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A hedonic approach to burial plot value in French cemeteries

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Abstract
Cemeteries are typical urban fixtures occupying a vast portion – at least 0.5% – of municipal territories. However, urban economists have generally neglected this topic to date. Our paper establishes the main determinants of pricing for burial plots, excluding columbaria. We analyse the prices proposed by 185 cemeteries from 42 large French cities with more than 100,000 inhabitants. We use a specified Ln-Ln hedonistic model. Our results highlight the complexity of cities' pricing, as these strategies imply the combination of several determinants, such as the main features of the burial concessions (term, surface area, location within the boundaries of the cemetery, etc.), the environment defined within and outside the cemetery (type of cemetery, cemetery's surface area, existence of verdant areas, etc.) and various other urban features (population structure, real estate prices, purchasing power).

Keywords
burial plot, cemeteries, France, hedonic function, prices

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Introduction

Despite the fact that cemeteries are typical urban features occupying a large portion – at least 0.5% – of municipal territories, urban economists have generally neglected this topic in the past. Thus, to the extent of our knowledge, the rather embryonic research on burial plots and cemeteries has been relinquished to sociologists (e.g. Herman, 2010; Marchetti, 2011), to historians (e.g. Lassère, 1997) and, more recently, to urban planners (e.g. Bennett and Davies, 2015; Coutts et al., 2011; Kjøller, 2012). Very few economists approach this field of research, with the notable exceptions of Canofari et al. (2013) on burial plot prices, Hussein and Rugg (2003), Longoria (2014) and Wickersham and Yehl (2013) on the management of cemeteries, or Harrington and Treber (2013) on the market for funeral services.

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However, this gap in European economic literature tends to be unsettling at a time when the ageing of European countries' populations will most certainly reinvigorate the demand for burial plots – notwithstanding the increase in cremation practices. Moreover, in most European countries, the legal framework governing the creation or restructuring of cemeteries bears a high level of constraint upon the offer of burial plots. Finally, in a general context of budget restrictions, municipalities must abide by a legal obligation to provide a burial plot for all deceased inhabitants, which, in turn, leads to higher prices. Several French newspapers[1] recently expressed their astonishment at the differences in prices between several large cities without, however, suggesting any explanation for or providing any serious national survey of these disparities.

As municipal information on the prices of burial plots is public in France, this country can be considered a significant first case study, as the French model of cemetery management remains generally similar to those of other European countries such as Germany, Switzerland, Belgium, Italy or Spain – even if these similarities should be considered in comparison with the UK's or the USA's models. It is therefore high time to tackle this extremely complex – and seemingly stressful – economic topic.

This complexity pertains to the cumulative effects of pricing and management models for burial plots. First, the offer of funeral land relates simultaneously to the public and private domains, even if the territory of a cemetery in France comes under public ownership and responsibility. In fact, it is compulsory for municipalities to devote a part of the cemetery – the communal plots – as free burial spaces for indigents or poor inhabitants, with these free burial plots being granted for a period of five years. However, the other paid section of the cemetery comprises all burial plots under a concession regime – that is, all plots that have been granted after the conclusion of a purchase contract between the municipality and an inhabitant and/or a family. Our study is strictly limited to the burial plots under this concession regime. Second, the contracts for these concessions and their prices are so diverse – according to the term, surface area or even the location within the cemetery – that these burial plots can indeed be considered a very heterogeneous item. Third, cemeteries are themselves heterogeneous because their features were determined and adapted over a very long historical period during which municipalities have faced very different constraints. Therefore, their locations in the municipal territories and their amenities greatly vary from one city to another – or even from one cemetery to another in the same municipal territory – and this generally leads to marked variations in prices and management costs. Finally, the constraints burdening the annual price fixation for the concessions are closely related to the specific attributes of the cities, such as their demographic, real estate and financial features. The prices are thus the result of an interlinked heterogeneity of situations involving a large range of variables.

This paper proposes an original national study on the price fixation for burial plots by evaluating the impact of each of the features and variables presented above. The aim of this study is both academic and professional: academic as it enlightens practices in an unknown market; and professional as it informs public actors on the components and determinants of pricing in a market typified by a mere trickle of information between cities or even countries. Based on documents pertaining to the French funeral legislation and on interviews with experts (Le Havre, Lille and Bordeaux directors of the cemetery divisions), this study investigates how burial plots are conceded by the municipalities. A sizeable database on prices

of burial plots has been structured: 4520 prices have been integrated for the 2010–2013 period (depending on data availability) concerning 185 cemeteries of 42 French large cities (cities with a population of more than 100,000, according to the 2006 national population census). For each price, the features of the burial plots, cemeteries and cities have also been implemented within the database.

This paper clearly relates to auction theories (Epple 1987; Rosen, 1974) because burial plots are generally conceived as final residences, the choice of which responds to strong individual preferences and attachments revealed during qualitative interviews with the directors of cemetery departments. This theoretical approach is also commonly used for the study of the real estate value and is a good framework for estimating the implicit prices of each variable. It is noteworthy that the offer for burial plots is a natural monopoly governed by municipalities. This offer has to provide free burial plots for the poorest inhabitants (a very elastic/flexible demand) and fixed-priced plots – the concessions – for other population segments (an inelastic demand). For the latter, the price can be substantially higher than the marginal cost in order to reach a budget balance (the Ramsey–Boiteux pricing system). However, this paper does not mobilise the theories of public good pricing (Baumol and Bradford, 1970; Coase, 1946) for two reasons. First, data on the cemeteries' management costs were not available.[2] Second, the auction theories allow the integration of a larger range of information and are thus a better tool for understanding public prices, insofar as the surface area of the cemetery communal space (and, indirectly, its management costs) is legally determined by the annual proportion of deaths among the city's population.

From a methodological standpoint, this study aims at validating the existence and measuring the weight of the impact of each variable on the annual price of each burial plot's square metre. We estimate a specified Ln-Ln hedonic function in order to evaluate their impact in terms of elasticity. This function will then be re-estimated using diverse subsamples in order to test the coefficient's stability according to the pricing patterns and the cemetery types. This methodological approach is commonly used for real estate valuation in France (e.g. Cavailhès, 2005).

Legal constraints framing the offer and the pricing of burial plots

As noted above, French cemeteries are considered public infrastructures owned by municipalities. As such, their management cannot be delegated to other public or private institutions. However, some cemeteries are managed under inter-municipal administrations, but the same rules remain applicable in these cases. According to the scope of our study, it is useful to specify, on the one hand, the legal constraints pertaining to the offer of burial plots – as these constraints tend to generate some inelasticity – and, on the other hand, the constraints pertaining to the pricing of these plots. All these rules are stated nationally by the General Code of the Local Authorities (Code général des Collectivités Territoriales) and locally, to a lesser extent, in the regulations of each cemetery.

