Promoting Social Housing : Insights from Redevelopment Policies in Paris

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Abstract

The issue of income segregation plagues numerous cities, and in particular Paris which is studied here. To mitigate this problem, the local government has implemented redevelopment policies that increase incentives to convert offices and other commercial units into moderate-rent dwellings in high-demand areas. We find that these policies have mixed effects. Only the most restrictive law significantly stimulates the conversion of social housing in the city center, but none of these policies have an impact on social diversity.

JEL Classification: R12, R20, R52.

Key Words: Neighborhoods, Real Estate Demand, Redevelopment Supply, Gentrification

1 Introduction

Income seggregation is a significant problem in many cities in the world leading to unequal access to employment, education, healthcare, and other important resources and opportunities. Housing scarcity in high-demand areas is one of the cause of this

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social phenomenom, that has for instance led the movement of YIMBY (*Yes In My Back Yard*) in the U.S. to support more private and public housing (Dougherty, 2020).

In this study, we investigate a range of urban regulations in Paris, where the YIMBY label is not used, but where the arrival in power of a socialist mayor, and its re-election in 2008, was in part driven by the same narrative of ensuring affordable housing in Paris.[1] Indeed, Paris has a long history of concentrating a disproportionately high level of wealth in its center compared to its metropolitan area and the rest of France.[2] To combat this long-term trend, several laws have been voted in the past decade, including rent control[3] and a steady increase in the minimum quota of social housing, hereafter called HLM (*Habitations à Loyer Modéré* which means moderate rent dwellings).[4] Beside these standard policies, the city of Paris has passed in 2009 a new act regarding the conversion of Offices and Commercial use (hereafter denoted OC)[5] into housing which fosters redevelopment of private housing or of public dwelling. More precisely, three laws have been voted in 2009, 2011 and 2014 under the same principle that one square meter of private housing redeveloped for OC should be compensated by the redevelopment of two square meters of OC unit into private housing. There is however one important exception to this rule, if the conversion goes to the redevelopment of public dwelling (and not private), then the compensated surface should be identical to (only) the initial change (1:1 rule). This offers a distinct economic benefit for the redevelopment of social housing, and through this channel, the housing composition of Paris may gradually shift. In the spatial context of Paris, where construction of new buildings are limited, redevelopment already represents the lion share of the supply of social dwelling (more than 80% in the center of Paris).

Additionally, these regulations support environmental objectives by targeting market failures that ignore the ecological impacts of unoccupied spaces in densely populated cities. These unoccupied OCs and/or private housing contribute to urban

[1] The website of the candidate and future mayor, Bertrand Delanoë, is no longer online but can be accessed via waybackmachine. One of its main campaign promise in 2008 was the building of 40,000 additional social housing units in the capital over the period 2008-2014.

[2] According to Piketty et al. (2006), just before the World War I, the estates of Paris decedents made up over 26 percent of the French total.

[3] Rents were regulated in Paris discontinuously between 2015 and 2017 and have been regulated again since 2019

[4] HLM are intended to provide housing for disadvantaged or low-income people. They are are owned by specific entities, private or public.

[5] Shops but also warehouses, restaurants, hotels, cinema, etc. The full list is defined by Art R151-28

sprawl and then to the artificialization of soil, energy inefficiency from dispersed single-family homes, and high CO2 emissions from commuting (Blaudin de The et al., 2021; Castells-Quintana et al., 2021). Furthermore, compared to new construction projects that heavily rely on materials like concrete and steel, which produce significant greenhouse gas emissions, redeveloping existing structures is more environmentally sustainable (Rock et al., 2020). It thus seems interesting to analyze whether these redevelopment policies can have a significant role, at least concerning their basic goal to foster public dwellings.

We find that these three regulations have significantly increased the social housing conversions. However, the subtle differences between these laws have had different spatial effect making them more or less efficient to impulse more social diversity. For instance, the 2009 regulation, which was the most restrictive since it imposed compensation within each district, succeed to foster the redevelopment of public dwellings in the center of Paris. In contrast, the 2011 law, and to a lesser extent the 2014 law, were less restrictive in high-demand area because the compensation could be done in other districts.[6] We show that this relaxation of the spatial constraint increased the redevelopment of social housing at the periphery but not in the center, where the concentration of the richest population is the most deeply rooted. In support of this result, our research indicates that these laws have exerted no significant influence on social diversity as measured by occupation.

Our paper contributes to a large literature on the effects of local regulations on the supply of housing in general (Turner et al., 2014, Gyourko and Molloy, 2015, and Glaeser and Gyourko, 2018) and in public dwelling in particular. In the U.S., public housing development is no longer a major policy objective (replaced by housing vouchers), and in several cities, plans for demolition have been implemented. Several studies have then analyzed the effects of these demolitions on income and racial segregation (Almagro et al., 2023, Chyn, 2018, Jacob, 2004).

In France, much of the research has focused on the consequences of the Solidarity and Urban Renewal act[7] that aimed to foster the building of public housing in cities

[6]For instance, an investor that want to transform x square meters of private housing in OC (including short-term rentals) at the foot of the Eiffel Tower, could compensate by converting x square meters of offices into public dwelling at the periphery of the compensation area.

[7]Since the Solidarity and Urban Renewal (SRU) law ("loi de solidarité et renouvellement urbain") of 2000, a minimum quota of social housing per municipality has been established: social housing should represent at least 20% of the total stock of housing. Municipalities under the quota are required to build affordable housing, or be subjected to penalties. In 2018, the Elan's act ("Evolution du Logement, de l'Aménagement et du Numérique") has both increased this minimum rate and the

where this supply was scarce (Gobillon and Vignolles, 2016, Beaubrun-Diant and Maury, 2022, Jaupart, 2020). By analysing the within-municipality segregation effect of this law, over the 1998-2008 period, Chapelle et al. (2022) find a significant positive effect on the construction of public dwellings, but little impact on low-income segregation. Our analysis complements these approaches. Instead of focusing on demolition (as in the U.S. case) or construction (as in France), we analyze the redevelopment of public housing from commercial units. To our knowledge, there is no article concerning redevelopment toward public housing. Most of the literature has focused either on office conversion toward private housing or on Airbnb's laws that limit redevelopment for short-term rentals. For instance Beauregard (2005) analyzes how office conversion in private housing have changed the lower Manhattan after the New York City's revitalisation plan. Cheshire and Kaimakamis (2021) analyse a new british regulation implemented in 2013 that provides an automatic right to convert offices to residential use. They find a statistically significant increase in value of buildings that became entitled to convertion (a 50% premium for these offices). The regulation of conversion into housing for short-term rentals has been studied by Robertson et al., 2023, they find that this policy has reduced the number of Airbnb rentals in Bordeaux by a significant number of 316 rented days per month per district on average. We share with this literature a similar empirical strategy based on regression by discontinuity and synthetic difference-in-differences but we study a very different type of redevelopment.

