House Price Dynamics : The French Case

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Abstract During the early 2000's, house prices doubled in most of developed countries including France. Several studies analyse this evolution from a macroeconomic point of view using the market fundamentals to explain the real estate prices boom. However, this approach seems to be insufficient since it gives no explanation on the evolution inside the market, nor on the agents' behaviour. This paper focuses on the micro-level changes of the housing market in order to detect the dimensions of residential property which have absorbed the price increase. For this purpose, we make use of the two-staged hedonic methodology which allows to explore the effects of both structural and locational attributes of dwellings and social and economic characteristics of purchasers. Combining data from several sources, we build a comprehensive database on transaction prices for the department of Oise (more than 33000 observations over the period 2000-2008). Our results reveal that the willingness to pay for some environmental attributes have increased over the period, nevertheless this appreciation don't absorb the entire house prices' boom as it commonly argued. Otherwise, the results of the second stage show that the role of environmental amenities grew between 2000 and 2006. However, some of these attributes involve important depreciation of dwellings so that we cannot agree with the hypothesis of over-valuation of land and environmental features.

Keywords: House prices, Two-stage hedonic analysis

JEL Classification: D40, R21, R31

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1 Introduction

In many developed countries the recent financial crisis manifested itself first of all by the burst of the housing bubble that induced great difficulties for financial institutions. The term of "bubble" is rather controversial as it implies that the agents have a speculative behaviour what must be justified while the "boom" term is more convenient since it is defined as abiding price rise with an amplitude that deviate significantly from the long-run trend. In fact, starting from 2000, house price began an exceptional growth in most of OECD countries (except Germany and Japan) and they reached their highest level in 2006-2007 before the bust that occurred in 2008. Figure 1 presents house price indexes in several OECD countries and we can remark that in a few of them, such as France, Spain and the UK[2], house price have doubled between 2000 and 2006

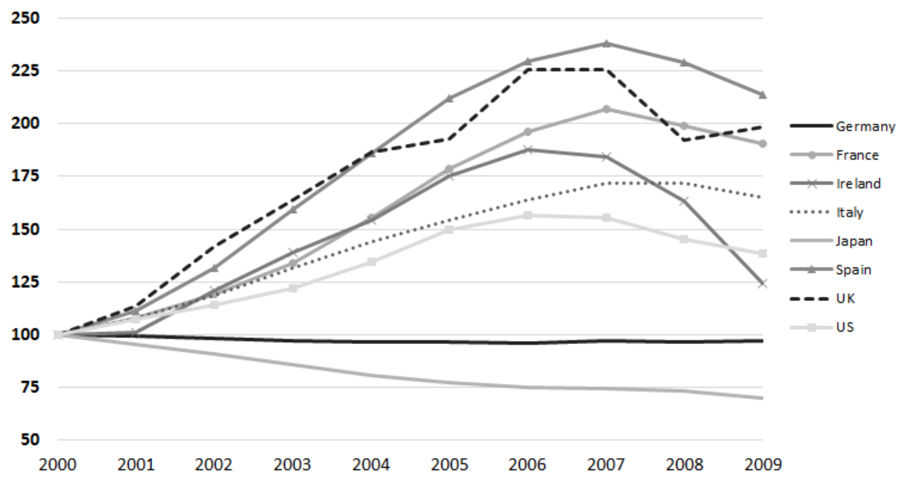

Figure 1: House Price Indexes in some OECD countries, 2000-2009

In view of the extent of the phenomenon and its consequences on the financial sector and the global condition of the economy, numerous researchers have taken an interest in the behaviour of the housing market between the late 1990's and 2006-2007. Naturally, most of the works try to identify the reasons of house prices' hike most of which derive from the financial sector.

The existing literature related on the housing price evolution can be divided into two major strands. The first one analyses the link between market fundamentals and the house price level (see Leung (2004) for a survey). Capozza, Hendershott, Mack & Mayer (2002) study the link between house price dynamics and the city size, real income growth and real construction costs and make an empirical study based on 62 U.S. metropolitan areas from 1979 to 1995. A

[2]The IHP data indicates reduced house price index for Ireland comparing to the House Price Index of the General Statistics Office of Ireland which states that house prices were multiplied by 2.1 between 2000 and 2006.

similar analysis is done by Hilbers, Banerji, Shi & Hoffmaister (2008) who use more recent data for examining the impact of market conditions, demand factors such as income and interest rates and financial sector on the house price dynamics in different countries. In their model, user costs, demographic pressures and per capita income determine house prices and their effect is variable depending on the country. More recently, Hiebert & Roma (2010) and Gyourko, Morales, Nathanson & Glaeser (2011) report similar results about the link between income growth, construction costs and population on the one hand, and house price level on the other hand.

The second strand of literature has been developed around the asset approach to housing. It may be justified by the fact that dwellings and land remain major non-financial asset for households and it stands for more than a half of households' wealth in the most of developed countries. The asset approach has been introduced by Poterba (1984) who uses the 1970's house price boom like a background for developing and estimating an asset-market model of the housing. The model is based on the hypothesis that home-buyers estimate the house price as a "present discounted value of its future service stream" and assigns traditional asset features[3] to real estates. Poterba (1984) uses Census Bureau data for 1963-1982 period to reveal inflation, credit rationing and interest rate impacts on housing demand and supply, as well as tax system's effect on the housing market. Further applications of asset-pricing approach to housing market give contradictory results : Himmelberg, Mayer & Sinai (2005) tend to conclude that there is no express signs of housing bubble[4] while Black, Fraser & Hoesli (2006) and Ayuso & Restoy (2006) lead empirical studies which show that the difference between fundamental and actual house price is significant meaning housing bubble[5].

In contrast with these works, we try to adopt an alternative approach to price analysis. In fact, macroeconomic approach based on general variables is dominating existing literature as much researchers try to identify the reasons of house price rise among political, financial and monetary issues. Therefore, this mainstream practice fails to explain the process inside the housing market. In concrete terms, it seems to be interesting to know the households' reaction to the increase of housing purchasing power due to monetary and financial phenomenons. In theory, four scenario can be imagined:

1. Home-buyers who accept higher prices become more exigent and attach

[3]House price equation integrate depreciation rate, expected revenue (future service flow), repair cost.

[4]The authors maintain standard hypothesis of equality between the cost of ownership and the rent and take risk-free interest rate, property tax rate, maintenance costs, capital gain and additional risk premium into account. Their empirical study is based on 46 US metropolitan areas over the 1980 to 2004 time period where house prices follow different trends. In contrast with traditional framework, Himmelberg et al. (2005) use the imputed rent as an indicator of user cost instead of the purchase price.

[5]Black et al. (2006) use UK Nationwide data for 1974-2004 time period to calculate fundamental home prices and compare them to actual prices. After a peak in the late 1980's, this gap became negative and increasing from 1991 to 1996, then actual prices started their rapid growth to catch up with their fundamental level and starting from 2002, exceed the latter. A similar result was obtained by Ayuso & Restoy (2006) who benchmark the gap between price-to-rent ratios and equilibrium at a 30% level for the UK, 20% for Spain and 10% for the USA using 1987-2003 data.

more importance to each aspect of their property comparing to the situation where home prices were low. This behaviour can take two forms : in the first case, households' decisions become more regular and precise in general and more justified, or, in the second case, they attach more importance to some criteria relatively to other ones

2. Households keep their preferences unchanged facing the house price rise. This would mean that the only change in the house market is the households' purchase power increase and the situation on housing market is the consequence of the financial and monetary policy

3. Buyers become less exigent and purchase commodities that correspond to their willingness-to-pay without having clear prerogatives. Such behaviour corresponds to speculation which was widely argued especially in the United States

4. Home-buyers' profile (age, origins, occupation) have changed during the house price boom and new buyers have new prerogatives in terms of housing service and are ready to pay more for the same level of . This means that the entire demand function is changed, and it raises another questions such as affordability and accession to home-property of some categories of households

In French case, such an analysis seems to be especially relevant as far as, according to the Insee[6], there was no evidence of speculative behaviour of home-buyers (Gallot, Leprevost & Rougerie 2011). This means that most of households bought their homes in order to occupy them and, as a consequence, purchasing a house follows a standard economic logic and responds to households' needs and preferences which need to be analysed. Moreover, the Commission of Economic Affaires and Plan of French Senat indicates in one of its reports that home crisis was generated by the land crisis. More recently, the Strategy Analysis Center which is a governmental analytic institution maintains that land price growth is one of the major factors of the house price boom (Ben Jelloul, Collombet, Cusset & Scaff 2011). If these statements correspond to reality, we should notice that the weight of land component the house price have been increased during the house price boom.

In order to define which of scenarios described above has been realised and whether land component or another one has been overvalued, we need to adopt a micro-level approach of price. In order to perform this analysis , we make use of a particular method which is widespread in housing economy and in construction of house price indexes.

