional form. If it is desired to treat both periods symmetrically, this can be achieved by taking a geometric mean of the Laspeyres and Paasche-type indices in (6.6) and (6.7), which yields a Törnqvist-type index (also referred to as a Fisher index — although strictly Törnqvist is more accurate).

One important issue with imputation type indices is whether all price relatives should be weighted equally — as is the case in the equations above — or whether the price-relatives should be weighted by their expenditure shares. Equal weights have the advantage of being simpler and more egalitarian (i.e., giving all homes an equal say in determining the price index).

An alternative to taking geometric means of the price relatives is to take arithmetic means. This yields the formulas in (6.8) and (6.9).

$$\frac{P_{t+1}}{P_t} = \frac{\sum_{h=1}^{n(t)} \hat{\mathrm{p}}_{t+1,h}(x_{t,h})}{\sum_{h=1}^{n(t)} \hat{\mathrm{p}}_{t,h}(x_{t,h})}$$

(6.8)

Again (6.8) is a Laspeyres-type formula in that it focuses on the homes actually sold in period t. A Paasche-type alternative is the following:

$$\frac{P_{t+1}}{P_t} = \frac{\sum_{h=1}^{n(t+1)} \hat{\mathrm{p}}_{t+1,h}(x_{t+1,h})}{\sum_{h=1}^{n(t+1)} \hat{\mathrm{p}}_{t,h}(x_{t+1,h})}$$

(6.9)

Taking the geometric mean of (6.8) and (6.9) generates a Fisher-type index that treats both periods symmetrically. On balance the formulas that take geometric means of the price relatives should probably be preferred since they are more robust to omitted variables bias. It should be noted that to avoid rounding error problems it is better to compute the geometric means in (6.6) and (6.7) by summing the log price relatives and then exponentiating the total, rather than computing the geometric means directly.

The hedonic imputation method can work well for large countries with higher levels of housing transactions. However, it is more complicated to implement than the time-dummy or RTD methods.

6.2.4. THE AVERAGE CHARACTERISTICS METHOD

The average characteristics method is a special case of the hedonic imputation method where instead of imputing a price for every house sold, a price is imputed only for the average house. The price index is given by the ratio of the imputed price of the average house in period t+1 to the

imputed price of the same average house in period t. The Laspeyres variant taking the average house of period t is calculated as follows:

$$\frac{P_{t+1}}{P_t} = \frac{\hat{p}_{t+1,h}(\bar{x}_t)}{\hat{p}_{t,h}(\bar{x}_t)} = \exp\left[\sum_{c=1}^{C}\left(\hat{b}_{t+1,c} - \hat{b}_{t,c}\right)\bar{x}_{t,c}\right], \quad (6.10)$$

where $\bar{x}_t = (1/n(t))\,\Sigma_{h=1}^{n(t)} x_{t,h}$ denotes the average vector of characteristics. Again the last term in (6.10) assumes the hedonic model is log-linear. From this last term it can be seen that the average characteristics method can be thought of as a ratio of the weighted shadow prices of the two periods being compared.

When some of the variables are dummy variables, it is still possible to average them across the possible values. For example suppose houses are located in five different postcodes. The average house is then split fractionally across these five postcodes (e.g., 0.2 in postcode 1, 0.3 in postcode 2, 0.3 in postcode 3, 0.1 in postcode 4, and 0.1 in postcode 5) where the fractional shares sum to 1.

The denominator in (6.10) is obtained by inserting the characteristics of the average house of t into the hedonic model estimated for period t. The numerator is obtained by inserting the characteristics of the average house of t into the hedonic model estimated for period t+1. Again, there is also a Paasche-type price index that instead takes the average house of t+1 as the reference:

$$\frac{P_{t+1}}{P_t} = \frac{\hat{p}_{t+1,h}(\bar{x}_{t+1})}{\hat{p}_{t,h}(\bar{x}_{t+1})} = \exp\left[\sum_{c=1}^{C}\left(\hat{b}_{t+1,c} - \hat{b}_{t,c}\right)\bar{x}_{t+1,c}\right]. \quad (6.11)$$

Taking geometric means of Laspeyres and Paasche in (6.10) and (6.11) to ensure that both periods are treated symmetrically generates a Fisher-type hedonic imputation price index.

When the hedonic function is log-linear, it can be seen that the Laspeyres-type hedonic imputation index in (6.6) is equivalent to the average characteristics Laspeyres-type index in (6.10). Similarly, the Paasche-type hedonic imputation index in (6.7) is equivalent to the average characteristics Paasche-type index in (6.11). These equivalence results are derived in Hill and Melser (2008). Some further equivalence results are derived in Ramalho and Ramalho (2011a, 2011b).

This equivalence between the hedonic imputation and average characteristics methods breaks down however when locational effects are modelled directly using geospatial data (i.e., exact longitudes and latitudes) instead of locational dummy variables (see for example Hill and Scholz 2017). Averaging longitudes and latitudes throws away most of the informational content of the geospatial data, and may not even be economically relevant. For example, the average longitude and latitude in Sydney, Australia may be underwater (given that Sydney is built around a natural harbour).

Nevertheless, the average characteristics method is conceptually easier to understand and computationally simpler to implement than the hedonic imputation method. Hence as long as the hedonic model is log-linear and geospatial data are not used, the average characteristics and hedonic imputation methods are equivalent and hence there is no reason to use the latter given the greater simplicity of the former.

6.2.5. THE REPRICING METHOD

The repricing method is a special case of the average characteristics method. Instead of comparing the imputed price of the average house in periods t and t+1 it measures the quality difference between the average houses of both periods, using characteristic shadow prices from period 0 as the point of reference. The formula is as follows:

$$\frac{Q_{t+1}}{Q_t} = \frac{\exp\left(\sum_{c=1}^{C} \hat{b}_{0,c}\, \bar{x}_{t+1,c}\right)}{\exp\left(\sum_{c=1}^{C} \hat{b}_{0,c}\, \bar{x}_{t,c}\right)},$$

(6.12)

where c=1,…,C indexes the characteristics in the comparison. In principle, either periods t or t+1 could be designated as period 0. This would generate Laspeyres and Paasche-type versions of this formula. However, generally the reference characteristic shadow price vector b0 is held fixed for a number of periods. In some cases it may be possible to compute the reference shadow prices using the pooled data of multiple periods so as to increase their robustness.A quality-adjusted hedonic price index is now obtained by dividing a quality-unadjusted price index by the quality adjustment factor defined above (see Hill 2013). The repricing method typically uses a ratio of geometric means as the quality-unadjusted price index. The hedonic price index therefore is computed as follows:

$$\frac{P_{t+1}}{P_t} = \frac{\left[\prod_{h=1}^{n(t+1)} p_{t+1,h}\right]^{1/n(t+1)}}{\left[\prod_{h=1}^{n(t)} p_{t,h}\right]^{1/n(t)}} \frac{\exp\left(\sum_{c=1}^{C} \hat{b}_{0,c}\, \bar{x}_{t,c}\right)}{\exp\left(\sum_{c=1}^{C} \hat{b}_{0,c}\, \bar{x}_{t+1,c}\right)}.$$

(8.13)

An interesting feature of the repricing method is that it only requires the hedonic model to be estimated in one period. This pins down the reference shadow prices b0. In one sense this is an advantage and in another a disadvantage. It is an advantage in that it requires less computations to be made since the hedonic model does not need to be recomputed every period. This may also allow the HPI to be computed in a timelier manner. However, there is a limit as to how far forward results can be extrapolated using old reference shadow prices, even if the shadow prices were calculated using pooled data. Sooner or later the hedonic model must be re-estimated. This will introduce a shock into the price index. Furthermore, in the periods directly preceding the updating of the shadow prices the price index could start to drift (since the shadow prices are no longer sufficiently representative). It should be noted though that in the empirical example using Australian data described below in section 6.4 there is no evidence of drift in the repricing results even though the sample period covers 14 years.

One practical advantage of imputation type methods (i.e., hedonic imputation, average characteristics, and repricing) over time-dummy type methods (including RTD) is that price indices on any desired breakdown of the index can be computed without re-estimating the hedonic model. For example, supposing one wants separate indices for larger houses (e.g., 3 or more bedrooms) and smaller houses (e.g. 1-2 bedrooms) or for two different regions within a country, these can be obtained by applying the imputation price index formulas specifically to these subsets of the data.

6.3. Some practical guidance on the use of hedonic methods

6.3.1. TREATMENT OF OUTLIERS

Prior to estimation of the hedonic models the data set should be checked for outliers. A distinction can be drawn between three types of outliers.

(i) Unusual residential dwellings

(ii) Structures misclassified as residential dwellings

(iii) Data entry errors

Outliers of the first type (e.g., large mansions) should in principle be retained in the data set. A dwelling with 50 bedrooms, however, is more likely to be a hotel than a mansion. A hotel is an example of a type (ii) outliers. When these can be identified they should be excluded. An example of a type three outlier could be a house recorded as having 30 bedrooms when in fact it has only 3

bedrooms. In this case an extra zero was accidentally added at the point of data entry. Type (iii) outliers should be removed from the data set.

In practice it can be difficult to tell whether a particular outlier is of type (i), (ii), or (iii). The important point is that in large data sets type (iii) outliers are the most common, and have the potential to seriously distort the estimated hedonic model. A standard solution to this problem is to simply delete observations with the top and bottom say 1% of house prices. Similar truncation rules can be applied to characteristics such as land area and floor space. For dummy variables like number of bedrooms, the variable can be capped at a maximum value such as 4 or 5. Higher values can be deleted or included in the highest category (eg., 4+ or 5+). NSIs should experiment with different cut-off thresholds for outliers. The treatment of outliers is also discussed in Annex E.

6.3.2. NUMBER OF OBSERVATIONS

The classification should be constructed and applied in such a way that the classes used in the hedonic estimation should have enough observations and, vice versa, where samples are used there should be sufficient observations to support the hedonic application. It is, however, difficult to state precisely what is the sufficient number of observations as this will depend not only on the heterogeneity of the housing market but also on the data needs of the particular application of hedonics. For example, in the time-dummy method the expected value of the exponential of the time-dummy coefficient is not exactly equal to the exponential of the time-dummy parameter. So the issue of bias as well as variance arises. The associated bias is often referred to as small sample bias: it diminishes when the sample size grows and can usually ignored in practice unless the sample size is extraordinarily small, as the bias will be small compared to the standard error. But the latter assumption should be checked. A final decision should be based on a detailed analysis of the data. As a rule of thumb, for all applications of hedonics there should be at least 20 observations for each variable that enters the regression. If there are no observations in some classes, then a joint regression should be considered.

6.3.3. KEY EXPLANATORY VARIABLES

An important issue is the choice of explanatory variables to be included in the hedonic equation. If some relevant variables — characteristics that can be expected to affect the price of a property — are excluded, then the estimated parameters of the included characteristics will suffer from omitted variables bias. The bias carries over to the predicted prices computed from the regression coefficients and to the hedonic indices. Where relevant information is missing and not entered into the hedonic regression, omitted variable bias will be present although its sign and magnitude is difficult to predict.

Experience suggests that the most important price-determining characteristics of a residential property that should be controlled for — either by applying a detailed classification or quality adjustment — are:

- Geographical location (e.g., postcodes): refers to which region or city the property is located in. Increasingly geospatial data (i.e., exact longitudes and latitudes) are available for each house. Hill and Scholz (2017) investigate the impact on a hedonic imputation price index of switching from controlling for locational effects using postcode dummy variables to using exact geospatial data modelled as a spline surface. Using a dataset for Sydney, Australia they find that the two indices are almost indistinguishable. It remains to be seen whether the same result holds for other cities. But their findings certainly suggest that postcodes may be sufficient to control for locational effects. If so this is good news for NSIs, since using postcodes is undoubtedly simpler.
- Micro-location and its desirability: variables describing the type of neighbourhood in terms of socio-demographic characteristics, ratings of schools, leisure and recreation facilities, good transport links etc. This type of data may be available from detailed census-files or from companies providing geographically targeted marketing information. In principle, though, such micro-level location data are not needed when exact longitudes and latitudes are available.

- Type of dwelling: flats, detached houses, semi-detached houses, terraced houses.
- Age of dwelling.
- Size of the dwelling: as measured in square meters of usable floor area. An alternative or additional measure could be number of rooms excluding corridors (or number of bedrooms), kitchens and bathrooms.
- Size of plot.
- Energy efficiency rating. Energy ratings could be a very useful proxy measure for the quality of the structure. Energy efficiency ratings have been included in a hedonic model estimated by Evangelista, Ramalho and Silva (2016) for Portugal.

6.3.4. ECONOMETRIC SPECIFICATION ANALYSIS

In any econometric analysis, including hedonic studies, various misspecification problems may affect the estimation of parameters. These problems may be directly related to the specification of the hedonic function or to deficiencies in the data so that the data does not adequately describe the target population. Misspecification problems cause inconsistencies in the estimators of the implicit prices and in the hedonic price indices. The most common misspecification issues relate to the choice of functional form for the hedonic function (e.g. handling the nonlinearities of the characteristics in an incorrect way), the omission of relevant explanatory characteristics, and the existence of parameter instability (the relationship between dwelling price and characteristic changes over time and/or the strata grouped together). It should be noted that heteroskedasticity in the error term distorts the variance of the OLS estimators but does not affect the consistency of the estimators. The detection of these problems is relatively straightforward by using specification tests. More detail is given in Annex E.

Sampling issues that may cause concern are: the existence of missing data and the related problem of endogenous sampling (which arises in cases where dwellings with particularly high or low prices are over-represented or under-represented in the sample); measurement error; excessive collinearity between the regressors; and unusual observations. Amongst these, the excess of collinearity — the sampling issue that has received perhaps the most attention in empirical studies on hedonic price indices for houses — is the one with less serious consequences, since in general it does not cause inconsistency in the OLS estimators. The detection of sampling issues is not a simple or straightforward issue, as for most cases the available literature merely provides rules of thumb.

For normal circumstances a simple strategy for specification analysis is recommended. Firstly a heteroskedasticity test should be deployed, since the existence of heteroskedasticity determines whether other tests (including the simple t and F tests for individual and joint significance of characteristics) can be deployed robustly and in standard forms. The Ramsey Regression Equation Specification Error Test (RESET) test is recommended for functional form specification. The RESET test is a general specification test for the linear regression model. More specifically, it tests whether non-linear combinations of the fitted values help explain the response variable. The reasoning behind the test is that if non-linear combinations of the explanatory variables have any power in explaining the response variable, the model is misspecified. If the null hypothesis of correct model functional form of the RESET test is not rejected, the index compiler can be relatively confident about the appropriateness of the specification chosen for the hedonic function. Otherwise, the model must be re-specified and, possibly, other tests may have to be employed - tests which are designed to detect particular forms of misspecification. Annex E gives more details.

Hedonic regression methods can be used in conjunction with stratification to deal with any residual quality-mix change that remains within the strata. This has the added advantage of dealing with the fact that different model specifications may be needed for different segments of the housing market or that the ‘value’ of some characteristics will vary across different market segments.

6.4. Two empirical examples

6.4.1. EXAMPLE WITH AN ARTIFICIAL DATASET

The first empirical example uses an artificial data set consisting of 16 transaction observations spread over two periods. The data set is listed below in Table 10. As can be seen from Table 10, all the explanatory variables are dummy variables with the exception of SIZE. Applying each of the hedonic methods described above generates the price indices shown in Table 11.

Table 10: An Artificial Data Set

Price	Region	Type	Size	Garage	Period
500	0	0	75	1	0
600	0	0	115	1	0
600	1	1	80	0	0
450	1	1	60	0	0
400	0	0	70	1	0
437	1	1	55	0	0
522	1	0	90	0	0
589	1	0	75	1	0
510	0	1	80	1	1
650	0	1	140	0	1
670	0	0	140	1	1
764	1	1	95	1	1
495	1	1	65	0	1
460	1	0	60	0	1
580	0	0	110	0	1
620	0	1	120	1	1

Table 11: Price Indices for the Artificial Data Set

	Price Index
TD	1.03774
Laspeyres	1.04407
Paasche	0.97214
Fisher	1.00746
Repricing	0.97214
Geomean	1.15612

The price indices in Table 11 all give the price level in period 2 with the price level in period 1 normalised to 1. For example a value of 1.03774 implies that the price level is 3.774% higher in period 2 than in period 1. The methods included in Table 11 are as follows: TD is the time dummy method; Laspeyres is the Laspeyres-type hedonic imputation method in (6.6) which here is the same as the Laspeyres-type average characteristics method in (6.10); Paasche is the Paasche-type hedonic imputation method in (6.7) which here is the same as the Paasche-type average

characteristics method in (6.11); Fisher is the geometric mean of (6.6) and (6.7) and of (6.10) and (6.11); The repricing method is defined in (6.13); Geomean is the ratio of the geometric mean price in the two periods and corresponds to the quality-unadjusted first term in (6.13).

A few comments are in order regarding the results in Table 11. First, the quality-adjusted hedonic indices are all lower than the quality-unadjusted ratio of geometric means. This implies that the average house sold in period 1 is of better quality than the average house sold in period 0. This can be seen for example in the SIZE variable, which has an arithmetic mean value of 77.5 in period 1 and 101.25 in period 2. Second, given there are only two periods here, the RTD method is the same as the time-dummy method. This is the reason RTD is not included in Table 11. Third, rather disconcertingly the hedonic methods disagree over whether (quality-adjusted) house prices have risen or fallen in period 1!

As noted previously, the time-dummy method estimates a single hedonic model that includes a dummy variables for houses sold in period 1. The estimated parameters are shown in Table 12. The PERIOD dummy in the time-dummy model equals 0.037. The corresponding t-statistic is 0.76. Given this is not statistically significantly different from zero at the 5% significance level, what should we conclude from this? According to the time-dummy method here prices rose by about 3.8% from period 0 to period 1. However, given that the 95% confidence interval includes zero, one cannot say with 95% confidence that the price level has actually risen. The insignificant t-statistic indicates a high level of heterogeneity and hence noise in the data. The wide spread of price indices in Table 11 (some saying that the price level has risen and others that it has fallen) is likewise a consequence of the low signal to noise ratio. In other words, when the PERIOD dummies are not significant this suggests either that prices have hardly changed or that there is a high level of heterogeneity in the data and hence the estimated price index for this period may be quite sensitive to the choice of hedonic method.

