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▶ To cite this version:

Yasmine Essafi, Raphaël Languillon, Arnaud Simon. The Relation between Aging and Housing Prices A Key Indicator for the French Spatial Wealth Reshaping. 2017. halshs-01654445

The Relation between Aging and Housing Prices

A Key Indicator for the French Spatial Wealth Reshaping

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Abstract

Using the link between demography and house prices in a life-cycle economy perspective, this article documents the ongoing spatial reshaping of wealth in France due to the elder-boom breaking point. This modification in the wealth circulation across generations is also a spatial modification that carries consequences for the local territories. While the wealth losses are amplified for some departments, others benefit from the reorganization. Metropolization is insurance against important wealth losses, whereas for the nonmetropolitan departments, a combination of second-order factors is required to limit or reverse the negative trend. Our results suggest that these evolutions are mainly structural and that the economic variables are of secondary importance. There is no case of compensation for structural decline by a positive cyclical trend. Gentrification also appears to be a direct and emblematic avatar of this change, in which various macrostructural inequalities are reinforced. As for the unemployment rate, this indicator poorly reflects the shift and can be misleading.

Keywords: Ageing, Life-cycle, Spatial reshaping, Territories, Metropolization.

1. Introduction

Since the 1990s, France, like many developed countries, has been facing deep changes in its spatial structure and regional geography. Globalization and Europeanization, the end of the Weberian and Fordist logics of space allocation, the rise of competition, and the importance of financial interests are among the multiple facets of this evolution. Simultaneously, at the national scale, a split in two opposite dynamics has been emerging for local territories: a metropolitan dynamic and a peripheral one. This new geography of spaces does not just concern economic aspects; its link with the contemporaneous global ageing trend and, more precisely, with the elder-boom breaking point is also central. However, the relations between these spatial, economic, and demographic changes are complex and difficult to disentangle. Which one causes the others? How should we understand these evolutions: from a cyclical perspective or as reflecting irreversible structural shifts? If it is a mix of shifts and cycles, in which proportions?

This article deals with these issues at the junction between regional geographical studies and life-cycle economy. The relation between demographic evolutions and house prices is used as a key indicator to identify and characterize various dynamics across the French departments. In a life-cycle perspective, ageing decreases wealth; however, it is possible to identify departments that reverse this global trend as well as others where the wealth losses are amplified. In other words, an important spatial wealth reorganization takes place during elder-booms. Different factors are considered to analyze the determinants of these variations (the role of Paris, the role of the metropoles, littoral proximity, and border proximity) and their respective magnitudes. Then, the spatial structure of this ongoing reshaping is compared with other macrostructures. Is it equivalent to the gentrification process or to the geography of

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unemployment? Are the wealth losses concentrated in the sparsely populated departments? Does the local housing affordability difficulties mirror the reshaping?

Section 2 is devoted to the literature review. Section 3 presents the data, the models, and the first results. The analysis for the whole set of departments and for various sub-groups is presented in section 4, and section 5 provides comparisons with others geographies. The last section offers concluding comments.

2. Literature review: Shrinkage through aging, beyond life-cycle economy approaches of local territories

a. Cyclical and structural declines of spaces

Shrinkage studies are generally associated with two approaches: cyclic models composed of four stages (urbanization, disurbanization, counterurbanization, and reurbanization; Fol and Cunningham-Sabot 2010), and linear approaches based on three steps, in an "end-of-pipe" perspective (urbanization, stagnation/maturity, and decline). But what does aging tell us about the space losses? Does it reinforce cycle models or linear models? Or does it break with them and call for radical new analysis?

Cyclical models are strongly related to economic cycles. They provide relevant insights with which to analyze suburbanization (Fishman 1987; Jackson 1985) and deindustrialization dynamics (Friedrichs 1993). Fishman (1987) indicates that suburbanization is the result of both microeconomic and sociological factors. The microeconomic factors are due to residential strategies aimed at maximizing real estate investments. Le Goix (2016) also establishes the role of the welfare-based regime in the case of American suburbanization, where public policies have been encouraging the planification of suburbs (Jackson 1985; Downs 1999). The sociological

factors are due to the rise of individual mobility (Gutkind 1 1966), residential strategies based on homogeneity (social, professional, confessional, etc.; Hoyt 1 1939), and strategies of self-betweenness (Le Goix 2005, 2016). In such a context, the decline of city centers and the growth of suburbs are the consequences of neighborhood evolutions regarding the potential capital gains and the devalorization of residential assets (Hoyt 1 1939). The second one, deindustrialization, is more linked with macroeconomic factors. It can be explained by the shift from the industrial stage to the globalized stage, which substitutes Weberian localization logics with globalized logics of production chains. Declines in monofunctional spaces are the results of this change of paradigm, which has led to most of the studies on shrinking (Weaver 1 1977; Rybczynski and Linneman 1 1999), or the so-called German *Schrumpfende Städte* (Häussermann and Siebel 1 1988). More generally, deindustrialization is related to the correlation between urban life cycles and economic cycles. For example, Booth (1987) and Hall (1988) showed how the obsolescence of productive systems, corresponding to outdated innovations, could explain urban decline in certain cases, referring to the "creative destruction" of Schumpeter (1939).

These approaches do not consider urban decline as absolute or definitive but as conjunctural. In the case of suburbanization, the paradigm of a continuous urban growth trend at the scale of urban regions is not questioned, nor is the appreciation of general house prices at the upper scales and from a long-term perspective. In the case of deindustrialization, the decline is cyclic and corresponds to a structural adjustment in relation with a post-Weberian transition of productive systems, or a critical transition between two cycles after a temporary misfire of one cycle. However, demographic changes (aging, elder boom, second demographic transition) are challenging these views. They force structural modifications in the local housing economy and the irreversible decline of spaces to be considered (Van de Kaa 1 1987; Sardon 2004). From

another perspective, Fol and Cunningham-Sabot (2010) point out the evolution of the systemic relations between spaces due to globalization to explain structural and irreversible changes. Therefore, the contemporaneous decline or rise of spaces, especially of urban spaces, might not just be the expression of cyclical trends such as suburbanization and deindustrialization; they could also be the consequences of the elder boom and the spatial manifestation of globalization (Aglietta and Boyer 2006). These three factors; cyclical optimizations, the elder boom and globalization are surely interrelated.

b. <u>The great spatial heterogeneity of the aging process</u>

Aging is a global change of societies and territories (Lutz, Sanderson, and Scherbov 2008). All OECD countries have been experiencing it at different scales (Fougère and Mérette 1 1999; Sardon 2004), from local rural territories (Burholt and Dobbs 2012) to urban metropolitan areas such as Tokyo (Abe 2015; Languillon 2016) and macro-regions such as Eastern Europe (Lintz, Müller, and Schmude 2007; Hoff 2011). Even emerging and developing countries are concerned by the phenomenon, such as China (Peng 2011) and Russia (Gavrilova and Gavrilov 2009).

Two continuous elements contribute to explaining aging: longer life expectancies, which increase the total number of people beyond 65 years old, and lower birth rates, which lead the young and working populations to shrink. Some scholars even speak about an hypothetical second demographic transition (Van de Kaad 1 1987) based on the continuous decrease of birth rates and the timid but structural increase of death rates in super-aging societies (Hino and Tsutsumi 2015; Christensen et al. 2015). But the role of the so-called "baby boom," which is now becoming an "elder boom," is also a very important factor and may be the most important one. It acts discontinuously and introduces a strong break.

Aging is not a ubiquitous phenomenon and is not spatially homogeneous. This is due to demographic variations in natality as well as mobility and various migrations (at the local, national, and international scales). The Japanese case have been well-analyzed as a pioneer of aging changes. Rural exodus, especially of the young population, is the main cause for super-aging of more than 50 percent of the national territory (Japanese call *kasô* municipalities those that have lost more than 10 percent of their population between two decennial censuses; Pelletier 2008). At the metropolitan scale, several factors occurred simultaneously: the bursting bubble and the decline of land prices (Noguchi 1 1994; Scoccimarro 2007), public policies and economic incentives for the qualitative regeneration of city centers (Languillon 2015), and new high-rise residential tower developments (Koizumi et al. 2011). These factors explain the arrival of young working and gentrifying populations, especially couples with children, from urban fringes to city centers (Scoccimarro 2007). This movement is correlated with the rise of vacant houses in peripheries, including in the Tokyo metropolitan area (Kubo, Yui, and Sakaue 2013). Hirayama (2010) shows how the aging of homeowners has negatively impacted housing prices in the fringes of the Japanese capital.