This paper is organized as follows : in the second section we discuss existing methods of analysis corresponding to our purpose and describe the methodology we choose for this work. In Section 3, database and some statistical elements about housing market are presented. Sections 4 and 5 display different stages of the model and the results of its estimation.

[6] Institut National de la Statistique et des Etudes Economiques

2 Theoretical Framework and Methodology

As we state above, the starting point of our analysis is the individual level and particular behaviour of the agents. In housing economy, there are two approaches that let analyse housing from this point of view : repeat sales method and hedonic pricing method. Repeat sales method, as its name suggests, consists in temporal follow-up of real estate being bought several times during the observed period of time (Bailey, Muth & Nourse (1963), Meese & Wallace (1997), Wang & Zorn (1997), Nagaraja, Brown & Wachter (Forthcoming)). Naturally, the evolution of the house price can be directly assessed from the observed data. Nevertheless, this method imposes some constraints on the data base since it requires long-term following of the same market, and the area of the observed zone needs to be either vast or very dynamic (such as great metropolitan areas for example) in order to dispose a sufficient number of repeat sales. These constraints are not the major inconvenience of the repeat sales method in our case : in fact, this approach focuses on the simple evolution of the prices and fails to take into account features of the homes and of the home-buyers, as well as it ignores whether the observed homes were improved or renovated between two sales. Hence, the repeat sales method cannot be used to examine the agents' behaviour.

Hedonic price method seems to overcome most of the inconveniences of the repeat sales method. First of all, hedonic pricing is based on the idea that real estate is not bought for itself but for its features and for the housing services that can be obtained from these features. Therefore, this approach makes possible the assessing of the customers' willingness-to-pay for different aspects of home-ownership, in particular those of land and amenities. Hedonic pricing let us examine the evolution of the home prices between two dates without strong constrains on the dataset.

Hedonic price method was firstly used by Court (1939) who applied it to the automotive car sector and by Griliches (1961). The theoretical framework base was constructed by Lancaster (1966), but the major contribution to the development of hedonic methodology has been done by Rosen (1974) who presents a two-stage hedonic model for differentiated goods markets. Several aspects of this methodology have been discussed later (Brown & Rosen 1982, Bartik 1987, Epple 1987, Bishop & Timmins 2011) but the theoretical founding principles remained unchanged.

The basic statement of the hedonic pricing method is the idea that some goods are not exchanged for themselves but for the utility that provide some of their features. Hence, a differentiated good Z is a vector of quantitative and qualitative characteristics $z_1, ..., z_n$ and its price is a function of these characteristics

$$P(Z) = p(z_1, z_2, ..., z_n) \tag{1}$$

with n a finite number of variables. Given the total price and a sufficient number of characteristics, hedonic regression provides implicit prices of different features of the good which are the derivative of the price over the characteristics:

$$p_i(z) \equiv \frac{\partial P(Z)}{\partial z_i} \tag{2}$$

On this stage, choice of exogenous variables to be introduced to the analysis can be discussed. Naturally, a consumer's choice in terms of housing depends on an infinite number of criteria, but the hedonic analysis must include a limited number of relevant characteristics that are often classified into three groups: (a) structural characteristics, (b) neighbourhood and (c) amenities' availability and accessibility. In a general way, data set including all of these groups are rare, and hedonic analysis requires computing new large data set.

The second stage of the hedonic analysis seeks to recover the coefficients of demand and supply functions for each characteristics by regressing the marginal prices of each characteristics at the bundles actually purchased by consumers onto the characteristics of the good and some characteristics of the consumers. Rosen (1974) obtains a system of $2n$ equations :

$$p_i(z) = F^i(z_1, ..., z_n, Y_1) \tag{3}$$

$$p_i(z) = G^i(z_1, ..., z_n, Y_2) \tag{4}$$

for $i = 1, ..., n$ where p_i and z_i are all dependant variables and Y_1 and Y_2 are exogenous demand and supply characteristics. Later, it was proved that this second stage has one major problem that leads to inconsistent estimators. This problem is an identification one but not in its standard kind : it is not due to the demand-supply interaction. It is caused by the simultaneity of the consumer's choice: consumers with high preferences for some characteristic tend to purchase bundles with large amount of this characteristics which means that there is endogeneity of prices and quantities[7].

Further research works bring several solutions to these problems depending on the hypothesis concerning the market[8]. Several articles discuss solutions for the second stage and the choice of the correct one depends on the data used for the empirical study. In particular, Epple (1987) suggests that using data from multiple markets under the hypothesis that consumers' tastes are the same in all the markets avoids duplicating information from the first stage. In fact, disposing of a large data set is rare, and as a result, Rosen's second stage was not widely used until the instrumental variables estimation became widespread. In our application we dispose of sufficient data to assume that we study multiple markets that resolves the endogeneity problem.

[7]Nevertheless, Bishop & Timmins (2011) argue that "there is no fundamental endogeneity problem" in the basic hedonic model as well as consumers take the hedonic price function as given when they choose quantities of each amenity and make their choice in order to maximize their utility which depends on their characteristics and unobserved taste shifters which are assumed to be orthogonal in the hedonic model.

[8]Bajari & Benkard (2005) discuss the effect of several hypothesis on the application of hedonic method. The authors relax such hypothesis as perfect competition, continuum of products and perfect observability of characteristics and demonstrate that the first stage of the analysis, that is the hedonic price function, is justified.

Before presenting data and estimation results, we must discuss two important points of the model. The first one is the functional form of the hedonic price function. On the basis of existing empirical works, we can consider four functional forms which are usually used in the hedonic analysis : linear, log-linear (or semi-log), double-log (or log-log) and Box-Cox[9] transformed. Considering the simultaneity of consumer's choice of price of quantities of each characteristics, we cannot accept the linear specification as it provides marginal prices which don't depend on the exchanged quantities (Bartik 1987, Marchand & Skhiri 1995). As for the Box-Cox transformation, its greatest advantage is that this form is flexible and, in its general form, it includes all the functional forms used in the hedonic literature. Nonetheless, the Box-Cox transformation infers estimation results which are not interpretable since variables are transformed. Moreover, it produces estimation which is close to the semilog one(Mok, Chan & Cho 1995, Nappi-Choulet, Maleyre & Maury 2007) and this transformation makes hedonic regressions not-comparable because α-parameter can vary amongst years. Hence, semi-log and log-log functional forms seem to be more appropriate for the hedonic analysis. In our estimation, we use a "mixed" functional form which is presented in Section 4.

Another major issue concerning the hedonic price model is the introducing time into the latter. In fact, literature offers two possibilities which are both frequently used : Time-Dummy method and Hedonic Imputation method. Time-Dummy method(Din, Hoesli & Bender 2001, de Haan, Diewert & Hendriks 2011) consists in introducing time-periods like dummies into the hedonic price function. Naturally, this approach forces implicit prices of different characteristics to remain constant over time and, as a consequence, this method cannot answer the main question of this paper which is the evolution of the demand for some characteristics. The Hedonic Imputation method (Zabel 2004) consists in running separate regressions for different time periods removing the time-stability constraints of the Time-Dummy method.

3 Data Set and Summary Statistics

Two-stage hedonic method corresponds to our aim which is to discover whether land components have risen more than the structure components. However, the application of this method needs a large dataset including information on the price of the dwelling, on its characteristics, as well as some information about the buyers and the sellers. Such data is rare, although in France, the transaction system allows gathering this information and creating such a database. Every transaction must be registered by a notary's office which has access to information on the buyer, on the seller, on the price and the location of the dwelling. During the signature of the bill of sale, notary collects some informa-

[9]The Box-Cox transformation consists in transforming variable as follows:

$$\begin{cases} x^{(\alpha)} = \frac{x^{(\alpha)}-1}{\alpha} & \text{if } \alpha \neq 0 \\ x^{(\alpha)} = \ln(x) & \text{if } \alpha = 0 \end{cases}$$

Its use for hedonic pricing was firstly suggested by Goodman (1978) and Halvorsen & Pollakowski (1981). Later, this transformation was frequently used in house pricing models (Marchand & Skhiri 1995, Chattopadhyay & Braden 1999, Wilhelmsson 2002).

tion about the dwelling (such as number of bedrooms, number of bathrooms, general condition and others) which is later transmitted to a private firm Perval who standardize all the data and create a single database.

We dispose Perval data on individual transactions for Oise department. The dynamics of Oise real estate market has been influenced by several factors. First of all, Oise is bordering on Parisian region, Ile-de-France (see Figure 2), and different kinds of transport connections between with Paris are available. Hence, the train ride between Paris and some cities of the Southern part of Oise department takes less than 30 minutes, which makes these cities potentially attractive. This attractiveness was strengthened by the extent of house price growth in Parisian region. In fact, between 2000 and 2006, apartment prices in Parisian region increased by 112%, house prices - by 96%. This growth has been all the more significant in two departments which are bordering on Oise : Val d'Oise (+126% for the apartments and +99% for the houses) and Seine-et-Marne (+121% and +99% respectively).

