Chapter 1: Introduction

Information and transparency are essential conditions for the smooth running of a competitive market. It is therefore crucial that economic actors have reliable information at their disposal on house prices and how these are changing, particularly as housing plays an essential part in the economy, in terms of household production, assets, budget and debt.

Housing for sale may be new (never been occupied) or used ("second-hand"). Since January 2013, a price index of used dwellings has been available on the INSEE website www.insee.fr as well as an index of all dwelling prices (new and used). *The present document covers only indices of used dwellings.*[1]

The price of a dwelling is seldom observed

The production of a housing price index raises the same problems as any other price index: how to separate "pure" price changes from changes in housing quality? But there are specific problems too.

Firstly, no two dwellings are ever exactly alike. A dwelling is a combination of characteristics (also referred to as "qualities") which only when taken together constitute the "housing good". A dwelling is not only a geographic location (and hence access to a neighbourhood defined by local public goods), but also a construction (defined by type, size and a multidimensional level of comfort) and often an emotional good, a place that holds family memories.

Secondly, a dwelling may change hands only infrequently. It is estimated that on average dwellings are sold once every 35 years[2] and undergo change, with or without financial consideration, every 25 years. Observation of the price of a given dwelling is therefore rare. This long time lag between purchase and resale of a given dwelling complicates the compiling of a price index. Some indices are based on the stated price or the asking price, others on estimates, but it is better to have access to market prices, i.e. prices of transactions actually completed.

How, then, should we measure the change in the price of a given dwelling, or more generally of a set of dwellings, even though only a few transactions are observed in each period?

Which prices are observed?

If we want to build an index of changes in the price of the entire housing stock, we cannot simply calculate the average current transaction price and compare it with that of the previous period. Such a comparison would mix price effects with changes in stock quality and in the non-representativeness of transactions. There are two parts to the problem: on the one hand, transactions observed in each period are not drawn at random from the housing stock; on the other, the housing stock changes and its quality does not remain constant from one period to the next.

Let us disregard the second of these problems and assume little or no change in the housing stock, i.e. that there is no new construction and that maintenance exactly offsets building wear and tear. If the transactions in a given period were in sufficient number and drawn at random from this fixed housing stock, then we could simply determine the average current transaction prices, compare them with that of the preceding period and so obtain an index of housing stock prices. If, however, as is often the case in practice, the transactions in a quarter are not a representative sample of the total housing stock, such a comparison would mix together changes in the quality of the sample with changes in prices.[3] To understand this, let us assume that the price of each dwelling remains absolutely constant over time; in a given quarter the majority of sales take place in the more prosperous

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[1] In the years after the Second World War, new dwellings predominated in purchases of primary residences (and they were still in the majority at the beginning of the 1980s: 58% of transactions between 1980 and 1984, according to the 1984 Housing Survey). By 2006 they represented just under a third of purchases during the previous four years (source: Housing Survey 2006).

[2] This estimate disregards housing stock held by corporate bodies (mainly social housing bodies, but also institutional investors and real estate companies), which is usually sold in blocks. These average periods between two transactions are calculated on the basis of 800,000 transactions against payment and 330,000 transactions without financial consideration (where the reference person of the property-owning household changes) per year, reported in a stock of 28 million dwellings owned other than by a company (source: CGEDD).

[3] This problem concerning change in the quality of transactions observed from one period to the next is sometimes described as a problem of weighting. It has been well formulated by Triplett (1983) who makes a distinction between input-price and output-price indices.

neighbourhoods, then in the following quarter the majority of sales are at the lower end of the range. The average price will fall, but this will bear no relationship to the actual zero change, which is what a pure price index is designed to capture.

Changes in housing quality

Let us now turn to the second problem. Let us make the opposite assumption, namely that a sample of transactions representative of the housing stock is available at each date, but that this stock is not fixed. We cannot construct a price index in this case either, because such a comparison will combine a price effect and the effect of the change in quality of the stock as the older dwellings wear out or are destroyed and replaced by new ones.[4]

The problem posed by the change in quality is familiar to price-index producers. If the price of a light bulb goes up from 1 to 2 euros, but its life increases, its price appears to have doubled. However, if the consumer derives the same satisfaction from the long-life bulb as from two short-life ones, we will say that the quality has also doubled, and hence that the pure price has remained constant. For consumer goods, such changes in quality are common; sometimes comparing the goods themselves can be tricky when we are dealing with a new product.