As Tokyo testifies, metropolitan evolutions and their interactions with the territories emblematically reflect the three factors mentioned above: cyclical adjustments, aging and globalization. Migrations of young people, due to the reinforced attraction of metropoles to study and for jobs, accelerate the aging process in the rural territories, whereas these cities become younger than rural peripheries or other regions (Ghekière 2006). However, heterogeneous effects are observable even within the metropolitan areas (Pihet 1999), such as with the unplanned concentration of elderly people in the urban fringes or with planned gated communities. The concentration of elderly people in urban fringes can be explained by the spatialization of the job

market, which attracts young people to city centers through the renovation or gentrification of housing, as well as by the life-cycle (Fishman 1987; Le Goix 2016). In a situation of aging suburbs, the local economy can meet difficulties, with shops closing, the public transportation system shrinking, and services becoming rarer (Ishiguro 2014). This constitutes a real issue for the elderly population, whose mobility is also decreasing (Lord and Luxembourg 2007). Regarding the gated communities, Townshend (2002) and Le Goix (2005) analyzed the planned segregation of aging people, such as in Laguna Woods in California (Andel and Liebig 2002). In opposition to the spontaneous dereliction of residential economy, those aging enclaves tend to protect the value of real estate assets and the dynamism of the local economy, including services, leisure, and commercial activities.

If spaces and people were homogenous, the aging effect would be simple and negative. But for various reasons, many existing situations reverse this trend locally. The concern, then, is to find a way to deal simultaneously with the structural changes of aging and globalization, the contrarian dynamics, and the optimization of the urban process. We chose to use real estate prices as a key indicator, based on the life-cycle theory, to get a synthetic view on the ongoing reshaping of spatial wealth.

c. Life-cycle economy and house prices

The life-cycle theory indeed posits an interesting relation between population aging and asset prices (Ando and Modigliani 1963, Allais 1947, Samuelson 1958, Diamond 1965). The basic idea consists of assuming that people invest in multiple assets during their working age and later convert them into retirement income. They are first buyers and then sellers. If the ratio between the working population and retired people stays constant across years, the supply and demand for assets will be unchanged, and their prices should not be affected. However,

important prices variations are expected if the structure of the population shifts. Thus, given the demographic trends, many countries nowadays face important capital and property market outflows, which lead to asset and housing prices declining, also called a "meltdown." The central point for us lies in the fact that housing price meltdowns are spatially observable and mirror the spatial reshaping and the wealth circulation (Davezies 2008).

Many authors have found evidence of meltdowns in bond and stocks markets (Abel 2003; Jamal and Quayes 2004; Campbell et al. 1997), with varying magnitudes across countries (Ang and Maddaloni 2005; Poterba 2001, 2004). Yet, this phenomenon can sometimes be difficult to detect (Marekwica et al. 2011) because individuals are not the only market participants. For housing markets, the situation presents two favorable particularities: contrary to the capital markets, households are the main participants, and if a property is an investment, it is also a consumption good. This strongly household-oriented market is thus a good case study with which to analyze the occurrence of meltdowns due to an aging population. Two periods can be distinguished in the real estate literature: before 1995 and after 2005.

Regarding the first period, the reference article of Mankiw and Weil (1989) studied the impact of important demographic shifts (namely the baby boom and baby burst) on the real estate market in the United States. They concluded that stronger demand from a larger working population makes real property prices surge and that prices decline when this cohort retires. Their findings were challenged by Hendershott (1991) and Holland (1991) with econometric arguments related to their model specification. However, by integrating these critics, Di Pasquale and Wheaton (1994) and Lee et al. (2001) continued to find evidence of the relationship between demographics and housing demand. A second critique was made: some authors pointed to the fact that Mankiw and Weil's findings could be specific to the United States. Engelhardt and

Poterba (1991), following the same approach with Canadian data, did not find any significant relationship. Whereas, for Japan, Ohtake and Shintani (1996) noted that the demography's influence was limited in time and affected the housing stock more than it did to the prices.

Thereafter, between 1995 and 2005, the publications on that topic became less frequent. Here, it is of special importance to remark that these ten years are very specific for the issue. They correspond to the moment when all of the baby boomers belonged to the working population and were thus potential housing buyers. This is also the exact period when house prices increased strongly in numerous OECD countries. This interval ends with the years 2005–2006, which represent a structural break; the number of retired people began to drastically increase at this point, heralding the elder-boom period.

In the literature, these two major elements allowed the previous results to be revised in a much more positive sense. After 2005, papers that criticized the relationship between aging and house prices became scarcer. The empirical studies are clearly positive for numerous countries, including Fortin and Leclerc (2002) for Canada, Neuteboom and Brounen (2007) for the Netherlands, and Shimizu and Watanabe (2010) for Japan. For Japan, Nakamura and Saita (2007), contrary to Ohtake and Shintani (1996), also found that the influence exerted by demographic changes on real estate prices was greater in the long run than in the short run. At the same time, Nishimura (2011) and Takáts (2012) redeveloped a theoretical model. The research of Takáts (2012) deserves special attention because it validates the empirical relationship from a panel data approach for 21 countries during the period 1970–2009.

For Belgium, Kryvobokov and Pradella (2016) validated the aging effect but remarked that its magnitude was smaller compared to the effect detected in France by Essafi and Simon (2017). D'Albis and Djemai (2017) also studied this issue in terms of newly built housing,

whereas Monnet and Wolf (2016) considered the investment aspect; both articles were written in the French context.

3. Structural and cyclical evolutions: The case of France

a. The demography–price relation

In their article, Essafi and Simon (2017) estimate a panel model[1] for housing prices in France at the department-level (NUTS3) for the period 2000–2013. The dependant variables are the housing prices evolutions, measured by hedonic indexes (PMAI for houses, PAPP for apartments):

$\Delta \ln \text{PAPP}_{it}$ (or $\Delta \ln \text{PMAI}_{it}$)

$$= \alpha_i + \beta_1 \Delta\ln \text{REV}_{it} + \beta_2 \Delta\ln \text{TPOP}_{it} + \beta_3 \Delta\ln \text{OLDDEP}_{it}$$

$$+ \beta_4 \Delta \ln\text{OFF(APP or MAI)}_{it} + \beta_5 \Delta\ln \text{TEG}_t + \beta_6 \Delta \ln \text{DIV}_t + \varepsilon_{it} \quad (1)$$

Three explanatory variables are related to the demographic aspects: the total population (TPOP), the old dependency ratio (OLDDEP), and the divorce rate (DIV). OLDDEP is the ratio of the number of people older than 60 divided by the number of persons between 20 and 60. Two variables refer to the economic and financial aspects: household disposable income (REV) and the interest rate for fixed-rate mortgages (TEG). The number of newly built houses is also included (OFF). The results obtained in this article corroborate the importance of the demographic variables for the housing prices dynamics, as suggested by the literature. The relationship is strong and robust for the case of France. The main variables are the total

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[1] For stationarity reasons, the model was estimated in terms of first differences. The individual effects are significant, and the retained specification is a fixed effect. The presence of spatial autocorrelation was tested and rejected.

population, TPOP, and the aging ratio, OLDDEP; the former has a positive impact on prices, while the latter has a negative impact. Income and the divorce rate are of secondary importance, whereas the interest rate and the intensity of construction are almost nonsignificant. However, Essafi and Simon (2017) concluded their article by noting that the spatial dynamics were strongly heterogeneous and should be analyzed in a more detailed manner.

For ease of interpretation, their model is slightly modified in the present article, substituting ΔLnOLDDEP in the previous equation with ΔOLDDEP. The series stays stationary, and this modification does not change the coefficients obtained for the other variables nor their significance, as indicated in table 1A. In order to concentrate on the relationship between price and demography, we assume that the variations of the four others variables (OFF, REV, TEG and DIV) are null. As the estimated coefficients for these variables are small or even nonsignificant, this simplification appears reasonable. Assuming that the errors terms are also null, we obtain the relation:

$$\Delta \ln PAPP_{it} \text{ (or } \Delta \ln PMAI_{it}) = \alpha + \beta_2 \ \Delta lnTPOP_{it} + \beta_3 \ \Delta OLDDEP_{it} \qquad (2)$$

ΔlnTPOP corresponds to the annual percentage of variation of the total population, while ΔOLDDEP corresponds to the annual absolute increase of the aging ratio. In the plane (ΔlnTPOP, ΔOLDDEP), we can thus determine a line where the positive effect of TPOP on price is exactly compensated by the negative effect of OLDDEP on price.[2] On the right side of the line, the positive effect of total population is stronger than the negative effect of the aging ratio; consequently, prices increase. On the left side of the line, the aging effect is stronger than the total population effect, so prices decrease.

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[2] As the lines of constant prices for houses and apartments are very close, we choose to work with a single line, the bisector of the two lines.