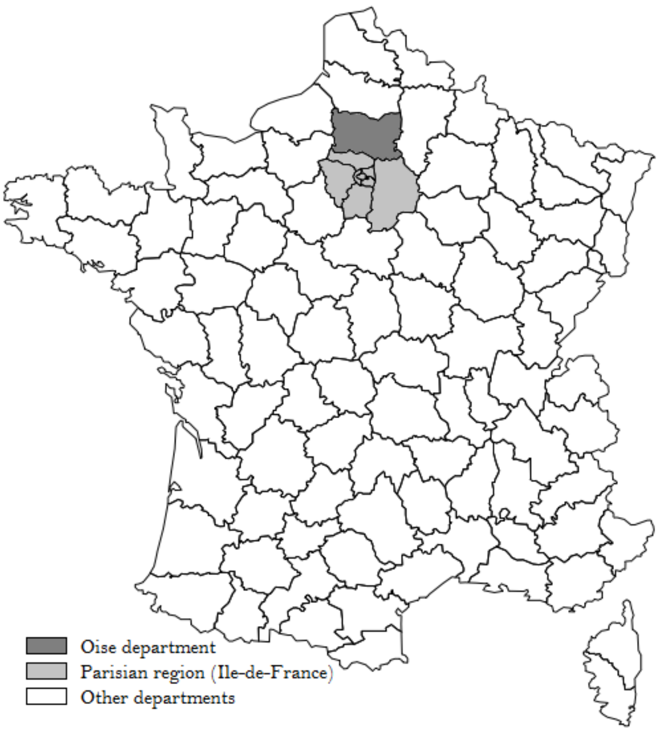

Figure 2: French Departments

Furthermore, Oise department was revitalized under the influence of the reopening of Beauvais-Tillé airport. In 1997, a low cost air company Ryanair concluded a contract with Bauvais airport for Beauvais-Dublin air link, afterwards, number of destinations and passangers was continuously increasing up to making Beauvais the 9th Franch airport. These facts let suggest that housing market of Oise department is a good example of a dynamic area which has been subjected to important transformations.

We dispose Perval data on individual transactions for 5 years : 2000, 2002, 2004, 2006 and 2008. This data is separated into two files: Apartments and Houses. Several empirical studies deal with these types of dwelling as a unique commodity although, as the further analysis shows, the tastes and the preferences of the buyers of apartments are not the same that those of the buyers of houses. Hence, after deleting transactions with entry errors, we obtain a database with 7165 transactions for apartments and 22590 transactions for houses.

Perval database includes also a spatial identification number which is unique for each dwelling. This ID let us to geolocate the dwelling and complete information by using different cartographic data. Geolocalisation permits to get information about the amenities that are accessible for the household living in each dwelling. Most of cartographic data come from the National Institute of Geographic and Forest Information which provides maps of different scales including plot level which enables calculating distances between houses and infrastructure elements such as motorway junctions, railway stations and others. As for an other major amenity, the public transport amenities, data is available from the Regional Transport Observatory of Picardie database.

The third type of information which is necessary for the hedonic analysis is data on neighbourhood of the dwelling. Most of this information are available from different surveys of the INSEE at the municipality level. Such data as Percentage of social housing and Type of urban fabric[10] are produced by the national census.

Tables 2 & 3 give some summary statistics about the dwellings bought during the period 2000-2008. We can immediately notice that the mean price grew constantly during the period while the structural characteristics which can be interpreted as comfort indicators remained relatively constant. This observation is partially confirmed by a comparison t-test for each variable between 2000 and 2006 which corresponds to the start and the boom of housing prices[11].

Neighbourhood and environmental characteristics of purchased dwellings remained also relatively constant (Tables 4 & 5). The only remarkable difference concerns the distribution between urban poles, which became less popular and their immediate suburbs whose frequency increased both for the apartments and for the houses.

Concerning the agents' characteristics, we can notice some changes especially for the purchasers. The rate of non-working persons reduced while single persons became more frequent among home-buyers in 2006 than in 2000. The most

[10] INSEE created the classification of urban fabric on the basis of home-to-work commuting time information announced by persons in employment via the National Census. The main advantage of this classification is the fact that it describes implicitly the size of the urban unit, the density , the level of infrastructure development. For more details of the classification, see Table 1 in Appendix.

[11] Depending on countries, the bust of housing market occurred in 2007 or 2008 and had different magnitude. Nevertheless, in France house prices reached their highest level in 2006. For this reason, in our further analysis we focus especially on 2000 and 2006.

remarkable evolution concerns the provenance of the home-buyers : only 13.1% of purchasers moved from Parisian region to settle down in Oise in 2000 while 21.5% of purchasers came from Parisian region in 2006[12]. Households' personal investment increased considerably from 48557 to 90459 euros for the apartments and from 66193 to 139593 euros for the houses. These phenomenons are *a priori* likely to influence the house price evolution but their impact needs to be verified at the second stage of the hedonic analysis.

4 Hedonic Price Function Estimation Results

Taking into account the above presentation of our aim, the chosen methodology and the available data, we begin our empirical analysis by estimating the hedonic price function. This function has the following form:

$$\ln P_t = \alpha_{0t} + \sum_{i=1}^{n} \alpha_{it} z_t \tag{5}$$

The variables included into regressions are detailed in Table 6. The structural variables differ slightly between regressions for the apartments and those for houses, but the basis remains the same : Area, number of rooms, number of bathrooms, need any renovation repairs, number of parking places. Notice that we use a mean room area instead of total area which is likely to be correlated with the number of rooms.

Since one of the purposes of this paper is to show the evolution of demand and supply behaviour between the beginning of prices' rise-up and their peak, and given the above presentation of the hedonic imputation method, we run separate regressions for each year. For the apartments, the estimated function is :

$$\begin{aligned}
\ln P_t &= Intercept + \alpha_1 LOGMAREA + \alpha_2 NBROOMS + \alpha_3 NBBATHS \\
&+ \alpha_4 DREPAIRS + \alpha_5 GARDEN + \alpha_6 NBPARKPL \\
&+ \alpha_7 DTRANSP + \alpha_8 SOCIALH + \alpha_9 RAILW + \alpha_{10} RAILWSQ \\
&+ \alpha_{11} MOTORWAY + \alpha_{12} MOTORWAYSQ \\
&+ \alpha_{13} ZAUER2 + \alpha_{14} ZAUER3 + \alpha_{15} ZAUER4
\end{aligned}$$

For houses, the regression is :

$$\begin{aligned}
\ln P_t &= Intercept + \alpha_1 LOGMAREA + \alpha_2 LOGLOTAREA \\
&+ \alpha_3 NBROOMS + \alpha_4 NBBATHS + \alpha_5 DREPAIRS \\
&+ \alpha_6 NBPARKPL + \alpha_7 DTRANSP + \alpha_8 SOCIALH \\
&+ \alpha_9 LOGRAILW + \alpha_{10} LOGRAILWSQ + \alpha_{11} LOGMTRWAY \\
&+ \alpha_{12} LOGMTRWAYSQ + \alpha_{13} ZAUER2 + \alpha_{14} ZAUER3 \\
&+ \alpha_{15} ZAUER4 + +\alpha_{16} ZAUER5 + +\alpha_{17} ZAUER6
\end{aligned}$$

[12]This feature is typical for the department of Oise which is bordering on the Parisian region called Ile-de-France. Due to the housing crisis in Paris, numerous households left the IDF perimeter and moved to neighbouring departments in order to reduce their housing expenses

In these regressions, some variables are introduced in multiplicative form (mean room area, lot area, distance to railway station, distance to motorway junction), other variables - in additive form (number of rooms, number of bathrooms, number of parking places, unemployment rate, social housing rate), and some variables are dichotomous and cannot be transformed[13].

Tables 7 & 8 report the estimation results for these regressions. We obtain models with a determination coefficient which varies between 55.45% and 63.05% for the apartments and between 58.86% and 62.12% for the houses. A smaller R^2 for houses regressions can be explained by the fact that houses are more heterogenous concerning their age, structure and location unlike the apartments, which are generally concentrated in dense urban space and have similar structural features. This heterogeneity of the houses implies higher variances and, as a consequence, lower explicative power of our models. Nevertheless, the obtained coefficient of determination remains satisfactory given the great heterogeneity of dwellings and relatively low number of regressors. For the apartments, we can notice that few characteristics had significant effect on the price at the beginning of the price rise but their impact was progressing every year. For the houses, the attributes which had significant impact on the price remained substantially constant.

