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Suburban Street Patterns at Stake.

Evaluating the effects of local contexts between street patterns in subdivisions, property values and socio-occupational trajectories in the western suburbs of Paris

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Abstract

This paper aims at classifying the local contexts of property price and socioeconomic changes in the southwestern suburban areas of the Paris metropolitan region, municipalities where single family planned housing developments and subdivisions are preeminent in morphology. Data from the Paris Chamber of Notaries (1996-2006) have been analyzed in a GIS at the municipal and subdivision levels. The resulting typologies describe property value change (using smoothing and multivariate analysis) and trajectories of social and occupational status of seller and buyer pairs in properties located in subdivisions and planned developments. This is compared to another typology of residential subdivisions according to street patterns and public vs. private street structure (loops, lollipops, dead-ends, hierarchical street patterns; gated and non-gated status). The paper engages an exploratory discussion of combinations, spatial arrangements and correlations between the three typologies, focusing on two main issues: how the different types of street patterns correlates with the housing price structure at the municipal level over time (1996-2006); and to what extent dominant street patterns and residential morphologies are related to social change, analyzed in terms of seller-buyer pairs. This exploratory research highlights the multi-scalar issues that are to be analyzed together to get a better understanding of social and spatial change on the urban edge and its intricate contexts: residential morphology, rent-seeking strategies at different geographical levels, neighborhood street patterns and developers planning strategy, municipal trajectories and regional planning.

Keywords: residential production, suburbs, morphologies, street patterns, property values, social and occupational trajectories

1 Introduction

Developers build residential subdivisions to meet the demand of various market segments and niches. In suburban areas, preferred locations to meet the criteria for these market segments are related to local contexts, identified through social stratification, built environment and preferences for local services and amenities. Private industries are preeminent contributors to the production of suburban areas (i.e. land developers, managers of commercial spaces, individual housing developers and planned-unit developments builders) (Pollard, 2009; Topalov, 1974). The impact of operators from the financial industry has also recently been preeminent in the dynamics of urban renewal and urban sprawl (Renard, 2003, 2008). Local public authorities also play key roles, imposing regulations and control on land-use, restricting the land availability, and regulating urban sprawl or slow-growth policies; all this being instrumental in controlling property values and social change by the means of social selection of residents (Comby, 2010; Donzelot, 1999; Jaillet, 1999). This makes smaller suburban communes isolated “clubs” fitting local demand according to Tiebout’s principles (1956), and reinforced by local social pairing strategies among which school districts have been a powerful tool of residential selection at the municipal level (Charmes, 2009). Municipal policies and contexts are therefore very powerful in sorting out residents and prospective buyers.

Beyond this contextual effect, residential subdivisions are designed according to standard street layouts that have been influenced by various theoretical and doctrinal frameworks. Studies on suburbia have highlighted the prevalence among residential schemes of enclave morphologies such as loops and curvilinear street patterns in the 1960s, with a trend towards more seclusions (*culs-de-sacs* and “lollipops on a stick”) in the 1980s. This is due to the adoption of romantic suburban attributes on the one hand (Jackson, 1985), and the adaptation of street patterns to the car during the last 60 years on the other. This change also conveys rationales for construction cost, maximization of density, access to amenities and open space (Lang and Lefurgy, 2007; Lang et al., 2006; Southworth and Owens, 1993), and carries hypothesis on local social interactions between neighbors. Indeed, the rapid diffusion of innovative street patterns also derives from Newman’s planning principles of neighborhoods as “defensible spaces” (Newman, 1972, 1996) and *Crime Prevention Through Urban Design* theories have been adopted by a variety of actors of urban planning and renewal in France, and have been implemented in urban renewal of decaying public housing neighborhoods (Le Goix and Loudier-Malgouyres, 2004). Newman’s principles rely on morphology (*culs-de-sac*, loops, street gating), but are also related to increased neighborhood social homogeneity, increased owner-occupancy vs. renter occupancy, tighter social control, enhanced neighborhood-based social interactions and surveillance in streets and have been considered as tools against urban decay in aging neighborhoods. More recently, the adoption of principles inspired by *New Urbanism* and the coincidence with new sets of land-use regulations have contributed to increased density and a tighter control of urban sprawl within a polycentric metropolitan area, promoting in-fill development nearby transit stations, mixity of landuse and transit options, smaller subdivisions (Christoforidis, 1994; Grant, 2006; Katz, 1994), along with a preference for street patterns better fitting these constraints, such as the *cul-de-sacs* or the single loops hence associated with urban compactness and the revitalization of public space neighborhoods (Ghorra-Gobin, 2011). Here again, these morphological principles are explicitly related in suburban communities to promote social control and social change where

they have been applied: i.e. attracting new subsets of prospective buyers, promoting social interaction, social control and neighborhood cohesion by means of increased density.

This paper elaborates on the relatively complex set of interactions between suburban neighborhood street patterns and different levels of social sorting, stratification and distribution of property prices. We draw on a range of empirical data to classify the local contexts of property price and related socioeconomic changes in the southwestern suburban areas of Paris metropolitan region (*Département des Yvelines*). The argument of this paper proceeds as follows. In section 2, we start with a general background discussing sprawl, fragmentation and change, to contextualize the role of subdivisions and planned unit developments in the shaping of the suburban social fabric. We also use a critical overview of the relationships between subdivisions, their structuring within the private urban governance realm, in order to better understand the relationships between planned subdivisions and price and social change. In section 3, we have analyzed data from the Ile-de-France Chamber of Notaries (1996-2006) in a GIS at the municipal level, in order to produce a typology of value change (using smoothing and multivariate analysis) and of trajectories of social and occupational status of sellers and buyers pairs in properties located in subdivisions and planned developments. Section 4 introduces the typology of residential subdivisions according to street patterns and public vs. private street structure (gated vs. non-gated ; loops, lollipops, dead-ends, hierarchical street patterns). Section 5 elaborates on combinations, spatial arrangements and correlations between the three typologies, focusing on two main issues: (1) how the different types of street patterns correlates with the housing price structure at the municipal level over time (1996-2006); and (2) to what extent dominant street patterns and residential morphologies are related to social change, analyzed in terms of seller-buyer pairing, at the municipal level. This quantitative analysis is exploratory and does not establish direct inference or causality. It highlights some significant local contexts where the produced built suburban environment (subdivision street patterns) is related to price and social change.