This line of constant price and the vertical axis actually define three areas in the plane (figure 1A). The first one, noted Z_1, is the portion to the left of the line and to the left of the vertical axis: the population decreases, aging is strong, and prices decline. The second one, noted Z_2, corresponds to the portion on the left of the line but on the right of the axis. Here, the population increases but not enough to compensate for the aging; housing prices slightly decline. The third one, Z_3, is on the right side of the line and on the right side of the axis. The population effect exceeds the aging effect, so prices rise. It is also interesting to indicate that the further from the line a department is, the larger the variation in prices is.

b. <u>The elder-boom breaking point</u>

The fundamental relation (2) brings a major regime shift to the fore. The scatterplots of Figure 1 represent the annual demographic evolution of the 94 departments for various sub-periods. For the period 2000 to 2006, the OLDDEP ratio is approximately constant, and its variations are globally close to zero (figure 1A). Regarding the total population, the dispersion is wider; a few departments lost population, while others quickly increased at an annual rate greater than 1 percent.

The year 2006 for France was a breaking point. The baby boom in France began in 1945 and lasted almost up to 1970. As the OLDDEP ratio measures the number of people older than 60 divided by the number of people aged between 20 and 60, its evolution has changed since the year 2006 because of the baby-boom cohorts reaching the age of 60. Figure 1B is associated with the period 2007 to 2014. As we can see, the scatterplot shifts upward and to the left: aging becomes strong, and the population increases less. During the period 2000–2006, almost all of the departments were to the right of the line of constant prices, meaning that the dynamics of

housing prices were bullish everywhere. But after 2006, the line splits the departments between those with bullish trends and others with bearish trends.

In the following analysis, we exclude the year 2008–2009. This choice is based on the idea that the intradepartmental mobility could have been specific during the global financial crisis and thus could have affected the evolutions of the total population.[3] Consequently, we retained the period 2010–2013 to mirror the contemporaneous tendencies of this new real estate environment characterized by aging. Another option would have consisted of using forecast scenarios for the demographic data. Figure 1D presents the scatterplots for the period 2015 to 2025 when using these scenarios (median scenario established by the National Statistical Institution [INSEE]). As we can see, the dispersion is smaller. The main problem with this choice is that the forecasts depend on hypothetical assumptions that may or may not be reliable. For instance, it is difficult to clearly anticipate what the results of the metropolization policies in France will be in the next ten years or what their effects will be on mobility. This is a key point. On that basis, the period 2010–2013 is preferred.

c. Two orthogonal dimensions

In the above panel model, the long-term structural demographic variables appear to be the main drivers, whereas the economic variables are of secondary importance. Principal component analyses were implemented to better qualify the role and importance of the various variables.[4]

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[3] Even if the differences are small, as we can see when comparing Figures 1B and 1C.

[4] This technique consists of restructuring data to identify patterns in a set of variables (Child 2006). Some uses can include data transformation, hypothesis testing, and mapping (Rummel 1970). This technique can reduce the number of variables; this is known as dimensionality reduction (Bartholomew, Knott, and Moustaki 2011). The new factors are linear combinations of the initial variables. They permit an easier

This technique is also a means of characterizing the departments as a whole and in subgroups of interest. Eighteen variables reflecting the demographics, socioeconomics, and housing market features were used (cf. table 1B). The goal was to observe how the variables could be factorized. Two dimensions emerged (cf. table 2).

The first dimension was "demographic, real estate, gentrified" (DREG), which was positively characterized by the demographic variables (important and increasing population, younger, limited aging) and housing market features (high real estate prices, low vacancy and ownership rates, high level of construction). It was completed by socioeconomic variables associated with gentrification (high GDP and revenues, high percentage of executives, unequal living standards). The second one, UNPREM, was more centered on economic factors (high unemployment and poverty rate, low revenues, equal life standard) with negative or null net migration; its reduced form was termed UNP (high unemployment and poverty rates). In one situation, the UNP/UNPREM was replaced by another group of variables, termed MMASR (small or medium departments in terms of population and GDP, positive net migration, low unemployment, and high secondary residence rate).

The DREG dimension is centrally associated with the previously discussed structural spatial changes. It is always the first component whatever the segmentation and explains between 37 percent and 56 percent of the variance. The UNPREM dimension corresponds to the cyclical and economic aspects. It captures between 15 percent and 32 percent of the variance. This

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understanding of the data and also facilitate interpretations (Rummel 1970). By placing variables into meaningful categories, principal component analysis converts measures into the underlying concepts that were not initially observable. This can be realized either within an exploratory framework or a confirmatory approach.

limited variance is coherent with the small role of the economic variables in the panel model. These results suggest that the spatial changes were mainly structural. Moreover, it is important to point out that the poverty and unemployment dynamics were always orthogonal to the real estate and demographic dynamics, whereas the gentrification process was correlated with the price-demography dynamic.

4. Spatial trends of the wealth circulation caused by the aging shock

a. Economic localization of the aging process: Standard, contrarian, or amplified?

According to the life-cycle theory, an aging process creates a meltdown and limits economic growth. In this article, the spatial manifestations of this mechanism are tracked through the evolution of the housing stock's value. The scatterplot and map 2A represent the evolution of the real estate prices for 94 French departments. The portion of the plan Z_1 corresponds to an important loss of wealth, for Z_2 the loss is moderate, whereas for Z_3 wealth increase. As the global trend is negative, the existence of the contrarian departments Z_3 means that their wealth loss is endured by the Z_1-departments, which concentrate the negative effects of aging on wealth.

The Z_1-departments are mainly rural ones that have never really experienced high positive trends in the long-run during the last two centuries. They are located in the center of France and in some parts of the east. Enclaving, in particular railway enclaving, their distance from metropoles, and industrial crises are the common admitted explanatory factors. However, a key point is that aging pursues and amplifies this trend, in absolute but also relative terms, i.e. more harshly than it does for the other departments. The medium group is formed by departments that are closer to the metropoles or even sometimes hosting a regional capital,

departments on the Channel Coast or those not too far from a coast, and departments on the northeastern border. They endure wealth decreases but in a limited manner. The third set includes the departments of the Parisian region, the ones hosting metropoles, the Atlantic and Mediterranean littorals, and almost all of the southeastern departments. Here, the global dynamic is reversed; prices increase and wealth becomes concentrated in these contrarian departments.

The PCA results for the full set of departments[5] clearly corroborate these elements (see table 2). The structural DREG factor is the first one and captures half of the variance. Almost all of the positive[6] examples belong to Z_3 and correspond to metropolitan, littoral, or border departments, whereas the negative examples belong to Z_1. We now refine the analysis for various subgroups.

b. Extended Parisian region

The extended Parisian region is made of three concentric groups of departments, in a center-periphery logic with a decreasing gradient. In the first group, we find Paris and its ring of small and very urbanized surrounding departments. They approximately constitute the zoning of the "Grand Paris" metropole development project. The second ring is made of urban departments that are directly connected to the center with a dense public transport network. Their size is more important, and some of the furthest areas can be considered rural. The administrative region, Île-de-France, includes the first two groups but not the third one. We included it in the analysis to test the direct extension of the Parisian influence. This last ring is made of departments that

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[5] The Parisian departments have been removed from the full set for stability reasons and ease of interpretation.

[6] The positive (negative) examples correspond to the departments close to the axis, in the same (opposite) direction.

belong to other regions. An important portion of these spaces can be qualified as rural, but significant transport connections with Paris and urban zones also exist; moreover, one of these departments hosts a regional capital.[7] As we can see in Figure 2B, the magnitude of aging clearly differentiates the three groups. At the national scale, the departments of the first group are even among those less concerned by aging.

As expected, the administrative region increases or maintains its wealth homogeneously in the first group and heterogeneously in the second. This is also true for the west of the third group. Traditionally, the wealth inside Paris and the region is west-skewed; hence, aging tends to reinforce this pattern and increase the integration of the western part. In opposition, although their distance to Paris is less than 100 km, the eastern departments did not succeed in reversing the meltdown, with no department belonging to Z_3 but one department even belonging to Z_1 (the others belong to Z_2). It also must be noticed that the DREG in the Parisian region gave less importance to the population increasing and is completed by negative net migration. This is coherent, as some people try to leave when they retire or during the second half of their career. The role of the cyclical factor UNP was smaller (17 percent of explained variance). Classically, it opposes a suburb in the north with a high poverty rate (Seine-Saint-Denis) with a very middle- and upper-class department in the west (Yvelines).

c. Departments with regional capitals

In the previous case, the scope was regional, with a DREG factor far ahead the UNP. We now consider metropolitan areas with the departments hosting regional capitals. This set is formed by eleven units, excluding Paris. The line of constant price separates the observations into two groups; the first group is positioned in Z_2 or very close to the line, while the second

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[7] Orléans, Loiret, for the "Centre" region.

group clearly belongs to Z_3. There is no regional capital in Z_1. The metropole status acts as bulwark against important wealth losses caused by aging and even helps to reverse it locally. Group 2 mainly corresponds to the technopoles arc (Rennes, Nantes, Bordeaux, Toulouse, and Lyon).