Nevertheless, obtained coefficient estimates are coefficients of an envelope function which reflects the equilibria between demand and supply functions. Hence, on the basis of these coefficients, it becomes possible to compute implicit marginal prices of each characteristics. Equation (6) gives the form of estimated hedonic price function which implies that the underlying price function has a following form:

$$P_t = \beta_{0t} \prod_{i=1}^{n} z_t^{\alpha_{it}} \tag{6}$$

Equations for marginal prices are obtained by differentiation of price function with respect to each characteristic. Since different continuous variables were introduced into the equation under different forms, the derivative functions differ consequently. For discrete variables such as number of rooms, number of bathrooms etc., implicit prices are obtained by computing discrete derivative of the hedonic price function. The detailed derivative functions are presented in the Appendix.

Computed mean implicit prices are reported in Tables 9 & 10. For the apartments, prices of basic structural characteristics such as area, number of parking places and number of rooms have doubled like the entire apartment prices. The negative implicit price of the fact that an apartment needs repairs grew consequently. As for the neighbourhood and environmental attributes, trends differ between variables. The implicit prices of availability of an urban transport network in the city increased though this increase is moderate and the depreciation

[13] Notice that shocks on the Rate of social housing are rare and the adjustment of agents' behaviour is relatively long. The part of social homes is much more a part of reputation of a city than an explicit economic or urban indicator. Hence, we use data on Social housing rate for 1999, available from Insee database.

induced by social housing remained practically constant. Notice that the negative price associated with distancing a railway station increased while that of a motorway junction decreased. This phenomenon can show that households' preferences in terms of transport changed in favour of common means of transport[14].

Different marginal prices associated to urban spaces show that the spatial choices of households became more polarized in 2006 that they were in 2000. In fact, for the space classification, the reference is an urban pole so that we can observe that prices related to distancing from the urban pole have greater absolute value in 2006 that 2000. Immediate suburbs (Zauer2) and rural employment poles (Zauer4) became more enhancive, while back-country suburban areas depreciated.

As for the houses, prices of the main structural features, excepting the lot area and bathrooms, more than doubled between 2000 and 2006, while the depreciation related to possible repairs increased also. This situation can mean that houses in perfect condition became more demanded and households might be less inclined to make affords on the quality of purchased commodities. The trends related on the spatial choices evolved in the same direction that in the case of the apartments : agents' choices are concentrated in urban poles and its immediate suburbs, while far suburbs and rural spaces entail important depreciations. Implicit prices of major transport means reveal that availability of both rail and road transport became more enhancive in 2006 that they were in 2000.

Generally speaking, on the basis of these results we cannot agree with the hypothesis that the house price growth of early 2000's was almost integrally absorbed by the land and locational characteristics. If this were true, we would obtain marginal prices for 2006 which are equal to at least twice marginal prices for 2000 in case of positive prices, and equal to half of absolute values of marginal prices for 2000 for negative prices. This is verified only for suburb localisation for the apartments, but not for other characteristics. Hence, we need to proceed to the second stage of hedonic analysis in order to obtain complete description of agents' behaviour determinants.

5 Estimation of Demand and Supply Equations

According to the standard hedonic pricing method, the second stage of the analysis consists in estimating bid and offer functions of attributes of the dwellings. In order to obtain these functions, we regress marginal prices obtained at the first stage on attributes' quantities on the one hand, and on the socio-economic characteristics of the buyers and sellers on the other hand. Hence, we estimate a system of simultaneous equations since the decisions of selling and purchasing a definite quantity of each attribute are taken simultaneously.

[14]We can suppose that this fact is tightly connected with the profile of home-buyers : households coming from Parisian region became more numerous in 2006 than in 2000. If these households keep their jobs in Paris, they tend to use rail transport more frequently in order to avoid traffic jam.

Nevertheless, one point needs to be clarified before estimation. Witte, Sumka & Erekson (1979) suggest that although dwellings are highly heterogeneous and making decision of purchasing can depend on an infinite number of criteria, consumers make major part on their decision on the basis of a reduced set of characteristics. Housing economics let assume that some attributes are not subject of implicit markets, but rather they serve to adjust bid and offer curves (Witte et al. 1979). For instance, the fact that a dwelling needs any renovation repairs cannot be demanded or offered while its impact on the price is important. Taking into account these considerations, we estimate bid and offer functions for the mean room area ($MAREA$), number of rooms ($NBROOMS$), distance to the nearest railway station in metres ($RAILW$, for the apartments), availability of urban transport ($TRANSP$, for the apartments), lot area ($LOTAREA$, for the houses) and distance to the nearest motorway junction in kilometres ($MOTORWAY$, for the houses). Other attributes which have a significant impact on the dwelling price in the hedonic price function, are introduced into bid and offer functions as shifters.

In order to obtain bid and offer functions, we need to include buyer and seller characteristics into the regressions. Theoretically, the vector of demand characteristics Y_1 should include data on the income as a measure of purchasing power and indicators of tastes which can be approximated socio-economic characteristics of the household such as occupation of the head of household, his age, education and sex, number of persons and children in the household. The vector of supplier characteristics should include measures of cost such as the way of acquiring the dwelling (purchasing or inheritance/donation), dwelling price at acquiring, number of years seller owned the dwelling, income of the household and some indicators of household preferences such as its size and the age of the head of household. However, data set containing such information is extremely rare, so that we are constrained to deal with available data. The details on available variables which are introduced into regressions are given in the Table 11.

As we state above, decisions are made simultaneously concerning on the one hand, demand and supply of dwelling characteristics, and on the other hand, concerning each attribute. Hence, the system equation is estimated by a method of full information in order to take into account the interaction between all marginal price equations. We choose 3SLS method as it appears to be as powerful as FIML method but is more simple compared to the latter (Greene 2003, pp. 409-413).

Estimation results are reported in the Tables 12 to 15. Concerning the apartments, we obtain estimates with a system-weighted R^2 equal to 34.33% in 2000 and 39.29% in 2006. We notice that the main determinants of bid functions for structural amenities remained relatively constant through the period with slight changes however. Area and room bid functions reveal that marginal prices of the latter depend on environmental amenities in 2006 more than in 2000. Hence, coefficient related to the urban transport doubled, as well as distance to the nearest railway station. Location in suburbs had no significant impact on the marginal price of area and rooms in 2000, whereas its impact is highly significant in 2006. Inverse demand for locational amenities reveals that the marginal price of distancing a railway station does not depend on the structural characteristics of the dwelling, while urban transport does, especially in 2006. As for socio-economic characteristics of home-buyers, they had little impact on bid functions in 2000, and it became more significant in 2006.

Structural offer functions reveal that marginal prices of apartments' attributes depend mostly on other dwellings attributes. The impact of locational attributes seems to be more important in 2006 than it was in 2000, except social housing the impact of which remained relatively steady. Obtained estimation results show no significant impact of socio-economics characteristics of suppliers on the marginal prices of the attributes.

The quality of estimation of structural bid functions for houses' attributes is lower than in the case of apartments (39.99% in 2000, 25.61% in 2006), probably because of a higher heterogeneity of dwellings. Nevertheless, we can extract some features of demand and supply from these estimates. First of all, we note that cross coefficients are not significant in the area, room and lot area bid functions. Bid prices of area and rooms are sensitive to the number of bathrooms and to the need of repairs in the dwelling, but localisation has also a significant impact which strengthened over the 2000 to 2006 period.

Offer price functions are in accordance with housing economy theory as cross prices are positive or non significant. Number of bathrooms and need of repairs have significant impact, as well as localization zone. All coefficients increased between 2000 and 2006, but the growth is extensive in the case of environmental amenities.

Conclusion

In this paper, we try to lead a micro-level analysis of the growth phase of the last real estate cycle. On the basis of a large data set of transactions, we examine agents' preferences by means of a two-stage hedonic analysis.

Our empirical results reveal that dwelling attributes which have a significant impact on prices, remained nearly constant. However, marginal prices of most attributes increased revealing the deformation of preferences. Hence, we noticed that agents accord higher marginal values to main structural characteristics in 2006 than they did in 2000, but they became more reticent towards need of repairs in the dwelling. Marginal prices of locational amenities and neighbourhood evolved also and reveal that give more importance to different transport means in 2006 than in 2000. The effects of spatial polarisation are grater in 2006 as distancing from urban poles evolve an important depreciation up to a half of the price.

The results of the second stage of hedonic analysis are not in accordance with what one would expect. Estimates indicate weak impact of socio-economic characteristics of agents though housing economics suggests that most of these characteristics influence willingness-to-pay for housing services and tastes. Hence, we are thinking out some possibilities to improve the models which might follow shortly.

References

Ayuso, J. & Restoy, F. (2006), 'House prices and rents: An equilibrium asset pricing approach', *Journal of Empirical Finance* **13**(3), 371–388.

Bailey, M. J., Muth, R. F. & Nourse, H. O. (1963), 'A Regression Method for Real Estate Price Index Construction', *Journal of the American Statistical Association* **58**(304), 933–942.