The other hedonic methods in Table 11 estimate separate hedonic models for periods 0 and 1. The estimated parameters for the period 0 and 1 hedonic models are also shown in Table 12. The TYPE and GARAGE characteristics are not significantly different from zero at the 5% level in any of the three hedonic models. Also it can be seen that the coefficient values in periods 0 and 1 are quite similar. The R-squared coefficients are quite high and lie in the range 0.84 to 0.87.

Table 12: Estimated Coefficients of the Hedonic Models for the Artificial Data Set

	Time-Dummy				
	Coefficient	Std. Err.	t-stat	[95% Conf. Interval]	
REGION	0.2389	0.0601	3.97	0.1049	0.3729
TYPE	0.0390	0.0454	0.86	– 0.0622	0.1403
SIZE	0.0067	0.0011	6.29	0.0043	0.0090
GARAGE	0.1342	0.0484	2.77	0.0264	0.2420
PERIOD	0.0370	0.0487	0.76	– 0.0715	0.1456
CONSTANT	5.4816	0.1183	46.32	5.2179	5.7453
R-squared	0.8544				
	Model estimated for Period 0 only				
	Coefficient	Std. Err.	t-stat	[95% Conf. Interval]	
REGION	0.2779	0.1144	2.43	– 0.0861	0.6419
TYPE	0.1530	0.1263	1.21	– 0.2490	0.5550
SIZE	0.0086	0.0024	3.55	0.0009	0.0163
GARAGE	0.2499	0.1405	1.78	- 0.1973	0.6972
CONSTANT	5.2046	0.2868	18.15	4.2918	6.1174
R-squared	0.8400				
	Model estimated for Period 1 only				
	Coefficient	Std. Err.	t-stat	[95% Conf. Interval]	
REGION	0.2327	0.1044	2.23	-0.0995	0.5650
TYPE	0.1530	0.1263	1.21	-0.1953	0.2728
SIZE	0.0086	0.0024	3.55	0.0009	0.0118
GARAGE	0.2499	0.1405	1.78	-0.1232	0.3472
CONSTANT	5.2046	0.2868	18.15	4.8951	6.2336
R-squared	0.8669				

6.4.2. EXAMPLE WITH A REAL DATASET FOR SYDNEY, AUSTRALIA

The second empirical example uses a real data set for Sydney, Australia obtained from Australian Property Monitors (APM) and covering the period 2001 to 2014. Quarterly hedonic price indices are computed over this period using the same methods as in the first example. In addition the RTD method is also considered with three different windows lengths (i.e., 2, 4, and 5 quarters).

The total number of observations in the data set is 49882. It should be noted that this is just a sample of all the houses sold in Sydney over this period. The sample is not necessarily representative. Hence the resulting price indices should not be interpreted as necessarily representing price developments in Sydney over this period. The objective here is simply to use this data set to compare alternative hedonic methods empirically.

The characteristics in the data set are as follows: number of bedrooms, number of bathrooms, land area, property type dummy (detached or attached), and region dummy (16 Residex regions). The RTD and time-dummy methods also include time dummy variables. The data set focuses only on houses (i.e., flats are excluded). The number of bedrooms and number of bathrooms are both converted into dummy variables. This allows greater flexibility (i.e., the effect on price of increasing the number of bedrooms from 2 to 3 is no longer constrained to be the same in percentage terms as

increasing the number of bedrooms from 1 to 2). The bedrooms and bathrooms range from 1 to 6. However, more than 4 bedrooms and 3 bathrooms are scarce. Hence the allowed values in the hedonic model of bedrooms are 1, 2, 3, 4, and 5-6, while for bathrooms it is 1, 2, 3, 4-6. In the time-dummy case there are also 56 quarters. In the RTD case, the number of quarters included depends on the length of the rolling window. For all the dummy variable categories, one value is chosen as the reference and is then excluded from the model. The defaults are 5-6 bedrooms, 4-6 bathrooms, attached property, and Residex region 1. In the case of the RTD method the default quarter is the first included in the rolling window, while for the time-dummy method it is the first quarter in 2001.

The price indices in the last quarter of 2014 for each method considered are shown in Table 13 (with a base value of 1 in first quarter 2001). As previously, TD is the time dummy method. RTD2 is the RTD method with a two quarter window. Similarly, RTD4 and RTD5 are RTD with 4 and 5 quarter windows. The other methods are the same as in Table 6.1 except that now the Laspeyres, Paasche and Fisher indices are chained. The TD result of 2.396 can be interpreted as saying that prices rose by 139.6 % between 2001 and 2014. The most striking aspect of Table 6.4 is how close the results are for the TD, RTD2, RTD4, RTD5, chained Fisher, and Repricing methods. For these methods the price indices in the last quarter 2014 range between 2.396 and 2.442. The chained Laspeyres and Paasche indices, however, seem to exhibit a significant amount of upward and downward drift respectively. These drifts seem to cancel out though when one takes the geometric mean of Laspeyres and Paasche as measured by Fisher. It is also worth noting that the quality-unadjusted geometric mean index is 2.664. Given that the hedonic indices are all lower than this, this implies that the average quality of housing in Sydney rose over the 2001-2014 period. In other words, a quality-unadjusted index has an upward bias.

Table 13: Price Indices for Sydney in Final Quarter 2014 (with Q1 2001 as the Base)

	Price Index
TD	2.39554
RTD2	2.39387
RTD4	2.44152
RTD5	2.42920
Chained Laspeyres	2.53819
Chained Paasche	2.29312
Chained Fisher	2.41254
Repricing	2.41505
Geomean	2.66383

Price indices for the whole 2001-2014 period, with first quarter 2001 as the base, are graphed in Figures 7 and 8. Figure 7 focuses on the TD, RTD2, RTD4, and RTD5 indices, while Figure 8 focuses on RTD5, chained Fisher, and Repricing. From Figure 7 it can be seen that the RTD price index is quite robust to the choice of window length. From Figure 8 it can be seen that the RTD5, chained Fisher, and Repricing price indices are almost indistinguishable.

Figure 7: Time-Dummy and RTD Price Indices

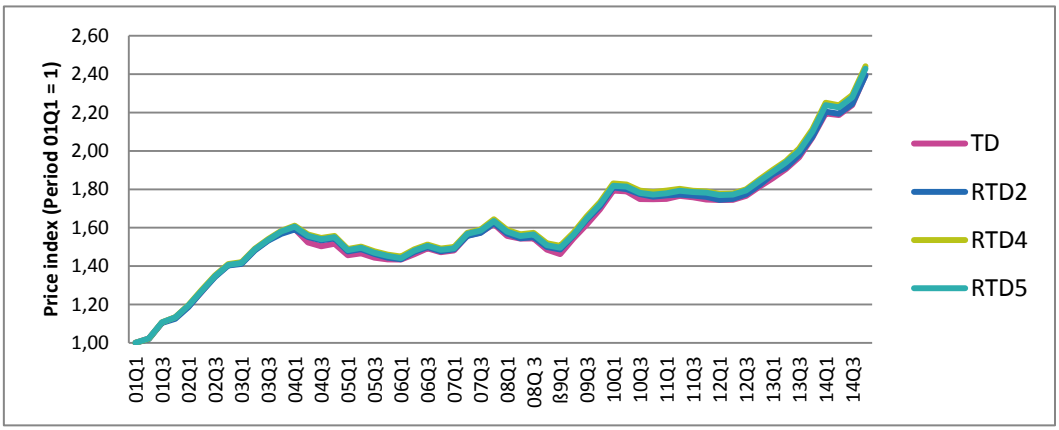


Figure 8: Repricing, Chained-Fisher and RTD5 Compared

The poor performance of chained Laspeyres and Paasche in Table 13 suggests that the biases in the individual bilateral comparisons between adjacent quarters compound when the index is chained. Hence it is important when chaining that a Fisher or Törnqvist price index formula is used.

A somewhat surprising feature of the results is the lack of drift in the Repricing index. The repricing method avoids the chain drift problem by making direct comparisons between each quarter and the first quarter in 2001. The repricing method, however, by always using the shadow prices of the first quarter as the reference for computing the quality adjustment term in (6.13) could be subject to a different type of drift (i.e., the reference shadow prices become gradually less relevant). Table 14 compares the shadow prices in first quarter 2001 with those in last quarter 2014. Also included in Table 14 are the time dummy shadow prices (excluding the PERIOD dummies). It can be seen that the shadow prices in 2001 and 2014 differ quite a bit. In light of this it is perhaps surprising that the Repricing index is so similar to the RTD5 and chained Fisher indices.

Table 14: Estimated Coefficients of the Hedonic Models for the Sydney Data Set

Time-Dummy					
	Coefficient	Std. Err.	t-stat	[95% Conf.	Interval]
bed1	-0.40 998	0.02 461	-16.66	-0.45822	-0.36174
bed2	-0.18 166	0.00 665	-27.33	-0.19469	-0.16863
bed3	-0.18 808	0.00 592	-31.78	-0.19967	-0.17648
bed4	-0.05 908	0.00 547	-10.8	-0.06979	-0.04836
bath1	-0.62 994	0.00 937	-67.25	-0.64829	-0.61158
bath2	-0.50 452	0.00 898	-56.2	-0.52211	-0.48693
bath3	-0.31 536	0.00 905	-34.84	-0.33310	-0.29762
AREA	0.00 029	0.00 000	63.91	0.00028	0.00030
PROPTYPE	0.10 388	0.00 715	14.53	0.08987	0.11789

Time-Dummy					
	Coefficient	Std. Err.	t-stat	[95% Conf.	Interval]
r1	0.11088	0.00831	13.35	0.09460	0.12716
r2	0.95675	0.01271	75.28	0.93184	0.98166
r3	1.43030	0.00842	169.89	1.41380	1.44681
r4	1.02371	0.00844	121.32	1.00717	1.04025
r5	1.22827	0.00914	134.42	1.21036	1.24618
r6	0.77990	0.00817	95.46	0.76389	0.79592
r7	1.57362	0.01189	132.32	1.55031	1.59693
r8	1.06495	0.00873	121.94	1.04784	1.08207
r9	0.72028	0.00797	90.4	0.70467	0.73590
r10	0.67210	0.00832	80.83	0.65580	0.68839
r11	0.35262	0.00794	44.42	0.33707	0.36818
r12	0.22428	0.00879	25.52	0.20705	0.24150
r13	0.46436	0.01025	45.3	0.44427	0.48445
r14	0.67908	0.00827	82.15	0.66288	0.69528
r15	0.61705	0.00872	70.78	0.59996	0.63413
R-squared	0.73350				

Model Estimated for First Quarter 2001 Only					
	Coefficient	Std. Err.	t-stat	[95% Conf.	Interval]
bed1	-0.29025	0.18331	-1.58	-0.65017	0.06966
bed2	-0.20202	0.06034	-3.35	-0.32050	-0.08355
bed3	-0.21061	0.05924	-3.55	-0.32693	-0.09429
bed4	-0.08424	0.05653	-1.49	-0.19523	0.02675
bath1	-0.37207	0.09286	-4.01	-0.55439	-0.18975
bath2	-0.28308	0.09148	-3.09	-0.46269	-0.10347
bath3	-0.06467	0.09620	-0.67	-0.25354	0.12420
AREA	0.00041	0.00003	12.35	0.00034	0.00047

PROPTYPE	0.02729	0.05182	0.53	-0.07445	0.12904
r1	0.20093	0.06146	3.27	0.08025	0.32161
r2	1.06433	0.10057	10.58	0.86687	1.26178
r3	1.60167	0.06831	23.45	1.46755	1.73579
r4	1.03579	0.06582	15.74	0.90655	1.16503
r5	1.32585	0.07753	17.1	1.17363	1.47807
r6	0.80750	0.06866	11.76	0.67269	0.94232
r7	1.79639	0.11571	15.52	1.56920	2.02358
r8	0.97274	0.06711	14.49	0.84097	1.10451
r9	0.81111	0.06189	13.11	0.68960	0.93262
r10	0.68249	0.06292	10.85	0.55896	0.80603
r11	0.40617	0.05985	6.79	0.28866	0.52368

Model Estimated for First Quarter 2001 Only

	Coefficient	Std. Err.	t-stat	[95% Conf. Interval]	
r12	0.33514	0.06430	5.21	0.20889	0.46138
r13	0.49901	0.08108	6.15	0.33982	0.65821
r14	0.70981	0.06469	10.97	0.58279	0.83683
r15	0.73602	0.06656	11.06	0.60534	0.86669
_cons	12.41405	0.12729	97.53	12.16413	12.66396
R-squared	0.72880				

Model Estimated for Last Quarter 2014 Only

	Coefficient	Std. Err.	t-stat	[95% Conf. Interval]	
bed1	-0.47645	0.27892	-1.71	-1.02416	0.07125
bed2	-0.06198	0.05257	-1.18	-0.16522	0.04125
bed3	-0.08860	0.04231	-2.09	-0.17169	-0.00551
bed4	-0.04422	0.03525	-1.25	-0.11345	0.02501
bath1	-0.60044	0.06810	-8.82	-0.73416	-0.46672
bath2	-0.44984	0.06251	-7.2	-0.57260	-0.32708
bath3	-0.32231	0.06139	-5.25	-0.44285	-0.20176
AREA	0.00031	0.00003	9.38	0.00025	0.00038
PROPTYPE	0.18736	0.12556	1.49	-0.05921	0.43392
r1	0.08644	0.06045	1.43	-0.03226	0.20514
r2	1.22010	0.09906	12.32	1.02558	1.41462
r3	1.47611	0.06475	22.8	1.34896	1.60327
r4	1.10095	0.06435	17.11	0.97459	1.22731
r5	1.28475	0.07315	17.56	1.14111	1.42839
r6	0.93202	0.05878	15.85	0.81659	1.04745
r7	1.52891	0.10372	14.74	1.32524	1.73259
r8	0.99127	0.06757	14.67	0.85858	1.12395
r9	0.86050	0.05547	15.51	0.75157	0.96943

r10	0.77753	0.05921	13.13	0.66127	0.89380
r11	0.52964	0.05642	9.39	0.41885	0.64043
r12	0.32013	0.06337	5.05	0.19569	0.44456
r13	0.69356	0.07880	8.8	0.53882	0.84829
r14	0.72907	0.05824	12.52	0.61470	0.84343
r15	0.62969	0.06003	10.49	0.51180	0.74758
_cons	13.30004	0.14941	89.02	13.00666	13.59343
R– squared	0.74200				

Inspection of the 55 RTD2 regression models reveals that the coefficient on the PERIOD dummy is significantly different from zero at the 5% significance level only 18 times, and insignificant the remaining 37 times. This finding illustrates that insignificant coefficients on the PERIOD dummies are a common feature of the RTD2 method. Insignificant PERIOD dummies become less common as the length of the rolling window increases since then the average time interval between the periods being compared and the base period becomes longer (and the price differences greater). For example, in the limiting case where the window length becomes 55 quarters (i.e., the time-dummy method) only one of the 55 PERIOD dummies is insignificant.

6.5. Other methods of compiling house price indices

This section reviews three alternatives to hedonic methods that can be used to construct quality-adjusted house price indices: stratification or mix-adjustment; repeat sales; and the SPAR method.

6.5.1. STRATIFICATION

There are several ways to control for quality change. As already suggested in section 3.6, the most basic way is to use an appropriate stratification strategy. Strata can be defined in a more detailed or less detailed way, according to specific national circumstances, such as the availability of data and the size and diversity of the housing market.

The aim of stratification is to control for quality differences by stratifying the house transactions that have taken place according to the main price determining characteristics of the houses sold. Assume that R strata are considered. After the calculation of an index for each stratum, the overall index can then be computed from a weighted-average of the stratum indices using expenditure weights. Stratification (otherwise known as mix-adjustment) could be applied to the situation described in the example given at the beginning of Section 6, where in a given period the majority of purchases are of cheap houses. Stratification will help if it is able to identify why they are cheap. For example, if the houses are cheap because of their geographical location then stratification by region should provide an adequate basis for re-weighting. The effectiveness of stratification in dealing with a change in the 'quality' mix of houses sold depends on whether there are other compositional factors also helping to account for the change in house prices, such as more flats than houses being sold.

The degree of quality adjustment depends naturally on the degree of detail of the stratification and its relevance, both of which are hard to determine empirically, since the introduction of more detailed stratification reduces the number of dwellings in each stratum and increases the statistical noise. On the positive side a very detailed stratification according to housing characteristics such as size of the structure, plot size, type of dwelling, location and amenities will increase homogeneity and thus reduce the quality-mix problem, although some quality mix changes will most likely remain. Thus there is a trade-off to be considered. Increasing the number of strata increases the effectiveness of stratification in terms of mix-adjustment but reduces the average number of observations per stratum, and a very detailed stratification might raise the standard error of the overall HPI. Stratification is dependent on the availability of data on the relevant characteristics of each transaction. However, it does not control for quality changes of the individual properties e.g. the effect of renovations and

remodelling done to properties or the effect of depreciation. Depreciation depends on the age of the structure and, additionally, depreciation rates can vary across different types of dwellings or across different locations.

The average price change in a stratum can be calculated using either the geometric mean formula in (6.14) or the arithmetic mean formula in (6.15).

$$P_t = \prod_h^{n(t)} \left[{p_{t,h}}^{1/n(t)} \right]$$

(6.14)

The arithmetic mean here is:

$$P_t = \frac{\sum_h^{n(t)} p_{t,h}}{n(t)}.$$

(6.15)

After constructing a measure of the average price change in each stratum using price indices based on (6.14) or (6.15), the aggregate mix-adjusted HPI is typically calculated as a weighted average of indices for each stratum. With M different strata, the mix-adjusted index, as calculated in practice in various countries, can be written as follows:

$$\frac{P_t}{P_0} = \sum_{m=1}^{M} w_0^m \, p_{0,t}^m$$

(8.16)

where $p_{0,t}^m$ is the index for stratum m which compares the mean or median price in the current or comparison period t with the mean or median price in an earlier or base period 0, and where w0m denotes the weight of stratum m. The weights are value shares of transactions applicable to the strata. They refer to the base period, which is usually a year, whereas the comparison periods may be months or quarters. For practical reasons, the weights are often kept fixed for several years, but keeping weights fixed for a long time is generally not good practice as they become increasingly out-of-date and unrepresentative.

It should be noted that the data requirements of stratification can be just as large as for those required for hedonics. The main advantage of the stratification over hedonics is that no econometric modelling is required. As this method controls for some heterogeneity, its combined application with other methods for dealing with the quality change issue should be considered. Stratification/mix-adjustment can be useful in dealing with issues like the parameter constancy in hedonic regression, or sample selection in the repeat sales and SPAR methodologies explained below.