2 Background: subdivisions, property price and social change in suburban areas

This section aims to provide an understanding of the relationships between planned subdivisions, local prices and social change. The discussion first covers the issues of sprawl, fragmentation and change, to contextualize the role of subdivisions and planned unit developments in the shaping of the suburban social fabric of suburban municipalities. We then elaborate on a critical summary of the legal (property owners associations) and planning structuring of subdivisions to clarify their potential influences on the social sorting processes of prospective buyers and residents.

Suburban change in the context of sprawl, fragmentation and metropolitan change

Scholar's interest in suburban areas has essentially focused on residential estates and planned-unit developments, the morphological outcomes, and the fears of an uncontrolled urban sprawl. The literature is too vast to all be cited here, but in different contexts (in the US and in Europe) the legal form (homeowners association) and the urban morphology (residential park or estate) first appeared in the early 19th century (McKenzie, 1994), and then generalized in the peripheries

of every metropolitan areas. These large subdivisions, or Planned Unit Developments (PUD) and Planned Communities have been quite early documented, describing their many forms and how they are part of sprawling processes including a high level of space consumption because of their low densities. Many discuss the reasons underlying this suburban dynamic, the most frequently advanced being: public spending on freeways and mass transit systems, fiscal incentives for individual home ownership, generalization of individual transportation means, pressure of the development industry on vacant land (Jackson, 1985), and this has also been documented in the French context (Berger, 2004). The links between the multiplication of suburban residential estates and the cost of sprawl and mobility, as well as their correlated lengthening of commuting (Cervero, 1989; Cervero and Kang-Li, 1998) are well known. Recent studies have also developed the local outcomes of suburban subdivisions, with an emphasis on relational characteristics and street design. The role of New Urbanism on sense of place (Brown and Cropper, 2001), on interactions between residents (Kirby, 2008; Lund, 2003), on travel patterns have been analyzed (Baran et al., 2008): using Space Syntax techniques, Baran *et al.* discuss the relationships between street design and both leisure and utilitarian travel behaviors in New Urbanism communities.

For regional economists and planners, the impact of planned subdivisions upon the urbanization costs and public service provision is a salient issue, especially because of low densities (Southworth and Owens, 1993). Classical economists indeed demonstrate the efficiency arguments for private governance in Planned Unit Developments (PUD), which are based on the assumption that the public provision of services leaves potential welfare gains unrealized, whereas a private provision of collective services within a PUD, relying on a local direct democracy (Home Owners Association, HOA), would be economically more efficient (Foldvary, 1994). Both arguments need to be balanced and the sustainability of private urban governance of residential schemes is a matter of contexts and depends on public policies framing their diffusion (Webster and Le Goix, 2005).

In a French context, scholarly works have focused on the socio-spatial outcomes of low-density landscapes, in which suburban single-housing and subdivisions are archetypes. Indeed, many actors consider that the housing category (one family detached units) and the legal and territorial unit, i.e. the subdivision, the master planned community, or PUD, all belong to the same kin. Some have studied the housing estates as urban forms, and by doing so develop a juridical and financial point of view (rights of way, purpose of subdivisions for local governments' planners) (Wattine, 1990) ; other demonstrate how housing estates are dominant forms in the history of cities, since the 19^e century as cul-de-sacs, "villas" (private streets) in Paris and its suburbs to the more recent development of blue-collars subdivisions in the first suburban belts (Fourcaut, 1988). Developments in the late 1960s and 1980s has often been inspired by the US experience of *Levittowns*, new suburban villages and master planned communities (Berger, 2004), and the capitalist dynamics of a growing industry of developers and builders behind these trends are preeminent (Topalov, 1974).

The characteristics of residential estates are therefore often instrumental in defining the overall characteristics of the urban edge, thus assimilating them as a no-city or an anti-urban world: land division, morphological fragmentation of the urban fabric, monotonous built environment, homogeneity of the residents' socio-demographic characteristics (Burgel, 1989), all these being

detrimental to the social diversity of the urban edge. Many analysis also seek to contextualize the relationships between PUDs and other salient suburban places (such as shopping-malls, business districts, recreational areas), all being the bricks of a fragmented urbanity produced by mobility and structured by individual means of transportation. The fabric of suburb is then entirely devoted to the daily and weekly rhythms (daily commuting vs. leisure occasional mobility...) (Bordreuil, 2000), yielding fragmented patterns of residency, commuting and employment according to socioeconomic status or even gender status (Berroir et al.). Indeed, polycentrism and morphological fragmentation produced by urban sprawl was often discussed as being detrimental to social cohesion of larger metropolis in which cars and new urban life-style are based upon territorial reticular patterns (Dubois-Taine and Chalas, 1997).