Even within the metropoles group, DREG is the first structuring factor and explains 40 percent of the variance. Aging cannot be reduced to a simplistic opposition between rural and urban areas; it produces effects on all types of territories, including the most urbanized, and is always the strongest factor. This point is crucial. However, some specificities appear for metropoles. The economic factor UNPREM is important (32 percent), and some variables are transferred from the first to the second factor (increasing population, revenues, and unequal living standards). The two factors can be considered as having almost equal structuring power for the metropoles.

It is also interesting to remark that the Z_2 group is composed of departments with a poor DREG dynamic (Côte-d'Or, Loiret, Bas-Rhin) but also of departments with a bad UNPREM dynamic that are almost on the line of constant price (Bouches-du-Rhône, Nord, Seine-Maritime). These latter departments have been hit by industrial crises (in the steel, mining, textile, and chemical industries) and experienced failures of industrialisation policies in the 1970s and 1980s. The Z_3 group is made up of attractive metropoles with smaller social issues and increasing population (Loire-Atlantique and Haute-Garonne, for instance). In other words, for regional capital, the good trends in DREG and UNPREM can accumulate (Haute-Garonne), but there is no case showing compensation (a bad UNPREM dynamic compensated by good DREG, or the opposite).

d. <u>Littoral departments</u>

Compared with the metropoles group, aging is higher on average for the littoral departments without being in the Z_1 area. If these departments limit the important wealth losses due to the aging process, however, they must gather a combination of factors to become contrarian, including proximity to a technopole or a metropole, better weather conditions to maximize the Sun Belt effect (Channel littoral compared to the Atlantic and Mediterranean littorals), and an absence of past industrial crises. It is also interesting to note the split of the Mediterranean littoral; while the rich and old departments of the east only maintained their wealth, the younger departments of the west increased it significantly. Importantly, working-class populations and mass tourism also characterize the western part, and there is a notable difference in terms of planning as well (unplanned for the east, planned for the west).

The DREG factor presents some particularities. The role of real estate prices is slightly reduced and partially transferred to the third factor (MMASR). Moreover, the population increase no longer participates in DREG. The flow of the newly retired people arriving in the Sun Belt contributes to explaining this last point: as long as the flow continues, the population is steadily replenished (due to the important aging and mortality rate), allowing the departments to maintain their wealth and population. The best example of the situation is Alpes-Maritimes with the city of Nice, whose population has stayed constant and is already quite old, at an average of 43 years old (lowest point on the graphic).

The second factor, UNPREM, classically opposes the departments with economic difficulties in the North or on the west Mediterranean littoral with the good economic situations observable on the upper part of the Atlantic littoral. The third factor regroups high real estate prices and a high percentage of secondary residences. While prices always participate to in

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DREG, they also exhibit a link with another factor here. Littoral departments are the only case for which a price effect is detected without being associated with the DREG. However, overestimation has to be contained, with the explained variance being only 17 percent. This factor puts the Mediterranean departments of the Sun Belt in opposition to the northern ones.

e. Border departments

The border departments constitute the last group. Several elements are positioned in the Z_3 area. They correspond to littoral or metropolitan departments, but there is also a specific sub-group bordering the Italian and Swiss frontiers near Geneva. This positive effect does not exist for the German frontier, at least at the departmental scale. It is also possible to find elements in Z_1. A border is not by itself insurance against aging wealth losses.

While the first factor is once more the DREG (47 percent), things are different for the second one. It still corresponds to a cluster of economic variables, but here the combination changes. The MMASR points to the small or medium departments in terms of population and GDP, with a positive net migration, a low unemployment rate, and a high percentage of secondary residences. Its positive examples belong to the sub-group close to Geneva mentioned above and have to be interpreted in terms of the economic activity generated by the border. However, the range of the border effect is generally small—less than 30 km—and is therefore not enough to affect a whole department. The MMASR economic model is in fact completed by the touristic activity and the winter sports, as suggested by the presence of secondary residences. The third factor also corresponds to the secondary residences but this time on the Mediterranean littoral, as exemplified by the Alpes-Maritimes and the Pyrénées-Orientales departments.

5. To what extent does the demography-price wealth circulation correspond to others logics?

In this last section, we discuss the similarities and differences of the demography-price logic with other factors. For each case, an indicator is used to classify the departments into thirds and to compare them with the Z_1, Z_2, and Z_3 groups (cf. figure 3).

a. <u>A size effect?</u>

The correspondence between value circulation caused by aging and the population size is good (Figure 3A). Almost all of the Z_1 departments have a small population, whereas all of the populated departments belong to Z_2 or Z_3. In other words, the aging shock tends to amplify the disparities between dense and sparse departments by means of their wealth evolutions. However, a few exceptions exist with small departments, where the wealth evolution is strongly positive. These singularities can be explained either by proximity to an important metropole (Toulouse for Tarn-et-Garonne) or by the concentration of industrial districts in a Marshallian perspective (Hautes-Alpes).

b. <u>A gentrification effect?</u>

Gentrification—namely, the substitution of low-income populations by middle or upper-classes—is a well-known subject in the urban literature (Meligrana and Skaburskis 2005 for Canada, Boterman et al. 2010 for Amsterdam, Pattaroni et al. 2012 for Paris, Boschma and Fritsch 2009 for Europe, etc.). Hochstenbach and Boterman (2017) studied its intergenerational determinants. A ratio based on the socio-professional categories was computed to measure it.[8]

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[8] The ratio of farmers, artisans, merchants, entrepreneurs, employees, and workers to executives and intermediate and higher intellectual professions.

Here, the correspondence is also strong: lowly gentrified departments belong to Z_1 or Z_2, while highly gentrified departments in general belong to Z_3 (Figure 3B). This means that middle and upper classes tend to avoid wealth losses due to the aging process, whereas departments with numerous people in the less privileged classes tend to overpay wealth losses. The exceptions— the lowly gentrified departments avoiding wealth losses—are quite similar to the previous case (Landes, Aude, and Tarn-et-Garonne). The littoral department of Vendée is also an exception, with its entrepreneurship culture, its dynamic industrial sector, and the proximity of a metropole (Nantes).

Globally, regarding size and gentrification, the anomalies can be easily explained by the littoral and border aspects, the metropole effects, and a few additional agricultural or industrial local specificities. Another point deserves a comment: while the urban literature documents the gentrification process at the intraurban scale, it is interesting to remark that it would also act at a wider scale.

c. <u>An unemployment effect?</u>

The link between housing and the labor market has drawn attention in recent years, particularly with the idea of "house lock," whether in relation with mobility (Valetta (2013)), unemployment risk (Jansson 2017), public housing (Dujardin and Goffette-Nagot 2009), or self-employment (Reuschke 2016). Regarding the present article, is it possible to find a relationship between value circulation caused by aging and unemployment?

The previous results relative to the UNPREM have already given some indications. For all of the segmentations, this factor was never correlated to the DREG factor and was always second most important. Given this orthogonality, it is no surprise that figure 3C exhibits no clear relation. In each area, Z_1, Z_2 or Z_3, it is possible to find departments with low, medium, and high

unemployment rates. The map comparison is also eloquent. All of the cases are possible; some

regions can benefit from a good price-demography dynamic with low unemployment (the

northwest area), while others can have negative trends accumulate ("Centre" region). But it is

also possible to find examples with a good price–demography dynamic and an important

unemployment rate (Mediterranean departments, especially the western departments), or a bad

price–demography dynamic but a low level of unemployment (the south center area). As a

consequence, the use of unemployment level to drive a policy to spatially redistribute wealth

would be misleading. The wealth circulation caused by the aging shock and the one caused the

labor market are two distinct problems.

d. <u>An affordable effect?</u>

Literature about housing affordability is multifaceted (Linneman 1992; Skaburskis 2004;

Hughes 1991; Yates 2011), and there is clearly not a single way to assess it (Jing 2014).

However, as most of the definitions focus on the relationship between housing expenditure and

household income (Whitehead 1991), it is acceptable to define housing affordability as the

ability of a household to meet its housing need, considering its income, the house prices or rents

levels, and the tenure choice. For the particular case of home buyers, affordability is basically

related to accessibility of homeownership (Yi 2004).