Section 2 presents the different laws and the historical urban background in Paris. Our empirical analysis is divided in two parts, in Section 3 we analyse the effect of the laws at the border of the compensation area and in Section 4 in its center. In Section 5 we analyse the impact of these laws on seggregation by occupation. The last Section concludes.

2 Background

2.1 Growth of redevelopments toward housing

The basic idea of these laws is that the redevelopment of housing into commercial units and offices (OC) in areas with high market potential should encourage similar

penalities.

redevelopment in less dynamic neighborhoods. Such a policy is feasible only if there is sufficient OC available for these types of redevelopment. This assumption, often made by medias and politicians, is based on the number of vacant commercial and office spaces, which is considered as an indicator of the potential for conversion. For instance, it has been highlighted in the media that the Paris region (Ile-de-France) has around 4.5 million m² of office space available, leading to a simple calculation that "based on an average surface area of 75 m² per home, vacant offices represent a theoretical potential of 60,000 homes in the Paris region".[8] However, not only do these figures overestimate the region's redevelopment potential, but they also do not represent the situation in inner Paris, where vacancy rates are much lower.

If we analyze the total number of redevelopments into housing (both private and public) in central Paris as shown in Table (1), considering both the compensation area where the policy has been enforced and the rest of the Parisian region,[9] we indeed observe smaller numbers. However, the total number of redevelopments is significant, representing 76,293 conversions of OC in housing *over the whole period* (2006-2019). Table (1) also reveals at least two interesting stylized facts. First, the number of redevelopments has increased rapidly over the past decade. Starting from 2,571 between 2006 and 2008, the numbers rose to 14,203 after 2014 in the reinforced area and 24,514 outside this area. Second, the period between 2009 and 2011 appears atypical since a relative slowdown in redevelopment is noticeable particularly outside the reinforced area.

Table 1: Number of conversions toward private and public housing

	Inside the reinforced area	Outside the reinforced area
Between 2006 and 2009	2571	6360
Between 2009 and 2011	2142	4248
Between 2011 and 2014	8184	14071
Between 2014 and 2019	14203	24514

2.2 Price and share of private and social housings

After describing the rise in housing redevelopment, it might be interesting to analyze the differing costs of redeveloping an OC into either private or public housing.

[8] See for instance l'Institut Paris Region

[9] The area considered here as "outside the reinforced area" is the area defined as control in Section 4.

In this study, we do not analyze the costs associated with purchasing commercial space, and reselling it as private/social housing, due to a lack of data concerning conversion costs. However, we do have data on the selling prices per square meter for properties converted to either private or social housing from 2011 to 2019.[10] This data allows us to briefly discuss how expensive the housing market for redevelopment in Paris is.

Figure 1: Average price of housing redeveloped (Euro per m², 2011-2019)

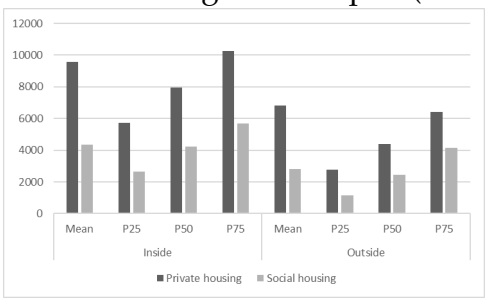


Figure (1) depicts the difference in square-meter price between social and private housing both inside and outside the compensation area. The first observation is that the prices for both social and private housing are higher inside the compensation area than outside. The difference between social and private housing are smaller outside this area but remain important. For instance, the price of private housing at the top of the distribution (75th percentile) is much higher inside this area than outside (above 10,000 €/m² versus 6,000 €/m²). In contrast, the variation in social housing prices is smaller between the two zones (4,000 to 5,600 €/m² for the 75th percentile). However, we still have a higher price for private housing which is quite significant (between 1500 €/m² to 2000 €/m²). These elements indicate that, without considering the cost of compensation laws, it seems always more profitable to redevelop properties into private housing rather than social housing, particularly inside the compensation area.

This immediately raises a question: what is the share of redevelopment that effectively goes toward social housing? To address this question, we have data prior to 2011. Observations between 2006 and 2008 in Table 2 show that the share of properties redeveloped into social housing was almost non-existent inside the compensation area, representing only 0.35% of the total. However, in 2009, the year when the first compensation law was enacted, this share increased to a level never seen before,

[10]For each kind of housing, we analyse conversion occuring during the same year.

reaching 8% of the total. Conversely, outside the compensation area, this share fell from 6% to 3%. In contrast, between 2012 and 2014 and after 2014, we observed more balanced growth.

Table 2: Share of social housing in the total of housing redeveloped (%)

	Inside the reinforced area	Outside the reinforced area
Between 2006 and 2009	0.35	6.34
Between 2009 and 2011	8.64	3.27
Between 2011 and 2014	2.66	6.53
Between 2014 and 2019	3.28	4.55

To understand these changes, we must analyze how the laws of 2009, 2011, and 2014 differ. However, before analyzing these details, it may be interesting to discuss the share of social housing that comes from redevelopment in comparison to new construction. After all, if new construction represents the main channel for providing social housing, then our analysis of redevelopment might seem secondary. This is not the case.