Town-planning rules firmly restrict the cemetery's extension or creation and regulations setting the minimal distance between the cemetery outer walls and adjacent constructions or residences. For municipalities of more than 2000 inhabitants – that is, all cities in our database – a very strict and lengthy process is involved in extending or creating a cemetery located less than 35 m from any other construction in a urban area. A public inquiry is conducted, and an authorisation must be obtained from the

regional health agency and, finally, the prefect delivers an order. Similarly, the choice for the new cemetery's location must respect general requirements regarding health, security and salubriousness: for instance, flood-risk areas or extremely sunny and poorly ventilated areas should be avoided, and grounds located on hills or facing north are preferred.

The offer of burial plots is also legally controlled. It is mandatory for the municipalities to create a communal section with free burial plots within the boundaries of their cemeteries. The surface area of this communal part should be five times larger than the surface area needed to bury the annual mean number of dead on the municipal territory. It is not compulsory for the city council to offer paid burial plots. However, if concessions are made available, then the cemetery's total surface area should be sufficient to accommodate these burial plots and the required surface area should be sufficient for the communal part. The offer for concessions is thus doubly constrained by town-planning rules and by obligations defining the domain and purposes of the public service.

Moreover, the concession terms clearly state in the contract that when the burial period comes to an end, if the concession owner did not ask for a renewal period, then the municipality is entitled to launch a procedure to reassert ownership of the burial plot. The municipality can use the same procedure for perpetual concessions that are not maintained. This represents an opportunity for the municipality to maintain the concession offer without extending the boundaries of the cemetery. However, this procedure remains legally constrained and is long and costly, according to the cemetery directors, and thus marginally efficient. Indeed, the legal complexity of the procedures (and thus their cost) to reassert the ownership on the concession is a strong restraining factor. The municipality can launch a procedure to reassert the ownership of the concession when the concession is obviously abandoned. However, municipalities are bound by the French law and it is mandatory to search for and to inform all the heirs of the first owner of the concession in order to obtain the right to transfer the ownership of the concession to the municipality. This is, in most cases, a very long, fastidious and costly process.

Thus, these funeral concessions are burial plots that are available after the conclusion of a contract for the occupancy of the public domain and after the payment of fees that is determined by the city council. This occupancy cannot be resold to other persons, but the occupancy right is bequeathed to the heirs after the death of the contracting party. The municipality determines the concession features in the contract. Several terms are commonly offered: temporary concessions of less than 15 years, 30- or 50-year concessions, or perpetual concessions. Different categories of concessions also exist according to their surface area, their locations within the boundaries of the cemetery, or even their management – individual, family or collective. Supposedly, the granting of a concession in a municipal cemetery is bestowed only upon citizens residing in the municipal territory, persons who died in this territory or people who can demonstrate that they nurtured special emotional links with this territory. The mayor is duly authorised to refuse any burial requests from people who do not meet at least one of these three requirements. These requirements are sufficiently inclusive to benefit most people who do not live in the municipal territory but who want to be buried in the territory. Thus, the location choice of one's final residence is rather open.

The city council votes on concession pricing. A price can be fixed for each category of concession according to the location, term, surface area and/or cemetery. In any case, these prices are universally applicable, and it is illegal to apply specific prices for people

who do not reside in the municipal territory. Similarly, the council's decisions regarding concession prices or terms cannot be retroactive: any new pricing is only applicable to future concessions. Therefore, voting on a new price scale does not entail additional costs for previous burial plot owners, or even for new acquisitions for the municipality on these existing concessions.

Thus, the municipal concession offer is strictly contingent upon French legal technicalities. This level of constraint is further heightened by considerations pertaining to the division of the cemeteries between their communal and conceded sections. Looking at the coexistence of these two types of burial plots within French cemeteries – free and paid burial plots – leads unavoidably to new questions regarding the definition of the service offered to its citizens. If the mandatory communal section of the cemetery seems to fit the idea of a free and universal public service, then the conceded part should be more judiciously adjusted to the private market sector. Moreover, this coexistence also implies a question regarding the balance of management costs for the public service as regards funeral operations. Indeed, the offer of conceded, paid burial plots is a means for the municipality to raise revenue, whereas the communal plots are offered for free, without compensation for their maintenance costs (landscaping, etc.). Although these rules concerning the mandatory existence of a communal part in the cemeteries apply to each city and cemetery, they do not introduce any specific bias in our approach.

Presentation and justification of data

The sample

The sample comprises 42 large French cities of more than 100,000 inhabitants and 185 cemeteries. The number of cemeteries per city is largely dependent upon the evolution of the choices relating to municipal matters in history. Some cities have created multiple burial sites whereas others have chosen to increase the surface area of existing cemeteries, thus having fewer but larger cemeteries. In some cities or cemeteries, the burial plot density is higher, notably in large metropolitan areas. Based on the density of 47 cemeteries for which data were available, a mean density has been computed (1718 concessions per hectare). The surface area of the cemeteries appears rather high, as it represents, on average, as much as 0.49% of the urban centre (with a maximum of 3% in Nancy) and 0.11% of the urban area (with a maximum of 0.46% in Reims). Comparatively, the total area of public green space is about 1.43% of the total area of the 50 largest French cities, giving an average size of 540 ha (UNEP, 2014). This is all the more significant as French cemeteries, characterised by their strict rules and their high density of concessions, are not public leisure places, as may be English cemeteries. The distribution of the burial area per city shows, however, a type of proportionality between the urban population and the total surface area of the cemeteries for each city. Figure 1 more precisely calculates the relationship between the surface area of the cemeteries and the surface area of the city, moderated by their density.[3] This indicator of 'tension' is more pertinent to pinpoint the existing constraints for the large cities where the surface areas dedicated to the concessions appear to be quite limited. Indeed, despite the number and the surface areas of their cemeteries, the largest French cities (Paris, Lyon, Marseille, Toulouse, Lille) offer an extremely limited area considering their number of inhabitants.

Each municipality determines concession pricing according to the features of the conceded burial plots: size (in square metres), term (in years) and location within the

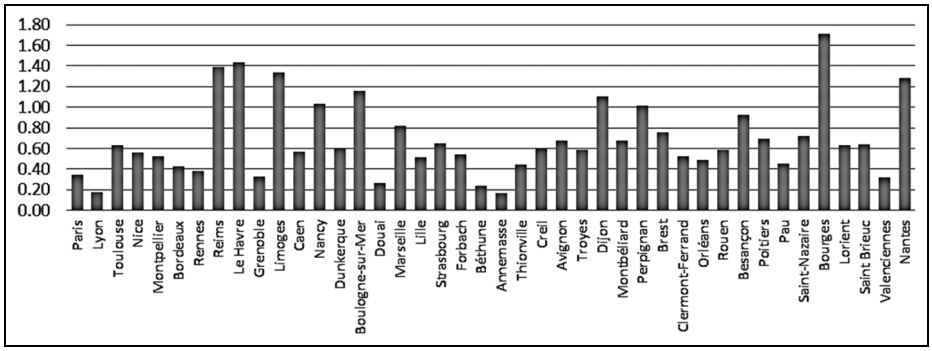

Figure 1. Ratio of the cemetery total surface area to the city total surface area moderated by the city density (mean = 0.69; s.d. = 0.36).

cemetery. It should be noted that most cities propose standard features for the concessions, even if specific offers can exist regarding the concession term (for instance, in Toulouse or Montbéliard) or size (in Marseille, Nice, Brest and Clermont-Ferrand). An annual price per square metre for the concession can be computed taking these descriptive variables into account. This price will be our endogenous variable.