6.5.2. REPEAT SALES METHOD

The repeat sales method only uses data on properties that have been sold at least twice. At each period data is collected on sales, but only those dwellings that have been sold on at least one previous occasion (i.e., a repeat sale) enter the index calculation. In the earlier example relating to the purchase of particularly cheap dwellings in a given period, the repeat sales method accounts for this by comparing the recurring sale prices of the same properties. One of the attractions of the repeat sales method is that it avoids the need for strata, and the availability of information on dwelling characteristics required by both the stratification and hedonic methods. The only information required is prices and unique identifiers for each dwelling. Also the standard repeat-sales regressions are relatively easy to run and the price indices easy to construct. However, the repeated sales method has three main drawbacks. First, each period may be too small to compute a reliable index. Second, there may be sample selection bias resulting from the fact that dwellings sold more frequently may be associated with particular characteristics such as those associated with starter homes designed

for small families new to the housing market. This is the so-called 'lemons' bias identified by Clapp and Giaccotto (1992). Third, the method relies on the assumption that the quality of a repeat-sales dwelling remains constant (i.e. it does not depreciate with use or age, or appreciate due to renovations between transactions). There is also the question of whether repeat-sales at different time intervals should be weighted differently in the repeat-sales formula.

6.5.3. THE SALES PRICE APPRAISAL RATIO (SPAR) METHOD

The SPAR method uses appraisals with a common reference period as base period prices in a standard matched-model framework. It improves the repeat sales method by matching pairs of property sales and appraisal values in such a way that all sales in a given period can be incorporated in the index and, simultaneously, the compositional changes in the universe of transactions are better captured. In the earlier example relating to the purchase of particularly cheap dwellings in a given period, the SPAR index adjusts for the change in the mix of dwellings transacted by comparing the sale price of the cheap dwellings with their appraisal values in the base period.

The SPAR index is compiled as a ratio of ratios.

$$\frac{P_t}{P_0} = \frac{\prod_{h=1}^{n(t)}\left(p_{t,h}\right)^{1/n(t)} / \prod_{h=1}^{n(t)}\left(A_{0,h}\right)^{1/n(t)}}{\prod_{h=1}^{n(0)}\left(p_{0,h}\right)^{1/n(0)} / \prod_{h=1}^{n(0)}\left(A_{0,h}\right)^{1/n(0)}}$$

(8.17)

where A_{i0} stands for the appraisals carried out in base period and P_{i0} the known transaction prices in the base period which are used to normalise the indices so they equate with 1 in the base period.

Apart from its ability to deal with changes in the compositional mix of dwelling transactions, the SPAR method is also simple to apply since no regression model is required. Also it is not subject to revision.

There are three main disadvantages with the SPAR method. First, in contrast to hedonics, changes in the quality of dwellings are not explicitly controlled in the SPAR method through an accounting of the characteristics of the dwelling, but rather by the assumption that the quality remains constant in the time between the appraisal and the transaction. This assumption may not be a realistic one in all cases. Second, the SPAR method is dependent on the reliability of the appraisals ([99]). The effectiveness of the SPAR methodology can be enhanced by applying it in conjunction with stratification. Third, it cannot incorporate the transactions of completely new houses that are built and sold between the appraisals and sales period. The exclusion of these houses may lead to sample selection bias ([100]). These two problems can be mitigated to a large extent by conducting appraisals regularly over relatively short periods of time.

The SPAR methodology addresses some of the weaknesses of the repeat sales methodology and is to be preferred to the latter if appraisal data of sufficient quality are available and if the sample selection bias associated with the repeat sales methodology is considered to be problematic. The SPAR method can be a good alternative to using hedonics if the necessary data is available and of reliable quality ([101]).

([99]) It would be better if the appraisals are all done simultaneously by independent and experienced valuers, in the same institution and according to the same valuation criteria so that valuations are uniform across the market and biased or implausible appraisal prices do not enter the calculation. That said, it can be seen from a simple inspection of formula (6.17), that if systematic biases exist (i.e. the biases are uniformly upward or downward then the index itself will still be unbiased.

([100]) The existence of short intervals between appraisals should mitigate this problem.

([101]) For studies comparing hedonics and SPAR, please refer to Vries, Paul de *et al* (2007), Rossini, P. and Kershaw, P. (2006), Bourassa, S. *et al* (2006). For an in-depth research on SPAR and its statistical properties check de Haan *et al* (2006).

6.6. Conclusions on methods for constructing house price indices

None of the three alternatives to hedonic methods (i.e., stratified medians, repeat-sales and SPAR methods) displays the ability of hedonic methods to explicitly capture the individual quality change of the dwellings to facilitate the isolation of the pure price movements. Therefore, subject to sufficient data being available on salient housing characteristics, the hedonic regression method is generally the best technique for constructing a constant quality HPI.

The empirical example using Australian data suggests that the HPI is quite robust to the choice of hedonic method when the choice is restricted to TD, RTD, chained Fisher, and Repricing. However, this is just one data set covering only a single city. Comparisons across a whole country could be more sensitive to the choice of method, as could comparisons based on smaller data sets.

The RTD method (e.g., with a five quarter window) is recommended as a reliable and robust way of computing the HPI that should perform well on both small and large data sets. Chained Fisher (Törnqvist) seems like an acceptable alternative to RTD for larger countries with more data. While Repricing performs well on the Sydney data set, the criticisms of it raised in Section 6.2 above should not be forgotten. Extrapolating the shadow prices of one period into the future is potentially problematic. It is recommended that NSIs avoid chaining Laspeyres or Paasche-type indices from one quarter to the next. At least for the Sydney data set such chaining seems to generate significant drift in the price index. Where possible, NSIs should experiment with alternative hedonic methods (such as varying the length of the rolling window when RTD is used). STATA programs for computing all the hedonic price indices discussed above are included in Annex F.

7. The price of land

In principle, a net acquisition-based index may or may not include the price of the land in which the new dwelling unit sits on. This point is nicely put by Diewert (2003: 6-7):

…The acquisition approach concentrates on the purchases by households of goods and services that are provided by suppliers from outside the household sector. Thus if the land on which a new house sits was previously owned by the household sector, then presumably, the cost of this land would be excluded from an acquisition type new house price index.…

However, the question of whether to include or exclude the land price element goes beyond the application of the net acquisition principle. In fact, this issue plays a key role in the definition of the derived price indices and, as a result, is very important to determine its coherence with the HICP.

The acquisition of a dwelling can be included in the scope of a consumption price index on the grounds that, by doing this, households are satisfying some of their needs through the consumption of shelter and other services ([102]).

However, and unlike the great majority of other products that households purchase, the acquisition of a dwelling can be regarded in addition as an 'investment' ([103]). This is to say that the total expenditure for the acquisition of a dwelling for own-occupancy encompasses both a consumption element and an investment element. The structure could be viewed as the consumption element and the land as the investment element (ILO et al, 2004: 184).

The relative importance of each one of these two elements can vary from country to country. For instance, it may be expected that the consumption element dominates in countries where the rental market is small and inefficient. In these situations, the need for shelter is essentially satisfied by the owner-occupied housing market. However, other considerations come into play, such as expectations about income returns from investments in the housing market, and these are not easily discerned.

How to disentangle these two elements from total acquisition price is, perhaps, the key issue to tackle and the one that will ultimately determine if what is being measured is household monetary expenditure or, as in the HICP case, household monetary *consumption* expenditure.

From a practical point of view, this separation between land and structure is difficult to make since land and structure are usually purchased as a 'single package' with one overall price. In this context, one possible way of dealing with this issue is simply to consider the full transaction price and use a 'net weight, gross price' approach (see Chapter 8, Table 15, Section E). This approach is already used in the treatment of insurance premiums in the HICP ([104]). In a housing context, a net/gross approach implies excluding land from OOH expenditure but included land in the OOHPI. The simplicity of its application is an important advantage of the method, as a net/net approach would require the development of a satisfactory way of separating land from structure.

But before tackling the issue of separating land from structure, it is important to begin by defining the concept of land.

7.1. Definition of land

In the SNA2008, land is defined as:

…the ground itself, including the covering soil and any associated surface waters over ownership rights are enforced. Excluded are any buildings or other man-made structures situated on it or running through it…

([102]) While some of these needs can be satisfied in the rental market (e.g. the need for shelter), others are exclusive to the non-rental market (e.g. the need for tenure security).
([103]) Another such investment would be, for instance, the acquisition by a household of works of art, antiques and precious stones.
([104]) Article 4 of Commission Regulation (EC) No 1917/1999.

According to the SNA2008, land is categorised as a tangible non-produced asset which is valued at current prices paid by a new owner, including costs associated with ownership transfer. Major land improvements such as the construction of dikes, dams, clearance of forests and public works for the prevention of flooding and erosion should be, at least in principle, included in the valuation of land.

For land underlying buildings, when the price of the land cannot be separated from the price of the structure that rests on top of it, the recommended approach in national accounts is to fully classify the composite good in the category representing the greater part of its value.

Although national accounts concepts provide a good basis for establishing a usable land definition, some areas remain unclear as to its correct treatment in the OOH context. For instance, is the cost of building basic infrastructures, such as surrounding roads and streets or public gardens to be included in the price of land or is this type of infrastructure to be taken into account elsewhere?

This is an important issue as the concept of land and its valuation can vary between countries leading to non-comparability.

7.2. Different approaches for constructing land price indices

Following Larson (2015), three approaches for constructing land price indices are considered here. All start from the basic premise that the value of a property V can be written as the sum of the value of the structure PS and the land PL on which it is built as follows:

$$V = PL + PS, \tag{7.1}$$

If now V in time period 1 (denoted by V1) is divided by V in time period 0 (denoted by V0), on rearrangement (7.1) yields the following expression:

$$V1/V0 = wL0\ (PL1/\ PL0) + wS0\ (PS1/\ PS0), \tag{7.2}$$

where V1/V0 denotes a house price index, (PL1/ PL0) is a land price index, (PS1/ PS0) is a price index for structures, and wL0 and wS0 are weights measuring the value shares of land and structures respectively. They are calculated as follows:

wL0 = PL0/(PL0 + PL1), wS0 = PS0/(PL0 + PL1), and hence wL0 + wS0 = 1. An adjustment should be made in (9.2) for any additions to the stock of land and structures between periods 0 and 1.

7.2.1. THE RESIDUAL METHOD

The residual method rearranges (7.2) as follows:

$$(P_L^1/\ P_L^0) = (1/w_L^0)\ (V^1/V^0) - (1 -\ w_L^0\ /w_L^0)\ (P_S^1/\ P_S^0). \tag{7.3}$$

The price index for land $(P_L^1/\ P_L^0)$ is then obtained as a residual once the house price index (V^1/V^0), structure price index $(P_S^1/\ P_S^0)$, and weight w_L^0 have been calculated. This approach can be applied at the level of individual properties or at the regional/national level. Davis and Heathcote (2007) use this approach to construct price indices for the aggregate stock of land in the USA. These authors use the Office of Federal Housing Enterprise (OFHEO) repeat-sales index as their house price index (V^1/V^0), while they use the price index for gross investment in new residential structures from the

National Income and Product Accounts (NIPA) as their structure price index (P_S^1/ P_S^0). The weight w_L^0 is obtained from the Bureau of Economic Analysis's series for the replacement cost of residential structures. One weakness of this approach though is that the value of a structure does not necessarily equal its replacement cost.

7.2.2. DIRECT ESTIMATION OF LAND PRICES

A price index for land can be obtained directly from sales data for vacant land and/or from tear-down sales. There are three main problems with using vacant land. First, a distinction must be made between building land and other land uses, such as agriculture or forests. Second, in some countries there may be very little vacant building land and hence transactions will be sparse. Third, what transactions there are may be primarily in rural areas and hence not representative of the urban housing stock. Nevertheless, Nichols, Oliner, and Mulhall (2013) find enough observations to use this approach to construct land price indices for the USA. Tear-downs provide a potentially useful additional source of data, particularly in urban areas. The price of a tear-down should equal the price of the land minus the demolition costs. This approach has been used for example by Dye and McMillen (2007) to measure land values in Chicago. It however also suffers from the criticism that the sample size may be too small and unrepresentative of the overall stock of land.

7.2.3. ECONOMETRIC METHODS FOR SEPARATING LAND FROM STRUCTURE

A number of papers have been written recently on this topic. Three such methods are considered here. The first is the method of Diewert, de Haan and Hendricks (2015) using data from the Netherlands, and Diewert and Shimizu (2015) using data for Tokyo. Here we will focus on Diewert and Shimizu. They estimate variants on the following nonlinear hedonic regression model:

$$V_h^t = a_t L_h^t + b_t(1- d_t)^{A(t,h)} S_h^t + e_{th}, \quad (7.4)$$

where V_h^t is the price of property h sold in period t. L_h^t is the land area of the property, A(t,h) is the age of the structure, and S_h^t is the floor space of the structure. The parameters to be estimated are a_t, b_t, and d_t, where d_t is the depreciation rate. The last term e_{th} is a random error. The imputed value of the land of house h in period t is obtained as follows:

$$P_{h,L}^t = \hat{a}_t L_h^t, \quad (7.5)$$

where $\hat{a}_t$ is the estimated value of the parameter a_t from the hedonic model. A land price index measuring the change in the land price from period t to t+1 is then obtained as follows:

$$P_{h,L}^{t+1} /P_{h,L}^t = \hat{a}_{t+1}/ \hat{a}_t. \quad (7.6)$$

Diewert and Shimizu identify two main problems with this approach. First, there may be a multi-collinearity problem with regard to land area and structure size, which if left unresolved will result in unreliable parameter estimates. Diewert and Shimizu resolve this problem by assuming that the price of new structures is proportional to an official index of condominium building costs denoted here by p_{tS}. In other words, b_t in (7.4) is replaced by bp_{tS}. The second problem is deciding how to allocate land across condo units. Two simple rules are to either allocate land shares in proportion to floor space, or to allocate an equal share of the land to each unit in the building. See Diewert and Shimizu (2015) for further details.

A second approach instead begins by estimating a functional relationship between floor space (or building volume) and construction cost, and also a depreciation rate. Given the construction cost, the age of a dwelling, and the depreciation rate, it is then possible to estimate the value of the structure.

As with the residual approach, the value of the land is then obtained by deducting the value of the structure from the price of the property. For example, Bourassa, Hoesli, Scognamiglio and Zhang (2011) assume that construction cost (C) is related to building volume (V) as follows: C = Vc, where c denotes the construction cost per cubic meter. Bourassa et al. have the volume of each property in their data set for Zurich. Construction costs per cubic meter are obtained for 2008 from the construction industry, and then extrapolated to other years using the Zurich construction cost index. A more sophisticated version of this approach is implemented by Francke and van de Minne (2016). Bourassa et al. use different depreciation rates depending on the assessed quality of the structure. The land price index is then obtained from a time-dummy hedonic regression, where the log of the land value is the dependent variable, and the explanatory variable are the available characteristics of the land which consist of land area, floor area ratio (the floor area divided by the land area), and macro and micro-location indices. Also included are time dummy variables, which when presented in the exponential yield the land price indices for each period (see chapter 6 for more details on the time-dummy method).

A third approach has been used by Rambaldi, McAllister and Fletcher (2015). They estimate hedonic models for land and structures for areas in Queensland, Australia, each as a function of the relevant characteristics. In the case of land these are land area and location. For the structure these are the size of the structure and age. The hedonic models are linked over time and to each other using the Kalman filter. The restrictions imposed by the Kalman filter offer an alternative for stabilizing the land and structure parameters to the Diewert-Shimizu method of using an exogenous price index for structures. Rambaldi et al. then compute their land price index using the hedonic imputation method (see Chapter 6).

Further conceptual and practical guidance concerning the estimation and valuation of land is given in the *Eurostat-OECD compilation guide on land estimation*. Luxembourg: Publications Office of the European Union, 2015. At this point in time the academic literature of estimating land prices has not converged to form a set of firm and prescriptive recommendations relating to practical measurement issues.

8. Evaluation of the price indices

8.1. Eurostat's quality dimensions

After the OOH price indices have been compiled an assessment needs to be made of the quality of the indices computed. First and foremost an evaluation needs to be undertaken of the extent to which the indices meet HICP requirements i.e. the extent to which the computed indices deviate from the target indices, using *Eurostat's Quality Framework for European Statistics*. *The ESS Handbook for Quality Reports* provides the reference documents for the latter (Eurostat, 2003). Quality is a multi-dimensional concept which is defined with reference to the following six criteria:

- relevance;
- accuracy;
- timeliness and punctuality;
- accessibility and clarity;
- comparability; and
- coherence.

Meeting the different dimensions of quality and the compliance with HICP requirements may entail latent trade-offs. For instance, when constructing a price index for new dwellings, the deployment of data on real market transactions is likely to lead to an increase in the time lag between the index reference date and the computation of the index. Other possible trade-offs include: indices calculated only over newly built dwellings are likely to be based on much smaller samples and hence may lack reliability; the use of the hedonic time dummy regression method would lead to revisions thereby undermining the appropriateness of the resulting indices in the context of the HICP which is non-revisable except in the case of errors ([105]).

8.2. The A/B/C classification

Preferred methods of index construction can be challenging to implement, particularly when the available data is limited, so in the interim NSIs may have to resort to acceptable but not optimum methods of index construction. The A/B/C classification system for statistical methodology could be applied in the evaluation framework of price indices relating to OOH. This classification, first given in *Eurostat's Handbook on Price and Volume Measures* (Eurostat, 2016), and already applied to some aspects of HICP computation, most particularly for quality adjustment, uses the following grading system:

- A methods: most appropriate methods/solution ([106]);
- B methods: methods which can be used in case an A method cannot be applied (i.e. 'acceptable/interim method' solution); and
- C methods*:* methods which shall not be used.

In the HICP context, the A/B/C classification has essentially been used in the definition of minimum standards for replacement and quality adjustment methods, either for specific products ([107]) or generically for all products ([108]).

([105]) However, this problem can be dealt with in circumstances where revisions are minor by using the time dummy method only to update the latest period. Also, the index can be kept reasonably current by using a rolling time dummy method. See Chapter 6.
([106]) In practice, for an index with a low weight, a 'B' method might be more appropriate than an 'A' method, if the 'A' method would lead to a significant increase of the administrative burden. A decision on this should include an assessment of the impact on the overall index of the adoption of a 'B' method compared with a more robust 'A' method. Also a 'B' method is recommended for the sake of inter-country comparisons. See entry E.1.1 in Table 15.
([107]) See, for instance, Eurostat (2005).
([108]) Commission Regulation (EC) No 1334/2007 of 14 November, amending Regulation on initial implementation measures for the HICP.