Subdivisions and social homogeneity: morphology vs. governance

The balance sheet of causality and independence between suburban morphology (i.e. fragmentation, seclusion, privatization, land-use...) and changing socioeconomic patterns have been a corner stone of urbanism and discourses about urban change for several decades. As previously discussed, the arguments linking both derive from a wide set of theories (*CPTUD*, *New Urbanism*) and planning practices, aimed at promoting social control or social change in residential neighborhoods. These considerations all implicitly assume that street patterns and urban morphology are related to socioeconomic stratification of population, have obvious influences on property values and are often analyzed through the lenses of seclusion as promoting social homogeneity of neighborhoods (Newman, 1972). In France however, the lines of argumentations linking built environment, street patterns and social contexts have mostly drawn on the radical opposition between increasingly fragmented and secluded residential suburbs, and declining multifamily public housing super-blocks of the *banlieue* (Donzelot, 1999), also known as the “Red-Belt”, that is the deindustrializing peripheral working-class areas of advanced marginality produced by post-fordists regimes of exclusions and the withdrawal of the State (Wacquant, 2008). Schematically over the last three decades, in France and in other Western European countries, ‘governments have moved from financing the building of social housing destined for the working class to providing subsidies for individual households to help them move into and up the single-home market’ (Wacquant, 2010). Consequently, an array of research in social geography have focused on the processes of seclusion and gating (Billard et al., 2005), on the individual spatial identities (Cailly, 2009), sense of place (Dodier, 2009), lifestyle, precariousness and deprivation of lower-income homeowners (Rouge, 2009) in French suburbs.

The aforementioned insights are not sufficient to formally link the street layout of subdivisions, and social sorting of residents. However, it is well known that on the long run, the implementation of CC&Rs (Conditions, Covenants and Restrictions), and the overall private urban governance effort in proprietary neighborhoods are not tangential in protecting or shielding property values (Bible and Hsieh, 2001; Le Goix and Vesselinov, 2012; McKenzie, 1994).

From a legal point of view, the 1804 *Code civil* sets up an initial condominium legal framework and regulates property rights, enclosures, rights of ways... Subsequent laws (1923, 1976, 1986) stipulate that every new subdivisions of more than 5 lots are required to set up restrictive

covenants and, in the case of privately owned streets, a homeowners association; and the same apply to planned developments. Municipality may dedicate streets to public use 10 years after the scheme has been developed, but many subdivisions will prefer to keep their street private, despite France's strong urban municipal culture. Private governance of planned developments is a key features: subdivisions are building morphologies of privatism through their street patterns and architecture (Charmes, 2010), and because they are often privately controlled common interest developments, as homeowners associations (HOAs) are commonly used (Glasze, 2005; Webster and Glasze, 2006). There is a well known history in the U.S. of exclusive regulations being implemented in the legal structuring of residential associations by means of restrictive covenants (Fox-Gotham, 2000; Kirby et al., 2006), which is relatively close to the French legal structuring of HOAs, that has also been adopted in the early 19th century in Paris suburban residential developments (Le Goix and Callen, 2010). As a consequence, setting up a subdivision has also been a means to develop the contractual framework that helps controlling the tidiness and ultimately the values of the properties, compared to isolated individual housing.

From a planning point of view we distinguish: (1) planned residential developments (*logements individuels groupés*), i.e. the production of housing schemes by a developer that acquire land, plan, build and often commercialize the housing program; (2) subdivisions (*lotissements*), in which individual lots are acquired on subdivided land, and owners are in charge of the building permits. The subdivision process is often realized either by a municipality, or by a subdivider, but both have the same responsibilities and provide streets, utilities and basic amenities. By convenience, the terminology of *lotissements* often stands for both. According to public data on building permits¹, in the region, detailed information is only available for planned developments *stricto sensu*, which represent 37.6% of the production of 100,300 individual homes built between 1999 and 2007, the rest being individual building permits within single lots or simple subdivisions² (Callen, 2012).

The impossibility to distinguish individual lots from subdivisions in statistics, along with the availability of property and price information at the transaction level, explains our choice that consists in identifying a sample of subdivisions and planned development according to layout scheme, and then compare this dataset with property prices and characteristics. The *Yvelines* was an interesting area to do so, as it provides a certain diversity of schemes. On the one hand, the area has been urbanized by the means of planned developments and subdivisions since the early 20th century, and has since been developed with several master planned communities especially in the New Town of Saint-Quentin-en-Yvelines: 29 large developments between 1966 and 1973, 1/3 of the greater metropolitan region; planned developments built between 1999 and 2007 still account in the department for 33.7% of the new individual homes supply (Callen, 2012).

¹ SOeS Sit@adel2 database, Ministry of Ecology, Sustainable Development and Energy, [ULR: <http://www.statistiques.developpement-durable.gouv.fr/donnees-ligne/r/sitdel2-donnees-detaillees-logements.html>]; accessed Sept. 2012]

² There is no available data that easily distinguish individual lots and simple subdivisions, both relying on individual building permits.

3 A spatial analysis of price change

Data used to analyze housing in subdivisions (detached or semi-detached) have been extracted from a database of real-estate transactions in Ile-de-France provided by the Paris Chamber of Notaries (BIEN database). The extraction contains 7936 transactions between 1996 and 2006 in the Yvelines department, along with variables describing the price, selected characteristics of sold properties and sellers and buyers informations (age, description of his place of residence, social and occupational status). The number of transactions per year has expanded from 463 in 1996 to 913 in 2006, and describes on the one hand the improving quality of the database³ and on the other hand the dynamism of this market in the area.

Increased property values and increased inequalities

The spatial distribution of properties in the database is unequal, as well as the sample quality may vary over time. Besides, there are restrictions on the diffusion of the dataset that requires a generalization of individual information available (smoothing or aggregation). We use the property price (instead of the price per sq. meter because discrepancies found in acreage and built surfaces data otherwise yield biased results) and derive an analysis of price trends between 1996 and 2006. Smoothing techniques using inverse distance weighting have been applied on a grid (cells 500x500 m.) to map the unequal distribution of property value growth. Figure 1 shows different waves of valorization during the decade, following a classical price gradient that extends to the periphery of Paris along an East-West corridor. Another step in the analysis consists in summarizing the local trends at the municipal level, by means of a cluster analysis of average property values at the municipal level for each year (average weighted mean of cells contained or intersected by municipal boundaries). The resulting typology (Figure 2) summarizes the most significant trends of property values by municipalities, everything else being equal: very slow growth (indeed relative decline), slow growth, fast growth and very fast growth of values.