According to APUR,[11] new construction accounted for 45% of the total number of HLM (Habitations à Loyer Modéré) created between 2001 and 2021. These aggregate numbers indirectly suggest that redevelopments are significant. However, their importance becomes even more apparent when examining the differences inside and outside the compensation area. Indeed inside the compensation area, the creation of new buildings for housing are extremely low and redevelopment takes the lion share of the total accounting for 82.75% of all the HLM provided on average over our period of analysis (2006-2019). Table (3) presents the details for different periods showing that the share of new HLM coming from redevelopment vary from 75,4% to 100% inside the reinforced area.

Table 3: Share of social redevelopment in the total supply of social housing (in %)

	Inside the reinforced area	Outside the reinforced area
Between 2006 and 2009	100	67.84
Between 2009 and 2011	92.03	31.51
Between 2011 and 2014	93.56	46.22
Between 2014 and 2019	75.4	20.97

[11] https://www.apur.org/fr/nos-travaux/chiffres-logement-social-paris-2021-edition-2022

2.3 What can be expected from these laws?

The 2009 law

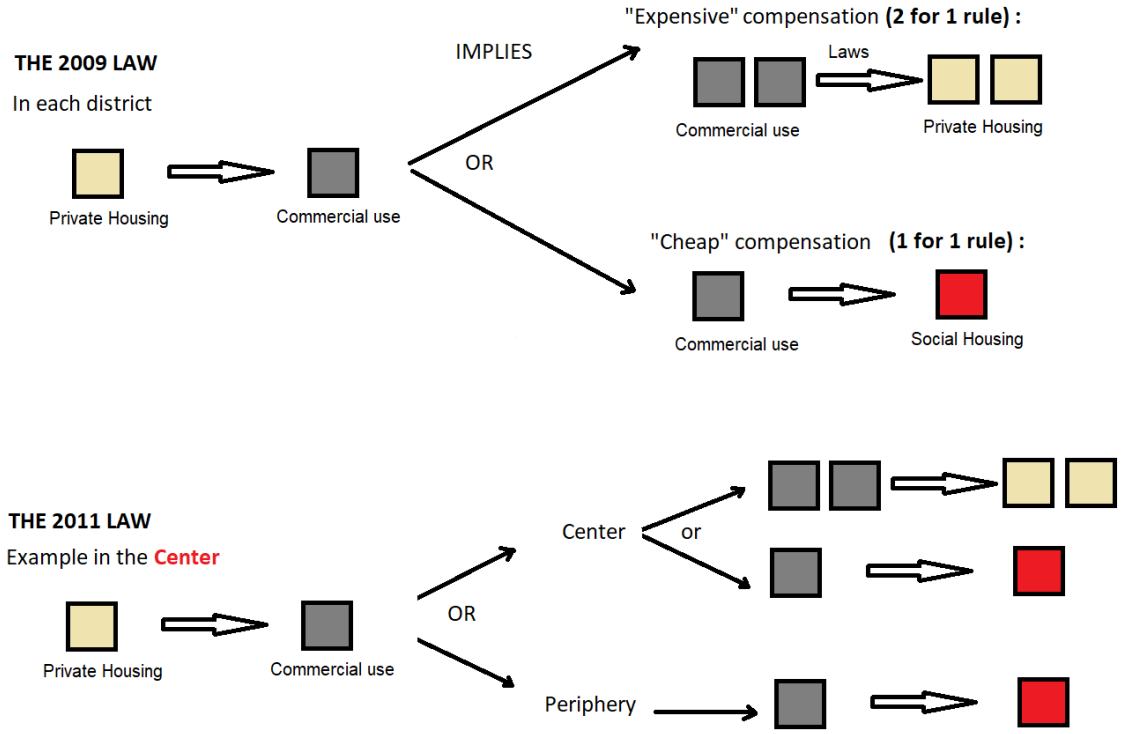
The local regulations studied here are the consequence of a significant change toward decentralization that occurs in 2008 with the law called 'modernization of the economy'. Pursuant to this law, the City of Paris has requested the transfer of jurisdiction from the State concerning the change of use of residential units. In 2009, a compensation zone is created, in which the surface of the private housing converted into commercial use should be doubled in the same administrative unit (called *arrondissement*) where the change of use occurs.

To give an example, a Property Redevelopment Developer (PRD) that changes a building of 300m² of private housing into offices in the city center (e.g. Bourse district) should compensate by buying 600m² of offices (or other comercial premises) there and convert them into residential accommodation. In that case, the law fosters the redevelopment of private housing and reduces the surface of offices.

However, to increase the stock of social housing, the rule of doubling the surface does not apply for HLM. Thus in the previous example, if these 300m² private housing are changed into commercial unit, but with a choice to compensate by the redevelopment of public dwelling, then only 300m² of commercial unit should be converted (and not 600m²). This provides a clear economic advantage for the redevelopment of public housing in comparison to private housing. Figure (2) below summarizes these different changes of use,[12] that may be decomposed into two stages with a *first stage* concerning the choice of commercial redevelopment and the *second one* regarding the compensation chosen.

[12]There is a distinction in the French administrative vocabulary between a "change of use" and a "change of designation/purpose" (called *destination* in French) that concerns for instance a *permanent* change from a commercial premice to a private/public housing or vice-versa. We come back on this definition/explanation with more details in the data section.

Figure 2: Redevelopment under conversion laws



This policy covers various different situations and investors. For instance, beside the previous example, a landlord that converts its housing into a short-term rental is also concerned by the law.

An interesting aspect is that this policy, with its spatial constraint requiring conversion within the same administrative unit, can have vastly different effects depending on the initial demand of redevelopment (first stage). In districts where the growth of redevelopment from housing to commercial unit is strong, such a law introduces an incentive to compensate by redeveloping public dwelling which is always the less costly choice (the redevelopment of private housing requires twice more space). In contrast, in districts where the initial change of use is low, then this regulation may not have significant effect. In other terms, the law introduces a spatial complementarity (in two steps) between the redevelopment of commercial unit (first step) and the one of public dwelling (second step) at the district level. By defining the "periphery" as neighborhoods located on the internal border of the compensation zone, we can summurize this discussion as follows.