In order to assess housing affordability, an affordability index was constructed at the

departmental level. Two series were used: a price index $Ind_i(t)$ and the borrowing capacity[9] $E_i(t)$

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[9] The calculation of the local borrowing capacity is made with the formula $E_i(t) = \frac{M_i(t)}{r(t)} *$

$\left[1 - (1 + r(t))^{-D(t)}\right]$. This formula gives, for a fixed-rate mortgage, the borrowing amount associated with

a monthly payment $M_i(t)$ for an interest rate $r(t)$ and a duration $D(t)$. The rate and the duration are constant

for the average household in the department "i." Both were normalized at 100 for the year 2010. The affordability index is the ratio between $E_i(t)$ and the price index $Ind_i(t)$.

$$Aff(t) = \frac{E_i(t)}{Ind_i(t)} \ (3)$$

If the borrowing capacity increases faster than the price, the index also increases; housing becomes more affordable. If the borrowing capacity increases less compared to the price or even decreases, the index falls; housing becomes less affordable. Figure 3D represents the affordability variations between 2010 and 2013.

As expected, the affordability worsened in general for the departments in Z_3, especially when aging is reduced. Conversely, in Z_1, the real estate purchasing capacity evolutions were favorable or intermediate. If a correspondence existed, however, it was less clear compared to the correspondences with size or gentrification, and the exceptions were more frequent. Thereby, three departments in the "Centre" region (Cantal, Aveyron, Allier) simultaneously presented a bad price–demography dynamic and affordability deteriorations. In other words, purchasing become more difficult for its inhabitants,[10] and prices are expected to decrease in the long run. These situations would deserve to be considered carefully by the public policies. On the other side, it is possible to find departments where the long-term price-demography dynamic is

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across the departments because the series are not available at this level on a regular basis. This simplification is acceptable because rates and mortgage duration are quite homogeneous between regions in France. The monthly local payment is deduced from the departmental median household revenue multiplied by 30%. Banks generally do not allow households to obtain loans that involve more than 30% of their income in France.

[10] In these departments, the property exchange rate is also low, with inheritances playing an important role.

positive and where the affordability evolutions are also positive, paradoxically. These situations can be explained from a diffusion perspective. By themselves, they do not have the best features, but all are close to departments with these good features: either a metropole proximity (Eure-et-Loire, Maine-et-Loire) or a metropole proximity reinforced by a littoral dynamic (Aude, Pyrénées-Orientales). In the southeast, a group of five contiguous departments (Vaucluse, Drome, Isere, Hautes-Alpes, Gard) simultaneously benefits of the metropoles, the littoral areas, and the border proximities.

6. Conclusion

Starting from a life-cycle approach for individuals, this article documents the leading structural role of the wealth shifts caused by the elder boom for the ongoing spatial reshaping in France. The spatial manifestations of the current meltdown are strongly heterogeneous; for some departments, the wealth losses are amplified, while others have taken advantage of it. It benefits the Parisian region, the metropoles, the Atlantic and Mediterranean littoral areas, and almost all the southeastern departments. It also tends to intensify the existing contrasts, in particular to the detriment of the sparsely populated departments, those in the center and northeast, and those of the far east of the extended Parisian region compared to their western equivalents.

Being a metropole is clearly the main insurance against important wealth losses, even though it is not a guarantee to automatically benefit the most of this implicit wealth reallocation. For the non-metropolitan departments, a combination of second-order factors is required to locally reverse the meltdown, including proximity to a metropole, littoral areas eligible for Sun Belt dynamics, proximity to a border, existence of an important touristic activity, and the

presence of Marshallian districts. However, none of these single factors is enough by itself to reverse the trend.

Gentrification is a direct and emblematic avatar of this change and, as a result, has to be considered as a long-term and structural phenomenon. We found that the middle or upper classes tend to avoid wealth losses, while departments with numerous workers and employees tend to overpay them. Further studies are required to better understand how gentrification can be the consequence of the elder-boom breaking point. The preceding rise of the housing prices induced by the demand of the numerous future retirees, combined with the fact that the middle and upper classes are then the only potential buyers at these high price levels, is likely the missing key.

Regarding the economic and cyclical variables, they appear to be relatively independent of this shift and of secondary importance—with the exception of the metropoles, where the magnitude of the economic factor is almost equal to the magnitude of the demographic factor. If the structural and cyclical dynamics can accumulate, there is no case where a bad structural dynamic is compensated for a good cyclical dynamic. As a consequence, unemployment is not a relevant indicator to track this contemporary reshaping. Using it for a public policy to counterbalance the negative effects would be misleading. It would result in ignoring territories and people being strongly hit by the phenomenon.

To conclude, it is important to underline that this modification in the wealth circulation across generations due to the elder boom is also a spatial modification that carries consequences for the local territories. The redistribution between departments can be spontaneous, through the tourism industry or local diffusion processes. However, not all the disadvantaged departments benefit from these corrective mechanisms. This issue calls for national and European involvements to limit the drawbacks and to manage these changes in a globally relevant way.

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Table 1A: Panel Regression Models for Apartments and Houses

	Apartments		Houses	
	Model with D(LN(OLDDEP))	Model with D(OLDDEP)	Model with D(LN(OLDDEP))	Model with D(OLDDEP)
REV	0.61***	0.55***	0.73***	0.69***
TOTPOP	5.11***	4.79***	4.55***	4.34***
OLDDEP	-1.77***	-3.75***	-1.93***	-3.97***
DIV	0.29***	0.28***	0.27***	0.27***
OFF	0.02***	0.02***	0.13***	0.12***
TEG	0.01 (n.s.)	0.02 (n.s.)	0.12 (n.s.)	0.10 (n.s.)
Adjusted R^2	44%	45%	62%	62%

Note: Panel models for apartments and houses prices. 2000 to 2013. Annual frequency.
[*]$p < .10$
[**]$p < .05$
[***]$p < .01$

Table 1B: Variables and Databases

Variables	Source
	Notarial databases, INSEE
Collective and individual new housing constructions (OFFAPP / OFFMAI)	Sit@del
Total GDP (2013)	Oxford Economic
Household annual income (REV)	Direction générale des finances publiques
Mortgage interest rates (national level, TEG)	CSA
Percentage of secondary residences (2013)	INSEE
Percentage of vacant residences (2013)	
Rate of ownerships (2013)	
Poverty rate (2013)	
Ratio of total income received by the 20% of the richest individuals, to the 20% of the poorest individuals (2011)	
Unemployment rate (2013)	
Ratio of the high socio-professional categories to the lower socio-professional categories (2013)	
Total population (TPOP)	
Ageing ratio (OLDDEP)	
Migratory balance (2012)	
Divorce rate (national level, DIV)	

Note: All of the variables are at the departmental level, except TEG and REV (national level).

Table 2: Principal Component Analyses

Axis	Axis characterization	Explained variance (%)	Positive example	Negative example
	Full set of departments less the extended Parisian region			
F1	- **DREG**	50%	Ain, Alpes-Maritimes, Bas-Rhin, Bouches-du-Rhône, Gironde, Haute-Garonne, Haute-Savoie, Hérault, Ille-et-Vilaine, Isère, Loire-Atlantique, Nord, Rhône, Var	Allier, Ariège, Aveyron, Cantal, Creuse, Haute-Marne, Indre, Lot, Lozère, Meuse, Nièvre, Orne
F2	- **UNP**	15%	Bouches-du-Rhône, Nord, Pas-de-Calais	Haute-Savoie, Savoie, Vendée
F3	- High percentage of secondary residences	11%	Aude, Hérault, Pyrénées-Orientales, Var	Côte-d'Or, Haut-Rhin
	Extended Parisian region			
F1	- **DREG** • reduced role of increasing population - Negative net migration	56%	Hauts-de-Seine, Paris, Val-de-Marne	Aisne, Aube, Yonne
F2	- **UNP**	17%	Seine-Saint-Denis	Yvelines
	Departments of the regional capitals (Paris excluded)			

F1	- **DREG**
	  • reduced role of increasing population and vacancy rate
	  • no role of revenue and unequal life standard
		40%	Haute-Garonne, Rhône	Côte d'Or, Loiret

F2	- **UNPREM** - Constant or decreasing population	32%	Bouches-du-Rhône, Nord, Seine-Maritime	Haute-Garonne, Loire-Atlantique
	Littoral departments			

F1	- **DREG**
	  • reduced role of real estate prices, unequal life standard
	  • no role of increasing population, vacancy rate
		37%	Bouches-du-Rhône, Gironde, Loire-Atlantique, Nord	Aude, Côtes-d'Armor, Manche

F2	- **UNPREM**	22%	Aude, Nord, Pas-de-Calais	Loire-Atlantique, Vendée

F3	- High percentage of secondary residences - High house prices	17%	Alpes-Maritimes, Pyrénées-Orientales, Var	Eure
Border departments				
F1	- **DREG**	47%	Alpes-Maritimes, Haute-Garonne, Haute-Savoie	Ardennes, Ariège, Meuse
F2	- **MMASR**	21%	Hautes-Alpes, Haute-Savoie, Savoie	Nord
F3	- High percentage of secondary residences	11%	Alpes-Maritimes, Pyrénées-Orientales	Ain

Note: A positive (negative) example is a department close to the axis and in the same (opposite) direction.