First, the variation in annual prices per square metre can be explained by the differences between the cities. Second, some cities can still introduce distinctions in their pricing scale according to the cemetery features (for instance, Paris and Perpignan). Third, the pricing can also differ according to the management model (municipal or intermunicipal). This entails the introduction of an identification variable for each management model. In conclusion, our model includes descriptive variables for the concessions, cemeteries and cities to factor in the different structures of pricing.

Considering a standard concession (30 years, 2 m^2 with maximal accessibility), Figure 2 displays the differences in annual square metre prices for the 42 cities of our sample. The choice of this standard concession responds both to the modal value of the surface area for our sample (2 m^2) and the intention of the interviewed cemetery directors to limit the concession term to 30 years. When cities did not have a standard concession to offer, we considered the closest offer to this standard. The results show extraordinary differences in prices between cities, the highest prices being in Nice and the lowest in Thionville. The national mean is 10.51 euros per square metre (median 7.29) and the variation coefficient is 0.953.

The choice of variables

The dependent variable in this model is the annual price in euros per square metre for the concessions (free of registration rights and taxes and un-built[4]). It is mandatory for the municipality to communicate these prices and they are systematically published in the minutes of the city council meetings. The existence of three categories of presupposed explicative variables has already been justified above. Table 1 details these variables and presents the descriptive statistics.

The first category regroups the concession's descriptive variables – that is, the term of the contract (in years), the concession surface area (in square metres) and accessibility according to the location within the cemetery (on a scale from 1 to 4, where 4 is the highest accessibility). The variables term and surface

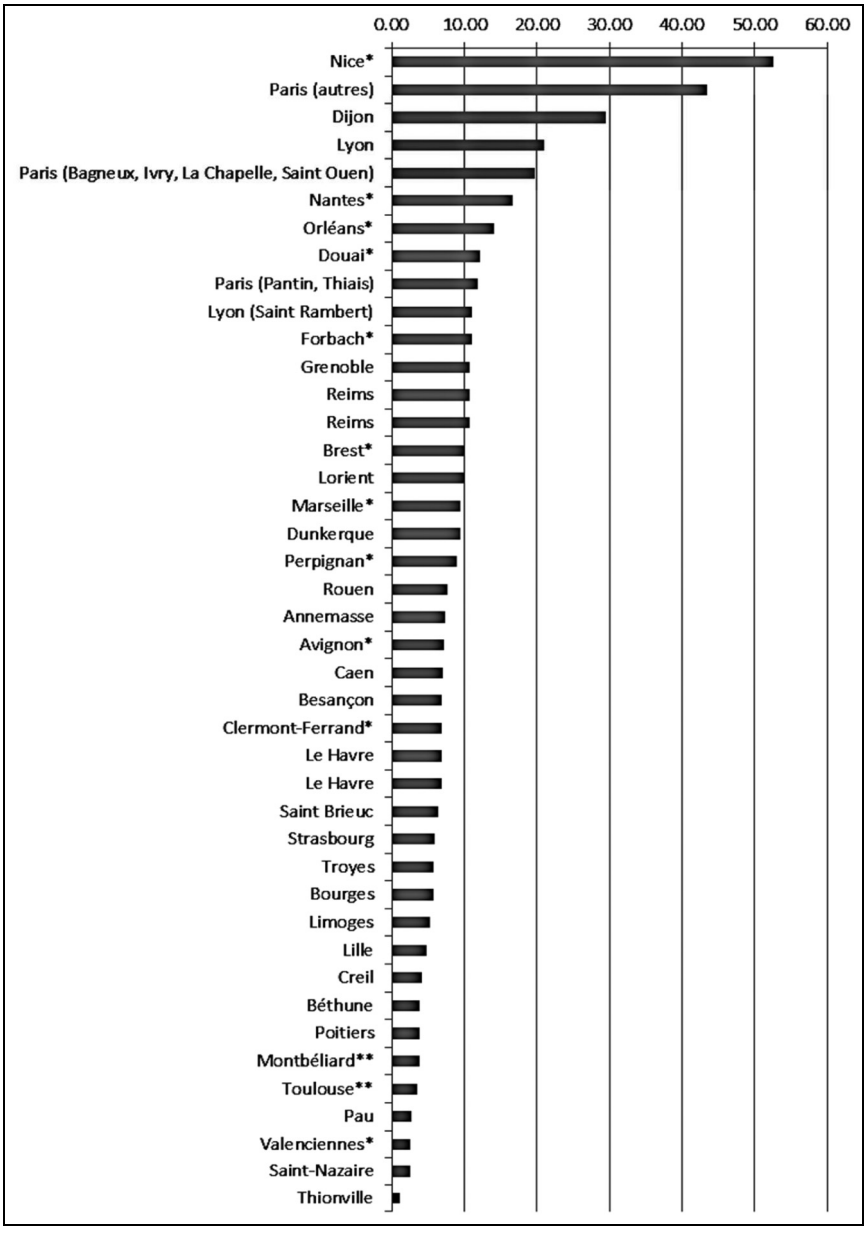

Figure 2. Standard concession price (in euros) per city (surface 2 m^2; term 30 years). *Otherwise the nearest surface and **the nearest term.

are considered continuous because of the high number of relevant items. The perpetual concession system has been arbitrarily converted into a 100-year term. Qualitative interviews with the cemetery directors justify this choice: concessions are generally

Table 1. Presentation of the variables and of their descriptive statistics.

Categories of variables	ID variables	Variables	Sources	Mean	Skewness (Fisher)	Kurtosis (Fisher)
Endogenous	PRICE/m^2/YEAR	Price of the concession in euros 2013 per m^2 per year	Municipalities	10.516	2.819	8.834
Exogenous variables pertaining to the concessions	TERM	Term of the concession in years	Municipalities	48.157	0.722	−0.796
	SURF	Surface area of the concession in m^2	Municipalities	2.973	1.800	3.338
	ACCESS	Accessibility of the concession within the cemetery (scale from 1 to 4)	Municipalities	Cf. Figure 3(d)		
Exogenous variables pertaining to the cemeteries	SURF CEM	Surface area of the cemetery (in hectares)	GEP	8.700	3.508	13.991
	UNOCC CEM	Unoccupied surface area of the cemetery (in hectares)	GEP	1.351	9.371	95.145
	VEG	Vegetation of the cemetery (1: non-vegetated; 2: scarcely vegetated; 3: vegetated; 4 : landscaped)	GEP	Cf. Figure 3(c)		
	LOCATION	Location of the cemetery within the urban fabric (1: city centre; 2: suburbs; 3: outskirts)	GEP	Cf. Figure 3(b)		
Exogenous variables pertaining to the cities	INCOME (2010)	Mean fiscal revenue per household (all households in euros)	INSEE	21,133.280	2.472	11.195
	POP (2010)	Population in 2010 (main city)	INSEE	201,941.61	4.87	26.62
	Dead 1999–2010	Number of dead between 1999 and 2010 (main city)	INSEE	17,264.68	4.40	21.87
	Dead 1990–1999	Number of dead between 1990 and 1999 (main city)	INSEE	15651.51	4.60	23.61
	Dead 1982–1990	Number of dead between 1982 and 1990 (main city)	INSEE	15,164.00	4.85	26.13
	Dead 1975–1982	Number of dead between 1975 and 1982 (main city)	INSEE	14,343.63	4.96	27.29
	Dead 1968–1975	Number of dead between 1968 and 1975 (main city)	INSEE	15,122.46	5.13	28.98
	Pop 45–59	45- to 59-years-old population in 2010 (main city)	INSEE	35,263.58	5.01	27.72
	Pop 60–74	60- to 74-years-old population in 2010 (main city)	INSEE	24,283.95	4.90	26.58