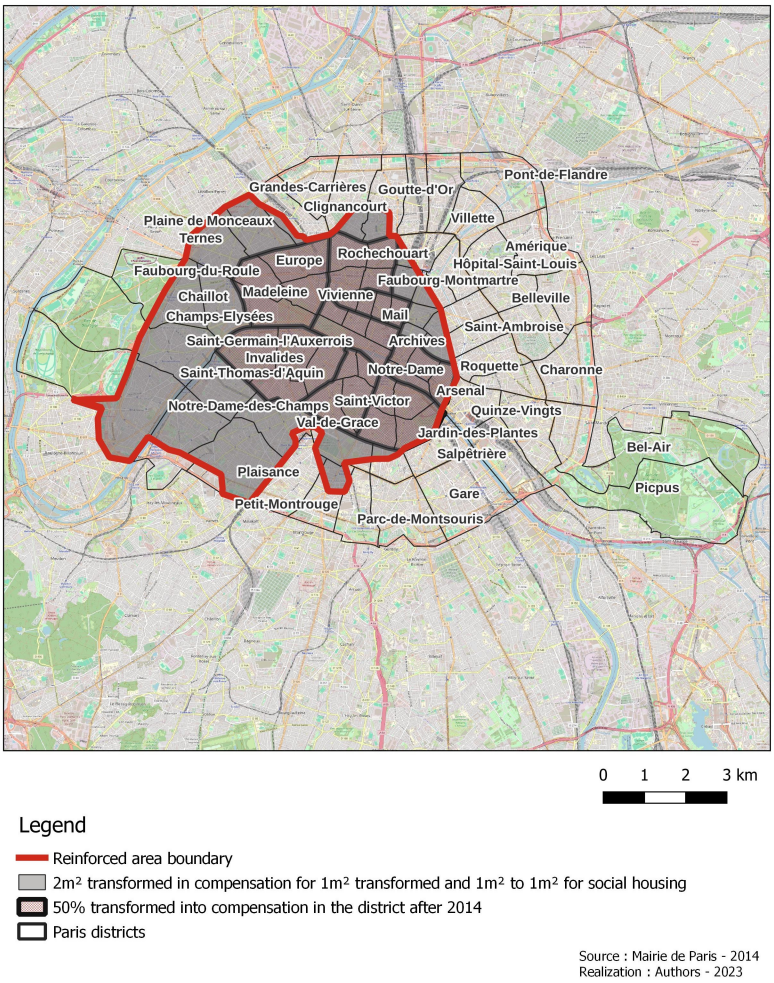
Proposition 1. *Testable Implications (law of 2009). A conversion law that stipulates com-*

pensation in the same district (under the asumptions of a high demand of redevelopment in the center, and a weak demand of redevelopment at the periphery), implies a significant increase in the number of social housing in the center. No significant effect on social housing at the periphery.

Map (3) represents by a red line the compensation zone of this law, also called "reinforced" or "enhanced" area. In Section 3 we are going to define more precisely what we consider as the peripheral neighborhoods at the internal border of this compensation zone, and in Section 4, the districts of the center. For now it simply matters to notice that districts/neighborhoods, which are delimited by a (thin) black line in Map (3), are defined by the "IRIS" classification which is the standard unit for infra-municipal data in France (population generally falls between 1,800 and 5,000). Our study area over the whole of our period, the average population is 2,223 inhabitants for 1,060 units. The average surface area of these IRIS in our area is 11 km².

It is also important to notice that the periphery of the compensation zone does not refer to the outer rings of the Paris metropolitan area. Rather, it is still within the city of Paris and recognized as an area with a shortfall in social and private housing relative to demand.

Figure 3: Compensation Zone



The 2011 and 2014 laws

In 2011, the law is amended to be less restrictive in the center. All the enhanced compensation zone is concerned by the possibility to compensate for public dwelling (i.e. not only in the arrondissement in which the change of use/designation occurs) but not for private housing (in that case doubling the area of private housing to compensate should be done in the same arrondissement). To give an example an owner in the city center that wants to change the use of his dwelling from residential to commercial, for instance to develop short-term rental (e.g. Airbnb), can compensate by converting commercial unit in public housing at the periphery. This simple change in the spatial opportunities to compensate can modify the different incentives. It be-

comes easier now to develop commercial units in the center without compensation there which opens the door to a reduction of public housing in the center. Indeed, since redevelopment of public dwelling is less costly than private housing (requiring half of the space of commercial unit to change) and less costly at the periphery than in the center (see the descriptive statistics of Figure 1), such a law favors public housing at the periphery. Then this new regulation totally reverts the spatial incentive to redevelop HLM. While the 2009 law fosters their redevelopment where the demand of change of use was high (in the center), the 2011 law may stimulate them in places relatively less attractives (namely where the price of revelopment is relatively low).

Proposition 2. *Testable Implications. A conversion law that enables to compensate commercial redevelopment in the center by public dwelling at the periphery implies (under the assumption of a high demand of commercial redevelopment in Core, and a weak one at the Periphery), a significant increase in the redevelopment of social housing at the periphery and no significant effect at the center.*

A new regulation is adopted in 2014 that partially come back to the seminal law of 2009. Eight districts in the center of the city are targeted with a compensation rule establishing that at least 50% of the surface should be compensated there (the eight districts are represented in dark gray in Map 1). The results of the 2014 are thus less clear and perhaps deserve, even more than the other laws, an empirical investigation.

2.4 Data

Change of what?

As described in Figure (2) the compensation laws can affect two stages of redevelopments but here we analyze only the second stage for two reasons. The main one is because we are interested by the redevelopment of social housings (and not redevelopment of OCs), but there is also a technical reason that requires to enter into the French administrative lexicon and to the data available.

The first stage of the compensation law concerns *changes of use*[13] of residential units into OCs. A change of use requires an administrative authorization that is mandatory for the conversion of a residential property. This authorization applies

[13] *Called "changement d'usage" in French.*

on an individual basis and it is temporary. When the landlord moves out or stops business, the procedure is suspended. In Paris, a change of use must be accompanied by a compensation that gives rise to a *change of designation* ("destination" or "attribution" in French[14]) of another unit. More precisely, a change in designation concerns redevelopment of OCs (namely all the conversion of units not intended for residential use) toward residential units (private or social housing). This procedure is attached to the converted unit, it is therefore more definitive and gives rise to a tax change. This is precisely what enables us to study this second stage. The data we use comes from property taxes and takes into account change of designation only.