The first area of fast increase of price delineates the eastern edge of the department, in the vicinity of the “beaux quartiers” of the western vicinity of Paris, that benefit from local amenities such as the Chateau de Versailles and its park and forests (east), or the national forest of Saint-Germain-en-Laye (northeast). A bubble of valorization clearly emerges in the Versailles flatlands and considerably extends westward. Another area of valorization extends from the semi-rural or exurban subdivisions located in the Valley de Chevreuse (east-southeast) and to the center of the map. An opposite trend of low values and relative decline is also recorded the northern perimeter of the Yvelines, along the Seine River and its industrial economical context.

³ The collection of data relies on voluntary response from the local notaries. The quality of information fluctuates, and it has considerably improved over the 10 years covered by our sample. Geocoding was also found to be imprecise, so new coordinates down to street address precision have been calculated.

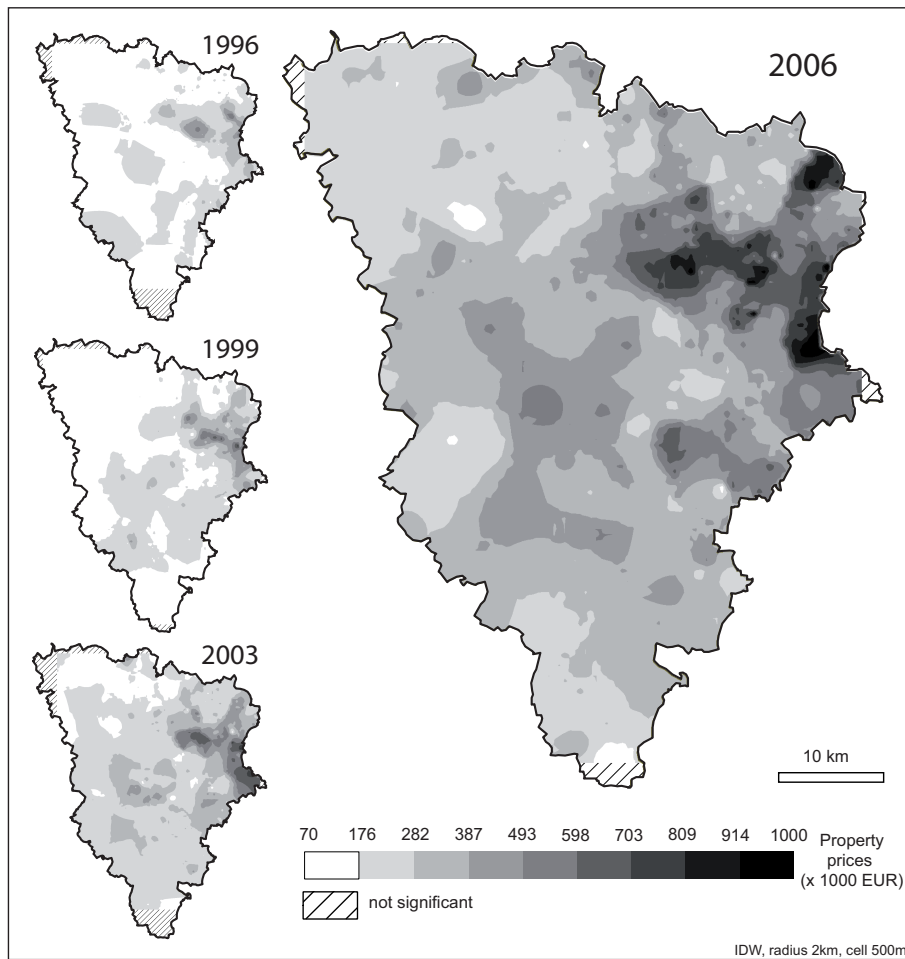


Figure 1 . The unequal distribution of property values growth.
 Sources: BIEN, Chambre des Notaires IDF 1996-2006.
 Cartography: Le Goix, Huet, UMR Géographie-cités 8504, 2011

Property values are not the sole result of housing characteristics and local amenities, but the economic context and employment patterns also play a major role. To better contextualize, unequal increase of property values has been fueled by intense changes in the local polycentrism of metropolitan activities. Whereas the Seine riverbanks remain a unique but declining cluster of manufacturing and automotive industries, as well as a cluster of logistic activities (transportation, warehousing...), the rest of the area has been transformed under the powerful influence of the La Défense high-rise business district and several nearby clusters of businesses, headquarters, schools and university, and activities in the Saint-Quentin-en-Yvelines New Town. Halbert describes a “multipolar-monocentric pattern of producer services”, along with a highly cluterized and hierarchized division of labor (Halbert, 2007). The multipolar distribution of TIC, business and management activities, financial and B2B services, associated with post-industrial changes, have considerably modified the socioeconomic profile of residents on the western edges of the metropolis.