Component	Description
DREG: Demographic, Real Estate, Gentrified	- Important and young population, not affected by ageing, with increasing population - High real estate prices, low vacancy rate, low ownership rate, high level of construction - Rich departments in terms of GDP and revenues - High percentage of executives - Unequal life standard
UNPREM (UNP)	- High unemployment and poverty rate (= **UNP**) - Low average revenues - Equal life standard - Negative or null net migration
MMASR: Medium, Migration, Activity, Secondary residences	- Small or medium population and GDP - Positive net migration - Low unemployment - High percentage of secondary residences

Figure 1: Population Data Several Sub-Periods

Figure 1A : 2000 – 2006

Figure 1B : 2007 – 2013

Figure 1C : 2010 – 2013

Figure 1D : 2015 – 2025
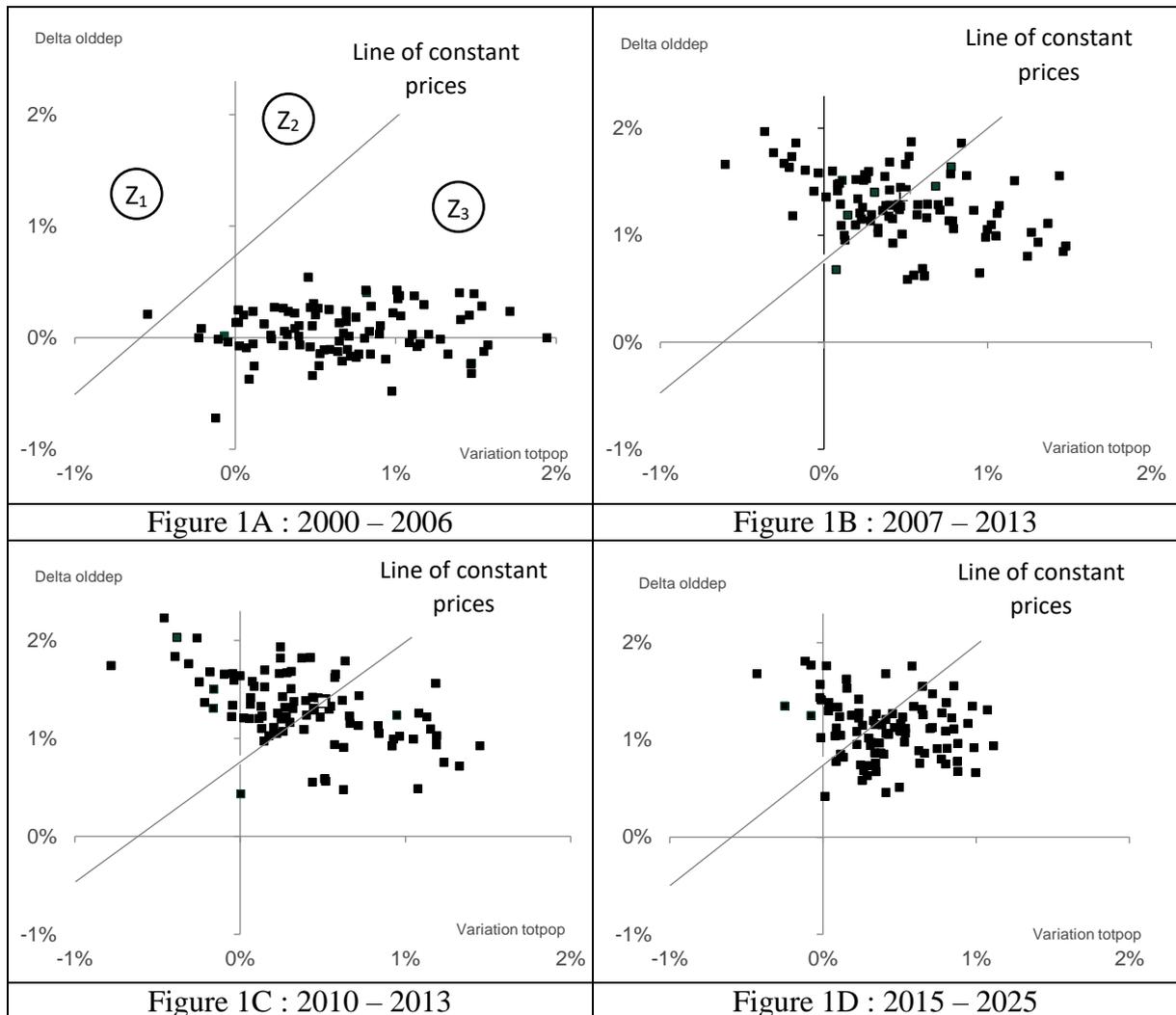
Figure 1. Population data for several sub-periods. Variations are calculated on an annual basis. Z_1 is the portion on the left of the line and on the left of the horizontal axis. Z_2 corresponds to the portion on the left of the line but on the right of the horizontal axis. Z_3 is on the right side of the line and on the right side of the horizontal axis.