For instance, an owner that want to rent one room on Airbnb (more than 120 nights in 2014), can make a simple *change of use* of its room from a private to a commercial space, but should compensate by generating a *change of designation* from a commercial unit to a private or public unit. Here we have data on this change of designation, and not on the change of use. To put this differently, we cannot study with our data the changes of use from housing to OCs and we focus our analysis on the changes of designation from OCs to social housing.

Dependent variable

The data used here come from the Land Registry Files provided by CEREMA (Center for Studies and Expertise on Risks, Environment, Mobility, and Spatial Planning).[15] This dataset enables the identification of housing units that have undergone a change of designation, with the date of the last change made (including social housing units). The data used covers the housing stock as of January 1st, 2020, in the departments of Paris, Hauts-de-France, Seine-Saint-Denis, and Val-de-Marne and provides the changes of designation over the period 2006-2019. These files provide the description and geolocation of all buildings and land parcels.

This dataset is exhaustive and provides all the redevelopment of social housing being own by social landlords or by private landlords.

The data are aggregated at the IRIS neighborhood level (often called districts or neighborhoods in what follows) and corresponds to the number of square meters that have undergone a change of designation.

[14]See for instance the urban code planning here and here.

[15]The CEREMA is a public institution responsible for processing files from the DGFiP (Directorate General for Public Finance), which centralizes fiscal information and characteristics of properties in France.

About zeroes (no change in use)

We take into account neighborhoods where no housing units have undergone changes in designation (the value is equal to 0). The choice to keep these neighborhoods in the analyses is justified by the fact that many neighborhoods, particularly in the compensation area before the regulation was put in place, have few square meters converted. For example, in 2006, 87.53% of the neighborhoods in the compensation zone had not undergone changes in use towards social housing, a share that rises to 97.59% in the high-income districts of the 1st, 7th, and 8th arrondissements of Paris. This proportion decreases by 12 percentage points in 2019. These figures show the importance of considering neighborhoods with no transformation. As the goal of this study is to identify the impact of the implementation of compensation rules in Paris, keeping these zeroes enable to observe the evolution of transformations in neighborhoods previously not subject to change of designation (and which are, in fact, implicitly targetted by the different laws).

3 Effects of conversion laws at the dividing line

3.1 Spatial Regression Discontinuity Design in Differences

The simple fact that these laws may have particular effects at the periphery of the compensation zone logically drives the empirical strategy toward a Spatial Regression Discontinuity design (SRD, Keele and Titiunik, 2015). Indeed the housing market and even the carasteristics of neighborhoods are similar on both side of the border (see the black line in Map 4), enabling to defend that the sole difference between districts treated and untreated around the dividing line comes from the law of compensation. Such an assumption is however strong, we cannot rule out that people chose to sort on either side of the borders according to characteristics that we do not control for. This could biased our analysis by creating significant differences between treated and untreated units, or to put it differently, the control group may no longer represents the potential outcome of the treated group if not treated. It is also possible that for each year the compensation law was enforced, other policies have been implemented within the compensation area and not outside this zone. We are not aware of such a possibility, but we may have overlooked it. In that case, the treatment becomes a combination of multiple treatments or interventions that are applied

at the threshold. This potential problem of compound treatments makes less credible the isolation of the causal effect of the compensation law with the SRD strategy (see however Appendix E where we presents the estimates of this SRD strategy).

We thus use a difference in discontinuity (Grembi et al., 2016), hereafter diff-in-disc, that enables to control for multiple treatments and time-invariant factors by time differenciation. Our framework finds its origin in border fixed effects model *à la* Black (1999) and to the geographic difference-in-discontinuities presented by Butts (2021).

We then estimate the following equation:

$$Y_{it} = exp(\lambda_i + \sum_j \beta_j Z_i T_j + \sum_j \varphi_j T_j D_i + \sum_j \gamma_j T_j D_i Z_i + \theta_t + \Gamma_{it})\varepsilon_{it}, \quad (1)$$

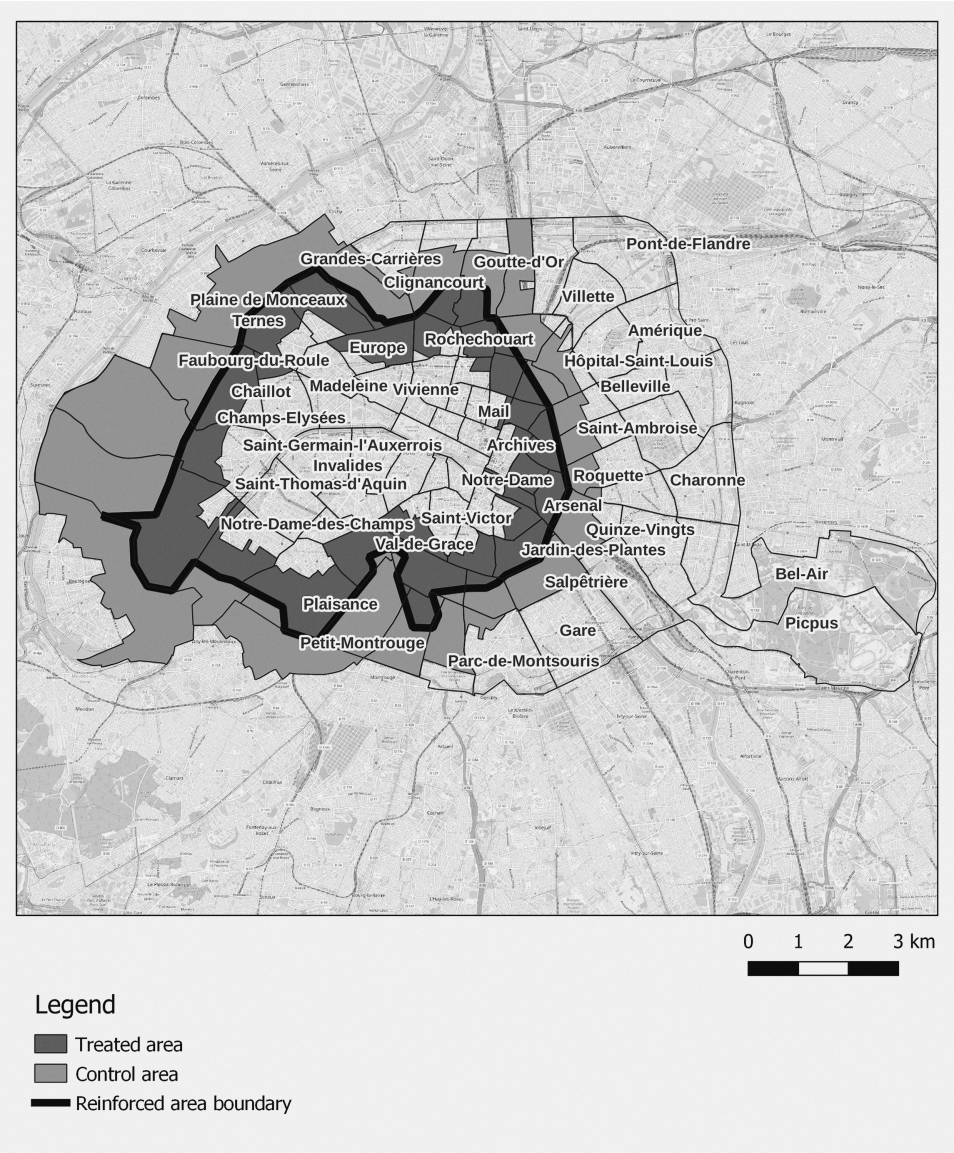
where Y_{it} is the number of square meters of social housing newly created (i.e. resulting from a change of designation) in the neighborhood i at the time t. As explained in the data section, this variable includes neighborhoods with no transformation and then leads us to use the Pseudo Poisson Maximum Likelihood estimator.[16]