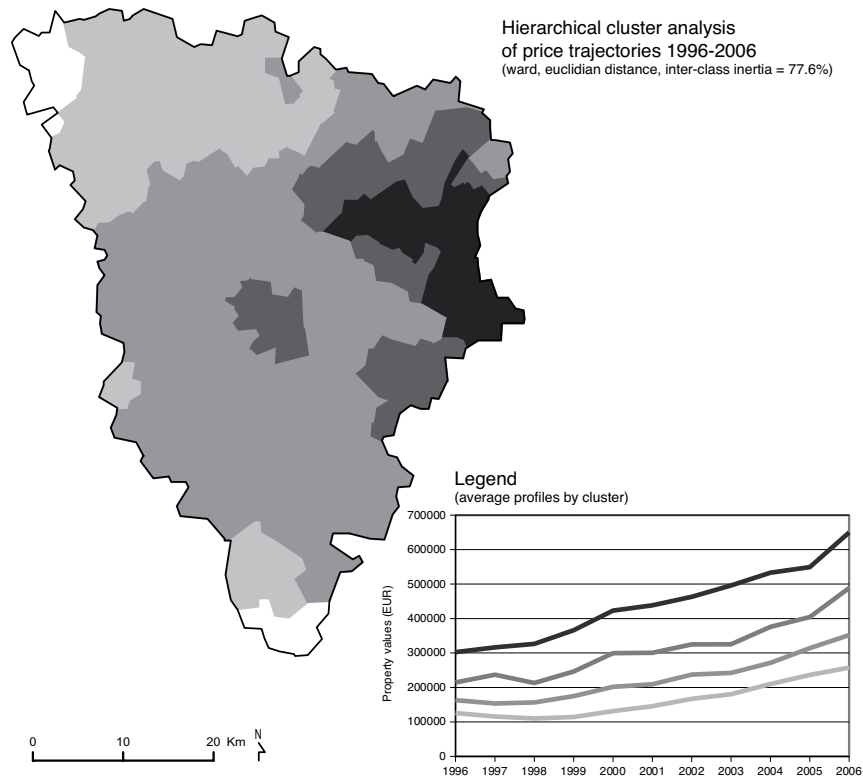


Figure 2. Cluster analysis of price trajectories 1996-2006

Source: BIEN, Chambre des Notaires IDF 1996-2006.

Cartography: Le Goix, Huet, UMR Géographie-cités 8504, 2011

Trajectories of social and occupational status of seller-buyer pairs in subdivisions

We test whether the global but unequal growth of property values yield a substantial transformation of the socio-professional status of dwellers in subdivisions. An analysis of social and occupational status has been conducted, by the means of variables describing the status of sellers and buyers of 4291 individual houses in subdivisions between 1996 and 2006.

The western suburb is on average the wealthier area of the Paris metropolitan region. Not surprisingly, among a total of 70 seller-buyer pairs between the relevant occupational categories, 12 of them represents the top 55% of transactions ([Table 1](#)), with a dominant share of professionals, intermediate occupations, retirees, employees and legal entities. The position of professionals (executives, managers, intellectual occupations) as dominant actors structure the market in this western area: as buyer, they interact with other professionals, with intermediate occupations, with employees, with legal entities for existing home sales (realtor, investors) and new housing market (developers).

Aiming to describe the main axis of social change in subdivision housing, a multivariate analysis has been applied to aggregated information on seller-buyer pairing. Geography for this analysis fits municipal boundaries; but we have also analyzed the subdivisions in which the sample quality permitted so. The analysis is twofold: in a first step, a contingency table of the top 30 pairs (87% of transactions) compiles seller-buyer pairs distributed throughout four periods of time (1996-1999, 1999-2001; 2002-2004; 2005-2006), and a correspondence analysis has been

applied. As on Figure 3, a cluster analysis summarized the position of municipal contexts according to their profiles on factors 1 and 2 for each of the 4 periods of time.

Table 1. Top seller-buyer pairs, 1996-2006 (55% of total)

	N	%
Professionals -> Professionals	326	7.6
Intermediate Occ. -> Professionals	270	6.3
Intermediate Occ. -> Intermediate Occ.	268	6.2
Professionals -> Intermediate Occ.	257	6.0
Employees -> Intermediate Occ.	172	4.0
Employees -> Professionals	167	3.9
Retirees -> Professionals	165	3.8
Legal entities -> Professionals	164	3.8
Professionals -> Employees	155	3.6
Retirees -> Intermediate Occ.	154	3.6
Intermediate Occ. -> Employees	150	3.5
Legal entitie -> Intermediate Occ.	141	3.3
... <i>other pairs</i>	1902	44.3
Total	4291	100

Source: Base BIEN, Chambre des Notaires IDF, 1996-2006

The resulting analysis of the data of sellers and buyers yields a typology of profiles by municipality:

- The first category describes the stability of social and occupational profiles with an overrepresentation of intermediate occupations, employees, retirees and executives in transactions. Several municipalities in the Saint-Quentin-en-Yveline New Town, exemplifies this category, in which the overall density and diversity of suburban type housing has led to a relatively mixed socio-professional profile among the middle and upper-middle class, structured by local employment clusters. This category is closer to the average profile of the typology.
- Another cluster describes suburban gentrification. Properties first sold as new constructions to intermediate occupations and employees are later returning on the market with increased values, and then sold to retirees, intermediate occupations, executives. Villepreux, a typical suburban village, mostly built up with subdivisions in the end of the 1980s, is a typical example of suburban gentrification fueled by the growth of property values.
- A third cluster highlights the leading role of professionals towards increased homogenization of socio-occupational profile. At first the transactions are close to the standard profile where there is an overrepresentation of transactions between executives and intermediate occupations, craftworkers and business owner. After the year 2002 however we see an overrepresentation of transactions between executives themselves, and then leading to an overrepresentation of executives to non-workers and at least from the retired to the executives in 2005-06.
- In some cases new constructions specifically target the most affluent occupational profiles, in a local trend of “elites reproduction”. These municipalities benefit from an overall stability of

social and occupational profiles within the groups of independent workers, high-level managerial workers, managers. Nevertheless the target of new construction is executives and the retired.

-The last category, often located in the area of the Seine left bank, subdivisions specifically target municipalities with lower-income profiles (refuge for workers). In these municipalities, there has been at first an overrepresentation of transactions between workers, executive and intermediate occupations, then in 1999-2001 there was an increase of transactions targeting workers and amongst themselves. More recently the transactions are from intermediate occupations, employees and retired to worker.