Bajari, P. & Benkard, C. L. (2005), 'Demand Estimation With Heterogeneous Consumers and Unobserved Product Characteristics: A Hedonic Approach', *Journal of Political Economy* **113**(6), 1239–1276.

Bartik, T. J. (1987), 'The Estimation of Demand Parameters in Hedonic Price Models', *The Journal of Political Economy* **95**(1), 81–88.

Ben Jelloul, M., Collombet, C., Cusset, P.-Y. & Scaff, C. (2011), L'évolution des prix du logement en france sur 25 ans, La Note d'Analyse 221, Centre d'analyse stratégique.

Bishop, K. C. & Timmins, C. (2011), Hedonic Prices and Implicit Markets: Estimating Marginal Willingness to Pay for Differentiated Products Without Instrumental Variables, NBER Working Papers 17611, National Bureau of Economic Research, Inc.

Black, A., Fraser, P. & Hoesli, M. (2006), 'House prices, fundamentals and bubbles', *Journal of Business Finance & Accounting* **33**(9-10), 1535–1555.

Brown, J. & Rosen, S. (1982), 'On the Estimation of Structural Hedonic Price Models', *Econometrica* **50**, 765–768.

Capozza, D. R., Hendershott, P. H., Mack, C. & Mayer, C. (2002), 'Determinants of real house price dynamics', *NBER Working Paper* **9262**.

Chattopadhyay, S. & Braden, J. B. (1999), 'Measuring the benefits of clean air: A two-stage hedonic study based on the chicago housing market', *Land Economics* **75**(1), 22–38.

Court, A. (1939), Hedonic Price Indexes with Automotive Exemples, *in* 'The Dynamics of Automobile Demand', General Motors Corporation.

de Haan, J., Diewert, E. & Hendriks, R. (2011), Hedonic Regressions and the Decomposition of a House Price index into Land and Structure Components, Ubc departmental archives, UBC Department of Economics.

Din, A., Hoesli, M. & Bender, A. (2001), 'Environmental Variables and Real Estate Prices', *Urban Studies* **38**(11), 19892000.

Epple, D. (1987), 'Hedonic Prices and Implicit Markets : Estimating Deamand and Supply Functions for Differential Products', *Journal of Political Economy* **95**, 59–80.

Gallot, P., Leprevost, E. & Rougerie, C. (2011), 'Prix des logements anciens et loyers entre 2000 et 2010', Insee Premiere No.1350.

Goodman, A. C. (1978), 'Hedonic prices, price indices and housing markets', *Journal of Urban Economics* **5**, 471–484.

Greene, W. H. (2003), *Econometric Analysis*, 5. edn, Prentice Hall, Upper Saddle River, NJ.

Griliches, Z. (1961), Hedonic Price Indexes for Automobiles : An Econometric Analysis of Quality Change, *in* 'The Price Statistics of the Federal Government : Review, Appraisal and Recommendations', General Series N.73, New York, NY : National Bureau of Economic Research, pp. 173–196.

Gyourko, J., Morales, E., Nathanson, C. & Glaeser, E. (2011), Housing duynamics, 2011 Meeting Paper 307, Society for Economic Dynamics.

Halvorsen, R. & Pollakowski, H. (1981), 'Choice of Functional Form for Hedonic Price Equations', *Journal of Urban Economics* **10**, 37–49.

Hiebert, P. & Roma, M. (2010), Relative house price dynamics across euro area and us cities: convergence or divergence?, WOrking Paper Series 1206, European Central Bank.

Hilbers, P. L. C., Banerji, A., Shi, H. & Hoffmaister, A. W. (2008), House price developments in europe: A comparison, IMF Working Papers 08/211, International Monetary Fund.

Himmelberg, C., Mayer, C. & Sinai, T. (2005), Assessing high house prices: Bubbles, fundamentals, and misperceptions, NBER Working Papers 11643, National Bureau of Economic Research, Inc.

Lancaster, K. J. (1966), 'A New Approach to Consumer Theory', *The Journal of Political Economy* **74**(2), 132–157.

Leung, C. (2004), 'Macroeconomics and housing: a review of the literature', *Journal of Housing Economics* **13**(4), 249–267.

Marchand, O. & Skhiri, E. (1995), 'Prix hédoniques et estimation d'un modèle structurel d'offre et de demande de caractéristiques. une application au marché de la location de logements en france', *Economie et Prévision* **121**, 127–138.

Meese, R. A. & Wallace, N. E. (1997), 'The Construction of Residential Housing Price Indices : A Comparison of Repeat-Sales, Hedonic-Regression and Hybrid Approaches', *Journal of Real Estate Finance & Economics* **14**, 51–73.

Mok, H. M., Chan, P. P. & Cho, Y.-S. (1995), 'A hedonic price model for private properties in hong kong', *Journal of Real Estate Finance & Economics* **10**(1), 37–48.

Nagaraja, C., Brown, L. D. & Wachter, S. M. (Forthcoming), 'Repeat Sales House Price Index Methodology', *Journal of Real Estate Literature* .

Nappi-Choulet, I., Maleyre, I. & Maury, T.-P. (2007), 'A Hedonic Model of Office Prices in Paris and its Immediate Suburbs', *Journal of Property Research* **24**(3), 241–263.

Poterba, J. M. (1984), 'Tax subsidies to owner-occupied housing : An asset-market approach', *The Quaterly Journal of Economics* **99**(4), 729–752.

Rosen, S. (1974), 'Hedonic Prices and Implicit Markets : Product Differenciation in Pure Competition', *Journal of Political Economy* **82**, 34–55.

Wang, F. T. & Zorn, P. M. (1997), 'Estimating House Price Growth with Repeat Sales Data: What's the Aim of the Game?', *Journal of Housing Economics* **6**(2), 93–118.

Wilhelmsson, M. (2002), 'Household expenditure patterns for housing attributes: A linear expenditure system with hedonic prices', *Journal of Housing Economics* **11**, 75–93.

Witte, A. D., Sumka, H. J. & Erekson, H. (1979), 'An estimate of a structural hedonic price model of the housing market: An application of rosen's theory of implicit markets', *Econometrica* **47**(5), 1151–73.

Zabel, J. E. (2004), 'The demand for housing services', *Journal of Housing Economics* **13**(1), 16–35.

Table 1: ZAUER Classification of urban and rural area

Urban class	Corresponding area
ZAUER1	Urban pole, or urban core : urban unit with more than 5000 jobs
ZAUER2	Peri-urban suburbs : municipalities where more than 40% of working people work in the same urban area but not in the municipality
ZAUER3	Multi-polar municipality where more than 40% of working people work in several urban areas without achieving this threshold in any of them
ZAUER4	Employment pole of the rural space : municipalities with no urban dominant and having more than 1500 jobs
ZAUER5	Rural employment pole suburbs : municipalities with no urban dominant in which more than 40% of working people work outside the municipality
ZAUER6	Other municipalities with rural dominant

Table 2: Mean values of major structure apartment characteristics between 2000 and 2006

Variable	2000	2002	2004	2006	2008
Price	65918	77469	97293	128367	141452
Interior area	58.9	61.1	60.3	59.8	59.2
Number of rooms	2.87	2.87	2.79	2.73	2.75
Number of bathrooms	1.04	1.06	1.05	1.03	1.01

Table 3: Mean values of major structure house characteristics between 2000 and 2006

Variable	2000	2002	2004	2006	2008
Price	108150	125846	155983	210736	220839
Interior area	106.9	108.5	110.1	113.7	108.9
Lot area	1240	1284	1109	1099	1269
Number of rooms	4.76	4.83	4.92	4.95	4.88
Number of bathrooms	1.22	1.23	1.25	1.28	1.28

Table 4: MEAN VALUES AND FREQUENCIES OF APARTMENTS' NEIGHBOURHOOD AND ENVIRONMENTAL CHARACTERISTICS BETWEEN 2000 AND 2008

Variable	2000	2006
Mean Social housing rate	0.2757	0.2611
Availability of urban transport	83.43%	76.41%
Mean distance to the nearest railway station	1794	1800
Mean distance to the nearest motorway junction	9399	9467
Localisation in an urban pole	60.38%	57.51%
Localisation in an urban pole's immediate suburbs	31.90%	34.35%
Localisation in far suburbs of an urban pole	6.67%	7.35%
Localisation in rural pole	1.05%	0.64%

Table 5: MEAN VALUES AND FREQUENCIES OF HOUSES' NEIGHBOURHOOD AND ENVIRONMENTAL CHARACTERISTICS BETWEEN 2000 AND 2008

Variable	2000	2006
Mean Social housing rate	0.1240	0.1191
Availability of urban transport	28.55%	25.42%
Mean distance to the nearest railway station	3908	3884
Mean distance to the nearest motorway junction	13018	13003
Localisation in an urban pole	23.49%	21.95%
Localisation in an urban pole's immediate suburbs	42.43%	49.94%
Localisation in far suburbs of an urban pole	24.54%	21.14%
Localisation in rural pole	1.97%	1.29%
Localisation in rural pole's immediate suburbs	0.15%	0.12%
Localisation in isolated rural area	7.41%	5.55%