When dealing with housing, the situation is both simpler but also more complicated. It is more complicated because, as noted earlier, quality cannot be measured according to a single dimension, like, for example, the lifetime of the light bulb. A large number of characteristics have to be taken into account.[5] This requires the use of "hedonic" econometric methods. However, the housing situation can also be simpler for the statistician to deal with because the number of technical revolutions is limited; over a given period of several years, changes in quality (defined as the emergence of a new dwelling characteristic) are slow to emerge. This might be a change in the number of bathrooms per dwelling or technical changes linked with compliance with new environmental standards.

We therefore make an initial assumption: the characteristics of dwellings that may influence their price, such as the quality of the neighbourhood, the number of rooms, whether there is a lift, which floor an apartment is on, etc. are finite in number and this number remains constant for the duration of the index-calculation period. If a new quality characteristic emerges to alter house prices, for instance the installation of air conditioners or mandatory asbestos testing, it will not at first be taken into account in the index estimation as a new quality, but as a price variation. In other words, we admit that consumer satisfaction is not yet truly influenced by air conditioning or asbestos testing, and that they consider this as a price increase. These changes in quality will be incorporated by the statisticians by adapting the specification of the models to regular intervals.

The hedonic method

Econometric methods are applied whenever a good is composite, whether this is in relation to the consumer price index (e.g. for computers, where their characteristics may change in value, but new characteristics do not appear as often[6]), the cost of a service (such as a bank,[7] or hospital), or labour market studies where workers' characteristics are heterogeneous and multidimensional.[8]

Hedonic methods were first developed in the United States between the two World Wars, in the midst of the Great Depression. According to official price indices estimated from average prices, automobile prices rose by 45% between 1925 and 1935 and strong pressure was being exerted on General Motors to reduce prices in order to maintain consumption and employment. So in 1939, Andrew Court, who worked for the Automobile Manufacturers Association and knew that the quality of the automobiles had also changed (safety glass, gear boxes, more powerful engines, etc.), developed a method to take into account the changes in characteristics of automobiles when calculating price indices.[9] Court defined a standard car, with given characteristics regarding speed, safety, windows, seat width, etc., which would serve as the benchmark for user comfort or *pleasure*.[10] He

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[4] Curiously, this second problem receives little attention in the literature on housing prices.

[5] In fact, many consumer goods and durables also display this composite and multidimensional profile. We need only think of a computer, a plane trip or even a simple sugar cube whose packaging can differ.

[6] On the use of hedonic methods applied to computers, see Moreau (1996), Triplett (2004).

[7] In this case, it is rather the number of characteristics that changes.

[8] Zvi Griliches has done a considerable amount of work on this technique; see, for example, Griliches (1971).

[9] At the same time, the Bureau of Labor Statistics was trying to compare the qualities of tractors and trucks, in order to gauge what was quality change and what was price change.

[10] Hence the term "hedonic" to describe the method, which in reality is a perfectly commonplace econometric regression model.

then divided the average car price by this benchmark, i.e. its "hedonic content" and found that the price of the standard car had fallen by 55% in the period.[11]

Concerning housing prices, in addition to the first hypothesis (whereby each dwelling can be defined by the combination of a limited number of characteristics), we put forward a second hypothesis, whereby the relationship between the price per square metre of a dwelling and its characteristics remain fixed throughout the index-calculation period for a given type of dwelling and primary area. In a primary area, the housing price index is defined as the ratio of the value of a fixed reference housing stock during the current period to its value during the base period of the index. The value of each dwelling in this stock is estimated each quarter from transaction prices actually observed and econometric relations estimated over a specified time period.

Available data and implementation of the method

In France, real estate transactions are carried out before a *notaire* (hereafter: notary), a State-appointed public officer, who ensures that the deed of sale is recorded in the land register and collects certain taxes on behalf of the State. Although every deed of sale must include identification of the land base in the land tax register, this obligation does not extend to a description of the dwelling sold. Notaries are well aware of the importance of this information and for the last few years have made a concerted effort to collect this data.

In Paris, a price index for used apartments had been calculated since 1984 using a stratification method developed with INSEE. In 1997, the Higher Council of the Notariat (*Conseil supérieur du notariat*) decided to create a price index for dwellings in all areas outside Paris (hereafter: the Provinces). This was the perfect opportunity for INSEE to develop a rigorous method for calculating a price index for all used dwellings, following the path opened up by Court and Griliches.[12] This method was first introduced in 2002 in *INSEE Méthodes* no.98, *Les indices de prix des logements anciens.*[13] A second edition of this document was published in 2005.[14] The present volume (*version 3*) is therefore a second update.