This dependent variable is delimited geographically according to a particular distance to the border treatment zone. We have chosen different bandwidths such as $[-300, 300]$, where 300 meters are taken on both side of the limit of the treatment area. We estimate this equation seven time by increasing this spatial window to 100 meters, namely $\{[-300, 300]; ..., [-900, 900]\}$.

Figure 4 presents a example with a bandwidth at [-600,600] for the year 2014. Treated districts are represented in dark gray, the control group is in bright gray.

[16]Similar results are obtained with OLS (without zeroes) in the Online Appendix.

Figure 4: Treated and Control Areas in the Difference in Discontinuity (bandwidth: 600 meters)



T_j is a dummy taking one for each period j implemented and zero before the period, with $j = \{[2009, 2019], [2011, 2019], [2014, 2019]\}$. Then, $T_{[2009,2019]}$ takes one from 2009 to 2019 and zero otherwise, $T_{[2011,2019]}$ equals 1 for 2011 to 2019 and zero otherwise and $T_{[2014,2019]}$ is 1 for 2014 and onwards and zero otherwise. These dummies measure the additional impact of each change in law, always comparing the effects with the pre-intervention trend (before 2009), which exhibits parallel trends. For comparison, if we had changed the dummies by 0 before 2009, 1 between 2009 and 2010, 2 between 2011 and 2013, and 3 between 2014 and 2019, we would have

observed the cumulative effects of each law (we have done this estimation in the online appendix and found that these cumulative effects are, in fact, weak). Here, we are only interested in the additional effect of each law. This is particularly relevant for the 2009 law, since the compensation area defined at that time remained unchanged until the end of the period. The 2011 and 2014 laws only changed the rules of compensation within this area.

Z_i a binary variable taking one for treated housing inside the compensation zone and zero for housing in the control group outside this zone. These two zones are obviously defined spatially by the different bandwidth. D_i is the distance between the district (IRIS) and the border treatment zone. λ_i and θ_t are repectively individual fixed and time effects. Γ_{it} is the vector of controls discussed in the theoretical model and described in the data section.

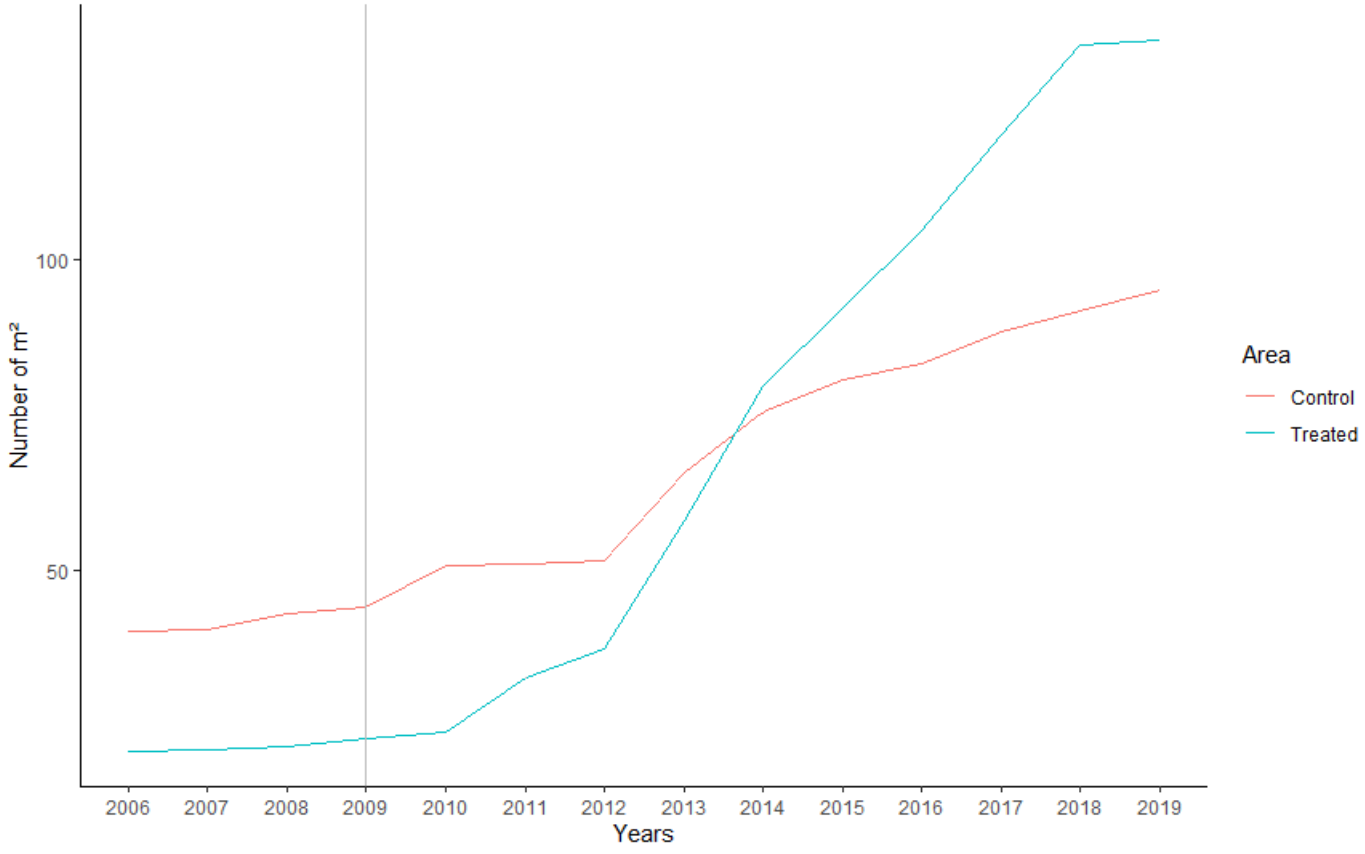
Standard errors are clustered at the district level to account for arbitrary serial correlation in the error term (Bertrand et al., 2004, Abadie et al., 2022). The coefficients of interest are $\beta_{[2009,2019]}$, $\beta_{[2011,2019]}$ and $\beta_{[2014,2019]}$.