The underlying principle guiding the application of the A/B/C classification is the definition of an 'ideal' index against which an index is evaluated according to a number of pre-defined criteria.

Table 15 below, presents a recommended set of 5 evaluation criteria and 24 sub-criteria for an OOH index, based upon the more broadly defined quality dimensions mentioned in the previous section. For instance, the criteria termed as 'Reliability of data sources' (sub-criteria B.1) is rooted in Eurostat's *Accuracy* quality dimension. On the other hand, the sub-criteria C.2, named 'Production delay', is based on Eurostat's *Timeliness* quality dimension.

The similarity between Table 15 and Table 8 can be noted. The evaluation grid depicted in Table 15 is, in effect, an extension of Table 8 and the ten desired characteristics for an OOH index — in accordance with the A/B/C classification scheme.

The metadata description of used methods for the compilation of OOH price indices should be based on standardised Euro SDMX Metadata Structure ([109]).

Table 15: Evaluation Grid

Criteria		A **Most appropriate method/solution**	B **Acceptable/interim method/solution**	C **Method which shall not be used/solution**
A	**Relevance**			
A.1	**Overall user needs**	OOHPI and HPI indices are being produced in accordance with HICP standards and the recommendations in the manual.		Outputs are not produced or do not meet the recommendations in the manual and no corrective action is planned.
A.2	**Specific user needs**	Indices are being produced with the level of detail that is required in relevant regulations.		Sub-indices are not being produced.
B	**Accuracy**			
B.1	**Reliability of data sources**	Data sources are representative of the country and adequately portrait the evolution of OOH transaction prices, at the time of the first binding contract, and of other OOH costs — in both cases to the required frequency and timeliness.	Data sources are **not** representative of the country and do **not** adequately portrait the evolution of OOH transaction prices, at the time of the first binding contract, and of other OOH costs — or in both cases are **not** to the required frequency and/or timeliness. Plans for tackling reliability timeliness	Data sources are **not** representative of the country and do **not** adequately portrait the evolution of OOH transaction prices, at the time of the first binding contract, and of other OOH costs — or in both cases are **not** to the required frequency and/or timeliness. No proposal on how to solve the problem exist.

([109]) Eurostat (2008), *The Euro-SDMX Metadata Structure and Quality Indicators: A new template for reference metadata*, available on: http://unstats.un.org/unsd/accsub/2008docs-CDQIO/Ses1-Pap4.pdf.

Criteria		A Most appropriate method/solution	B Acceptable/interim method/solution	C Method which shall not be used/solution
			and frequency of computation exist	
B.2	**Data validation and model specification**			
B.2.1	Data validation procedures	Robust data validity controls are implemented at lower levels of the compilation process (e.g. to spot data processing errors). In case of survey data, non-response errors are reported and the impact assessed.	Rudimentary data validity controls are implemented at lower levels of the compilation process. Plans for introducing more robust checks to spot problems exist.	No data validation procedures exist.
B.2.2	Model specification (where relevant)	Model specification is based on all relevant characteristics. The presence of misspecification errors is routinely assessed.	Model specification is based on a limited set of relevant characteristics. A review of characteristics data and their use in the model exist.	Model specification is based on a limited set of relevant characteristics. There are no plans for tackling this problem.
B.3	**Revision policy**	Depending on the method used, routine revisions can be expected, in general up to Q+4; back revisions may occur with significant sources and/or methodological changes.		
C	**Timeliness and punctuality**			
C.1	**Periodicity**	Quarterly		
C.2	**Production delay**	Transmitted to Eurostat at t+85		
C.3	**Frequency of output delivery**	Quarterly		
D	**Accessibility and clarity**			
D.1	**Metadata**	The OOHPI and HPI are described in separate common	Incomplete description or not in accordance with the	Non-existent

Criteria		A Most appropriate method/solution	B Acceptable/interim method/solution	C Method which shall not be used/solution
		data dissemination templates	harmonised template	
D.2	**Detailed methodological description**	A complete methodology on OOHPI/HPI is available	Partial descriptions of procedures on the compilation of the OOH/HPI indices exist	No description of compilation methods
E	**Coherence and Comparability**			
E.1	**Conceptual framework**			
E.1.1	Use of net acquisition approach for the OOH price index	the net/gross approach is used (i.e. excluding land value from weights but including land value prices — even if the net/net approach is feasible) ([110])	The net/gross approach (i.e. excluding land value from weights but including land value prices). In this case the 'A' & 'B' methods are the same,	Gross/gross approach (i.e. including land value both in weights and prices)
E.1.2	Index formula	Laspeyres-type, annually chained index		
E.1.3	Price concept	Full transaction price as registered when sale is completed.	Transaction price recorded prior to sale and not subsequently confirmed.	Expert estimate (e.g. bank or other kind of appraisal, Real Estate company evaluation),
E.1.4	Timing for pricing	When first binding contract is signed.	When offer price accepted subject to contract (i.e. the price has been agreed but there is no binding contract).	When property first advertised for sale with an advertised price.
E.1.5	Weight revision	Annually.		Regular frequency, but less than yearly; Irregular and uncertain.
E.1.6	Scope and coverage	Index aimed to be representative of all relevant monetary transactions.	Minor share of transactions (e.g. cash transactions) excluded. Exclusions quantified.	An important part of transactions are excluded with no explanation.
E.1.7	Index nomenclature	According to Regulation 93/2013.		

([110]) The net/net approach classified as an 'A' method is difficult to achieve in the short term by most countries and represents at the time more an ideal than a requirement. Therefore the net/gross approach should be used (even if the net/net approach is feasible) based on reasons of comparability of results between countries. However, for countries with a large self-built component, it might actually be very difficult to achieve the net/gross approach, because land and house are not purchased at the same time or from the same seller. At the moment both the net/net and the net/gross approaches are applied by Member States — net/net by those countries with a large share of self-builds and the net/gross approach by the other countries.

Criteria		A Most appropriate method/solution	B Acceptable/interim method/solution	C Method which shall not be used/solution
E.2	**Internal coherence**	Overall indices and their subdivisions are consistently calculated.	Slight divergences found and not explained.	Total inconsistency in the data.
E.3	**External coherence**	Full consistency between HPI and OOHPI data sets and coherence with other available data on the housing market within the framework of a global analytical approach and taking into consideration the effect of different coverage and concepts.	Minor inconsistencies resulting from the drawing of data from different sources for different aspects of OOH costs. No plausible explanations.	Major inconsistencies and a lack of coherence with no explanations.
E.4	**Geographical coverage**	Indices representative of the whole national territory.	Indices exclude some geographical areas without impinging on representativeness.	Significant parts of the country are not covered. Indices not representative of national territory.
E.5	**Sub-indices coverage**	The indices present no relevant exclusions according to OOHPI/HPI scope.	Some sub-indices not yet covered. Plans exist to achieve complete coverage (OOHPI and HPI scope).	No sub-indices computed/published.
E.6	**Treatment of quality change**	Use of an appropriate technique (e.g. hedonics or SPAR method) combined with stratification.	Stratification using variables determined on the basis of statistical analysis.	None (‘unit value approach’) Coarse stratification.

9. Some empirical considerations

9.1. Differences in the proportion of households in OOH across countries

The scope for non-comparability issues to arise increases with the relative importance of owner-occupied housing and the related expenditure in the economy. Table 17 presents the percentages of households in owner-occupied dwellings in each of sixteen European countries. The importance of the owner-occupied housing market varies significantly between countries, ranging from 42% in Sweden to 95% in Romania. The owner-occupier rates are highest in the CEE countries as well as in the more southern member states (Spain 78.9%, Italy 71.6%, and Greece 73.2%), while the lowest owner-occupier rates exist in Sweden (42.2%) and Germany (45.4%). Other things being equal, the bigger the share of the OOH the more impact it will have on the HICP. The HICP in Germany and Sweden should therefore be less sensitive to the treatment of OOH than the HICP in eastern and southern European countries. Other more detailed studies have also shown that the share of OOH is not distributed equally across individual member states either — with rented accommodation being relatively more important in the national capitals. For example, while Austria has a national average of 40% rented accommodation; about three quarters of dwellings in Vienna are rental dwellings, but only one quarter of dwellings in the Burgenland province of Austria fall into this category. This type of variation could cause bias if data collection is more focused on larger cities ([111]).

Table 17: Share of owner-occupied and rented dwellings, selected NUTS level 2 regions, 2011 (% of all dwellings)

	Owner-occupied dwellings			Rented dwellings		
	Region with the highest share		National average	Region with highest share		National average
EU (*)	Sud-Vest Oltenia (Romania)	97.7	64.3	**Wien (Austria)**	75.7	29.4
Belgium	Prov. Limburg	75.0	65.0	**Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest**	61.4	34.1
Bulgaria	Severozapaden	86.7	81.7	**Yugozapaden**	22.7	18.3
Czech Republic	Střední Čechy	66.5	55.9	**Praha**	34.0	22.4
Denmark	Sjælland	61.5	52.5	**Hovedstaden**	43.3	39.0
Germany	Saarland	62.2	45.4	**Berlin**	74.6	49.4
Estonia	-		82.0	-		8.7
Ireland	Border, Midland And Western	72.9	69.7	**Southern And Eastern**	27.6	26.3
Greece	Dytiki Makedonia	80.6	73.2	**Attiki**	26.6	21.7
Spain	País Vasco	84.2	78.9	Ciudad Autónoma de Melilla	24.1	13.5
France	Bretagne	66.6	57.7	**Île de France**	49.3	39.7
Croatia	:	:	:	:	:	:
Italy	Friuli-Venezia Giulia	77.1	71.6	Campania	19.1	13.1
Cyprus		-	69.0	-		18.8
Latvia		-	68.7	-		13.2
Lithuania		-	88.6	-		5.3
Luxembourg		-	62.9	-		24.4
Hungary	Észak-Alföld	93.7	91.6	**Közép-Magyarország**	9.2	7.1
Malta		-	60.4	-		19.9
Netherlands	Zeeland	64.5	55.6	**Noord-Holland**	49.3	42.4
Austria	Burgenland	75.7	51.9	**Wien**	75.7	40.0
Poland	Świętokrzyskie	89.0	77.1	Dolnośląskie	24.5	18.0
Portugal	Centro	80.8	72.5	**Lisboa**	27.3	19.9
Romania	Sud-Vest Oltenia	97.7	94.7	**Bucureşti - Ilfov**	5.2	3.2
Slovenia	Vzhodna Slovenija	78.6	78.0	Vzhodna Slovenija	10.4	9.3
Slovakia	Stredné Slovensko	86.6	86.1	Stredné Slovensko	2.7	2.3
Finland	:	:	:	:	:	:
Sweden	Småland med öarna	53.2	42.2	Västsverige	36.9	34.4
United Kingdom	Cheshire	73.1	64.3	**Inner London**	63.1	34.3
Iceland		-	71.3	-		14.1
Liechtenstein		-	51.1	-		47.2
Norway	Agder og Rogaland	71.5	62.8	**Oslo og Akershus**	25.2	22.8
Switzerland	Ostschweiz	43.3	36.3	Zürich	62.4	56.2

(*) Note that other ownership models exist in some countries (cooperative ownership or other types of ownership). Regions in **bold** typeface are capital city regions.
(²) Excluding Croatia and Finland.
Source: Eurostat (Census hub HC41)

Source: http://ec.europa.eu/eurostat/statistics– explained/index.php/File:Share_of_owner–occupied_and_rented_dwellings,_selected_NUTS_level_2_regions,_2011_%28%C2%B9%29_%28%25_of_all_dwellings%29_PF15.png

([111]) Additionally, with capital cities displaying a much larger proportion of rental accommodation than rural areas, the interpretation of relative changes in rental via owner-occupier rates is no longer straight-forward. An increase in rental rates in a particular country could reflect a drop in housing affordability, but it could also be the result of increased urbanization. Further research into this area is needed.

9.2. **Differences in the treatment of land in OOHPI**

The net acquisition approach dictates that both the prices and expenditures on new dwellings in the OOHPI should exclude land. This approach, labelled as the net/net approach, is considered the theoretical ideal (see Chapter 8 above). However, due to data availability issues the distinction between land and structure for new homes is not always feasible for all member states and many countries will therefore follow the net/gross approach, meaning that land values are excluded from weights but included in the price index of the OOH. For consistency reasons, it has therefore been suggested that all countries should use the net/gross approach. However, this may be challenging for some countries due to underlying differences in the housing markets across Member States (see Table 15 in Section 8.2 of Chapter 8 and corresponding footnotes),

Member states differ in the way new homes come onto the market ([112]). In some countries (e.g. the UK) developers play a major role, while in others (e.g. Slovenia, Austria) most new houses are self-builds. While a developer sells a complete new home including land, self-builders purchase the land separately, prior to construction (often years in advance). Thus, any purchase prices negotiated with building firms will not include the cost of land, which means that Statistical Agencies when gathering data for the OOHPI will generally find it impossible to link the structure with the corresponding land ([113]).

([112]) Structural differences in the housing market across Member States can come from a variety of sources: the availability of building land, the laws governing zoning regulations, or even the school system, as with a dual education system a larger proportion of the population has learnt a 'trade' and can therefore attempt to build their homes themselves.

([113]) Even if no systematic investigations exist about the impact of these differences on the OOHPI, it seems that the volatility of OOHPI could be affected. Some inferences can be drawn already: there is evidence that land (especially in good areas) is prone to increase more strongly than building costs during boom times. Evidence of this extra price pressure on land prices has been presented in Rambaldi et al (2011), who showed that for Brisbane, Australia, the land component of house prices increased from 42% in 2000 to 66% in 2010.

Glossary of main terms

Acquisition approach:

A theoretical construct in which the expenditure weights of a house price index are based on the full acquisition cost of a product to households. In this approach, the moment in which the commodity is consumed or paid for are not taken into account for index building purposes.

All dwellings index:

A price index covering all dwelling purchases, regardless of having been acquired by the household or non-household sector (e.g. private firms). This index covers all transactions carried out within the non-household sector and the transactions of dwellings that the non-household sector has purchased from the household sector. The scope of this index is broader than the one covered by the House Price Index (see below).

Hedonic regression method:

A statistical technique used for the adjustment of the change in the quality of products by regressing prices on characteristics. In a house price index context, this technique can also be used to tackle changes in the composition of each period's available market transactions of dwellings. Variants of this technique include the time dummy variable method, the characteristics price method and the hedonic re-pricing method.

New dwelling:

In this manual, a 'new dwelling' refers to newly built dwellings and self-built dwellings. It therefore refers to any flat, detached house or to any other type of a housing unit that is 'new' to the household sector (i.e., that increases the stock of housing units available for households' own use). The concept of 'new' has nothing to do with the age of the dwelling nor identifies if it was previously occupied or not.

Net acquisition:

In the net acquisition approach, only the expenditures that add value to the household sector are taken into account for index building purposes. Transactions of dwellings which are carried out within households are treated symmetrically and cancel out in this approach. Likewise, all dwelling conversions, major renovations and repairs that add something new to the household sector are included. Land should, in principle, be ruled out from the scope of this approach because it is a non-reproducible asset whose availability is fixed no matter how many transactions of dwellings are carried out throughout time.

OOH index:

House price index covering new dwellings, existing dwellings that are new to the household sector, other services related to the purchase of a dwelling, major repairs and maintenance, insurance connected with the dwelling and other services associated with ownership of dwellings. This index follows HICP requirements, is built based on the net acquisition approach and is weighted by the value of transactions of dwellings new to the household sector.

Owner-occupied housing:

All housing units owned and used by households. From a national accounts point of view, households living in their own houses are treated as unincorporated enterprises producing a flow of shelter services for their own use. A consumer price index following a strict national accounts perspective would preferentially have to estimate this consumption component as no market is available for the value of this service flow and as the acquisition of residential structures for own use is defined as gross fixed capital formation. (Secondary homes and dwellings which are acquired for the purposes of vacations are covered by this concept as long as they are used for the purposes of (temporary) own use.)

Payments approach:

A theoretical construct in which a house price index is built upon expenditure weights derived from actual payments made by households. In this approach, the moment in which the commodity is consumed or actually acquired are not taken into account for index building purposes.

Quality adjustment:

It refers to *…the procedure of making an allowance for an observed quality change by increasing or decreasing the observed current or reference price by a factor or an amount equivalent to the value of that quality change…* (Source: Regulation (EC) No 1334/2007).

Reliability:

It refers to 'precision' which, in turn, is measured according to the scale of sampling errors. See also 'Representativity'. (Based on Regulation (EC) No 1334/2007).

Representativity:

It refers to the lack of bias. (Based on Regulation (EC) No 1334/2007) Bias can occur, for instance, when concepts and definitions are wrongly perceived and applied in the construction of indices. The reliability and representativity combined provide a better measure of the quality of an index than looking at these two dimensions in isolation.

Second-hand dwellings:

In the context of this manual, 'second-hand dwellings' are divided into 'existing dwellings' (e.g. that increase the value of the dwelling stock available to households) and 'second-hand dwellings not new to the household sector'. This definition does not have anything to do with the age of the dwelling nor with its use.

Self-builder:

A self-builder can be characterised as someone that acts as his own developer. In most economies, it is expected that only a small percentage of all self-builders get directly involved in the building work themselves. It is thus expected that most of self-builders will administrate the building process either by contracting out a single builder/company or by making use of several sub-contractors which will be employed in different phases of the building work. Although the characteristics of a self-built dwelling will ultimately vary from country to country, they will typically consist of detached houses built on a plot of land already owned by the self-builder.

Self-builders index:

An index whose scope is constituted by all new dwellings built by households. In this situation households act both as producers and buyers.

House Price Index:

An index covering all market transactions of newly built and existing dwellings by households. This index is weighted by the gross value of transactions and, contrary to OOH indices, it does not exclude the price of land.

Stratification:

A statistical technique used for the construction of house price indices. The application of stratification involves the segmentation of the housing market by some of its price determining characteristics (e.g. by the use of geographic or micro-location variables). This technique can also be regarded as a special case of hedonics and be applied in combination with the adjustment for changes in quality.

Use approach:

A theoretical construct in which a house price index is built upon expenditure weights derived from the value of the service provided to owner-occupiers. As there is no market value for the value of such services, it has to be estimated based on the value of alternative best use of resources (e.g. use of resource in the rental market instead of using it for its own-consumption). Variants of this approach often fall into either what is known in the literature as the rental equivalence approach or the user cost approach.