Figure 2: Geography of Demographic-Price Relation

Figure and map 2A : Full set of departments

Figure and map 2B : Extended Parisian region

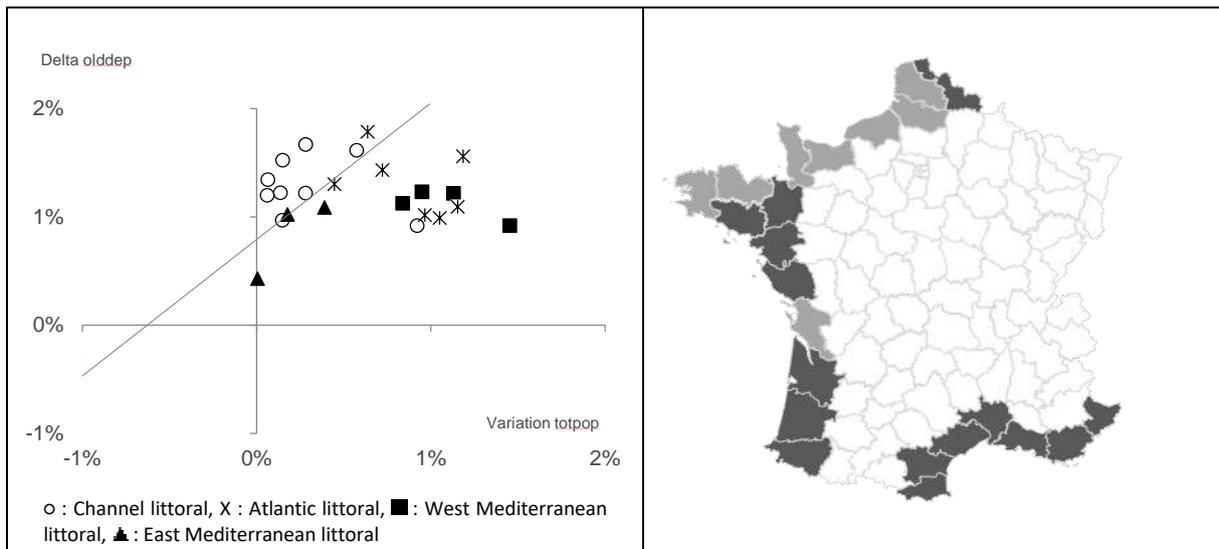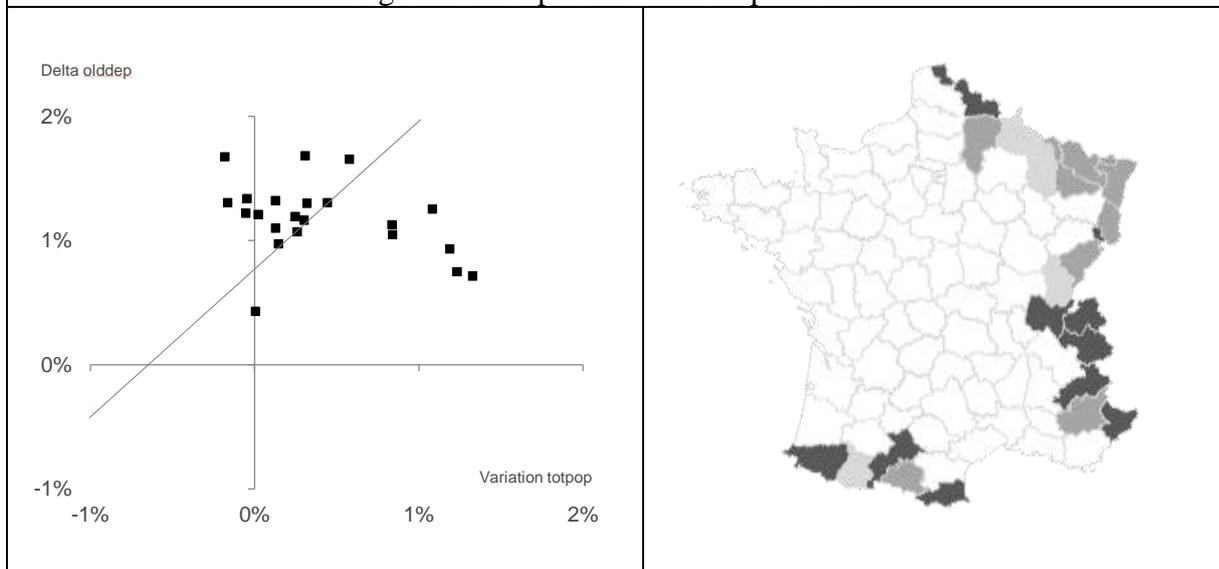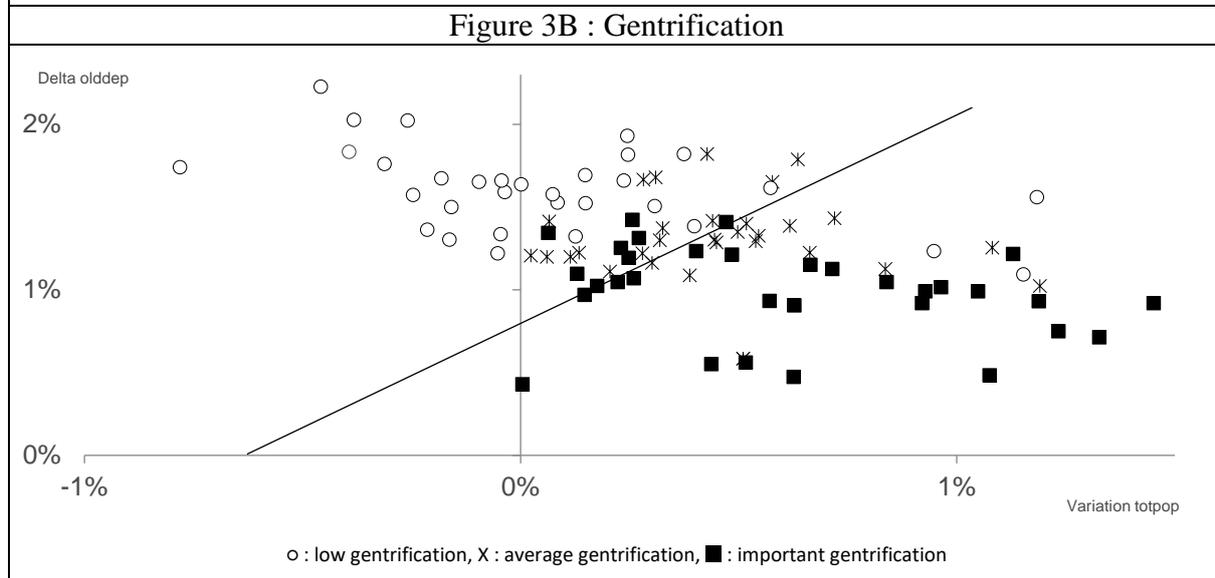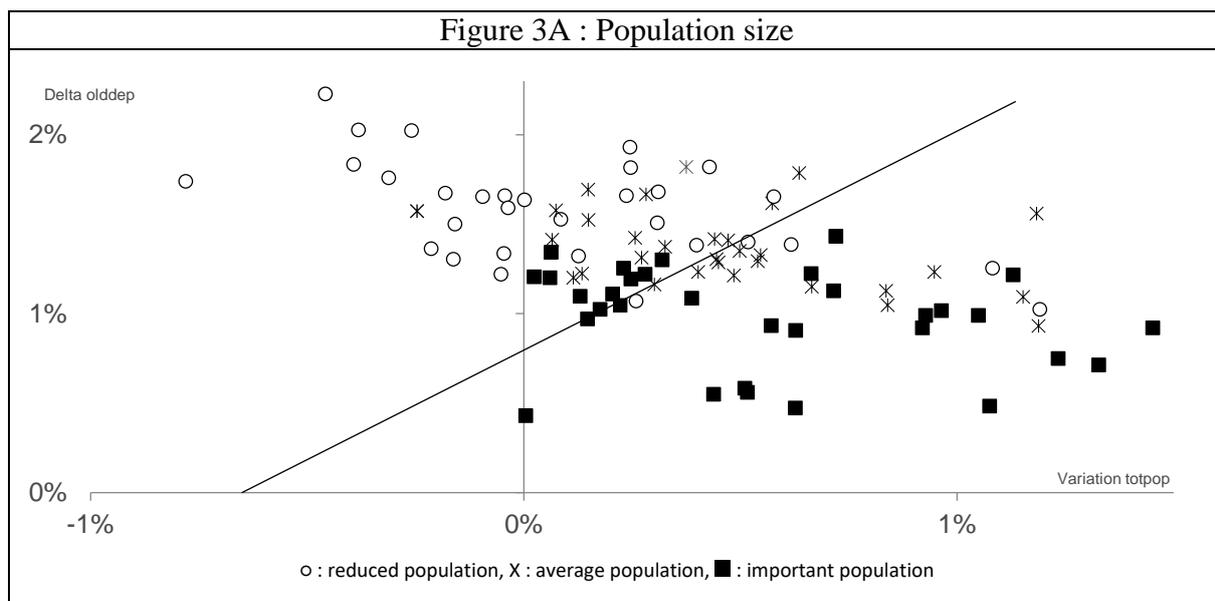| Figure and map 2C : Departments with regional capital metropoles |
|---|

Figure and map 2D : Littoral departments
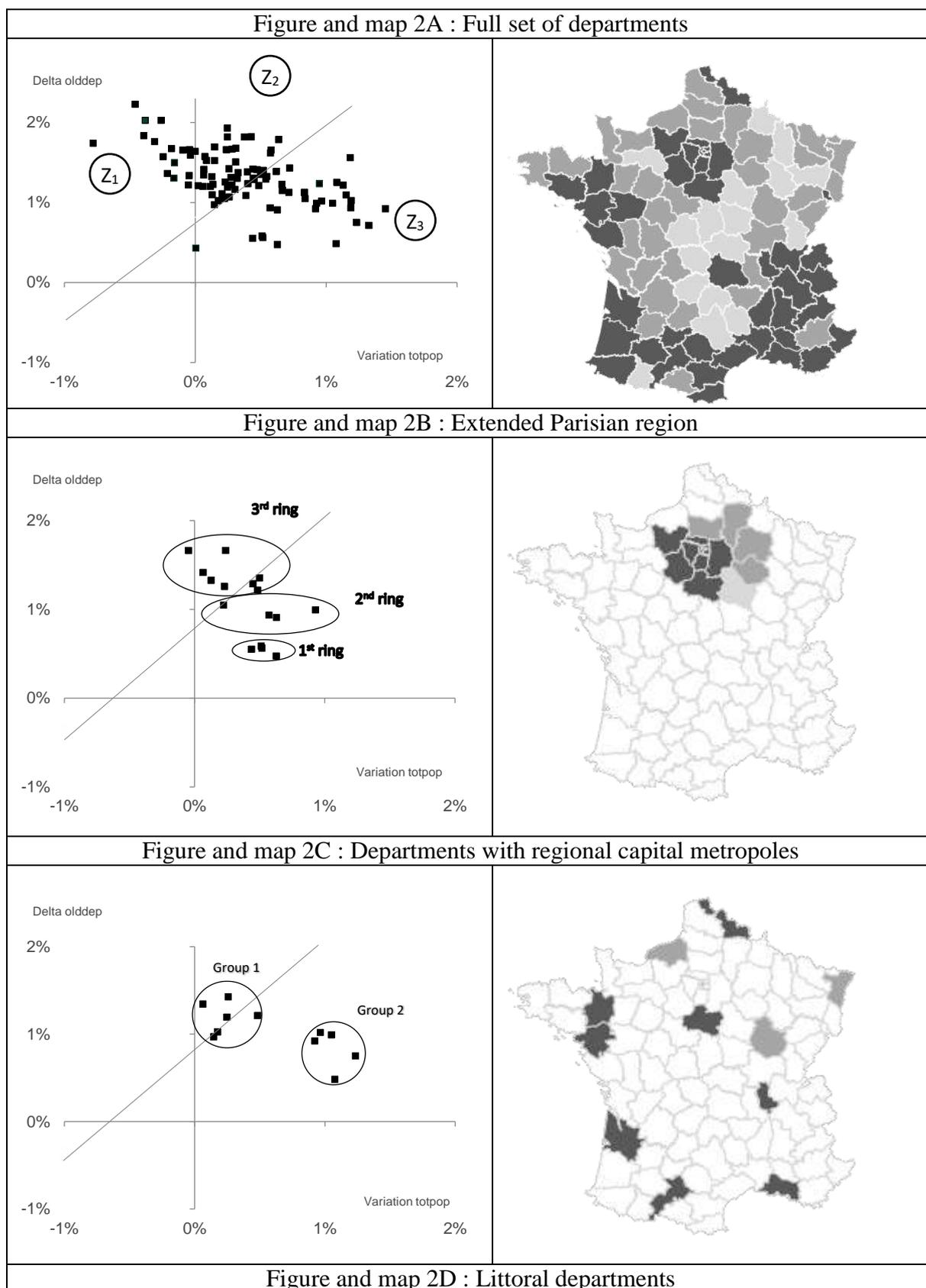
Figure and map 2E : Border departments