Since the first version of the models was introduced, the collection of housing transaction data has improved: the number of transactions recorded has increased and so the indices can now be "pure" quarterly indices, unlike the original indices, which were calculated on an annual or semi-annual "period-over-period" basis. In addition, there are now more published indices which are made available more quickly: provisional indices are published about eight weeks after the end of the quarter, a similar delay to our counterparts in the United States and in most European countries. The definitive indices for the previous quarter are published at the same time[15]. Today, the interdepartmental chamber of Paris notaries (*Chambre interdépartementale des notaires de Paris - CINP*), through its own association, the *Paris notaires service* (PNS), calculates the indices for Paris every quarter from the gross data and then adjusted for seasonal variations. The company Min.not, a subsidiary of the ADSN group (*Association pour le développement du service notarial*), does the same for the Provinces and calculates the indices for the whole of France. Every year, INSEE calculates the seasonal adjustment coefficients and validates the quarterly indices before publication.

On 28 March 2011, the French National Assembly adopted law no. 2011-331 on the modernisation of the legal and judicial professions and some regulated professions. Articles 15 and 16 of this law establish that it is the responsibility of the notarial profession to carry out the public service consisting of collecting, transmitting, centralising and disseminating information on property transactions against payment (this includes not only sales of used dwellings, but also sales off-plan for new dwellings, sales of plots of land or sales of premises for non-residential use). The implementing decree was published on 3 September 2013.[16] The resulting improvements in coverage in the databases, should open the way to more comprehensive regional, departmental and local information, and in particular to the establishment of extra sub-national indices, modelled on those that are already published for the Rhône-Alpes and Provence-Alpes-Côte d'Azur regions and, more recently for Nord-Pas de Calais.

The indices in the new database (version 3), described in the present document, were first used towards the end of 2011. At the same time, seasonally adjusted indices were published more systematically, which gave a better view of market trends. In addition, the possibilities that have opened up with the development of electronic

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[11] This story is told by Warsh (1999).
[12] The following worked on developing the method that was adopted: Alain David, François Dubujet, Christian Gouriéroux, Anne Laferrère and Claude Taffin.
[13] David *et al*. (2002).
[14] Beauvois *et al*. (2005).
[15] However, Corsica and the French overseas *départements* (DOM) are still excluded from the scope of the national indices.
[16] JORF no.0206 of 5 September 2013 page 14976, text no. 2, Decree no. 2013-803 of 3 September 2013 concerning notarial databases relating to real estate transfers against payment.

transmission of deeds by the notarial offices should reduce the time needed to process them. The quarterly indices of used dwelling prices in the Paris region were approved by the Public Statistics Authority (*Autorité de la statistique publique - ASP*) in June 2011.[17] This Authority checks that the principle of professional independence is complied with in the design, the production and the dissemination of public statistics and gives its quality certification to statistics produced for the general interest, by administrations, public and private bodies responsible for providing a public service. The indices covering the Provinces may also be checked by ASP subsequently.

Various extensions

The method used to calculate the housing price index can have various extensions.

One application is to create an expert system to assess housing prices. The aim is to see whether a property that is put up for sale is over- or under-priced compared with another property that is used as a reference. In addition, the tool may use the coefficients obtained when the hedonic equation was estimated to transform the price of the transaction into a reference-property equivalent price.

Another application could be to calculate price indices according to the modalities of a variable of interest. Initial investigations are underway and the possibility of defining indices according to the number of rooms in the dwelling is currently being examined.

Lastly, for a more reactive knowledge of the market, it has been decided that a new generation of indices will be created, so-called "advance" indices of the prices of used dwellings. In this case, instead of using transfers that have taken place in the course of a given quarter, it is the pre-contract sale agreements that will be considered. In fact, most pre-contract agreements become definitive transactions so these can give a good indication of market trends.

Content of this volume

After this introductory chapter, a second chapter sets out the theory of hedonic indices. Chapter 3 discusses the calculations applied and the new features in this second update. Chapter 4 describes the databases used. In Chapter 5, the method for estimating the hedonic equation is described, with some examples. Chapter 6 deals with seasonal adjustments to the indices, tools for quarterly tracking, and publications. Lastly, in Chapter 7, we compare the series of indices obtained in version 2 with those obtained in version 3.

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[17] The Official Statistics Autthority (ASP) was created by Act no. 2008-776 of August 4, 2008. it ensures that oficial statistics are prepared and disseminated in all professional independence and according to the fundamental principles in the European Statistics Code of Pratice : impartiality, objectivity, relevance and data quality (art. 144). It notified the labeling of the quarterly statistics on housing prices in the Paris region (Île-de-France), jointly produced by the Paris Chamber of Notaries and INSEE, for a period of five years, in its opinion no. 2011-01 of June 21, 2011.