List of abbreviations

ABS	Annual Business Survey
CF	Correction Factor
COICOP	Classification of Individual Consumption According to Purpose
COLI	Cost of Living Index
CPI	Consumer Price Index
DIY	Do-It-Yourself
ECB	European Central Bank
ERFCF	Expenditure on Residential Fixed Capital Formation
ESA	European System of Accounts
ESS	European Statistical System
EU	European Union
EXPR	Expenditure on Rentals for Housing
FISIM	Financial Intermediary Services Indirectly Measured
GFCF	Gross Fixed Capital Formation
HBS	Household Budget Survey
HEPI	Household Expenditure Price Index
HFMCE	Household Final Monetary Consumption Expenditure
HICP	Harmonised Index of Consumer Prices
HPI	House Price Index
ILO	International Labour Organisation
LCF	Living Costs and Food
LCI	Living Cost Index
NACE	Nomenclature generale des Activites economiques dans les Communautes Europeennes
NSI	National Statistical Institute
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
ONS	Office of National Statistics (UK)
OOH	Owner-Occupied Housing
OOHPI	Owner-Occupied House Price Index
PPI	Producer Price Index
RESET	Ramsey Regression Equation Specification Error Test
RPI	Retail Price Index
RPPI	Residential Property Price Index
RTD	Rolling-time-dummy
SDMX	Statistical Data and Metadata eXchange
SNA	System of National Accounts

SPAR	Sales Price Appraisal Ratio
VAT	Value Added Tax
WLS	Weighted Least Squares

Annexes

A: Example of Questionnaire on new dwellings ([114])

Purpose of the survey:

This survey collects information that is going to be used in the calculation of price indices for new residential property homes. This information is essential to the building of a number of important economic indicators.

The information gathered by this survey will only be used for the purposes of calculating aggregate information statistics. Individual information will be maintained **confidential**.

Section A: General characterisation of the dwelling

1. Location and type of dwelling

Location Municipality: …… NUTS area: ……

of the dwelling Town: …… Postal code: ……

Type of dwelling
1– Detached house ☐
2– Flat ☐
3– Other (specify below) ☐
……..

2. Date in which the dwelling was sold ……. / ……. / …….

3. Price of the dwelling ……€

4. Other expenditures

Notary's expenditure

……..€

Transfer Tax and other taxes

……..€

Registry fee

……..€

5. Total floor area (in square metres) ……..

6. Total usable floor area (in square metres) ……..

7. Number of floors ……..

8. Number of rooms ……..

([114]) This annex presents a general example of how a questionnaire would look like. In practice it is likely that statistical compilers need to adjust it to their national specificities, regarding for instance the characteristics that influence the price or the various taxes and assessments involved in the transaction process.

Section B: Qualitative information about the house

1. Number of bathrooms……..

2. Does it have central heating?

No ☐

Yes☐

3. How would you describe the quality of the neighbourhood?

a) In terms of its surroundings

Quiet ☐

Noisy ☐

b) In terms of access to basic infrastructure (such as shops, transports, health services, schools, etc)

Very Good ☐

Good ☐

Poor ☐

Extremely Poor ☐

4. Facilities of the House

Garage ☐

Swimming Pool ☐

Basement ☐

Storage Attic ☐

Other (please specify below) ☐

5. Details of person that should be contacted in case of queries

……..

6. Additional comments

……..

Date and signature of person answering this questionnaire

……. – ……. – …….

B: Elements of an index for self-builders

For construction of indices for self-builders (and also for major improvements and major repairs and maintenance), some or all of the elements of the following list might be considered. The purpose of this list is to provide an overview about the range of the coverage, it should not be deemed to be comprehensive.

Possible elements for an index for self-builders

Construction steps	Detailed description
building site equ.	
earthwork	humus excavation
	excavation
	excavation of foundation and pipe trench
	expenses for landfill
	Anti-icing protection for pipe trench
	gravel
	base frame for concrete
foundation	band foundation B160
	structural steel grid two-part
	formwork for foundation plate, concrete
	base concrete, 12 cm
cellar	concrete walls: casing, reinforcement, concrete, gravel concrete
	gravel concrete
	PVC grommet for channel, water
	cellar ceiling
	ceiling joist: casing, reinforcement, concrete
	internal partition
	vertical insulation outer wall
	horizontal insulation
	well synthetic
	perimeter insulation
building shell	ground floor: brickwork
	supporting wall
	internal partition
	ceiling joist: casing, reinforcement, concrete
	ground floor ceiling
	walls for gable
	reinforced concrete pillar
	walls for truss
	separating plate
	chimney
	wall for garage
	ceiling for garage
channel	slop channel
	rain water channel
	sump
	leaching cesspool
	inspection chamber
cladding	exterior rendering with silicate coating
	window sill outside
	scaffold
	paintwork for cladding
staircase	stairs outside with wall made of reinforced concrete
	cellar staircase
	interior staircase from ground to first floor
	staircase to entrance door with platform

Construction steps	Detailed description
	stair to the terrace
	spiral staircase
insulation for flat roof	insulation and blacktop work
	plate work
carpenter work	truss
	casing, board, lath
	construction of dormer
	construction of gable dormer
roofer work	roofer work
	roofing and cutting of the whole roof area
	gable
Tin-smith work	tin-smith work with cooper
	tin-smith work with aluminium
	lightening protection
	gable Al or Cu
	bordering of chimney
windows	architrave for cellar windows
	different windows
	cogging windows
sanitary installation	installation of sanitary pipes
	sanitary equipment including armature
electricity installation	electricity, switchers, fuses
interior rendering	indoor window sill
	interior rendering cellar
	interior rendering ground floor and roof floor
	structure render
completion of the interior	ceiling
	completion of the roof including insulation and cement board
	delivery and installation of sliding staircase in conical floor
	cement board walls
heating installation	heater elements and hot water
	floor heating
floor construction	thermal insulation, subsonic noise insulation
	floor pavement
	plates for subsonic noise insulation
doors	entrance door
	architraves
	different doors
	cogging indoors
	E-drive for garage door
railing for balcony and stairs	railing for balcony
	railing for stairs
painter	painter work
	painting of timber set
tiler	terrazzo plates
	floor tiling
	wall tiling
floorer	floor made of shelves
	parquet
	covering indoor stairs with wood
	handrail
outside facilities	paving stones
	border of grass
	stone paving
	construction of base frame
	terrace pavement

Construction steps	Detailed description
	base concrete
special equipment	demolition of asset including landfill
	water decalcification, water preparation
	construction of balcony railing
	vacuum cleaner system
	solar system
	swimming pool
	technique for swimming pool
	foil for swimming pool
office work and planning work	preparation of plans
	preparation of construction plans
	construction Management

C: Price index for other services related to the purchase of a dwelling

Example of calculation of equation (3.10):

Expenditure in services related with the acquisition	$r_{i;t}$	$r_{i;0}$	$\frac{r_{i;t}}{r_{i;0}}$	$e_{i;0}$	$e_{i;t}$	$I^t_{i;0}$	$r_{i;0} \cdot e_{i;0}$	w_i	$_{costsP} I^t_0$
Total expenditure with the purchase				195.853.226	173.427.568	0,89			
Mortgage	*0,20%*	*0,15%*	1,33				293.780	0,01	0,01
Notary fee + VAT (20%)	*1,20%*	*1,20%*	1,00				2.350.239	0,09	0,08
Land registry	*0,50%*	*0,50%*	1,00				979.266	0,04	0,03
Legal fees (Lawyer or solicitor) + VAT (20%)	*1,80%*	*1,80%*	1,00				3.525.358	0,14	0,13
Real Estate Broker + VAT (20%)	*0,60%*	*0,60%*	1,00				1.175.119	0,05	0,04
Transfer tax or VAT	*7,00%*	*8,00%*	0,88				15.668.258	0,63	0,49
Stamp duty	*0,50%*	*0,50%*	1,00				979.266	0,04	0,03
t=2010							24.971.286	1,00	**81,95**
0=2005									

Example of calculation of equation (3.15)

Expenditure in services related with the acquisition	$f_{i;t}$	$f_{i;0}$	$\frac{f_{i;t}}{f_{i;0}}$	$q_{i;0}$	$f_{i;0} \cdot q_{i;0}$	w_i	$_{F\,costsP} I^t_0$
Total expenditure with the purchase				1.306			
Mortgage	*200*	*200*	*1,00*		261.138	0,08	0,08
Notary fee + VAT (20%)	*128*	*128*	*1,00*		167.128	0,05	0,05
Land registry	56	56	*1,00*		73.119	0,02	0,02
Legal fees (Lawyer or solicitor) + VAT (20%)	1500	1300	*1,15*		1.697.395	0,54	0,62
Real Estate Broker + VAT (20%)	800	700	*1,14*		913.982	0,29	0,33
Stamp duty	48	36	*1,33*		47.005	0,01	0,02
t=2010					3.159.765		**112,89**
0=2005							

Example of calculation of equation (3.16):

Expenditure in services related with the acquisition	$f_{F;0} \cdot q_{F;0}$	$r_{i;0} \cdot e_{i;0} + f_{F;0} \cdot q_{F;0}$	$w_{r;0}$	$\left(\frac{r_{i;t}}{r_{i;o}} \cdot I_{i;o}^{t} \cdot w_{r;0}\right)$	$w_{F;0}$	$\left(\frac{f_{F;t}}{f_{F;0}} \cdot w_{F;0}\right)$	$PCostsI_0^t + FCostsI_0^t$
Total expenditure with the purchase							
Mortgage	261.138	261.138			0,01	0,01	0,01
Notary fee + VAT (20%)		2.350.239	0,12	0,11			0,11
Land registry	73.119	73.119			0,00	0,00	0,00
Legal fees (Lawyer or solicitor) + VAT (20%)	1.958.532	1.958.532			0,10	0,09	0,09
Real Estate Broker + VAT (20%)	1.044.551	1.044.551			0,05	0,05	0,05
Transfer tax or VAT		13.709.726	0,70	0,55			0,55
Stamp duty	62.673	62.673			0,00	0,00	0,00
t=2010	3.400.012	19.459.977					**80,66**
0=2005							

Example of calculation of equation (3.16) in the case of a fee that assumes a fixed amount until a predetermined value of the dwelling, plus a rate over the remaining value (mix taxation).

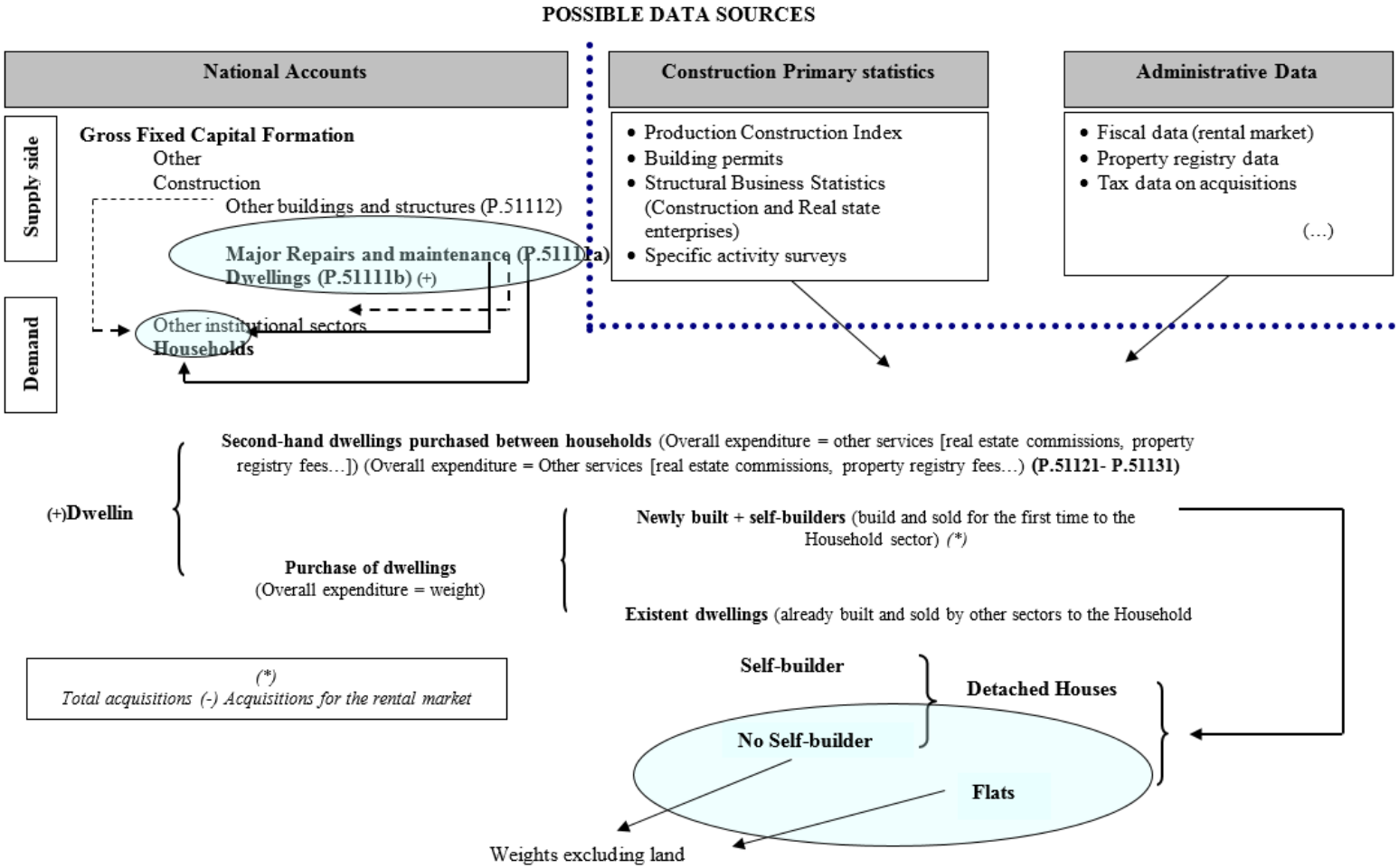
In this example consider that the average dwelling price is 150 000 transaction tax is 70 until the amount of 50 000, and a tax is a rate of 8% over the remaining price.

In this case the computation of $r_{i;0} \cdot e_{i;0}$ the total amount of the variable part of the transfer tax, must exclude the fixed part, as so a transformation shall be completed $r_{i;0} \cdot (e_{i;0} - 50000 * q_{f,0})$.

Expenditure in services related with the acquisition	$r_{i;0}$	$r_{i;t}$	$\frac{r_{1;t}}{r_{1;0}}$	$e_{i;0}$	$e_{i;t}$	$I_{i;0}^{t}$	$r_{i;0} \cdot e_{i;0}$	$f_{F;0}$	$f_{F;t}$
Total expenditure with the purchase				195.853.226	173.427.568	0,89			
Mortgage								200	200
Notary fee + VAT (20%)	1,20%	1,20%	1,00				2.350.239		
Land registry								56	56
Legal fees (Lawyer or solicitor) + VAT (20%)								1.500	1.300
Real Estate Broker + VAT (20%)								800	700
Transfer tax or VAT (variable)	8,00%	8,00%	1,00				10.445.505		
Transfer tax or VAT (fixed)								70	70
Stamp duty								48	36
t=2010							12.795.744		
0=2005									

Expenditure in services related with the acquisition	$f_{F;0} \cdot q_{F;0}$	$r_{i;0} \cdot e_{i;0} + f_{F;0} \cdot q_{F;0}$	$w_{r;0}$	$\left(\frac{r_{i;t}}{r_{i;o}} \cdot I_{i;o}^{t} \cdot w_{r;0}\right)$	$w_{F;0}$	$\left(\frac{f_{F;t}}{f_{F;0}} \cdot w_{F;0}\right)$	$PCostsI_0^t + FCostsI_0^t$
Total expenditure with the purchase							
Mortgage	261.138	261.138			0,02	0,02	0,02
Notary fee + VAT (20%)		2.350.239	0,14	0,13			0,13
Land registry	73.119	73.119			0,00	0,00	0,00
Legal fees (Lawyer or solicitor) + VAT (20%)	1.958.532	1.958.532			0,12	0,10	0,10
Real Estate Broker + VAT (20%)	1.044.551	1.044.551			0,06	0,06	0,06
Transfer tax or VAT (variable)		10.445.505	0,64	0,57			0,57
Transfer tax or VAT (fixed)	91.398	91.398			0,01	0,01	0,01
Stamp duty	62.673	62.673			0,00	0,00	0,00
t=2010	3.491.410	16.287.154					**88,50**
0=2005							

D: Weight data sources



E: Model evaluation and selection

In any econometric analysis, including hedonic studies, various misspecification problems may affect the estimation of the parameters of interest. Those problems may be directly related to the specification of the hedonic function (e.g. 'pure' functional form problems, which assume that all relevant dwelling characteristics were included in the hedonic function but not in the correct way, omission of relevant dwelling characteristics, parameter instability across time periods and/or dwelling strata) or to the characteristics of the data collected, which may not describe appropriately the target population (e.g. missing data and the related problem of endogenous sampling, measurement error, excess of collinearity between the regressors, and unusual observations). Most of these problems cause the inconsistency of the estimators of the parameters of the hedonic function.

The numerous possible sources of misspecification that may affect hedonic models for housing prices suggest that a comprehensive specification analysis should be carried out in any empirical study. The main aim of this appendix is precisely to discuss a global strategy to assess and document the validity of hedonic models. All the testing procedures and diagnostic criteria proposed are presented in a sequential manner and using an integrated approach that allows all tests to be implemented in a similar way. This integrated approach is mainly based on the formulation of all specification tests as tests for the joint significance of a subset of (possibly) artificial covariates: from test to test, only those artificial regressors need to be changed.

This appendix starts with the examination of alternative individual and joint significance tests, which are necessary not only to investigate which attributes are relevant to explain the price of the dwelling but also to implement all specification tests discussed. Standard and heteroskedasticity-robust versions of both types of tests are presented. Section 'Specification Test' considers various specification tests, starting with those for heteroskedasticity, which determine if all the remaining tests should be applied using standard or heteroskedasticity-robust versions. Some diagnostic criteria for multicollinearity and unusual observations are presented in Section 'Diagnostic Criteria' while the subsequent Section reviews some R^2-based measures appropriate to select between models for which the specification is statistically correct. The final section contains the Stata code which was used in chapter 6.4.2 for the estimation of the hedonic models for Sydney, Australia.