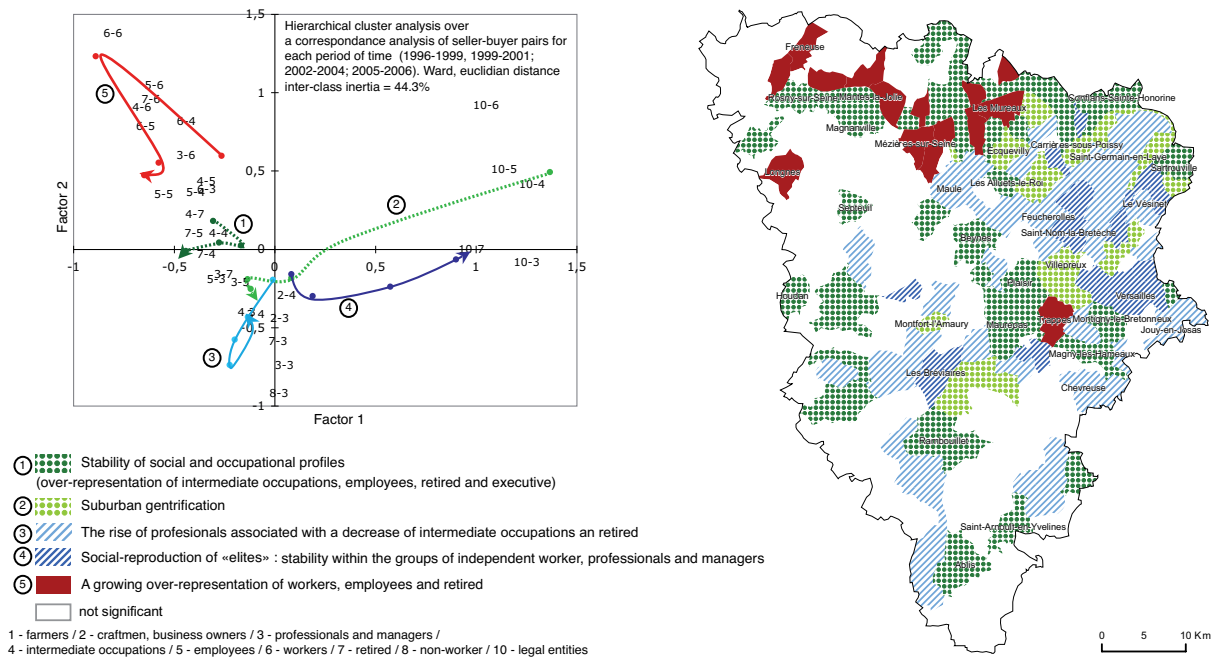


Figure 3. Social and occupational trajectories of sellers and buyers between 1996 and 2006 (factorial axis, scatterplot of sellers-buyers pairs and associated trajectories).
 Source: BIEN, Chambre des Notaires IDF 1996-2006. Cartography: Le Goix, Huet, UMR Géographie-cités 8504, 2011

4 Spatial interactions between street patterns and social change

This section elaborates on the resulting typologies to test whether the different types of street patterns correlate with the housing price structure at the municipal level over time (1996-2006); and to what extent dominant street patterns and residential morphologies relate to social change analyzed by the means of seller-buyer pairs. We also demonstrate that the correlation between street patterns and social change is also true when analyzed at the subdivision level.

An analysis of street patterns in subdivisions

The spatial analysis of suburban morphologies has originally been elaborated with an exploratory set of data on residential enclaves in planned unit developments on suburban areas developed between 1982 and 2003 in Ile-de-France provided by the IAU-IdF (Loudier-Malgouyres, 2010). Additional units have been surveyed and have improved the quality of the sample. Using aerial

photographical interpretation, local road network and land use, the categorization of street patterns has been performed for a total of 490 residential secluded planned unit developments, within 71 municipalities. Subdivisions have been described according to the characteristics of the local road networks including number of arcs, nodes, dead-ends, access points, node density, segment density and total length of the network. These measures allow to automatically research three basic shapes, following the contemporary suburban planning basics: dead-ends, lollipop and loops. As many suburban developments combine the three basic elements, the most common during the last 30 years being the “loops and lollipops” layout, an intricate combination of many loops, cul-de-sacs and lollipops (Southworth and Owens, 1993). The typology of street patterns has been established distinguishing four main types (Figure 4).

Although a dominant morphology in suburban landscapes, the production of individual housing in the *Yvelines* has considerably decreased during the last 30 years. 64% of the houses in the surveyed subdivisions had been built between 1981 and 1991, 26% between 1992 and 2000, and only 6% after 2001. This decline of the production in absolute value has been followed by a relative decline of complex street patterns (loops and lollipops), therefore yielding a diffusion of simpler street patterns in the early 1990s, and the growth of cul-de-sac layout in smaller in-fill developments (Figure 5). More recent trends show therefore more diverse street patterns, because land scarcity obliges developers to build within cluster development zones, in which in-fill developments require more flexible designs. Simple loops and cul-de-sac patterns are found in the newer parts of the suburban development, highly affected by new state regulations after 2000 that have set new standards and requirements of social mix in large scale residential projects (public housing) and a priority towards higher densities and in-fill developments within suburban areas by the means of legal restriction on zoning to avoid urban sprawl and consumption of agricultural lands⁴.