(continued)

Table 1. (Continued)

Categories of variables	ID variables	Variables	Sources	Mean	Skewness (Fisher)	Kurtosis (Fisher)
	Pop>75	75 + -years-old population in 2010 (main city)	INSEE	17,016.56	4.39	21.79
	FMP^2	Mean price of flats per m^2 (in euros, 2013)	INSEE	2200.63	3.75	18.56
	DEBTINHAB (2013)	Debt stock per inhabitant (in euros, 2013)	INSEE	1467.658	−0.609	−0.835
	TENSION	Ratio of the cemetery total surface area to the city total surface area, moderated by the city density	GEP/INSEE	0.741	0.726	0.357
	UNOCC CITY	Ratio of the sum of the estimated unoccupied surface areas for each cemetery to the cemetery total surface area of each city	GEP	0.136	1.536	3.048
Qualitative variables for subsampling		ZONING	Cemeteries where different prices exist according to the zoning (1 if specific prices for each zone, 0 if no zoning)	Municipalities	Unspecific price: 88.52%; Specific price for each zone: 11.47%	
	UNIC PRICE	Cities that apply different prices for each cemetery (1 if the same pricing is applicable to all of the cemeteries of the city, 0 if different prices are applied for each of the cemeteries)	Municipalities	Differentiated price for each cemetery: 11.9%; Same price for all cemeteries: 88.1%		
	TYPE	Type of cemetery	GEP	Cf. Figure 3(a)		
	TYP MANAG	Type of cemetery management (1: municipal management, 2: inter-municipal management)	Sites des communes	Municipal management: 98.90%; Inter-municipal management:1.10%		
	DIFF SURF	Cities having different prices according to the concession surface area (price that is not proportional to the surface area)	Municipalities	Differentiated by surface 95.5%		

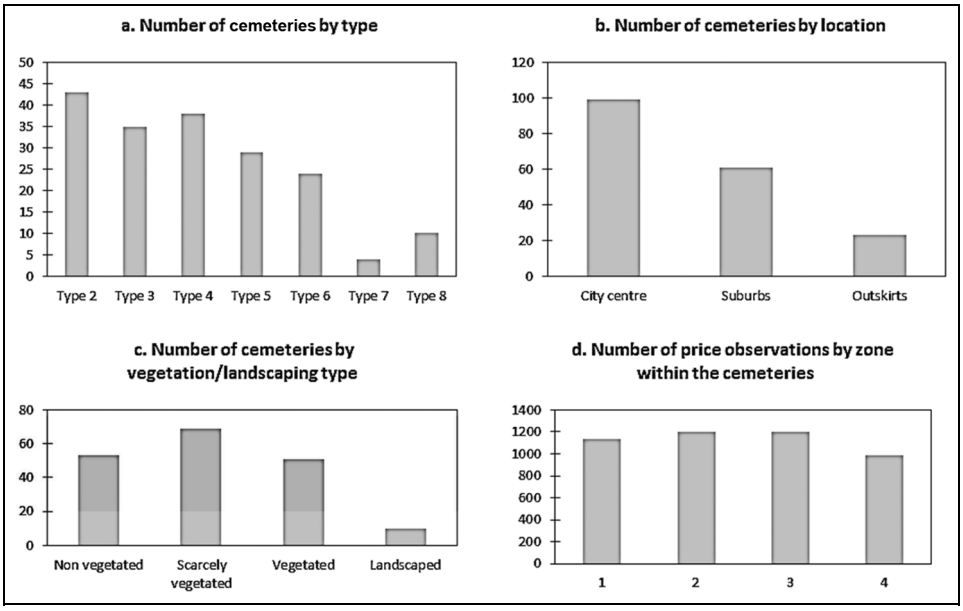

Figure 3. Presentation of the distributions of the qualitative variables.

abandoned after the third generation of owners. Furthermore, for some cemeteries, the prices may vary according to the vicinity of the cemetery entry points. The cities may define different zones within the cemetery based on various criteria of accessibility. In our model, these different practices have been matched and distinguished according to four price zones. For cities that do not apply different prices according to the concession location, we choose to maintain the same price in all four zones.

The second category of variables pertains to the concession environment – that is, the cemetery. As no information was available, these variables have been implemented by the analysis of satellite pictures via Google Earth Pro (GEP). These variables are: the cemetery's total surface area in hectares (SURF CEM); surface area free of any burial plots (UNOCC CEM);[5] the existence of vegetated areas (VEG); and the cemetery location within the boundaries of the urban area (LOCATION). The cemetery surface areas can be accurately evaluated by using the GEP tool for polygonal measurements on satellite pictures. Moreover, the cemeteries are organised in chequered patterns: this general layout of the cemeteries greatly eased the identification of their unoccupied parts. We consider that the UNOCC CEM variable provides a satisfying evaluation of the offer available for each cemetery. On the one hand, as the concessions are mainly owned and used by families, the number of places within a concession is rather similar (generally two or four in practice and/or even legally, as specified in the rules of most cemeteries). Thus, an evaluation of the available surfaces is proportionally a good indication of the number of places. On the other hand, the UNOCC CEM variable allows an identification of the surfaces available for the concessions because the communal part pre-exists in the cemetery as it is a legal constraint, and because the 5-year rotation rate

(also a legal constraint) does not incline to foresee (if we exclude exceptional and unfortunate circumstances) a need for their extension in the middle-term. These free burial plots are in reality old concessions with a tomb or funeral monument or it is compulsory to cover the plot with a concrete screed in order to facilitate the maintenance by the municipal workers. So these plots cannot be visually mistaken for an available non-used surface. Finally, the part of the available surface used for the public space (essentially the roads) is relatively similar in all the cemeteries. So the variations in the unoccupied space are a good indicator to differentiate the variations in the offer capacities from one cemetery to another.

Measuring the vegetated areas was more complex, but four main categories of cemeteries were determined from the analysis of the satellite pictures: those characterised by a complete absence of vegetated areas; those in which only the general entrance is landscaped; those in which only the entrance and the main paths have plants or grass; and those that are completely vegetated and landscaped. A scale integrating those different cases is used to measure the cemetery vegetation.