o : Channel littoral, X : Atlantic littoral, ■ : West Mediterranean littoral, ▲ : East Mediterranean littoral
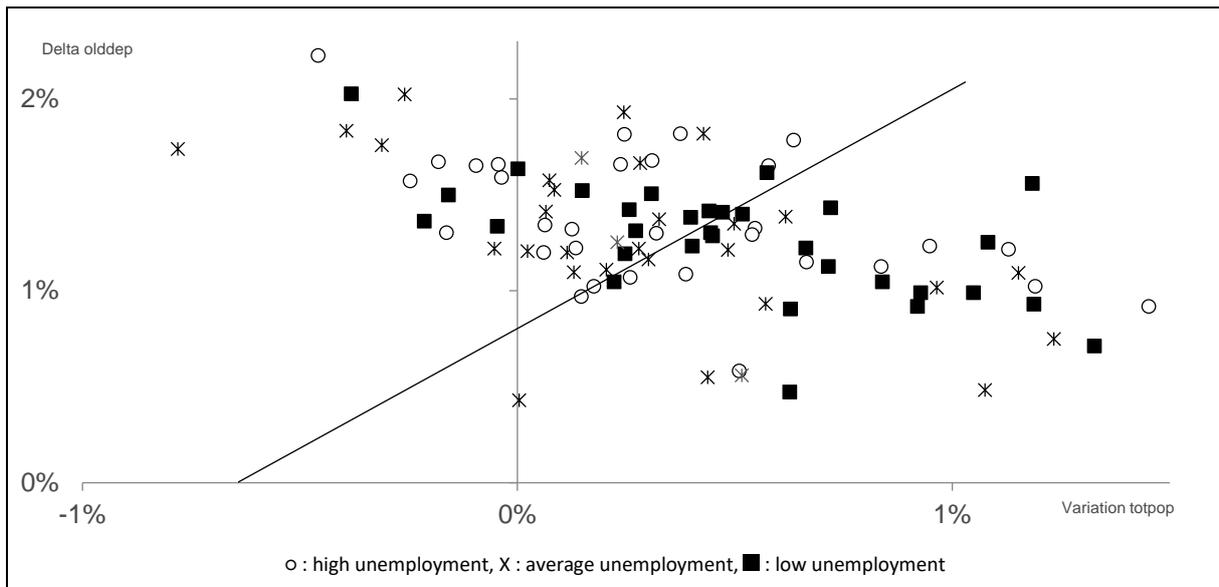
Figure 2. Geography of demographic–price relationship. The variations are calculated on an annual basis. The colors in maps represent Z_1 (dark), Z_2 (medium), and Z_3 (light). White is for out-of-sample units.

Figure 3: Comparison with others geographies

Figure 3A : Population size

Delta olddep

Variation totpop

o : reduced population, X : average population, ■ : important population

Figure 3B : Gentrification

Delta olddep

Variation totpop

o : low gentrification, X : average gentrification, ■ : important gentrification

Figure 3C : Unemployment

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o : high unemployment, X : average unemployment, ■ : low unemployment

Price-demography segmentation	Unemployment segmentation

Figure 3D : Affordability

o : low affordability, X : average affordability, ■ : high affordability
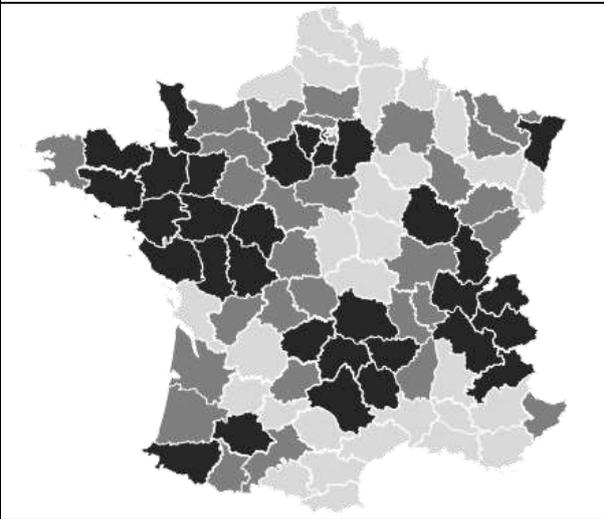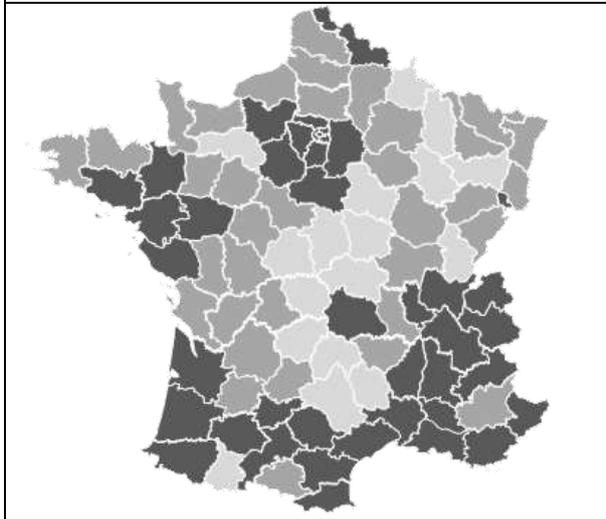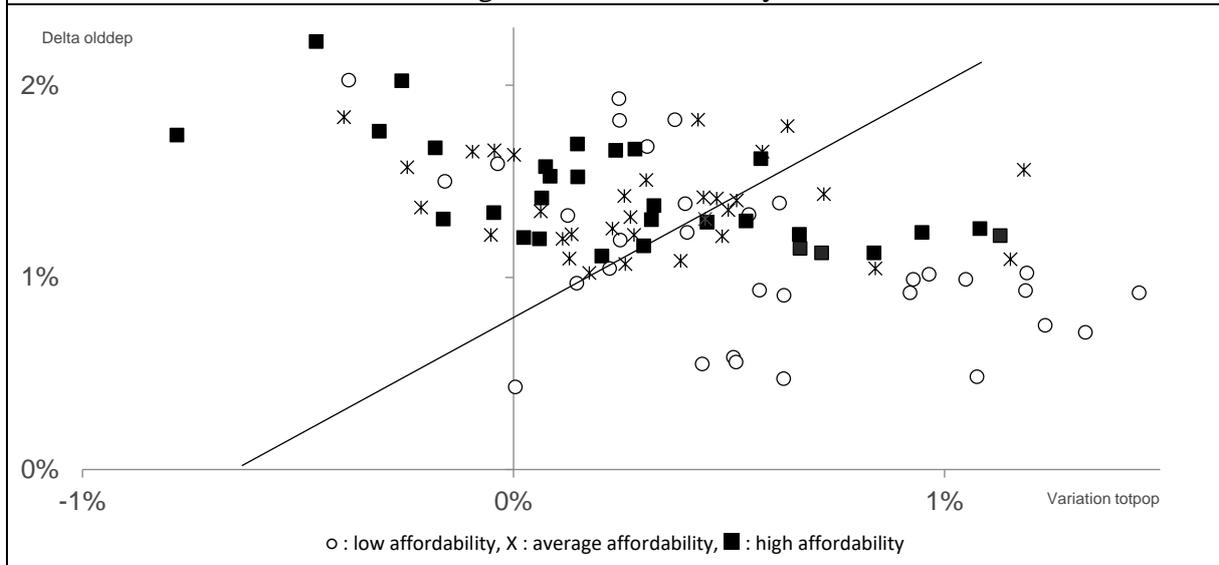
Figure 3. Comparison with other geographies. In each case, the 94 departments are split into three groups of the same size according to the mentioned factor; Population size, gentrification, unemployment, and housing affordability.