MARGINAL PRICE FUNCTIONS

1. If z_k was included into hedonic price function without transformation :

$$p_t(z_k) = \frac{\partial P}{\partial z_k} = e^{\alpha_{0t}} \alpha_{nt} e^{\alpha_{kt} z_{kt}} \prod_{\substack{i=1 \\ i \neq k}}^{n-1} e^{\alpha_{it} z_{it}}$$

2. If z_k was introduced into hedonic price function as a logarithm of the variable:

$$p_t(z_k) = \frac{\partial P}{\partial z_k} = e^{\alpha_{0t}} \alpha_{nt} z_k^{\alpha_{kt}-1} \prod_{\substack{i=1 \\ i \neq k}}^{n-1} e^{\alpha_{it} z_{it}}$$

3. If z_k was introduced into hedonic price function in a quadratic form :

$$p_t(z_k) = \frac{\partial P}{\partial z_k} = e^{\alpha_{0t}} (\alpha_{nt} + \alpha_{n't} \ln z_k) z_k^{\alpha_{kt} + \alpha_{n't} \ln z_k - 1} \prod_{\substack{i=1 \\ i \neq k}}^{n-1} e^{\alpha_{it} z_{it}}$$

4. If z_k is a discrete variable :

$$p_t(z_k) = \Delta_{z_k} P(z_k) = P(z_k + 1) - P(z_k)$$

Table 6: Variable Definitions in the Hedonic and Demand Regressions

Name	Description
LOGMAREA	Log of the mean room area in square meters
LOGLOTAREA	Log of the lot area in square meters
NBROOMS	Number of rooms
NBBATHS	Number of bathrooms
DREPAIRS	Dummy variable, 1 if the dwelling needs any renovation repairs
GARDEN	Dummy variable, 1 if the apartment has an access to private garden
NBPARKPL	Number of parking places related to the dwelling
DTRANSP	Dummy variable, 1 if there is a network of public transport in the city of the dwelling
SOCIALH	Percentage of social housing in the city of the dwelling
LOGRAILW	Log of the distance between the dwelling and the nearest railway station
LOGRAILWSQ	Square of the log of the distance between the dwelling and the nearest railway station
LOGMTRWAY	Log of the distance between the dwelling and the nearest motorway junction
LOGMTRWAYSQ	Square of the log of the distance between the dwelling and the nearest motorway junction
ZAUER2	Dummy variable, 1 if dwelling is located in a peri-urban area[15]
ZAUER3	Dummy variable, 1 if dwelling is located in a multi-polar municipality
ZAUER4	Dummy variable, 1 if dwelling is located in a rural employment center
ZAUER5	Dummy variable, 1 if dwelling is located in suburbs of a rural employment center
ZAUER6	Dummy variable, 1 if dwelling is located in other type of rural area which is neither an employment center nor its suburb

Table 7: Estimates of the Hedonic Price Function for Apartments

Variable	Estimated coefficient 2000	Estimated coefficient 2002	Estimated coefficient 2004	Estimated coefficient 2006	Estimated coefficient 2008
Intercept	7.83681***	9.62826***	11.21822***	8.67559***	6.71334***
	(2.616)	(2.329)	(1.755)	(1.221)	(1.296)
LOGMAREA	0.71752***	0.88318***	0.93762***	0.67932***	0.57306***
	(0.069)	(0.074)	(0.066)	(0.049)	(0.051)
NBROOMS	0.27697***	0.32214***	0.26502***	0.26004***	0.23977***
	(0.016)	(0.017)	(0.013)	(0.011)	(0.012)
NBBATHS	0.12525*	0.13448**	0.18999***	-0.03044	0.10440*
	(0.071)	(0.070)	(0.062)	(0.052)	(0.058)
DREPAIRS	-0.11991	-0.24438***	-0.21225***	-0.17816***	-0.27199***
	(0.076)	(0.088)	(0.062)	(0.052)	(0.061)
GARDEN	0.04697	0.08611	0.17564***	0.10621**	0.09698**
	(0.079)	(0.074)	(0.054)	(0.044)	(0.044)
NBPARKPL	0.13793***	0.15856***	0.21073***	0.14085***	0.16852***
	(0.043)	(0.041)	(0.031)	(0.027)	(0.029)
DTRANSP	0.12849**	0.13512**	0.17700***	0.09423***	0.05631
	(0.064)	(0.056)	(0.049)	(0.035)	(0.041)
SOCIALH	-1.54036***	-0.80284***	-1.11530***	-0.76008***	0.07376
	(0.251)	(0.255)	(0.187)	(0.148)	(0.192)
LOGRAILW	-0.79203***	-1.56846***	-0.53796***	-0.64182***	-0.23578
	(0.224)	(0.220)	(0.163)	(0.141)	(0.162)
LOGRAILWSQ	0.05548***	0.11352***	0.03847***	0.04619***	0.01828
	(0.016)	(0.015)	(0.011)	(0.009)	(0.018)
LOGMTRWAY	0.74148	0.60483	-0.48676	0.57194*	0.74209**
	(0.640)	(0.571)	(0.425)	(0.299)	(0.332)
LOGMTRWAYSQ	-0.04577	-0.03199	0.02971	-0.03567**	-0.04637**
	(0.036)	(0.033)	(0.025)	(0.017)	(0.019)
ZAUER2	0.11602**	0.37312***	0.21452***	0.34918***	0.33812***
	(0.053)	(0.049)	(0.041)	(0.034)	(0.037)
ZAUER3	-0.04012*	0.21741***	-0.10995	-0.17467***	-0.00158
	(0.024)	(0.082)	(0.082)	(0.054)	(0.054)
ZAUER4	0.14122*	0.52018*	0.33949***	0.10834	0.16474
	(0.083)	(0.278)	(0.084)	(0.157)	(0.209)
n	474	572	736	765	530
R^2	0.5545	0.6080	0.5867	0.6305	0.6195

Notes: Standard Errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: ESTIMATES OF THE HEDONIC PRICE FUNCTION FOR HOUSES

Variable	Estimated coefficient 2000	Estimated coefficient 2002	Estimated coefficient 2004	Estimated coefficient 2006	Estimated coefficient 2008
Intercept	10.70611***	8.75614***	8.60697***	9.63476***	7.36061***
	(0.854)	(0.916)	(0.729)	(0.859)	(0.942)
LOGMAREA	0.41027***	0.48206***	0.41640***	0.52032***	0.51291***
	(0.036)	(0.039)	(0.036)	(0.032)	(0.040)
LOGLOTAREA	0.10263***	0.10311***	0.08403***	0.08416***	0.07775***
	(0.011)	(0.013)	(0.011)	(0.009)	(0.012)
NBROOMS	0.10679***	0.13750***	0.10475***	0.14564***	0.11284***
	(0.007)	(0.008)	(0.006)	(0.006)	(0.007)
NBBATHS	0.20762***	0.13306***	0.21073***	0.03485***	0.14380***
	(0.022)	(0.022)	(0.019)	(0.008)	(0.022)
DREPAIRS	-0.26886***	-0.27180***	-0.31135***	-0.24985***	-0.21764***
	(0.023)	(0.027)	(0.022)	(0.023)	(0.029)
NBPARKPL	0.04433***	-0.02878	0.05908***	-0.00507	0.01872
	(0.014)	(0.025)	(0.019)	(0.017)	(0.024)
DTRANSP	-0.02856	0.00540	-0.06516**	-0.02921	0.02472
	(0.031)	(0.033)	(0.028)	(0.025)	(0.027)
SOCIALH	0.08329	-0.09375	0.07562	-0.05332	0.02315
	(0.111)	(0.116)	(0.104)	(0.093)	(0.109)
LOGRAILW	-0.01488	0.07045	0.13142	0.04466	-0.04437
	(0.116)	(0.134)	(0.099)	(0.107)	(0.118)
LOGRAILWSQ	0.00180	-0.00317	-0.00785	-0.00442	0.00189
	(0.007)	(0.008)	(0.006)	(0.007)	(0.008)
LOGMTRWAY	-0.29497**	0.02047	0.12083*	-0.00780	0.0.60292***
	(0.149)	(0.207)	(0.071)	(0.008)	(0.207)
LOGMTRWAYSQ	0.01055	-0.00596	-0.01140	-0.00360	-0.03799***
	(0.011)	(0.011)	(0.009)	(0.003)	(0.012)
ZAUER2	-0.01713	0.04863	0.04137	0.05628**	0.05607**
	(0.029)	(0.031)	(0.027)	(0.024)	(0.027)
ZAUER3	-0.11423***	-0.09224***	-0.13171***	-0.10412***	-0.06985**
	(0.029)	(0.034)	(0.029)	(0.026)	(0.029)
ZAUER4	-0.38803***	-0.34210***	-0.32430***	-0.36872***	0.19359***
	(0.072)	(0.077)	(0.079)	(0.091)	(0.069)
ZAUER5	-0.65966***	-0.69962**	-	-0.09840	-0.22869
	(0.222)	(0.322)		(0.209)	(0.162)
ZAUER6	-0.42371***	-0.37489***	-0.31849***	-0.32616***	-0.33219***
	(0.045)	(0.049)	(0.041)	(0.039)	(0.049)
n	1166	1121	1375	1385	905
R^2	0.6212	0.5886	0.5943	0.6182	0.6157