The last category of variables pertains to the city itself in terms of its offer and demand capacities. Concerning the offer, we consider the sum of the surface areas (in hectares) in the city cemeteries that contain no concessions (UNOCC CITY); the indicator of 'tension' that has already been computed (see above Table 1); and the real estate cost[6] estimated from the mean price (per square metre in euros, 2013) of the flats (FMP^2). For the offer, we selected the mean tax revenue per household (INCOME 2010) for the assessment of purchasing power; and variables measuring the total population (POP 2010) as well as its structure according to age (population aged 45–59 years, 60–74 years and 75 + years). The demand is more directly assessed using the number of deaths (DEAD) in the last five decades to integrate some potential delay in the pricing revision because of variations of this demand. Finally, another variable is considered: the municipal financial state, with the outstanding debt per inhabitant (DEBTINHAB2013) in euros. The impact of this last variable on the public service pricing is to be controlled. The potential impact of the development of alternative offers (in particular, the increase in the number of columbarium and crematorium) on the concession prices was not integrated in our model. The fast development of these practices in France is acknowledged, but the adequate indicators to measure this impact (such as the volume of classic concessions and columbarium per city and per cemetery) are still unavailable today, preventing any serious estimation.

Lastly, considering the complexity of the management and pricing models for urban burial plots, we also computed qualitative variables. As a matter of fact, the complexity and heterogeneity of these models may dilute the impact of some of our variables. For that reason, we created subsamples from the prices, regrouping the prices of the cities that share the same pricing models. The variable TYP MANAG distinguishes the prices between the municipal and inter-municipal models. The variable UNIC PRICE differentiates between the prices of the cities that offer the same prices for all of the cemeteries on their territories and the prices of those that fix different prices for each of their cemeteries. The variable ZONING distinguishes the prices between those in the cemeteries where the pricing remains the same regardless of the concession's location and the prices of the cemeteries that apply different prices according to location. With the variable DIFF SURF, another distinction is introduced between the prices of the cemeteries offering prices per square metre that are proportional to the surface area and cemeteries that do not.

The last variable in our sampling pertains to categories of cemeteries, which requires a specific presentation and justification. As an urban feature, the cemeteries were created and developed at and during different periods of time. For instance, the 'church graveyards' (type 1) that were located around churches – according to the medieval model – still exist in the urban fabric of old cities. These cemeteries are usually small and extremely crowded and are sometimes protected as historical monuments. As most of these cemeteries no longer accept inhumations, they were withdrawn from our sample. At the end of the 18th century, additional regulations were promulgated by the cities because of a newer awareness of sanitary issues, and inhumations were banned from the city centres. Large cemeteries were then created outside the city boundaries in suburbs that today are completely entwined in the urban fabric as a result of the extension of the city limits. Owing to the lack of additional land availability or in response to the growth in housing, the extension of some of those cemeteries ended and they are now labelled 'neighbourhood cemeteries' (type 2). However, among the cemeteries built during the 18th century, some experienced increased development and became 'city cemeteries' (type 3), or the cemeteries grew to extremely large dimensions, known as 'main urban cemeteries' (type 4). At the turn of the 20th century, the 'outlying cemeteries' (type 5) were created to address the saturation of the central cemeteries and the increase in the demand for concessions in the aftermath of the First World War. The outlying cemeteries are generally located on cheap land bordering large urban infrastructures (highways, railway hubs, industrial estates). This period is mostly marked by a growing sense of detachment between the dead and the living and by a constant debasement of the environmental quality of the cemeteries. During the second half of the 20th century, the urban sprawl prompted the city councils or inter-municipal councils to create three additional types of cemeteries. After their establishment, the density of the 'outskirts cemeteries' (type 6) and the 'cemeteries of peri-urban areas' (type 7) increased. Finally, more recently, as all of these previous types of cemeteries became overcrowed, major cities began to create a new type of cemeteries: the 'landscaped metropolitan cemeteries' (type 8). These large cemeteries are located in peri-urban areas with significant availability to extend onto neighbouring agricultural lands.

According to this typology, marked differences are noted between the cemeteries, and this should normally lead to correlated dissimilarities concerning their real estate costs, the economies of scale regarding their maintenance costs, or even the level of their amenities for the visitors or concession owners. Thus, it seems appropriate to confirm the impact of the cemetery types on the pricing as, on the one hand, some cities apply different prices to individual cemeteries and, on the other hand, different cemetery types can coexist in the territory of individual cities. Seven subsamples (type 1 being excluded) have been defined for the variable TYPE. This variable also indirectly describes the distance between the city centre and the cemetery.

The descriptive statistics of each subsample for the variable annual price per square metre are laid out in Table 2. The differences in mean are clearly noticeable and are confirmed by the comparison tests.[7] With a few exceptions, the similarity in the price distributions between the subsamples should be rejected. The distribution between the subsamples is thus relevant. However, two subsamples with similar distributions may relate to different hedonic structures, so we retain – for verification purposes – the samples for which the test validates the similarity of the distributions of the annual price per square metre.

Table 2. Descriptive statistics of the annual square-metre prices per sample.

Statistics of the concession annual prices per square metre	No. of observations	Median	Mean	Variation coefficient	Skewness	Kurtosis
Total sample	4520	12.133	17.575	0.780	1.292	1.319
Subsamples by types of pricing						
Subsample cities applying different prices for each cemetery	628	34.250	31.107	0.531	0.424	−0.343
Subsample pricing differentiated according to the zoning	1512	15.506	19.955	0.535	0.615	−1.103
Subsample prices differentiated according to the concession surface area in m^2	4316	12.159	18.016	0.768	1.241	1.167
Subsample prices for cemeteries under municipal management	4248	12.133	17.561	0.782	1.306	1.347
Subsample prices for cemeteries under inter-municipal management	56	25.783	18.644	0.652	−0.226	−1.905
Subsamples by cemetery types						
Subsample type 2	1256	15.506	22.847	0.698	0.904	0.145
Subsample type 3	820	12.159	17.640	0.762	1.342	1.618
Subsample type 4	793	8.900	12.535	0.822	1.900	4.018
Subsample type 5	667	11.218	14.830	0.827	1.231	1.269
Subsample type 6	600	12.645	16.808	0.682	1.283	1.111
Subsample type 7	120	13.362	20.811	0.706	0.687	−0.750
Subsample type 8	232	10.833	14.537	0.702	1.057	−0.005

Choice of model and estimate of the results

For the estimation of the models that relate the annual price per square metre to the different variables, we specify a functional Ln-Ln form of the model, matching the results of a RESET test.[8] In the absence of a serial correlation of order 1 (cf. DW), and considering the quasi-normality of the estimation residuals, we use an OLS (Ordinary Less Square) methodology with a White's correction in order to take the heteroskedasticity into account. The results are shown in Table 3. For each sample, we indicate the number of observations, the R^2 and Fisher's probabilities, the estimated coefficients of the variables with their significance pertaining to elasticities, the normalised coefficients that allow a comparison between the relative impact of the variables and their Variance Inflation Factor (VIF). The same layout is used in Table 4. The values of the Durbin's test and the indicators of the distribution of the residuals are presented at the end of each table.