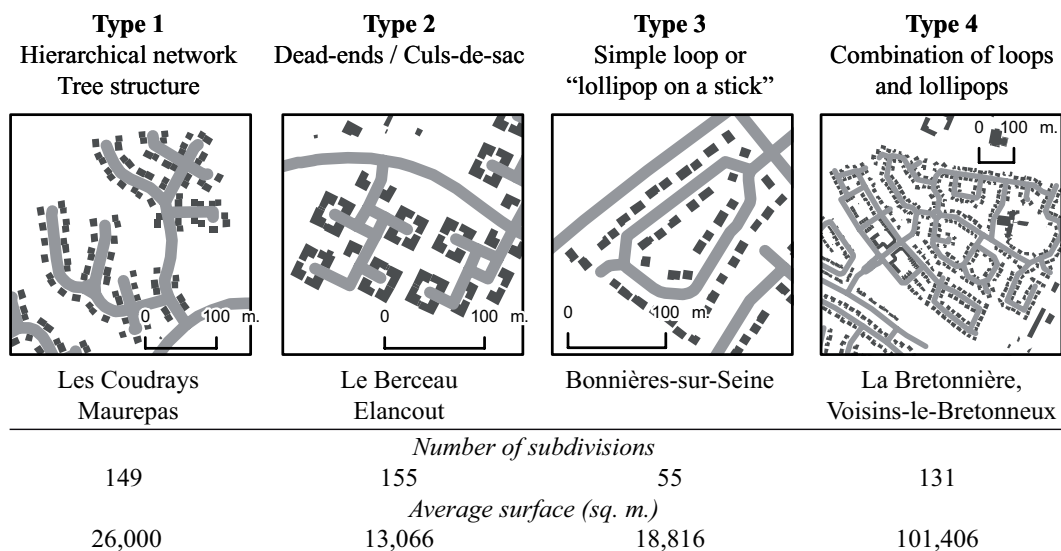


Figure 4. Typology of street patterns in subdivisions.

Sources: IAU-IdF; IP4 datasets, UMR Géographie-cités 8504, 2010; OpenStreetMap, 2012.

⁴ SRU Law, December 2000, “solidarities and urban renewal Law”.

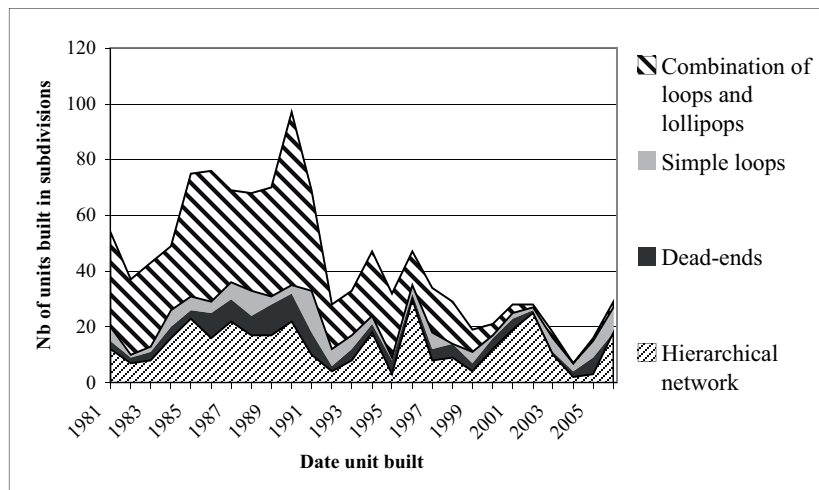


Figure 5. The evolution of street patterns in subdivided units in the Yvelines

Sources : BIEN, Chambre des Notaires 1996-2006 ; IAU-IdF ; IP4 database, UMR Géographie-cités 8504, 2010.

Dynamics of local contexts: street patterns, price growth and social change

The relationships between street patterns, price growth and socio-professional change cannot be analyzed in terms of direct causality, because we compare street layout at the subdivision level, and social change at the municipal geography. This however brings a better understanding of the local contexts occurring in suburbia. The results are analyzed in order to document how these local contexts induces a measurable spatial association with street patterns and urban morphology. This does not seek to conclude about causality, but highlights the coherence of strategies of planners, developers, municipalities, and how it is translated into built environment and morphological choices.

We test how the different types of street patterns correlate with the housing price structure of housing in subdivisions averaged at the municipal level over time (1996-2006) (Table 2) and these results are statistically very significant (based on chi-square test). Simpler street patterns are generally more likely to be found in areas of slower growth. Complex street layouts belong to price valorization contexts that are clearly distinguishable. Tree structure subdivisions, often covering large surfaces and in contact with forest and agricultural land-use are more likely to be found in areas of fast growth, whereas loops and lollipops street patterns are more likely to be found in “slow growth” areas. By contrast, simple loops are clearly more related to areas of slower growth (relative depreciation), and have higher risk to being associated with suburban decay. Subdivisions with dead-ends patterns may be found in different contexts, they are evenly found in very slow growth areas (47.3%), and in areas of fast and very fast growth.

Table 2. Property price growth (municipal level) and street patterns (subdivisions) – percentages of frequencies of the contingency table by row.

%	Very slow growth	Slow growth	Fast growth	Very fast growth	Total
Tree structure	22.7	33.2	31.6	30.6	30.4
Dead-ends	47.3	22.1	39.5	41.9	31.6
Simple loops	11.8	12.5	10.5	4.8	11.2
Loops and lollipops	18.2	32.1	18.4	22.6	26.7
<i>Total</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>100</i>

Pearson’s Chi-squared test: N=490, Chi-Sq = 32.339, DF = 9, P-Value = 0.00017 (Very significant).

The values displayed in bold are significant at the level alpha=.05

Source: Base BIEN, Chambre des Notaires de Paris, 1996-2006

Table 3. Contingency table: seller-buyer pairs trajectories (municipal level) and street patterns (subdivisions) – percentages of frequencies of the contingency table by row.

%	Stability	Reproduction of elites	Suburban gentrification	Refuge for workers	Professionals	Total
Tree structure	47.6	25.9	16.8	4.2	5.6	100
Dead-ends	32.2	23.8	16.8	14.0	13.3	100
Simple loops	42.3	21.2	17.3	7.7	11.5	100
Loops and lollipops	39.5	35.7	14.7	5.4	4.7	100
<i>Total</i>	<i>40.0</i>	<i>27.4</i>	<i>16.3</i>	<i>7.9</i>	<i>8.4</i>	<i>100</i>

Pearson’s Chi-squared test: N=467, Chi-Sq = 27.710, DF = 12, P-Value = 0.006 (Very significant).