Notes: Standard Errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Marginal Prices of Apartments' Attributes in 2000 and 2006

Attribute	2000	2006
Mean room area (m^2)	2093.74	3782.32
Room	19450.39	35152.41
Bathroom	8132.50	-
Repairs	-6887.20	-19316.24
Parking place	9014.03	17903.01
Garden	2931.06	13263.49
Urban transport	8356.69	11695.98
Social housing rate (%)	-938.83	-899.67
Railway station (m)	-6.41	-9.24
Motorway (km)	-445.57	-350.37
Zauer2	7497.82	49465.45
Zauer3	-2396.86	-18969.95
Zauer4	9244.59	13544.16

Table 10: Marginal Prices of Houses' Attributes in 2000 and 2006

Attribute	2000	2006
Mean room area (m^2)	1876.39	5007.34
Lot area (m^2)	23.31	38.79
Room	11114.34	33074.42
Bathroom	22755.71	7481.61
Repairs	-23249.23	-46639.80
Parking place	4470.10	-
Social housing rate (%)	-	-112.48
Railway station (m)	0.03	-2.04
Motorway (km)	-86.08	-2461.82
Zauer2	-	12213.35
Zauer3	-471.92	-20860.44
Zauer4	-1405.99	-65056.40
Zauer5	-2111.44	-19769.95
Zauer6	-1509.94	-58712.66

Table 11: Customer and Supplier Characteristics

Variable	Definition
OCCUP	Dummy variable equal to one if the head of household is a working person
AGE	Age in years of the head of household
SEX	Dummy variable equal to one if the head of household is female, zero if male
MARITAL	Dummy variable equal to one if the purchaser/seller is married or living in couple, zero if single/divorced/widow(er)
IDF	Dummy variable if purchaser is moving from the Parisian region (only for bid functions)
INV	Sum of personal investment financing the purchase in euros (only for bid functions)
FREEOBT	Dummy variable equal to one if the sold dwelling was acquired by inheritance or donation zero otherwise (only for offer functions)
YRSOWN	Number of years seller owned the dwelling (only for offer functions)

Table 12: Estimates of the Structural Bid Functions for Apartments' Attributes

	Bid price function for MAREA		Bid price function for ROOMS		Bid price function for RAILW		Bid price function for TRANSP	
	2000	2006	2000	2006	2000	2006	2000	2006
Intercept	978.69	1008.38	-16199.9**	-18411.3***	-26.51	-18.31	-5385.48	-7990.39***
	(658.04)	(641.61)	(8198.72)	(4956.39)	(44.50)	(38.63)	(3975.91)	(2911.93)
MAREA	-26.22	-21.96	852.47***	999.54***	0.16	-0.48	330.98**	396.86***
	(26.36)	(30.02)	(323.45)	(230.04)	(1.82)	(1.79)	(153.99)	(144.19)
NBROOMS	442.73***	749.54***	5547.849***	8164.32***	6.23	9.91	1805.50	2157.43**
	(108.35)	(120.61)	(1405.69)	(980.11)	(6.78)	(7.72)	(1149.12)	(966.40)
NBPARKPL	493.48***	627.47***	4578.69***	6092.03***	0.18	0.12	1975.95***	2228.44***
	(65.24)	(82.89)	(782.92)	(602.18)	(4.64)	(4.64)	(354.10)	(303.01)
TRANSP	397.16***	732.26***	2512.31***	5856.13***	-2.62	-1.91	-1630.30	4932.67
	(70.81)	(91.23)	(850.57)	(665.10)	(5.03)	(5.13)	(2686.76)	(3377.30)
SOCIALH	-25.34***	-25.88***	-234.98***	-286.78***	-0.009	-0.35*	-7.83	-97.02
	(2.83)	(3.59)	(34.01)	(26.27)	(0.20)	(0.20)	(12.17)	(82.60)
RAILW	0.084*	0.220***	-0.050	1.568**	0.002*	0.002*	-0.121	0.733*
	(0.05)	(0.08)	(0.62)	(0.65)	(0.00)	(0.00)	(0.31)	(0.40)
ZAUER2	-11.43	1077.16***	-1108.93	10247.45***	-4.30	-13.28***	683.07***	4071.43***
	(60.61)	(86.87)	(730.55)	(633.58)	(4.29)	(4.89)	(267.76)	(272.06)
OCCUP	28.89	-106.28	126.57	-931.78	-0.73	6.61*	15.80	-999.57
	(51.96)	(70.91)	(737.92)	(628.34)	(2.78)	(3.82)	(591.63)	(700.74)
MARITAL	-28.02	136.09**	431.98	941.39	2.05	-10.26**	231.02	455.16
	(70.99)	(68.51)	(901.83)	(590.23)	(4.64)	(4.73)	(466.59)	(418.45)
AGE	1.13	-3.23	-0.58	-37.77**	-0.05	0.13	-2.34	-26.49
	(1.97)	(2.15)	(25.11)	(19.31)	(0.13)	(0.15)	(13.15)	(18.29)
SEX	-25.82	20.37	178.71	-271.99	0.97	-3.83	136.76	-82.24
	(39.90)	(67.56)	(522.49)	(520.09)	(2.53)	(4.09)	(302.36)	(354.21)
IDF	-22.96	6.76	-306.92	485.05	1.07	2.97	-287.75	592.78
	(61.07)	(59.45)	(835.39)	(522.04)	(3.58)	(4.23)	(477.74)	(586.84)
INV	0.0028**	0.0012*	0.0283*	0.0187***	0.000	-0.0003	0.0193	0.0067
	(0.0012)	(0.000)	(0.015)	(0.007)	(0.000)	(0.000)	(0.019)	(0.006)

Table 13: ESTIMATES OF THE STRUCTURAL OFFER FUNCTIONS FOR APARTMENTS' ATTRIBUTES

	Offer price function for MAREA		Offer price function for ROOMS		Offer price function for RAILW		Offer price function for TRANSP	
	2000	2006	2000	2006	2000	2006	2000	2006
Intercept	-256.67	687.81	-29070.7***	-22399.7***	-27.14	-1.67	-8071.81**	-7607.46***
	(412.16)	(631.75)	(5702.60)	(6509.01)	(25.68)	(36.46)	(3600.54)	(2958.48)
MAREA	15.93	-41.89	1154.38***	707.57**	-0.19	-0.08	370.22***	317.00***
	(16.04)	(30.07)	(220.25)	(349.48)	(1.04)	(1.73)	(105.01)	(117.62)
NBROOMS	653.63***	1037.37***	7908.83***	11184.94***	6.59**	-5.63	3024.49***	3797.69***
	(53.15)	(77.81)	(633.70)	(900.44)	(3.44)	(4.47)	(275.51)	(316.81)
NBPARKPL	502.61***	626.71***	4644.59***	6077.71***	0.31	0.09	1981.75***	2230.20***
	(69.58)	(79.82)	(950.87)	(910.16)	(4.65)	(4.58)	(300.19)	(238.26)
TRANSP	401.13***	736.32***	2641.88***	5876.40***	-2.57	-2.29	404.72	-235.63
	(75.01)	(87.59)	(1024.25)	(999.35)	(5.03)	(5.03)	(1467.85)	(1721.47)
SOCIALH	-25.56***	-26.74***	-239.84***	-294.29***	-0.01	-0.28	-115.98***	-122.75***
	(2.99)	(3.44)	(40.94)	(39.31)	(0.20)	(0.19)	(45.27)	(35.03)
RAILW	0.044	0.244***	0.283	3.039***	0.005*	0.008*	0.002	0.300
	(0.06)	(0.09)	(0.85)	(1.07)	(0.003)	(0.005)	(0.32)	(0.41)
ZAUER2	5.59	1070.38***	-982.99	10227.55***	-4.09	-12.47***	689.97***	4070.32***
	(63.84)	(83.55)	(871.73)	(953.72)	(4.28)	(4.80)	(223.83)	(212.53)
OCCUP	8.49	-31.82	565.12	-724.07	1.10	-1.08	168.77	451.81
	(61.24)	(91.24)	(877.44)	(1113.28)	(2.85)	(5.29)	(359.49)	(488.99)
MARITAL	13.27	-73.78	278.13	-939.49	-0.01	3.00	103.80	64.17
	(37.39)	(54.33)	(545.94)	(674.12)	(1.31)	(3.16)	(205.81)	(240.40)
AGE	-0.92	-1.84	15.01	-0.07	0.05	0.21	9.44	19.21
	(2.23)	(2.70)	(31.22)	(31.78)	(0.13)	(0.15)	(10.94)	(11.91)
SEX	15.46	74.42	60.35	634.74	-0.08	-4.81*	-41.14	81.83
	(42.49)	(50.12)	(617.53)	(606.81)	(1.64)	(2.91)	(224.26)	(238.54)
FREEOBT	-55.85	-88.92	-809.56	-426.29	-0.08	8.31**	-358.73	-545.53
	(51.13)	(74.90)	(736.6808)	(900.35)	(2.17)	(4.35)	(288.68)	(349.74)
YRSOWN	1.84	0.51	-26.24	-11.19	-0.09	-0.12	-10.75	-20.93
	(4.03)	(3.92)	(56.60)	(46.53)	(0.23)	(0.22)	(21.44)	(17.02)