On the one hand, it should be noted that we rejected the extreme values in order to match the conditions of use of the OLS in three cases: when estimating the models pertaining to the B sample in Table 3 and to the samples for types 5 and 6 in Table 4. For these three cases, the extreme values were the prices of the two Haut-Verner cemeteries (Perpignan) and the Père Lachaise cemetery (Paris). On the other hand, a very high multicollinearity is noted among the variables related to the demographic structure (death, population) and to the wealth of the cities (income, real estate prices). Thus, these variables have been disregarded and only one was retained: a population of 75-year-olds and older. This variable describes both a potential demand for concessions in the cities and a relatively higher purchasing power.

The interpretation of the results

The results show an excellent global significance and a rather good explicativity ($R^2 > 0.55$) for the estimated models of the samples in Table 4. As might be expected, the more homogeneous the pricing systems within the samples are, the more the adjustment quality of the model increase, exceeding 0.85. As stated above, several variables have been removed from the model owing to their multicollinearity or to their insignificance.

First, the previous estimates based on the global sample show the explicative power of the urban variables (taking the standardised coefficients into account). According to the elasticity values, an increase of 1% of the 75 + -year-old population generates an increase of 0.354% of the concession annual price per square metre. This tends to prove the high impact of the demand – expressed in volume and in purchasing power – on the burial plot pricing. To some extent, this could also explain the real estate opportunity cost that is covered by the municipalities when the real estate prices increase – the older the population is, the higher the housing prices per square metre are.

Another strong explanatory factor is the municipal debt load per inhabitant (DEBTINHAB). A 1% increase of the debt load per inhabitant leads to an almost 0.3% increase of the concession price per square metre. This indicates a strong link between the concession pricing and the state of public finances – which could, to a certain extent, be explained by the balancing systems between different budgetary items.

Second, the impact of the concession features should also be taken into account. The variable ACCESS has a positive impact with a 0.163 elasticity; and the variable SURF has a negative impact with a −0.264 elasticity. From this point of view, the similarity of the laws that govern the valuation of the housing of the dead and the living is

Table 3. Estimation of the model normalised coefficients per sample (Ln-Ln model).

Type of sample	Global sample (A)			Subsample (B) cities applying different prices for each cemetery[a]			Subsample (C) prices differentiated according to the zoning			Subsample (D) prices differentiated according to the concession surface area			Subsample for prices of cemeteries under municipal management			Subsample for prices of cemeteries under inter-municipal management		
Number of observations	4520			628			1512			4316			4248			56		
Adjustment	R^2aj = 0.550; Pr Fisher < 0.0001			R^2aj = 0.857; Pr Fisher < 0.0001			R^2aj = 0.873; Pr Fisher < 0.0001			R^2aj = 0.550; Pr Fisher < 0.0001			R^2aj = 0.576; Pr Fisher < 0.0001			R^2aj = 0.974; Pr Fisher < 0.0001		
Sources	Coefficient	Standardised coefficients.	VIF	Coefficient	Standardised coefficients.	VIF	Coefficient	Standardised coefficients.	VIF	Coefficient	Standardised coefficients.	VIF	Coefficient	Standardised coefficients.	VIF	Coefficient	Standardised coefficients.	VIF
Constante	−4.284***			−2.443***			−3.726***			−4.178***			−4.594***			7.785		
TERM (ln)	0.264***	0.229	1.27	0.146***	0.222	1.00	0.760***	0.673	1.18	0.252***	0.219	1.28	0.292***	0.253	1.30	−0.068**	−0.066	1.243
SURF (ln)	−0.277***	−0.226	1.40	−0.134***	−0.085	1.08	−0.253***	0.227	2.11	−0.305***	−0.248	1.40	−0.249***	−0.205	1.60			
ACCESS (ln)	0.163***	0.103	1.00				0.262***	0.220	1.19	0.175***	0.110	1.00	0.159***	0.101	1.01			
SURF CEM (ln)	−0.061***	−0.100	1.17	−0.028***	−0.093	1.79				−0.058***	−0.095	1.20	−0.060***	−0.098	1.71	−1.759***	−0.956	1.243
UNOCC CEM (ln)				−0.089***	−0.153	1.19							−0.040***	−0.034	1.81			
VEG (ln)	0.140***	0.072	1.27							0.079***	0.039	1.29	0.108***	0.056	1.42			
+ 75 years (2010)	0.354***	0.524	1.31	0.597***	0.746	1.53	0.256***	0.231	1.77	0.358***	0.538	1.28	0.358***	0.534	1.41			
DEBTINHAB(2013 en ln)	0.294***	0.351	1.21							0.300***	0.365	1.22	0.317***	0.367	1.41			
UNOCC CITY (ln)	1.279***	0.109	1.08							1.292***	0.111	1.07	1.069***	0.092	1.24			
LOCATION-1	0.111***	0.069	1.00	−1.428***	−1.232	1.65							0.148**	0.092	1.87			
LOCATION-2	0.05*	0.034	1.02	−2.167***	−1.830	1.81							0.007	0.004	2.01			
LOCATION-3	0	0	1.03	0	0	1.418							0	0	1.06			
DW	2.038			1.932			2.088			1.976			2.008			1.87		
Skewness residuals	0.182			−0.159			−0.390			0.073			0.204			−0.825		
Kurtosis residuals	0.841			0.260			0.057			0.809			0.939			−0.146		

Note: [a]after suppressing extreme values. Significance *** < 0.0001; ** < 0.01; * < 0.05; ‘ < 0.1.

Table 4. Estimation of the model coefficients per subsample for cemetery types (Ln-Ln model).