1. TESTING INDIVIDUAL AND JOINT SIGNIFICANCE

In general, one of the major issues in empirical work is the selection of the set of covariates that is statistically relevant to explain the behaviour of the variable of interest. Hedonic studies are not an exception to this practice. Especially because of the serious consequences of the omission of relevant attributes, the selection of the covariates to include in the model should be performed in a very careful and conservative manner. Indeed, while the omission of relevant covariates may yield inconsistent estimators for the parameters of interest, the inclusion of irrelevant regressors only affects their variability. Therefore, the use of automatic forward and backward stepwise procedures, very popular in some branches of the econometric literature, is not recommended in this manual. Instead, we recommend a strategy where individual and joint significance tests for the dwelling characteristics are examined together with the results of the general RESET specification test described in 'Specification test' Section.

Assume that the aim is assessing the features of model (6.6) (the analysis is directly extensible for models of the type (6.7). For simplicity, we omit the subscript t throughout this appendix. Typically, most hedonic studies use Wald versions of individual and joint significance tests and assume homoskedasticity. Thus, the null hypothesis that an attribute x_{ij}, j=1,…k is not individually significant to describe dwelling prices, H_0: $\beta_j = 0$, is usually testes by application of the well-known t statistic,

$$t = \frac{\hat{\beta}_j}{\sqrt{Var\left(\hat{\beta}_j\right)}}$$

(1)

which follows a Student t distribution with n– k– 1 degrees of freedom. On the other hand, to assess the joint significance of a subset of the dwelling characteristics included in the hedonic function or the joint significance of a set of additional characteristics, the F test is the most common approach. As the test procedures are similar in both cases, next only the latter utilization of the F test is considered. Thus, to assess the joint significance of an additional set of J variables Z_{ij}, j=1,…J, included in the vector z_i, the F test is based on the comparison of the so-called unrestricted model,

$$P_i = x_i\beta + z_i\gamma + v_i,$$

(2)

with the restricted model (6.6), which excludes z_i. The null hypothesis that the additional variables are not significant (i.e. the restricted model is a better option), H_0: γ=0, may be assessed by the F statistic:

$$F = \frac{\left(SSR_* - SSR\right)/q}{SSR/(n-k-J-1)} = \frac{\left(R^2 - R_*^2\right)/q}{\left(1-R^2\right)/(n-k-J-1)},$$

(3)

where all quantities are relative to the unrestricted model except those indexed by a star, which are relative to the restricted model, q=J is the number of restrictions being tested, R^2 is the coefficient of determination, computed as

$$R^2 = \frac{TSS - SSR}{TSS},$$

(4)

$SSR = \sum_{i=1}^{n}\left(P_i - \hat{P}_i\right)^2 = \sum_{i=1}^{n}\hat{u}_i{}^2$ is the sum of squares of the residuals, and $TSS = \sum_{i=1}^{n}\left(P_i - \bar{P}_i\right)^2$ is the total sum of squares of the regression. The two expressions that appear in (3) are equivalent provided that a constant term is included among the regressors, as usually happens. The F statistic has a Snedecor F distribution with (q,n– k– J– 1) degrees of freedom.

The F test may also be used to assess the hypothesis that all characteristics of dwellings are not jointly significant to explain their prices. Assuming that the hedonic function is specified as in (6.6), the null hypothesis is H_0: $\beta_\bullet$=γ=0, where $\beta_\bullet$ excludes the constant term from β, and the same F statistic (3), with q=k+J, SSR_*=TSS and $R_*^2 = 0$, may be applied.

In presence of heteroskedasticity, inference becomes a little more complex. Assuming that OLS is still the method used in the estimation of the hedonic function, heteroskedasticity-robust versions of both the t and F tests have to be computed. Basically, this corresponds to employ White's (1980) formula given in footnote 96 to estimate the variance of the OLS estimators. Doing this, the expression of the t statistic does not change but that of the F statistic is no longer valid. In fact, the

heteroskedasticity-robust F statistic has to be written in the more general (and complex) Wald formulation. Fortunately, many econometrics packages have canned commands that compute automatically heteroskedasticity-robust F (and t) statistics.

In cases where it is not possible to use an econometrics package with canned commands to compute F statistics robust to heteroskedasticity, it is preferable to use the simpler heteroskedasticity-robust Lagrange Multiplier (LM) test. The simplest way of implementing this test for assessing H_0: γ=0 in (2) is using the following regression-based procedure (see Wooldridge, 2003, p. 263) ([115]):

1. Estimate the restricted model (6.6) and calculate the vector of residuals $\hat{u}_i = P_i - \hat{P}_i$;

2. Perform separately J different regressions, one for each of the variables contained in the vector z_i, where the regressors are always those of the restricted model (6.6):

$$Z_{i1} = x_i\delta_1 + r_{i1}$$

…

$$Z_{iJ} = x_i\delta_J + r_{iJ};$$

save the residuals from each regression and denote them by $\hat{r}_{ij}$, j=1,...,J;

3. Find the products between $\hat{u}_i^2$ and $\hat{r}_{ij}$, j=1,...,J, and form the J– dimensional vector $\left(\hat{u}\hat{r}\right)_i$;

4. Run the regression

$$1_i = \left(\hat{u}\hat{r}\right)_i \eta + \psi_i ,$$

(5)

where 1 is a n-vector composed of ones; note that this model does not contain an intercept term;

5. The test statistic is given by

$$LM = n - SSR$$

(6)

where SSR is the sum of squared residuals of the auxiliary model (5).

The LM statistic thus calculated has a chi-square distribution with J degrees of freedom.

2. SPECIFICATION TESTS

This section discusses several tests for assessing the specification of model (6.6), namely heteroskedasticity tests (Breusch and Pagan, 1979; White, 1980), the RESET test (Ramsey, 1969), tests for parameter stability (Chow, 1960), and tests for comparing two non-nested models (Davidson and MacKinnon, 1981). Each test is briefly described and expressed as a test for the joint significance of a set of variables.

I. Heteroskedasticity Tests

Several tests for the null hypothesis of homoskedasticity, H_0: $Var(u_i|x_i)=\sigma^2$, have been proposed in the econometrics literature. Two of the most well-known heteroskedasticity tests are those of Breusch and Pagan (1979) and of White (1980). Given that $E(u_i|x_i)=0$, it follows that $Var(u_i|x_i)= E\left(u_i^2 \mid x_i\right)$.

([115]) Under homoskedasticity it is also possible to use LM tests. However, as in that case the F test is simpler to compute, the LM statistics appropriate under that assumption are not presented in this appendix.

Therefore, testing heteroskedasticity is equivalent to test whether $E\left(u_i^2 \mid x_i\right)$ is related to (a function of) one or more of the explanatory variables. Both Breusch and Pagan (1979) and White (1980) tests are based on this idea. In both cases, first $E\left(u_i^2 \mid x_i\right)$ is predicted by $\hat{u}_i^2$, where $\hat{u}_i$ are the residuals of model (6.6). Then, $\hat{u}_i^2$ is regressed on a set of functions of the explanatory variables that appear in model (6.6). The only thing that distinguishes the two tests, in practical terms, is the choice of the function that relates $\hat{u}_i^2$ and x_i.

Breusch and Pagan (1979) assume that $\hat{u}_i^2$ and x_i are linearly related and specifies the following test regression:

$$\hat{u}_i^2 = x_i\delta + \varepsilon_i \,. \tag{7}$$

In this setting, testing for heteroskedasticity is equivalent to test for H_0: $\delta_\bullet$=0, where $\delta_\bullet$ excludes the constant term from δ. On the other hand, White (1980) considers a quadratic relationship between $\hat{u}_i^2$ and x_i, being based on an auxiliary regression similar to (7) but which includes as additional regressors the squares and the cross-products of the variables contained in x_i. In both cases, the tests may be carried out as F tests for the joint significance of all variables appearing in the test regression.

II. The RESET Test

The RESET test proposed by Ramsey (1969) is a general test for functional form misspecification. Although this test has been originally proposed to detect pure functional form misspecifications, it is also sensitive to many other types of misspecifications, namely those that affect the model functional form. The idea that underlies the RESET test is that any model of the form $E\left(P \mid x\right) = L\left(x\beta\right)$, for unknown L(.), can be arbitrarily well approximated by the linear model $x\beta + \sum_{j=1}^{J} \gamma_j \left(x\hat{\beta}\right)^{j+1}$ for J large enough. Therefore, testing the null hypothesis that model H_0: $E\left(P \mid x\right) = x\beta$, i.e. model (8.7) is correctly specified, is equivalent to test for H_0: γ=0, where γ is the vector that includes γ_1, …, γ_J, in the augmented model

$$P_i = x_i\beta + \sum_{j=1}^{J} \gamma_j \left(x_i\hat{\beta}\right)^{j+1} + v_i \tag{8}$$

where $x_i\hat{\beta}$ are the fitted values of P_i obtained from model (8.7). Therefore, the RESET test is typically implemented as an F test, under homoskedasticity, or an LM test, under heteroskedasticity, for the joint significance of the variables $z_i = \left[\left(x_i\hat{\beta}\right)^2, \ldots, \left(x_i\hat{\beta}\right)^{J+1}\right]$. The first few terms in z_i are usually the most important and, in practice, only the quadratic and cubic terms are usually considered.

III. The Chow test for structural breaks

In order to check the stability of the parameters in two groups (time periods or strata), say 0 and s, the popular Chow (1960) test may be employed. This test assesses the null hypothesis that the k+1 coefficients of the separate regressions (6.6) calculated for groups 0 and s are the same, H_0: $\beta_0=\beta_s$, i.e. if a single hedonic function of the type (6.6) should be used for both groups. Traditionally, the Chow test is implemented as the following F statistic:

$$F = \frac{\left[SSR_* - \left(SSR_0 + SSR_s\right)\right]/\left(k+1\right)}{\left(SSR_0 + SSR_s\right)/\left[n-2\left(k+1\right)\right]},$$

(9)

which requires the computation of three regressions: one that pools all the observations for 0 and s (to calculate SSR_*) and two others that include only observations for 0 and s (to calculate SSR_0 and SSR_s, respectively). Relative to the usual F statistic in (3), SSR_* works as the restricted sum of squares, since no differences are allowed between the parameters, while SSR_0 + SSR_s is the unrestricted sum of squares, because differences are allowed between the parameters. This test statistic has an F distribution with [k+1,n– 2(k+1)] degrees of freedom.

As discussed in Chapter 6, performing two separate regression for groups 0 and s is equivalent to run a single regression of the type described in (6.15), which still allows for differences in the parameters across groups:

$$P_i = x_i\beta + \left(d_i * x_i\right)\eta + u_i,$$

(10)

where d_i is a dummy variable which equals unity for data relative to group s, and is zero otherwise. In this case, the Chow test may be implemented as a test for the joint significance of the k+1 variables $z_i=d_i*x_i$, i.e. H_0: η=0. The main advantage of this formulation is that the Chow test can now being implemented as any other test for the joint significance of a set of parameters: under homoskedasticity, the standard F statistic (3) produces identical results to the traditional Chow statistic (9); under heteroskedasticity, the LM test (6) may be applied.

IV. Tests for Non-Nested Hypotheses

In hedonic pricing regressions, often the researcher has to choose between two regression models that are non-nested (i.e. one cannot be written as a particular case of the other). There is a simple test for non-nested hypotheses that may allow to discriminate between these alternative functional forms. In contrast to the RESET test, which is sensitive against a wide class of deviations from the postulated model, this test allows the direct comparison of two models,

A) $P_i = x_i\beta + u_i$

B) $P_i = x_i^*\gamma + \upsilon_i$,

where x_i^* is a non-nested function of x_i, checking the validity of A) after taking into account the information provided by B) and vice-versa. Note that, as it is common in non-nested tests, all four possibilities of rejecting both models, neither, or either one or the other may occur. See Veerbeck (2008, pp. 62–64), for more details.

Davidson and MacKinnon (1981) proposed a test, known in the literature as the J test, appropriate to check model A against model B, based on the following procedure:

1. Estimate model B and obtain predicted values for P_i : $\hat{P}_i$;

2. Estimate an auxiliary model that adds the regressor $\hat{P}_i$ to A:

$$P_i = x_i\beta + \alpha\hat{P}_i + v_i ,$$

(11)

3. Check the individual significance of α by a t test, using, if necessary, the heteroskedasticity-robust approaches described previously. Under H_0: $\alpha=0$, model A is correctly specified.

To test model B, this procedure must be adapted accordingly.

3. DIAGNOSTIC CRITERIA

In the absence of simple specification tests to detect some of the data problems mentioned before, the empirical literature employs some diagnostic criteria, which are briefly described below.

V. Multicollinearity

Many explanatory variables used in hedonic regressions may be highly correlated. For example, house attributes like house size and lot size, and number of rooms and number of toilets, may present a high positive correlation. Including in the hedonic function highly correlated explanatory variables (the so-called multicollinearity issue) does not produce the inconsistency of the OLS estimators but implies that OLS estimates: (i) have high standard errors, which may lead to individually insignificant regressors even though they may be still jointly significant; (ii) are highly sensitive to small changes in data (deleting or adding a few observations); and (iii) may present unexpected signs/magnitudes.

The literature provides some diagnostic measures to detect excess of correlation, for which most econometric software packages possess canned commands. However, in most cases there is no consensus about the 'rules of thumb' that suggest excess of multicollinearity. The most well-known criteria are those based on the variance inflation factor (VIF) and on condition indexes.

The VIF for a given covariate j is given by

$$VIF_j = \left(1 - R_j^2\right)^{-1}$$

(12)

where R_j^2 is the determination coefficient of the regression of the covariate x_j on the remaining covariates and a constant term. For each coefficient, this quantity is interpreted as the increase in its variance due to the existence of correlation between that covariate and the remaining explanatory factors. A derived measure is the tolerance, T_j=VIF_j^{-1}. Both VIF_j and T_j are 1 when R_j^2 =0 (x_j is orthogonal to the remaining covariates). In general, multicollinearity is considered excessive if VIF_j > 10 or, equivalently, T_j < 0.1.

The condition index for each covariate x_j is the squared root of the ratio of the largest eigen value of X'X, where X is the $n\times(k+1)$ matrix of observations on the explanatory variables whose ith row consists of the vector x_i, to the eigen value associated to x_j . This measure assumes the value of 1 in absence of correlation and the literature suggests that values larger than 10, 20 or 30 indicate excess of correlation among the regressors.

VI. Unusual Observations

It is well known that OLS estimators may be strongly influenced by one or a few atypical observations. This type of observations can, of course, arise in the housing market. For example, the price of a house may be too high for its characteristics, or the combination of attributes of a given property may be unusual. The literature distinguishes in general three classes of unusual observations, each of which has different consequences over the properties of OLS estimators (see Fox, 1997, pp. 267–294): (i) leverage points, which are observations presenting an atypical combination of covariates (e.g. dwelling presenting an unusual combination of characteristics); (ii) outliers, which are observations where the variable of interest assumes atypical values, given its characteristics (e.g. dwellings too expensive or too inexpensive for their attributes); and (iii) influent points, which are observations that combine the features of leverage points and outliers. Leverage points tend to shift the regression coefficients towards them. Therefore, this type of observation is not, in general, associated to large residuals, but its deletion exerts noticeable effects in the coefficients. Outliers usually do not exert a noticeable influence on regression coefficients, but produce large residuals, inducing an increase in their standard deviations. Influent observations produce a combination of the symptoms just described.

The three types of unusual observations are identified by different diagnostic measures. Leverage observations are often identified by the examination of the so-called hat values, h_i, which are the diagonal elements of the hat matrix $P=X(X'X)^{-1}X'$. These elements are defined on the interval $[n^{-1},1]$, where 1 indicates the maximum leverage point. An observation is considered to produce high leverage in the regression when its h_i is larger than the cut-off point $2((k+1)/n)$, which is the double of the average $((k+1)/n)$ of the hat values. Note that as leverage in the context of housing hedonic regression refers to dwellings for which the combination of attributes is unusual, their prices are not taken into account in this measure.

Outliers are characterized by large residuals. Therefore, the most well-known diagnostic measure to identify them is based on a function of the residuals. Specifically, it is based on the calculation of studentized residuals:

$$\hat{u}_i^s = \frac{\hat{u}_i}{\hat{\sigma}_{\hat{u}_i^*}\sqrt{1-h_i}} \tag{13}$$

where $\hat{u}_i$ and $\hat{u}_i^*$ are the residuals of the regression including all the observations and all the observations but i, respectively, and $\hat{\sigma}_{\hat{u}_i^*}$ is the standard error of $\hat{u}_i^*$. As approximately 95% of the studentised residuals are expected to lie on the interval [-2,2], usually |2| is the 'rule of thumb' above which an observation is classified as an outlier, although some authors prefer to use |3| (considering an interval that includes approximately 99% of the observations).

Finally, influential observations, presenting features of both the previous categories of unusual observations, are often identified in figures where hat values are represented against studentised residuals as the points that cross the cut-offs of both measures. Moreover, they are also classified according to the Cook-D measure.

$$D_i = \frac{\hat{u}_i}{k+1}\frac{h_i}{1-h_i} \tag{14}$$

Observations are taken as influent in cases where $D_i > \frac{4}{n}$ or $D_i > \frac{4}{n-k-1}$.

4. R-SQUARED MEASURES FOR MODEL SELECTION

In practice, it may occur that, after application of several specification tests, various models appear to be appropriate to describe the data. In such cases, if the competing models are nested (one model incorporates the other as a particular case), the t, F and LM tests described previously can be used to discriminate between them. In cases where those models are non-nested, it is convenient to use some additional criteria, like goodness-of-fit measures, to choose the best specification.

In applied work, researchers typically look at R^2 measures to discriminate between non-nested models for which application of non-nested tests produced inconclusive results. It is important to stress that R^2-based goodness-of-fit measures, *per se*, are not reliable measures of the quality of one model. For example, the R^2 tends to be very high in hedonic regressions, often above 0.9, but this does not imply that the model is correctly specified. This conclusion must be supported by the specification tests described before. Moreover, the use of this R^2 measure to compare models is only valid in cases where both models possess a constant term, employ the same variable of interest, and have the same number of explanatory variables. In order to compare models with a different number of explanatory variables, an alternative indicator that is adjusted for the degrees of freedom, designated as adjusted R^2, which is calculated as

$$\bar{R}^2 = 1 - \left(1 - R^2\right)\frac{n-1}{n-k-1} \tag{15}$$

should be used.

F: Stata code for the hedonic models in chapter 6.4.2.