The elements representing the double differences correspond to $\sum_j \beta_j Z_i T_j$ and $\sum_j \gamma_j T_j D_i Z_i$.

The raw data presented in Figure (5) show the number of square meters converted. It clearly shows that the treated and control groups followed a similar trend before the implementation of the first law. Subsequently, there is a noticeable increase in the conversion of areas within the treated group as compared to the control group, particularly after the year 2010.

It is important to note that this figure represents unadjusted data, one might expect that the parallel trends to the pre-2011 and pre-2014 laws would be partially corrected when controlling for other factors, as opposed to the trends depicted in this basic plot. In particular the fact to introduce simultaneously the dummies of these three laws in the same equation, partially control for the effect of each of them.

Figure 5: Treated and Control Areas in the Difference-in discontinuities (bandwidth: 600 meters)



Furthermore, by examining the three estimates across various spatial windows, we perform another type of robustness check. The estimation with the narrowest bandwidth is likely to best satisfy the conditions of the Diff-in-Disc approach, as treated and untreated individuals are geographically close enough that we can reasonably expect them to be similar. By employing a triangular kernel that assigns weights based on each observation's distance to the border, we also give more importance to observations near the spatial cutoff. [17]

Finally instead of using this list of ad-hoc bandwidths, we use the Mean Squared Error (MSE) optimal bandwidth choice for the local-linear regression point estimator proposed by Imbens and Kalyanaraman (2011) as well as the CE-optimal neighbor-

[17] As a result, even with a larger bandwidth, the potential outcome of the treated group can still be approximated by the untreated district, given that observations closer to the border are prioritized. We also provide similar results (see the online appendix) with the Epanechnikov and Uniform distribution of weights.

hood of Calonico et al. (2014) that provides a smaller neighborhood and enables to have the smallest coverage error (CE) probability.

Identification issues of the Difference in Discontinuity. As in standard RDD, manipulation of the assignment variable threatens the validity of identification (McCrary, 2008; Imbens and Lemieux, 2008; Lee and Lemieux, 2010). Such a manipulation is unlikely here, agents in the treated group that request a conversion cannot pretend to be in the control group where there is no regulation without taking significant risks. As explained in the previous section, the conversion is based on the address of the housing, inspectors control requests and a fine of €80000 is set for false declaration. Moreover once the manipulation is detected, the unit should return to the previous use (with additional fines).

An issue that can jeopardize the identification is the endogeneity of the zone, in particular the spatial discontinuity (the border line), may not be exogenous. Such a possibility is not obvious since the compensation zone has been drawn on a past regulation that concerns parking lots and thus for a very different motive than the one study here.

Finally, like in standard difference-in-difference analysis, the identication rests on the assumption of parallel trends, here local parallel trends. Figure (5) shows the parallel trend before 2009, and we provide in Table 4, the F-statistics that measure how much the mean outcomes in the treated and control groups deviate from each other in the pre-intervention period. The results indicate that there are no statistically significant differences in trends between the treatment and control groups before each of the intervention years tested (2009, 2011, and 2014).

Table 4: F-tests for parallel trends

Parallel trend test before 2009	F(1, 709)	0.23
	Prob>F	0.635
Parallel trend test before 2011	F(1, 709)	0.02
	Prob>F	0.884
Parallel trend test before 2014	F(1, 709)	1.14
	Prob>F	0.285

3.2 Results at the Periphery

Table (5) presents the results of the spatial difference-in-discontinuity with different bandwidth choices and various weight distributions to study the robustness of our result at the periphery of the compensation zone.

We find that no matter the assumptions made on the bandwidth, the 2009 law's initial implementation is not statistically significant.

This finding is in line with the expected results discussed in Proposition 1. During that period, the demand for redeveloping private housing into commercial units was likely low at the periphery of the compensation zone. For instance, this period is in the aftermath of the financial crisis, which may have hit the periphery harder than the center, limiting the demand of commercial redevelopment. Consequently, the law did not have any significant impact on public dwellings in this area. This situation highlight the complementarity effect that this regulation establishes between commercial and public redevelopment. During periods of economic downturn, this regulation fails to promote the redevelopment of public housing, yet it is precisely during such periods that the availability of commercial spaces (or offices) due to bankruptcies could facilitate the redevelopment of public housing at minimal costs.