Type of sample	Subsample type 2			Subsample Type 3			Subsample Type 4			Subsample Type 5 (1)			Subsample Type 6[a]			Subsample Type 7			Subsample Type 8		
Number of observations	1256			820			793			667			600			120			232		
Adjustment (Global significance)	R^2aj = 0.661 Pr Fisher < 0.0001			R^2aj = 0.547; Pr Fisher < 0.0001			R^2aj = 0.311 Pr Fisher < 0.0001			R^2aj = 0.774 Pr Fisher < 0.0001			R^2aj = 0.548; Pr Fisher < 0.0001			R^2aj = 0.857; Pr Fisher < 0.0001			R^2aj = 0.555; Pr Fisher < 0.0001		
Source	Coeff	St. coeff	VIF	Coeff	St. coeff	VIF	Coeff	St. coeff.	VIF	Coeff	St. coeff	VIF	Coeff	St. coeff	VIF	Coeff	St. coeff	VIF	Coeff	St. coeff	VIF
Constante	−4.182***			−3.265***			−0.20			−4.722***			−0.991**			2.817***			−3.503***		
TERM	0.298***	0.281	1.20	0.139***	1.247	1.24	0.209***	0.20	1.12	0.252***	0.206	1.136	0.668***	0.646	1.42	0.331***	0.329	1.76	0.35***	0.310	1.55
SURFACE	−0.376***	−0.347	1.32	−0.260***	1.338	1.55	−0.184*	−0.140	1.33							0.384***	0.365	4.79	−0.371**	−0.323	1.74
ACCESS	0.210***	0.141	1.00	0.099**	1.002	1.00				0.167**	0.099	1.002	0.195***	0.151	1.01	0.179**	0.112	1.10	0.176**	0.126	1.01
SURF CEM	−0.093***	−0.115	1.03	−0.121***	1.749	2.10															
UNOCC CEM				−0.074**	1.579	1.61										−14.62***	−1.002	1.35			
VEG				0.489***	1.621	1.86				0.492***	0.230	1.338	0.181***	0.106	1.23	−0.918***	−0.376	4.87	0.794***	0.130	1.10
75 + years (2010)	0.439***	0.655	1.34	0.239***	1.713	1.87	0.368***	0.413	1.23	0.363***	0.543	1.354	0.068**	0.115	1.88				0.387***	0.662	1.76
DEBTINHAB (2013)	0.197***	0.189	1.46	0.321***	1.230	1.37	0.304***	0.417	1.22	0.229***	0.331	1.068									
UNOCC CITY				0.784**	1.205	1.24	1.918***	0.198	1.09	3.235***	0.246	1.203	1.052***	0.09	1.23						
DW	2.071			1.926			2.064			1.896			1.920			1.824			1.988		
Skewness residuals	0.076			0.393			0.501			0.228			0.107			0.284			0.143		
Kurtosis residuals	0.526			−0.243			0.177			−0.826			0.937			−0.638			−0.191		

Note: [a]after suppressing extreme values. Significance *** < 0.0001; ** < 0.01; * < 0.05; ‘ < 0.1.

astonishing. Finally, the concession term also has a positive impact on the price with an elasticity of 0.264.

Third, the variables pertaining to the cemetery features have a lesser impact. A 1% increase of the cemetery surface area generates a decrease of −0.061% of the price. This could result from the economy of scale in the management costs incurred by the municipalities or from an offer exceeding the demand. Similarly, the cemetery vegetation and landscaping has a positive impact (with an elasticity of 0.14) on the prices. This could be explained by an induced increase in cemetery maintenance costs or by a valorisation of the amenities in demand. The last variable pertaining to the cemeteries is their location within the urban fabric. The proximity of the cemetery with the city centre has a high impact that could be explained by the extreme attractiveness of a well-deserved location for the demand or by the higher real estate costs incurred by the municipality in the centre. The elasticities of all of these variables are lower than 1 in absolute terms, the growth in prices being always less than proportional to the variation in the cemetery features. Only one variable has an elasticity superior to 1: the variable UNOCC CEM that measures the unoccupied surface area that could be dedicated to new concessions for all city cemeteries. Thus, a 1% increase of this variable implies an increase of the price that is more than proportional. This result shows that an increase of the cemetery surface area – by extending existing cemeteries or creating new ones – generates a growth in prices that is necessary in order to maintain the balance in the budget of the municipal services. Finally, these results indicate the complexity of the conceded burial plot prices. Even if it is difficult to ascertain their respective weights, several factors indeed have an impact on the pricing, such as the city debt load and the balance of the budget of the municipal services, the maintenance and management costs, or the demand patterns.

Those results should nonetheless be treated with caution: a levelling effect of the elasticities within the global sample could impact these results as the number of cities that do not offer different prices for each of their cemeteries is extremely high. The subsamples B, C and D are used to test the robustness of the global results obtained for the entire sample and to estimate the maximal value of elasticity when its related variable is intentionally valued by the municipality. Thus, for cities that offer different prices according to accessibility, the elasticity of the variable ACCESS (0.163 for the global sample) can reach 0.263. Within sample C, those cities tend to overrate the variable term (elasticity of 0.76) compared with the global sample (elasticity of 0.26). Furthermore, cities that do not establish proportionality between the prices and the surface area of the concessions (sample D) present a higher negative elasticity (−0.305) than the elasticity for the global sample (−0.27). This could imply that the standard surface areas – those with the highest demand – are overpriced by these cities compared with the prices of the concessions with larger surface areas. Finally, B sample – for the cities that set different prices for each of their cemeteries – shows that a premium price exists for the new, large peri-urban cemeteries and that the pricing is less impacted by the concession features but more sensitive to urban wealth. For the rest, the results obtained for the subsamples B, C, D and E show the same robustness as those in the global sample, with the exception of the variable UNOCC CITY for the subsample B – this subsample mainly concerns the large cities where the surplus offer remains low.

It is also interesting to compare the prices of the cemeteries under municipal and intermunicipal management. As the municipal

cemeteries are overweight in the global sample, the elasticities within the subsamples A and E are very close. However, as the sample for the cemeteries under inter-municipal management – which are often landscaped peri-urban cemeteries – is extremely limited, our variables have a very low impact on the prices. The term has a very low negative impact because of the removal of the perpetual and 50-year terms for the concessions within these new cemeteries. The cemetery surface area has also a very strong negative impact that could be explained by the availability of space and a willingness to attract the demand.

As the subsamples based on the cemetery types partially match up with the distance between the city centre and the cemetery, we also have an additional understanding of the differences in the recognition and use of the cemetery features. The graphs in Figure 4 show these differences between the subsamples for the features of the concessions, of the cemeteries and of the cities.

The negative impact of the surface area on the annual price per square metre decreases from type 2 to type 6, and then becomes positive for type 7, and again negative for type 8. One explanation could be that the old urban cemeteries offered very large concessions whereas new cemeteries tend to standardise the concession surface area[9] and to offer fewer concessions above 2 m^2. The rarity or scarcity of large concessions in suburban cemeteries may explain their premium status, as the surface area decreases from type 4. However, a negative elasticity, close to that of the urban cemeteries, applies to the new peri-urban cemeteries (type 8) as they are less subject to space constraints.