1. STATA FILE FOR COMPUTING TIME-DUMMY AND ROLLING-TIME-DUMMY (RTD) PRICE INDICES

```
// STATA FILE FOR COMPUTING TIME-DUMMY AND ROLLING-TIME-DUMMY (RTD) PRICE
INDICES.
// THE DATA SET CONSISTS OF 56 PERIODS.

log using f:\\OOHManual\td-rtd.log

set matsize 10000

infile PRICE BED BATH AREA PROPTYPE YEAR MONTH REGION QUARTER QUcum CST using
///
D:\STATA\apms7.txt

tabulate REGION , generate(r)
tabulate BED , generate(bed)
tabulate BATH , generate(bath)
tabulate QUcum , generate(q)

generate lnp = ln(PRICE)

// THE TIME-DUMMY METHOD
regress lnp bed1 bed2 bed3 bed4 bath1 bath2 bath3 AREA PROPTYPE r1 r2 r3 r4 r5
///
r6 r7 r8 r9 r10 r11 r12 r13 r14 r15 q2 q3 q4 q5 q6 q7 q8 q9 ///
q10 q11 q12 q13 q14 q15 q16 q17 q18 q19 q20 q21 q22 q23 q24 ///
q25 q26 q27 q28 q29 q30 q31 q32 q33 q34 q35 q36 q37 q38 q39 ///
q40 q41 q42 q43 q44 q45 q46 q47 q48 q49 q50 q51 q52 q53 q54 ///
q55 q56
matrix ptd=e(b)'

scalar td1 = 1

forval x=25/79 {
local a = `x' - 23
scalar td`a'= exp(ptd[`x',1])
}

// RTD2 (I.E., A TWO-PERIOD ROLLING WINDOW)
forval x=1/55 {
local a = `x' + 1
regress lnp bed1 bed2 bed3 bed4 bath1 bath2 bath3 AREA PROPTYPE r1 r2 r3 r4 r5
r6 r7 r8 r9 r10 ///
r11 r12 r13 r14 r15 q`a' if QUcum == `x'|QUcum == `a'
matrix rtd2`a'=e(b)'
scalar rtd2p`a'= exp(rtd2`a'[25,1])
}

scalar chrtd2p1 = 1

forval x=1/55 {
local a = `x' + 1
scalar chrtd2p`a' = chrtd2p`x' * rtd2p`a'
}

// RTD4 (I.E., A FOUR-PERIOD ROLLING WINDOW)
```

```
regress lnp bed1 bed2 bed3 bed4 bath1 bath2 bath3 AREA PROPTYPE r1 r2 r3 r4 r5
r6 r7 r8 r9 r10 ///
r11 r12 r13 r14 r15 q2 q3 q4 if QUcum == 1|QUcum == 2|QUcum == 3|QUcum == 4
matrix rtd41=e(b)'
scalar chrtd4p1 = 1
scalar chrtd4p2 = exp(rtd41[25,1])
scalar chrtd4p3 = exp(rtd41[26,1])
scalar chrtd4p4 = exp(rtd41[27,1])

forval x=2/53 {
local a = `x' + 1
local b = `x' + 2
local c = `x' + 3
regress lnp bed1 bed2 bed3 bed4 bath1 bath2 bath3 AREA PROPTYPE r1 r2 r3 r4 r5
r6 r7 r8 r9 r10 ///
r11 r12 r13 r14 r15 q`a' q`b' q`c' if QUcum == `x'|QUcum == `a'|QUcum ==
`b'|QUcum == `c'
matrix rtd4`c'=e(b)'
scalar rtd4p`c'= exp(rtd4`c'[27,1])/exp(rtd4`c'[26,1])
}

forval x=4/55 {
local a = `x' + 1
scalar chrtd4p`a' = chrtd4p`x' * rtd4p`a'
}

// RTD5 (I.E., A FIVE-PERIOD ROLLING WINDOW)

regress lnp bed1 bed2 bed3 bed4 bath1 bath2 bath3 AREA PROPTYPE r1 r2 r3 r4 r5
r6 r7 r8 r9 r10 ///
r11 r12 r13 r14 r15 q2 q3 q4 q5 if QUcum == 1|QUcum == 2|QUcum == 3|QUcum ==
4|QUcum == 5
matrix rtd51=e(b)'
scalar chrtd5p1 = 1
scalar chrtd5p2 = exp(rtd51[25,1])
scalar chrtd5p3 = exp(rtd51[26,1])
scalar chrtd5p4 = exp(rtd51[27,1])
scalar chrtd5p5 = exp(rtd51[28,1])

forval x=2/52 {
local a = `x' + 1
local b = `x' + 2
local c = `x' + 3
local d = `x' + 4
regress lnp bed1 bed2 bed3 bed4 bath1 bath2 bath3 AREA PROPTYPE r1 r2 r3 r4 r5
r6 r7 r8 r9 r10 ///
r11 r12 r13 r14 r15 q`a' q`b' q`c' q`d' if QUcum == `x'|QUcum == `a'|QUcum ==
`b'|QUcum == ///
`c'|QUcum == `d'
matrix rtd5`d'=e(b)'
scalar rtd5p`d'= exp(rtd5`d'[28,1])/exp(rtd5`d'[27,1])
}

forval x=5/55 {
local a = `x' + 1
scalar chrtd5p`a' = chrtd5p`x' * rtd5p`a'
}

forval x=1/56 {
scalar list td`x'
}

forval x=1/56 {
```

```
scalar list chrtd2p`x'
}

forval x=1/56 {
scalar list chrtd4p`x'
}

forval x=1/56 {
scalar list chrtd5p`x'
}

log close
```

2. STATA FILE FOR COMPUTING AVERAGE CHARACTERISTICS AND REPRICING PRICE INDICES

```
// STATA FILE FOR COMPUTING CHAINED-PAASCHE, CHAINED-LASPEYRES, CHAINED
FISHER,
// AND REPRICING PRICE INDICES. THE CHAINED INDICES USE THE AVERAGE
CHARACTERISTICS
// METHOD. THE DATA SET CONSISTS OF 56 PERIODS.

log using f:\OOHManual\avchar.log
set matsize 10000
infile PRICE BED BATH AREA PROPTYPE YEAR MONTH REGION QUARTER PERIOD CST using
D:\STATA\apms7.txt

// CREATE DUMMY VARIABLES
tabulate REGION , generate(r)
tabulate QUARTER , generate(qy)
tabulate BED , generate(bed)
tabulate BATH , generate(bath)

generate lnp = ln(PRICE)
// COMPUTE ARITHMETIC MEAN FOR EACH VARIABLE IN EACH PERIOD AND THEN ESTIMATE
THE
// HEDONIC MODEL SEPARATELY FOR EACH PERIOD
forval x=1/56 {
regress bed1 if PERIOD == `x'
matrix bed1`x'=e(b)
regress bed2 if PERIOD == `x'
matrix bed2`x'=e(b)
regress bed3 if PERIOD == `x'
matrix bed3`x'=e(b)
regress bed4 if PERIOD == `x'
matrix bed4`x'=e(b)
regress bath1 if PERIOD == `x'
matrix bath1`x'=e(b)
regress bath2 if PERIOD == `x'
matrix bath2`x'=e(b)
regress bath3 if PERIOD == `x'
matrix bath3`x'=e(b)
regress AREA if PERIOD == `x'
matrix AREA`x'=e(b)
regress PROPTYPE if PERIOD == `x'
matrix PROPTYPE`x'=e(b)
regress r1 if PERIOD == `x'
matrix r1`x'=e(b)
regress r2 if PERIOD == `x'
matrix r2`x'=e(b)
regress r3 if PERIOD == `x'
```

```
matrix r3`x'=e(b)
regress r4 if PERIOD == `x'
matrix r4`x'=e(b)
regress r5 if PERIOD == `x'
matrix r5`x'=e(b)
regress r6 if PERIOD == `x'
matrix r6`x'=e(b)
regress r7 if PERIOD == `x'
matrix r7`x'=e(b)
regress r8 if PERIOD == `x'
matrix r8`x'=e(b)
regress r9 if PERIOD == `x'
matrix r9`x'=e(b)
regress r10 if PERIOD == `x'
matrix r10`x'=e(b)
regress r11 if PERIOD == `x'
matrix r11`x'=e(b)
regress r12 if PERIOD == `x'
matrix r12`x'=e(b)
regress r13 if PERIOD == `x'
matrix r13`x'=e(b)
regress r14 if PERIOD == `x'
matrix r14`x'=e(b)
regress r15 if PERIOD == `x'
matrix r15`x'=e(b)
matrix q`x' =
(bed1`x',bed2`x',bed3`x',bed4`x',bath1`x',bath2`x',bath3`x',AREA`x',
PROPTYPE`x',r1`x',r2`x',r3`x',r4`x',r5`x',r6`x',r7`x',r8`x',r9`x',r10`x',r11`x
',r12`x',r13`x',r14`x',r15`x',1)
regress lnp bed1 bed2 bed3 bed4 bath1 bath2 bath3 AREA PROPTYPE r1 r2 r3 r4 r5
r6 r7 r8 r9 r10 r11 r12 r13 r14 r15 if PERIOD == `x'
matrix p`x'=e(b)'
}

matrix q57 = (1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1)
matrix p57 = (1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1)'
forval x=1/56 {
local a = `x' + 1
matrix p`x'q`x' = q`x' * p`x'
matrix p`x'q`a' = q`a' * p`x'
matrix p`a'q`x' = q`x' * p`a'
scalar ep`x'q`x'= exp(p`x'q`x'[1,1])
scalar ep`x'q`a'= exp(p`x'q`a'[1,1])
scalar ep`a'q`x'= exp(p`a'q`x'[1,1])
}

drop PRICE BED BATH AREA PROPTYPE YEAR MONTH REGION QUARTER CST

forval x=1/56 {
local a = `x' + 1
matrix drop p`x'q`x' p`x'q`a' p`a'q`x'
}

scalar chlas1 = 1
scalar chpaa1 = 1
scalar chfish1 = 1

// COMPUTE CHAINED LASPEYRES, PAASCHE AND FISHER INDEXES USING AVERAGE
// CHARACTERISTICS METHOD
forval x=1/55 {
local a = `x' + 1
scalar laspp`a' = ep`a'q`x' / ep`x'q`x'
scalar paasp`a' = ep`a'q`a' / ep`x'q`a'
```

```
scalar fishp`a' = sqrt(laspp`a' * paasp`a')
scalar chlas`a' = chlas`x' * laspp`a'
scalar chpaa`a' = chpaa`x' * paasp`a'
scalar chfish`a' = chfish`x' * fishp`a'
}

// COMPUTE REPRICING PRICE INDICES
forval x=1/56 {
regress lnp if PERIOD == `x'
matrix mlnp`x'=e(b)
matrix diff`x' = mlnp`x' - mlnp1
scalar exdiff`x'= exp(diff`x'[1,1])
matrix p1q`x' = q`x' * p1
scalar ep1q`x'= exp(p1q`x'[1,1])
scalar repr`x' = exdiff`x' * ep1q1 / ep1q`x'
}

forval x=2/56 {
scalar list chlas`x'
}

forval x=2/56 {
scalar list chpaa`x'
}

forval x=2/56 {
scalar list chfish`x'
}

forval x=2/56 {
scalar list repr`x'
}

// COMPUTE GEOMETRIC MEAN PRICE INDEX (THIS IS NOT QUALITY-ADJUSTED)
scalar geo = exdiff56/exdiff1
scalar list geo
log close
```

G: The treatment of housing co-operatives in the HPI/OOHPI

INTRODUCTION

This annex deals with housing co-operatives and it aims at providing a workable solution for its treatment in the HPI/OOHPI. The paper is organized as follows. Section one defines housing co-operatives and highlights its importance. Section two addresses the main issues underlying the inclusion of housing co-operatives in the HPI/OOHPI. Section three presents the result of an empirical study using data taken from the Internet on housing co-operative flats in Oslo. A proposal for the treatment of housing co-operatives is provided in the last section of the paper.

1. DEFINITION AND IMPORTANCE OF HOUSING CO-OPERATIVES ([116])

A housing co-operative is a legal entity that provides to their shareholders an alternative to both renting and owning a home. This type of housing tenure differs from direct ownership in that real estate is owned by the legal entity and not by households themselves. The precise nature of a housing co-operative varies across countries. In general, shares represent the right to occupy and use a certain housing unit in the co-operative and can be used as collateral for loans. Although co-operatives (co-ops) may restrict, at least to a certain degree, the freedom in which transactions are done ([117]), shares can be traded on the market for a price ([118]).

When purchasing a share, the buyer is not only acquiring the right to use a dwelling unit in a co-op. In fact, all unpaid mortgage, which is associated to the dwelling, is passed onto the new owner and 'purchased' together with the housing unit ([119]) ([120]).

Shareholders pay, in addition, a fee to the co-operative ([121]). This fee aims at covering a wide variety of items that include, besides the financing of the mortgage loans, stairs cleaning, garbage, house insurance and other such-like running costs.

The importance of co-ops varies among countries. In Denmark, Norway and Sweden co-ops represent, respectively, 4%, 15% and 20% of the total housing stock (Coordination Team, 2011a). In Finland and Iceland, housing co-ops are considered to represent a small (or unimportant) share of the housing market ([122]).

2. PROBLEMS POSED BY THE INCLUSION OF HOUSING CO-OPERATIVES IN THE HPI/OOHPI

2.1. Housing co-operatives as a type of tenure similar to owner-occupied housing

As a co-op is an indirect form of ownership, it is natural to ask whether or not it should be included in the HPI/OOHPI. Although shareholders do not actually own real estate, they are nevertheless free to occupy and use the housing units in which they live in (very much in the same way an owner occupier would do).

In this light, this type of housing tenure should be considered similar to owner-occupied housing and, as such, co-ops should be covered by the HPI and the OOHPI.

([116]) The Coordination Team would like to thanks the exchange of views it had with all colleagues from Statistics Sweden, Norway and Denmark on housing co-ops and its importance. In particular, the exchange of views with Martin Ribe, from Statistics Sweden and Jakob Holmgaard and team from Statistics Denmark, was very useful to clarify the definition of housing co-ops in the Scandinavian countries.
([117]) Examples include reserving the right to admit a new member and limiting the price at transfer.
([118]) This price will be labelled in this paper as 'Commercial price'.
([119]) Conversely, the new owner may also acquire savings associated with the position of the share in the housing co-op. This item will be called in this paper 'Saved money'. This is money that is typically saved if shareholders anticipate property repairs or upgrades.
([120]) The total debt on the property per household will be termed as 'Joint debt' in this paper.
([121]) Hereafter referred as 'Monthly fee'.
([122]) The relevance of the Finnish and Icelandic co-ops housing markets was checked through the exchange of e-mails and in Coordination Team (2011b).

2.2. Price concept

The first aspect to consider in this section has to do with possible restrictions to entrance and exit in a co-op.

In principle, as stated above, co-ops should be included in HPI/OOHPI compilation. However, if the co-ops housing market functions on the basis of discriminatory preferences (in favour of specific groups of potential buyers), then the price index compiler would have to see if housing co-ops should be disregarded from the HPI/OOHPI ([123]).

Social co-ops, available to low income households only, is an example of a possible exclusion. However, if it is found that these restrictions are more of a formal nature, then housing co-ops should be included.

It is up to each statistical office to see whether existing restrictions are more of a formal nature or if, on the contrary, they seriously affect the capability of all agents to have an equal opportunity to access to this market segment.

The second and final aspect to consider is related to the relevant price concept to use in this situation. The HPI/OOHPI should be based on transaction prices (Eurostat, 2011b). The question here is whether or not 'Commercial prices' can be regarded as transaction prices. In our view, they are not transaction prices as they do not reflect the unpaid mortgage, which is associated to the dwelling and that is passed onto the new owner when the transaction occurs.

A similar reasoning applies when someone buys a house with the help of a loan. In these situations, it is common that the house acquisition cost is partly supported by the buyer and partly financed by the loan. Obviously enough, the transaction price is not the sum of money that the buyer supports with his/her own funds but its sum with the incurred loan ([124]) ([125]).

The price concept is not a trivial issue and can impact on measured house inflation as illustrated in a paper by Jakob Holmgaard of Statistics Denmark ([126]). In Denmark the purchaser buys shares in a cooperative which reflects the assets and liabilities such as financial savings and outstanding mortgage of the cooperative as well as the price of the dwelling. In work undertaken by Statistics Denmark, four pricing concepts were adopted to compute a house price index. The difference is not academic as it can lead to different challenges relating to the practical calculation of the index and to different estimates of house price inflation. Also the different concepts represent departures to varying degrees to the price concept for dwellings that are not part of cooperatives.

By the same token, considering commercial prices alone opens up the possibility of having situations in which two identical houses, with the same quality-and-location attributes, have different prices simply because the amount of the Joint debt is different.

In this context, it is necessary to adjust 'commercial prices' so that they can reflect true transaction prices. The next section presents two possible ways of tackling this issue.

2.3. Two ways of dealing with housing co-operatives in the HPI/OOHPI

In principle, the problem mentioned in the previous section can be tackled through two approaches. Both of them assume that 'Commercial prices' need to be subject to some treatment as they do not reflect the prices of a dwelling with similar characteristics, had it been transacted without unpaid mortgage.

([123]) This is in line with HICP guidelines. See, for instance, the guidelines for the treatment of reduced prices in the HICP (Eurostat, 2001).
([124]) It should be remembered, in passing, that the way the debt is labelled (i.e. as common or private) does not hinder the above reasoning. In the case of co-ops, a 'common debt' exists and is passed onto to the new buyer. This cost is also present in the 'Monthly fee' that new shareholder will have to support. This view is consistent with the treatment of housing co-ops by national accounts.
([125]) This sum, when referred in this paper, will be termed as 'Total price'.
([126]) For more details see *Price concepts for Housing Cooperatives in a House Price Index*, Jakob Holmgaard, May 2015, Mimeo.

The first approach assumes that the price correction is done by adding to the 'Commercial price' (CP) the 'Joint debt' (JD) of the co-op housing unit. Thus, for the i^{th} housing unit, we have

$$(1)\ P_i \approx CP_i + JD_i$$

The relevant price index would be calculated assuming that the price of the i^{th} co-op unit is a function of its characteristics (X_i). This is to say that

$$(2)\ P_i = f\left(X_i\right)$$

A second possible approach sees the 'Monthly fee' (MF) as a price-determining characteristic of the co-op housing unit 'Commercial price'.