The values displayed in bold are significant at the level alpha=.05

Source: Base BIEN, Chambre des Notaires de Paris, 1996-2006

Pushing further the analysis with a comparison between street patterns and seller-buyer trajectories, we not only associate morphology with price valorization, but also introduce in the analysis some information about the changing socio-occupational characteristics accompanying price change (Table 3). We set the hypothesis that dominant street patterns and residential morphologies varies according to local context of social change, analyzed in terms of seller-buyer pairs, at the municipal level. Because of the average trends in the Yvelines, the stability of socio-occupational profiles best describe the dynamics occurring in a majority of subdivisions, whatever their morphology. This is for instance the case in Buchelay (Figure 6) where new secluded subdivision, built up as small in-fill schemes affiliated to New Urbanism references, highly contrast with the inherited landscape where lower density hierarchical patterns had once been dominant. The density and the size of the houses permit a stability of the price and consequently maintain the social structure, with arbitrage on the price of land and density.

Nevertheless, the interpretation of significant overrepresentation in Table 3 shows clear association between trajectories and morphologies (Figure 6).

- An overrepresentation of “loops and lollipops” is clearly associated with stability and the reproduction of the socio-professional elites. Located for instance in the Versailles flatlands, these are large subdivisions, located nearby golf courses and amenities, in very homogeneous environments. Saint-Nom-la-Bretèche has several “loops and lollipops” schemes, on the fringe of the metropolitan area. Newer developments follow the same patterns than older (1970s) and larger planned subdivisions in the area. Located nearby a golf course, this development maximizes its location rent, as it benefits from a high accessibility to the downtown area and suburban business districts. The enclave morphology of loops is related to a high level of property price and a strong homogeneity of the social level of the owners.
- Subdivisions with hierarchically tree-structure patterns belong to contexts made of typically very stable socio-occupational profiles. There are many reasons for this: they are usually larger developments and more likely to be built nearby immutable land-uses such as amenities, patrimonial forest, golf courses, water bodies. Requiring a large availability of land, they represent a quasi monopolistic share of residential land-use in a given area. The shape of street patterns allow a better contact with open space and amenities. All these characteristics, in a context of property price growth within the average trends ([Table 2](#)) contribute towards a higher level of stability.
- Dualism best describing the preferred locations of subdivisions in dead-end patterns: they are either overrepresented in municipalities where subdivision builders have been targeting lower-income owners (refuge for workers), or in municipalities with an increasing share of professionals and higher-income owners. These are planning tools designed to increase the density of built-up areas, and the seclusion of dead-end is a useful feature to maintain an appealing residential environment within a context of very diverse land-use. For instance, recent dead-ends subdivision in Magnanville (Figure 6). This very dense program is located in a relatively depreciated area, next to industries, warehouses and social housing and targets the lower middle class, previously living in rental multi-family housing units, and acquiring their first owner-occupied semi-detached unit.
- Simple loops are more ubiquitous and less likely to show clear spatial patterns in terms location within specific local socio-professional trajectories. They have been instrumental in densification strategies, and are often associated to new urbanism reference in brown-field redevelopment. While a majority is located within municipalities with stable profiles of residential subdivisions, everything being equal, they are more likely to be located within area affected by suburban gentrification, or with an increasing share of professionals. Because their market segment has recently increased, they are also more likely to be gated, and therefore associated with some typical residential strategies.






Location		Street pattern	Seller-buyer pairs profile
Buchelay		Type 3. Simple loops	Type 1. Stability with an overrepresentation of intermediate occupations, employees, retired and professionals
Saint-Nom-la-Bretèche		Type 3. Simple loops	Type 4. Social reproduction of the “elites”
Magnanville		Type 2. Dead-ends / culs-de- sac	Type 5. A growing overrepresentation of workers, employees and retired
Vernouillet		Type 4. Combination of loops and lollipops	Type 3. A growing overrepresentation of professionals
Bonnières		Type 1. Hierarchical network - tree structure	Type 5. A growing overrepresentation of workers, employees and retired

Figure 6. Landscapes, street patterns and social change. Sources: Huet 2009.

Conclusion

Our initial goal in this research was to analyze the complex and intricate variables that actors of the suburban growth machine have to anticipate at the local scale: spatial patterns reify the resulting choices and strategies, and are spatially associated with local contexts of urban change (decay, valorization, gentrification, increased segregation). Two conclusions derive from this joint study of local contexts changes analyzed with the proxy variables of price and socio-

occupational changes, along with residential street patterns in subdivisions. The analysis confirms there is a strong relation between the types of street patterns and the types of socio-occupational changes driven by increasing property values: clear spatial interactions occur, such as between hierarchical street networks and the overall stability of social profiles, between “loops and lollipops” and “the reproduction of elites”, or between simple loops and “suburban gentrification”. Second, some of these spatial correlations can also be observed at the subdivision level: loops and lollipops are more likely to yield the same seller-buyer profile than the rest of the municipality, unlike other street patterns.

But the stronger variable for differentiating subdivisions remains the age of a neighborhood and suburbia yields stronger generational effects of the built environment (Figure 5) on socioeconomic patterns than inner cities areas. And this gives way to strong effects on socio-occupational categories targeted by some products. To what extent these spatial associations are clues of a potential direct causality between morphologies and preferences by some subsets of the single housing prospective buyers will remain an out of scope question for this paper for obvious ecological fallacy reasons; nevertheless, it clearly appears that some local contexts clearly affect street patterns and morphological choices made by developers, or by local planners, and have an effect on seller-buyer characteristics and social change.

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