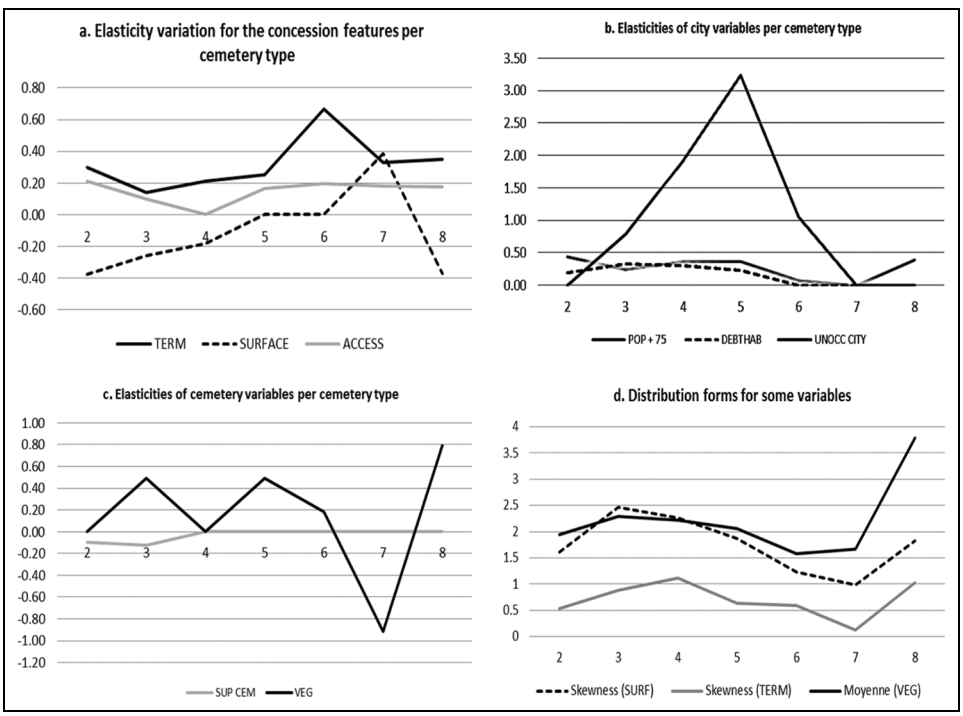

Figure 4. Evolution of the elasticities per type of cemeteries.

Furthermore, the impact of the term on the annual price per square metre increases to type 6, and then decreases. This can also be explained by the differences in the offer structure between the old and new cemeteries. For instance, types 3 and 4 still have perpetual concessions whereas the newer cemeteries offer more standardised terms of 30 or 50 years. The Figure 4(d) validates these explanatory hypotheses by showing a decrease in the skew of the distributions of the variables surface area and term per cemetery type (from type 3 to type 7). This also indicates a strong presence of the high modalities of the variables within the central cemeteries. This presence then decreases and increases again for type 8.

The variables that pertain to the cemeteries also show differentiated effects for each sample. First, on average, the degree of landscaping and vegetation is rather constant and high for types 3, 4 and 5, then decrease in peri-urban cemeteries (except type 8, which includes some peri-urban landscaped cemeteries). However, the impact of vegetation/landscaping on the price is positive only for types 3 and 5 because the impact on maintenance and management costs is higher for these cemetery types than these costs in the central and larger cemeteries, where these costs are distributed among a larger number of concessions. For the other cemetery types, the impact of the price is directly linked to the mean degree of vegetation/landscaping. Second, the cemetery surface area has a very low impact, except for the central city cemeteries, for which it has a negative impact on prices. Among the variables pertaining to the cities themselves, the variables POP75 + and DEBTINHAB show a decreasing impact, probably because of the distance from the city centres and their high level of land and budgetary constraints. The impact of the level of the concession offer (UNOCC CEM) increases from the city centre to the outskirts, and then decreases, as the creation or extension costs of the cemeteries are certainly lower for the suburbs and the neighbouring villages. Finally, taking the differences of elasticities for the different cemetery types into account, it seems reasonable to conclude that the pricing of each city is largely dependent on the features of their cemeteries, where these features condition the level and structure of the management costs.

Conclusion

This study of concession prices in the cemeteries of large French cities is original. It is interesting because of three general tendencies that lead to a worrying increase in concession prices: first, population ageing increases early demand; second, the concession offer is relatively inelastic because of strong legal constraints; and third, the large cities have to cope with budgetary difficulties. However, these general tendencies conceal the high degree of complexity of the prices that are determined according to the features of the concessions, cemeteries, and cities and their management models. On the whole, the hedonistic methodology shows that the prices are highly impacted by the volume of the offer and by the purchasing power of the potential demand (variable POP + 75). Similarly, the municipal debt and the costs derived from the creation of new cemeteries also have a high impact on the price formation. Thus, from this standpoint, a continuous increase in the prices is to be predicted. The impact of the cemetery features – and particularly their maintenance costs – is more moderate: the impact of the cemetery surface area remains negative – which can be explained by economies of scale – whereas the impact of vegetation/landscaping is positive. Finally, the features of the conceded burial plots for the dead (term, surface area, accessibility) have

strikingly similar impacts as those of the housing for the living with a positive effect for the accessibility and the term, and a negative effect for the surface area. Examining the annual prices per square metre, homogeneous subsamples for the prices and the cemetery types enabled a better measurement of the elasticities of the features in terms of the prices.

Considering the three main tendencies stated above and the impoverishment of the ageing population that should lead to an increase in the demand for free un-conceded burial plots, it should be expected that the municipality's natural monopoly on burial areas will further contribute to the increase in concession prices, as the municipalities must increasingly optimise their discrimination between the segments of demand. Even in the absence of data pertaining to cemetery maintenance costs, it seems reasonable to assume that the increase in revenues generated by the concessions should a minima cover the growing cost of the public service concerning the maintenance of the communal, or free, sections of the cemeteries, and a maxima constitute an additional bonus for the general budget of the municipalities.

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Notes

1. Bartolic, Nord Eclair, 2014 ; Journal du net, 2012 ; Sud Ouest 20 décembre 2011.
2. The financial data pertaining to funeral spaces are generally aggregated under diverse items in the global municipal budget. It is therefore nearly impossible to determine the part of the budget devoted to cemetery maintenance. For instance, the landscaping costs are integrated under the item 'technical services', that relates to all municipal landscaped spaces.
3. Indicators are in square kilometres and the result is multiplied by 10^6 to allow for easier reading.
4. Built concessions are negotiated by mutual agreement between the new owner and the municipality.
5. This variable is a means to evaluate the remaining capacity of 'accommodation' of the cemetery. We also created a variable occupation rate that establishes the link between the two variables related to surfaces. This variable may be interesting as there are large differences in the sizes of the cemeteries, but it was ultimately rejected.
6. The scarcity of bare land transactions in the French big cities, as a result of a retention strategy on the owners' side, does not permit, today, to obtain significant means for land prices. We thus opt for a 'proxy' that measures indirectly the differences in land values between the cities. The proxy is the real property prices. This method is not without risk as it assumes a constant composition of the quality of real property for all the cities.
7. The distribution of samples for the annual prices per square metre being abnormal (cf. skewness and kurtosis in Table 2), these distributions have been compared using non-parametric Mann and Whitney's tests. These tests are available upon request.
8. We tested four functional forms: linear in level; Ln-linear; Ln-Ln; and Box-Cox linear (the Box-Cox quadratic model is not tested here). The reset(2) test fails to reject Ln-Ln and Box-Cox linear forms. Therefore, we retain an Ln-Ln specification, which permits calculation of the elasticity.
9. The offer of very large concessions within the older cemeteries was at the time justified by the size of the families and by the desire of the richest and most religious families to build familial vaults and chapels on their concessions. Nowadays, this specific demand is much smaller as the birth rate and religious practice decreases and as families divide more frequently. The tendency moves more toward a minimalist funeral structure.

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