Thus,

$$(3)\ CP_i = g\left(X_i; MF_i\right)$$

Having these approaches in mind, it would be interesting to know if a price index using *(2)* shows a different price behaviour from an index compiled on the basis of *(3)*.

The next section provides an empirical example that attempts to shed some more light on this issue.

3. EMPIRICAL COMPARISON OF THE TWO PRICE CONCEPTS

3.1. Data

The data was taken from a Norwegian web portal, Finn.no, which covers most of real estate offers in Norway.

The internet data collection was carried out on a single day and covered information on advertised apartments (*Leilighet*) in housing co-ops in Oslo. As in any typical site aiming at promoting real estate businesses, transaction prices are not available. However, an estimated market price is provided for each apartment (*Prisantydning*) ([127]). In addition, it is possible to obtain information on the total debt on the property per household (*Fellesgjeld*) and on the Monthly fee (*Felleskostnader*) for each apartment. To our knowledge, this is the only source available of data that contains information on all these variables.

A total of 507 observations, containing information on ten variables ([128]), were collected. The table below provides the descriptive statistics of the drawn sample.

([127]) The price estimations are done by the real estate agent or the seller or both, usually based on the appraised value. This is a sort of a reference for potential buyers and can thus differ from real transaction prices.

([128]) An eleventh variable — 'address' — was also collected. This variable was used, together with all remaining variables, to identify duplicate records in the database.

Table 1: Descriptive statistics on variables of the drawn sample

	Total Price (in NOK)	Estimated commercial price (in NOK)	Joint Debt (in NOK)	Monthly Fee (in NOK)	Saved money (in NOK)	Usable Area (m^2)	No. of rooms	No. of bedrooms	Floor level	Postal code (counts)
N	474	507	475	500	365	506	392	467	432	507
MIN	700 000	120 000	989	192	59	13	1	0	1	1
MAX	5 996 971	5 950 000	3 480 000	15 036	91 626	139	6	4	14	12
MEAN	2 243 024	1 905 434	373 317	3 797	17 526	60	3	2	3	–
CV	0.34	0.46	1.53	0.60	0.82	0.33	0.34	0.44	0.64	–
MISSINGS	33	0	32	7	142	1	115	40	75	0

Summary statistics do not reveal abnormal (low or high) prices and suggest that the sample fall within expected values for apartments in Oslo. The 'Joint debt' and 'Saved money' variables show higher dispersions around their mean values. The latter variable also displays the highest number of missing values and will be disregarded from our analysis. Collected information on usable area, number of rooms and floor level also display expected values. As compared with the 'Number of bedrooms', the 'Number of rooms' variable displays a lot more of missing values, perhaps suggesting that the former is more relevant from a buyer perspective than the latter variable ([129]).

The table below presents the correlations among the nine non-categorical variables included in the sample.

([129]) A similar reasoning could be applied to the 'Estimated commercial price' and 'Usable area' variables, which have the lowest number of missing values.

Table 2: Correlations among variables

	Total Price	Estimated commercial price	Joint Debt	Monthly Fee	Saved money	Usable Area	No. of rooms	No. or bedrooms	Floor level
Total Price	1	0.76	0.21	0.25	0.26	0.70	0.65	0.54	-0.03
Estimated commercial price		1	-0.47	-0.35	0.15	0.62	0.50	0.43	-0.05
Joint Debt			1	0.88	0.13	0.01	0.13	0.06	0.05
Monthly Fee				1	0.21	0.17	0.23	0.17	0.06
Saved money					1	0.22	0.29	0.24	0.08
Usable Area						1	0.85	0.81	-0.11
Number of rooms							1	0.943	-0.113
Number of bedrooms								1	-0.028
Floor level									1

The correlations show expected signs. Somewhat unsurprisingly, the highest correlation is found between Number of rooms and Number of bedrooms (0.94). More interestingly, it is worthwhile to pinpoint the high correlation between 'Joint debt' and 'Monthly costs' (0.88). Although low, the correlations of 'Estimated commercial price' with 'Monthly fee' and 'Joint debt' display the expected signs (-0.35 and -0.47, respectively). Moreover, the 'Total price' variable is more correlated with usable area than the 'Estimated commercial price' (0.70 against 0.62). Finally, it should be noted that the 'Total price' and 'Estimated commercial price' show high correlation (0.76).

3.2. Design of the empirical exercise

The empirical exercise was based on the application of the bootstrap re-sampling method to the dataset described in the previous section ([130]).

The exercise implied the following steps:

1) Choose a functional form for *(2)* and *(3)* and estimate its regression parameters with the complete dataset;

2) Using the imputation method ([131]), calculate two index numbers and find the difference between them (this would be the test statistic);

3) Divide the dataset into two separate (fictitious) time periods with approximately the same number of observations;

([130]) A classical reference for the bootstrap is Efron and Tibshirani (1993).
([131]) See Eurostat (2011a: 50-3) for details.

4) Draw, for each time period, one thousand new samples of the same size as the original sample using simple random sampling with replacement;

5) Apply the functional forms, found in step 1 above, to *(2)* and *(3)* in each of the two (fictitious) time periods ([132]);

6) Reproduce step 2 for each resample and obtain one thousand differences;

7) Sort the differences by its result;

8) Pick the results that are in the 25th and 975th positions (these will be the estimated critical values).

Under step 1, several specifications for *(2)* and *(3)* were tried out. The following specifications passed the robust Reset test (Wooldrigde, 2002) and were used in the calculations.

Thus, for *(2)* we have

$$(4)\quad \log(TP_i) = \alpha + \beta_1.\log(\mathrm{SZ}_i) + \beta_2.\mathrm{NR}_i + \beta_3.\mathrm{central}_i + \beta_5.\ \mathrm{rich}_i + \beta_6.\ \mathrm{Floor}_i + \varepsilon_i$$

and for and *(3)* we used

$$(5)\quad \log(Comm_i) = \eta + \alpha_1.\log(\mathrm{SZ}_i) + \alpha_2.\mathrm{central}_i + \alpha_3.\ \mathrm{rich}_i + \alpha_4.\ \mathrm{Floor}_i + \alpha_5.\ \log(MF)_i + \xi_i$$

were,

$log(TP_i)$ = natural logarithm of the 'Total price' of the i^{th} housing unit;

$log(Comm_i)$ = natural logarithm of the 'Estimated commercial price' of the i^{th} housing unit;

β, η = intercepts;

$log(SZ_i)$ = natural logarithm of the usable area of the i^{th} housing unit;

$Rich_i$ = dummy assuming 1 when the 'Postal code' is located in a 'rich' area and zero otherwise;

$log(MF_i)$ = natural logarithm of the 'Monthly fee' associated with the i^{th} housing unit;

$Floor_i$ = floor level of the i^{th} housing unit;

$Central_i$ = dummy variable with 1 if the i^{th} housing unit is located in a central place in Oslo and 0 otherwise ([133]);

NR_i = number of bedrooms;

ε_i, ξ_i = error terms.

The regression outputs that were obtained for step 1 are available at the end of this paper.

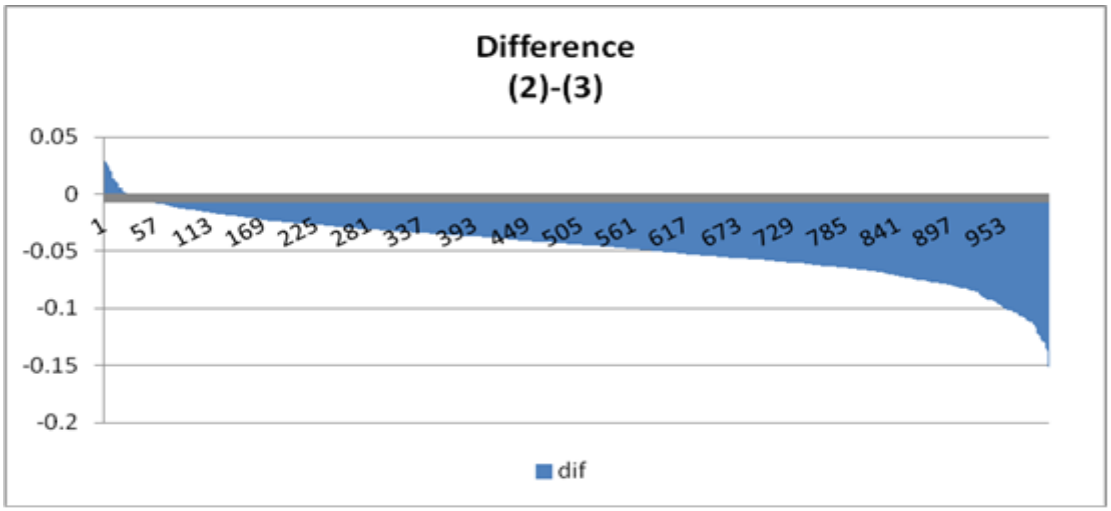
The next section shows the results of the simulation study.

([132]) As the design of the exercise covers two periods and two functional forms, it means that, in practice, four regressions had to be estimated.
([133]) Centrality and other variables (e.g. 'rich') were defined using the 'postal code' variable and other relevant information.

3.3. Result of the empirical study

The computation of the test statistic used 374 out of the 507 observations available in the sample. Around 26% of the observations were drop out from the exercise because they had at least one variable with a missing value.

The figure below displays the one thousand differences found in this exercise.



The value found for the difference between the two approaches ([134]) was -0.044 percentage points for the original sample (test statistic). The estimated bootstrap 95% percentile interval was 0.001 and -0.109 for the 2.5th and 97.5th percentiles, respectively ([135]).

As such, the null hypothesis of having no difference between the results provided by the two approaches is not rejected.

3.4. Proposal and final remarks

Several points are worthwhile to be mentioned. First, this paper reinforces the idea that, as a rule, housing co-operatives should be included in the HPI/OOHPI. However, each statistical office should analyse possible exclusions based on existent discriminatory entrance and exit restrictions. Secondly, 'Commercial prices' should be adjusted to reflect the true transaction price of housing units. In order to tackle this, two possible approaches were presented. The results of the empirical study suggest that both of them show similar results. Both of them are proposed as possible methods in the housing co-ops context.

Finally, the limitations of the present empirical study should not be forgotten. Although providing empirical evidence supporting the present proposal, the idea that there is no difference between the two approaches is not discarded.

Following this line of reasoning, it would be interesting to obtain empirical results from studies applied to other geographical contexts, to datasets containing real transaction prices and with more variables than the ones that were used in this paper and with a sufficient number of months to estimate the impact of the two methods over time ([136]).

([134]) I.e. index number found for *(2)* minus index number found for *(3)*.
([135]) The data, the SAS code of the experiment and the results can be provided upon request.
([136]) The estimation of the impact could be done using HICP's minimum standards for revisions as a guideline (Commission, 2001).

3.5. Regression results

MODEL	_DEPVAR_	Intercept	lg_sz	NR	Rich	Central	Floor	Lg_MF	N	_RSQ_	_ADJRSQ_
MODEL (2)	lg_Tp	12.2718	0.53437	0.046843	0.13491	0.21653	0.010235	_	376	0.53733	0.53108
MODEL (3)	lg_Comm	14.5451	1.04747	–	0.08865	0.26065	0.016691	-0.55818	425	0.66647	0.66249

Model (2)

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
Intercept	1	12.27180	0.17536	69.98	<.0001	0
lg_sz	1	0.53437	0.04866	10.98	<.0001	2.48478
NR	1	0.04684	0.02114	2.22	0.0273	2.41290
Rich	1	0.13491	0.04158	3.24	0.0013	1.37581
Central	1	0.21653	0.04282	5.06	<.0001	1.42165
Floor	1	0.01024	0.00558	1.83	0.0675	1.02591

Model (3)

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
Intercept	1	14.54511	0.25841	56.29	<.0001	0
lg_sz	1	1.04747	0.04143	25.28	<.0001	1.11716
Rich	1	0.08865	0.05671	1.56	0.1187	1.41565
Central	1	0.26065	0.05890	4.43	<.0001	1.46864
Floor	1	0.01669	0.00739	2.26	0.0244	1.03320
lg_mf	1	-0.55818	0.02931	-19.05	<.0001	1.07246

H: Other services related to the acquisition of dwellings

Services associated with the buying process

In order to account for all costs involved in buying a home one must understand the buying process in a given country. The process, which can take place of a period of months, is quite similar among European countries and consists of the following stages:

- Making an offer: The potential buyer makes an offer to the seller usually via an estate agent. Once accepted by the seller the offer is formalised and is subject to contract. The sale of the property is not legally binding until the signing and exchange of contracts.
- Applying for a mortgage and surveying and valuing the property: Once the offer has been accepted by the seller, the buyer may need to arrange a mortgage to buy it. Before approving the mortgage application, the lender will want to check the property's value and whether it is in good order. To do this, the lender may arrange for a qualified surveyor and valuer to inspect it. Normally the buyer has to pay for the valuation and in some countries may also be required to undertake some repair work as a condition of obtaining the mortgage. This safeguards the lender by ensuring that the loan is on a property which guaranteed to be in general good order. There may also be a re-negotiation of the price if the additional costs to the buyer are substantial e.g. if some under-pinning is required as a result of subsidence or timbers need to be treated to eradicate dry rot or wood-worm.
- Exchange of contract of sale: A contract of sale is drawn up and, once finalised, exchanged usually with payment of a 10% deposit of the price agreed. The latter is sometimes financed via a bridging loan from a Bank. At this point both seller and buyer are committed to the terms of the contract, most particularly the price, except in those countries where a five business-day cooling-off period is mandatory.
- Completion of sale: The sale is finalised, all the legal paper work completed, and the transaction and change of ownership takes place. The sale is registered with the Land Registry/Registry of Deeds. Registration may take several months.

The costs associated with the buying process

There can be various costs associated with the process of buying a dwelling which should be accounted for in the OOH price index and, more particularly, under heading O.1.1.3 ‘Other services related to the acquisition of dwellings’.

Lawyer or solicitors' fees for legal work and/or notary fees: Although in theory the buyer can do the legal work, in practice most home-buyers appoint a lawyer or solicitor to do the legal work involved in buying a property, particularly in countries where notaries are public and the documentation and legal checkups are prepared by the notaries that represent both parties. There will be notary fees where a notary carries out some of these activities. The solicitor and/or notary will do the following:

- Get the title deeds (documents giving evidence of ownership) of the property from the seller’s solicitor.
- Check that there are no planning conditions or particularly harsh conditions of ownership (for example an intrusive right of way) affecting the property.
- Check that the seller has all planning permission and completion certificates for any alterations or extensions to the property.
- Check that there are no local developments (for example, road-widening schemes) planned which might affect the value of the property.
- Check that the street, pavement and main drains are public and maintained by the local authority.

- Negotiate and agree (with the seller's solicitor) the draft of the contract setting out the terms.
- Register or record the change of title to the property, and the mortgage deed (loan agreement) in favour of the lender, with the Land Registry.

All charges relating to the above activities should be accounted for in the OOH price index.

The arrangement fees for any bridging loan needed to finance the deposit at the time that contract is exchanged should also be covered in the OOH price index This is sometimes included in and is part of the mortgage arrangement fee.

Registration fees

For the sale to become completed a Purchase and Mortgage Deed must be signed, usually with both parties and their legal representatives and sometimes in the presence of the notary. The deeds are then registered with the Land Registry/ Registry of Deeds and any fee associated with the registration should be accounted for in the OOH price index.

VAT&/or Stamp Duty

VAT and Stamp Duty (a duty levied on the legal document relating to transfer of ownership which historically required a physical stamp to be attached) should be accounted for in the OOH price index. These fees may be in addition to registration fees.

Insurances

Lenders often require Life Insurance and/or Home Insurance before giving a loan. Life Insurance is already accounted for in the HICP under COICOP 12.5.1 so should be excluded from the transaction costs associated with the process of buying a dwelling. However, Home Insurance, that is insurance relating to the structure of the building, is not included in the HICP so should be included in OOH price pndex under O1.2.2 – it does not belong to services related to acquisition. Note contents insurance is already covered under COICOP 12.5.2.

Utilities

Utilities connection charges for gas, electricity, water and telephone are in scope of the OOH price index and may require some licenses and inspection procedures to be paid.

In spite of the similarities of the process among all countries we advise each country to research for any local differences from the framework presented above.

Here follows an illustrative example of the costs associated with the process of buying a dwelling.

Price paid for the dwelling		**150 000,00**
Other costs	**% fee**	**euros**
Mortgage arrangement fee	0,2%	300 00
Notary fee + VAT (20%)	1,0%	1 800,00
Land registry	0,5%	750,00
Legal fees (Lawyer or solicitor) + VAT (20%)	1,0%	1 800,00
Real Estate Broker + VAT (20%)	5%	9 000,00
Transfer tax or VAT	7,0%	10 500,00

Stamp duty	0,5%	750,00
	Total cost	**24 900,00**
Weight		**16,6%**

Check list of 'other' services related to the acquisition of dwellings categorised under heading O.1.1.3 'Other services related to the acquisition of dwellings'

- Mortgage application fee.
- Mortgage indemnity fee (on loans above a certain percentage of the purchase price).
- Mortgage settlement fees, such as stamp duty, administrative fees, and contract loan deed
- Valuation (appraisal) fee.
- Notary fee.
- Legal fees (Lawyer or solicitor).
- Real Estate Broker fee.
- Fee for arranging a bridging loan.
- Land registry fees that may include, cadastral register fees, and fees for recording a change in ownership in the property fiscal/administrative register or deed selling contract register.
- Transfer tax.
- VAT.
- Stamp duty.
- The cost of an escrow account where money is held by a third party until the sale is completed ([137]).
- Utility connection fees if unconnected when dwelling acquired.
- Building license (in case of self- builders).

This check list is not exhaustive, it is merely indicative, it is for each country to research for local fees and other costs.

As already noted in Chapter 5, the expenses of both buyers and sellers who belong to the Household institutional sector as owner-occupiers, should be included in the costs associated with acquisition and change of ownership.

Some costs come under ownership costs if related to the provision of a service or under transaction costs if they only arise when a dwelling is being sold. The index compiler will need to investigate things at a detailed level. For example, in some countries an up-to-date Energy Efficiency Certificate may be a requirement of all home owners whilst in other countries it may only be required when the dwelling is put up for sale. A similar situation may apply to a Gas Safety certificate.

([137]) The service of an escrow is to provide safety to the transaction. The buyer deposits the amount of the price to be paid in an escrow account managed by a bank, lawyer, solicitor or estate agent (depends on the country's legal framework) and after the completion the money is transferred from the escrow account to the seller.

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