Table 14: Estimates of the Structural Bid Functions for Houses' Attributes

	Bid price function for MAREA		Bid price function for ROOMS		Bid price function for LOTAREA		Bid price function for MOTORWAY	
	2000	2006	2000	2006	2000	2006	2000	2006
Intercept	1957.39	8274.42	422.40	3208.40	-11.51	309.19	229.16	10154.23
	(1449.42)	(14936.59)	(5511.27)	(73563.61)	(69.93)	(579.55)	(1185.11)	(35859.51)
MAREA	-88.92**	-307.16	-4.94	-82.89	2.69	-10.92	-32.30	-451.01
	(43.59)	(546.03)	(165.95)	(2689.18)	(2.10)	(21.07)	(35.75)	(1310.96)
LOTAREA	0.025	1.58	0.159	9.04*	-0.016*	0.008	-0.17	-0.22
	(0.19)	(1.11)	(0.72)	(5.38)	(0.009)	(0.04)	(0.15)	(2.68)
NBROOMS	210.28	174.69	1032.72	1831.38	-0.15	-16.28	-83.39	-1457.57
	(197.83)	(927.15)	(713.47)	(4566.11)	(9.56)	(35.78)	(162.14)	(2226.03)
NBBATHS	779.46***	1299.44***	4488.09***	13095.69***	5.77	-8.07	-3.22	-1367.88***
	(84.05)	(157.31)	(319.91)	(774.68)	(4.06)	(6.07)	(68.89)	(377.75)
DWORKS	-501.39***	-1420.69***	-2387.88***	-5920.16***	-10.47***	-13.09	31.33	296.76
	(78.67)	(227.48)	(283.69)	(1120.41)	(2.75)	(8.78)	(64.45)	(546.05)
MOTORWAY	25.07	-12.27	69.22	112.42	-0.001	0.002	0.063**	0.233**
	(47.88)	(184.03)	(182.32)	(906.25)	(0.002)	(0.007)	(0.031)	(0.121)
ZAUER3	-35.13	-390.96**	-314.91	-2910.44***	-7.47**	-8.49	52.23	838.28**
	(75.31)	(173.08)	(286.64)	(852.33)	(3.64)	(6.67)	(61.73)	(415.62)
ZAUER4	-377.33**	-1869.07**	-4141.21***	-12008.5***	-6.68	-8.43	62.96	1500.16
	(186.38)	(793.33)	(709.63)	(3907.59)	(9.01)	(30.62)	(152.89)	(1904.18)
OCCUP	-11.25	423.29	323.41	1163.39	0.88	21.42	83.34	868.93
	(123.37)	(830.16)	(454.61)	(4089.02)	(5.56)	(32.05)	(93.03)	(1992.56)
MARITAL	28.07	-19.58	350.78	-757.15	-2.73	16.06	5.58	766.19
	(97.42)	(665.39)	(368.71)	(3285.96)	(4.65)	(25.78)	(78.74)	(1588.13)
AGE	-5.59	-3.36	-15.58	-40.90	0.22	-0.19	-2.12	33.49*
	(4.79)	(8.83)	(18.02)	(43.89)	(0.22)	(0.34)	(3.81)	(20.74)
SEX	-63.29	-61.19	-98.73	-15.18	3.47	10.66	1.09	-215.47
	(179.28)	(359.40)	(646.56)	(1777.64)	(8.67)	(13.96)	(146.93)	(854.87)
IDF	-23.31	35.41	209.04	-131.35	0.84	1.90	52.72	200.98
	(103.78)	(386.45)	(385.89)	(1906.38)	(4.77)	(14.95)	(80.16)	(924.51)
INV	0.0018	-0.0006	0.0121	-0.0109	-0.0001	0.0001	0.002	0.008
	(0.002)	(0.006)	(0.009)	(0.029)	(0.0001)	(0.0002)	(0.002)	(0.015)

Table 15: Estimates of the Structural Offer Functions for Houses' Attributes

	Offer price function for MAREA		Offer price function for ROOMS		Offer price function for LOTAREA		Offer price function for MOTORWAY	
	2000	2006	2000	2006	2000	2006	2000	2006
Intercept	638.16	-3424.68	-3679.02	-53325.0	66.18	-143.04	345.42	20125.81
	(688.16)	(6336.16)	(3168.84)	(41713.12)	(44.94)	(263.01)	(563.15)	(27140.30)
MAREA	-10.00	99.93	131.94	2085.27	-0.83	10.26	-32.49	-997.08
	(35.57)	(238.75)	(163.79)	(1571.44)	(2.32)	(9.90)	(29.11)	(1021.86)
LOTAREA	0.202	-0.593	0.423	-3.304	-0.018*	-0.04	0.026	3.13
	(0.17)	(0.99)	(0.81)	(6.52)	(0.009)	(0.04)	(0.14)	(4.24)
NBROOMS	122.69	837.67**	1826.62***	3772.63**	-0.09	2.77	-6.23	-402.84
	(122.93)	(381.62)	(566.18)	(2513.42)	(8.03)	(15.84)	(100.61)	(1637.05)
NBBATHS	782.14***	1300.21***	4486.62***	13100.61***	5.64	-7.91	-4.78	-1370.49**
	(59.29)	(141.65)	(273.18)	(832.99)	(3.87)	(5.88)	(48.54)	(607.76)
DWORKS	-502.69	-1427.49***	-2382.43***	-5953.81***	-10.31***	-12.72	36.65	302.12
	(55.71)	(205.37)	(255.98)	(1351.81)	(3.63)	(8.52)	(45.50)	(879.22)
MOTORWAY	-37.71	75.46	-120.99	510.29	0.75	-0.33	0.024	0.121
	(29.69)	(100.28)	(136.68)	(660.46)	(1.93)	(4.16)	(0.024)	(0.43)
ZAUER3	-33.04	-386.69**	-311.48	-2885.15***	-7.53**	-8.28	53.65	829.32
	(53.20)	(155.83)	(244.96)	(1026.39)	(3.47)	(6.47)	(43.53)	(668.65)
ZAUER4	-371.71***	-1908.48***	-4147.37***	-12246.4***	-6.96	-9.25	59.51	1588.26
	(131.84)	(713.78)	(607.31)	(4700.93)	(8.61)	(29.64)	(107.92)	(3061.60)
OCCUP	142.06	-47.45	-256.68	-10.64	-5.12	-5.70	-55.37	-314.07
	(134.21)	(203.94)	(614.58)	(1335.57)	(8.71)	(8.41)	(109.26)	(857.63)
MARITAL	91.63	101.18	200.44	796.81	-3.42	3.14	28.25	-483.88
	(60.21)	(170.08)	(253.71)	(1059.54)	(3.55)	(6.63)	(45.45)	(582.85)
AGE	5.15	1.33	4.94	11.59	-0.19	-0.11	0.85	-5.82
	(3.60)	(4.37)	(16.37)	(28.62)	(0.23)	(0.18)	(2.91)	(18.32)
SEX	36.48	-164.76	260.30	-1496.47	-1.37	-8.84	39.87	894.06
	(64.44)	(262.51)	(274.01)	(2198.63)	(3.84)	(10.85)	(49.04)	(1112.12)
FREEOBT	4.99	557.14*	-152.12	2945.16	-2.91	3.18	-126.51*	-626.69
	(95.52)	(334.18)	(431.66)	(2198.63)	(6.11)	(13.86)	(76.83)	(1428.31)
YRSOWN	3.54	4.54	-9.89	28.19	-0.09	0.09	-1.69	-10.69
	(3.86)	(8.04)	(17.29)	(50.08)	(0.24)	(0.31)	(3.08)	(27.46)