On the contrary, Table (5) presents the significant role that the 2011 and 2014 reforms have played in shaping the changes in social housing. The coefficient of 0.643 and the corresponding elasticity around 90%[18] suggest that the 2011 reform, in particular, has had a substantial impact. This confirms the mechanism behind the results presented in Proposition 2. The displacement of compensation from the center to the periphery has changed the geography of HLM redevelopment. These laws appear to have led investors to focus on redeveloping commercial units in the city center, opting to compensate by redeveloping public dwellings at the periphery, which typically represents the most optimal choice for them. Furthermore, this period is marked by the growth of Airbnb, initially concentrated in the center. This growth may have stimulated the redevelopment of public dwellings at the periphery, in response to these legislative changes. However, the peripheral area is relatively small and, beyond statistical significance, the economic impact is low; according to our estimates, fewer than 200 social housing units were developed between 2011 and 2013 due to the law.

[18]The model is a PPML model, and the interpretation of the coefficients is as follows : (exp(coefficient)-1)*100

The 2014 reform seems to have a even lesser effect, with a coefficient ranging between 0.4 and 0.5. This is consistent with its definition, as it is more restrictive in the Center than the 2011 law (50% of the compensation should be done in the Center, which reduce the displacement effect of compensation at the Periphery) but less so than the 2009 one.

Table 5: Social Housing Change from Difference in Discontinuities

Distrib of weights	Uniform		Epanechnikov		Triangular		Triangular	
Bandwidth choice	ad-hoc						CE-opt	MSE-opt
Bandwidth (in meter)	[-300,300]	[-600,600]	[-300,300]	[-600,600]	[-300,300]	[-600,600]	[-461,461]	[-1314,1314]
Treated in 2009	0.179	0.0416	0.247	0.116	0.240	0.144	0.208	0.0114
	(0.192)	(0.155)	(0.185)	(0.143)	(0.184)	(0.146)	(0.165)	(0.167)
Treated in 2011	0.643*	0.766***	0.666*	0.669**	0.665*	0.658**	0.634*	0.620***
	(0.376)	(0.279)	(0.389)	(0.309)	(0.390)	(0.322)	(0.359)	(0.222)
Treated in 2014	0.562**	0.564***	0.488**	0.564***	0.460*	0.545**	0.507**	0.522***
	(0.245)	(0.208)	(0.246)	(0.218)	(0.244)	(0.221)	(0.234)	6.426***
Constant	6.659***	6.164***	6.769***	6.459***	6.879***	6.592***	6.726***	(0.137)
	(0.116)	(0.166)	(0.0877)	(0.134)	(0.0742)	(0.114)	(0.0997)	
Observations	1,568	2,352	1,568	2,352	1,568	2,352	2002	4,004
R^2 adj.	0.895	0.879	0.902	0.888	0.908	0.895	0.900	0.875

Notes: Standard errors are clustered at the neighborhood level in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Results are obtained from a spatial difference-in-discontinuity using the PPML estimator. Individual fixed effects and time effects are introduced in all estimations. The dependent variable is the number/area of HLM converted (in m^2). Columns (1, 3, 5) and (2, 4, 6) present results for areas that are respectively delineated by 300 meters, and 600 meters on both sides of the boundary of the treatment area. The difference between these columns lies in the distributions of weights that follow a uniform, Epanechnikov, and triangular distribution respectively. Column (7) presents results with the Coverage Error (CE) probability neighborhood, and Column (8) utilizes the Mean Squared Error (MSE) optimal bandwidth. Each estimate includes neighborhood and year fixed effects

4 The effects of conversion laws in the heart of Paris

To study how these laws have affected redevelopments in the center of Paris, we can no longer use the empirical strategy based on discontinuity. Indeed in that case the observations outside the compensation zone but near the border cannot be considered as valid countrefactuals of the treated in the center, districts are simply too different. One solution in that case is to build synthetic controls of the treated units, we then use the Synthetic Difference-in-Differences approach of Arkhangelsky et al. (2021), hereafter SDID, which reweights and matches pre-exposure trends. One prerequisite for using synthetic controls is the absence of anticipation regarding the implementation of the laws. Given the specific timing of these laws, anticipation is unlikely. The 2009 law emerged following a series of reforms that were somewhat unexpected in a centralized country like France. Indeed this local regulations resulted from a significant shift toward decentralization that occurred in 2008 with the enactment of the 'modernization of the economy' law. Following this legislation, the City of Paris requested the transfer of authority from the State concerning the conversion of residential units in 2009. Such swift decentralization likely minimized the possibility of anticipation. Finally, the 2011 and 2014 laws are very technical, and one can reasonably assert that agents did not anticipate these changes.[19]

4.1 Synthetic Difference-in-Differences approach

The goal of this method is to weight the control units in the pretreatment period to make these different units comparable with the treated units such that the weighted control units are approximately equal to the pretreatment treated units such as :

$$\sum_{i=1}^{N_{control,pre}} w_i^{sdid} Y_{it} \approx \sum_{i=1}^{N_{traited,pre}} Y_{it},$$

[19] Another assumption of the SDID is a significantly long pre-treatment period. Here, we use all the reliable data available before 2009, which allows us to go back to 2006. This means that we have a pre-treatment period that is similar to the post-treatment periods between the different laws (2009-2011 and 2011-2014). In our online appendix, we conduct a different SDID by computing synthetic control before each policy. For instance, for the 2014 law, we have a synthetic control that is built on the period from 2006 to 2014, allowing us to have a much longer pre-treatment period. We obtain similar results with this empirical strategy.

with w_{it}^{sdid} the time weights t and units i multiplied by the dependent variable Y_{it} in the neighborhood i in year t. The time and unit weights are then used in a regression where the weights $\hat{\omega}_i^{sdid}$and $\hat{\Delta}_t^{sdid}$ minimize the difference between the treated and control units before treatment Z_{it} such as:

$$Y_{it} = \hat{\omega}_i^{sdid}\hat{\Delta}_t^{sdid} exp(\lambda_i + \sum_j \beta_j Z_i T_j + \sum_j \varphi_j T_j D_i + \sum_j \gamma_j T_j D_i Z_i + \theta_t)\varepsilon_{it},$$

with λ_i the neighborhoods, θ_t the years, ϵ_{it} the error term and Y_{it} the dependent variable. The weights used to build the synthetic controls are presented in the Online Appendix.[20]

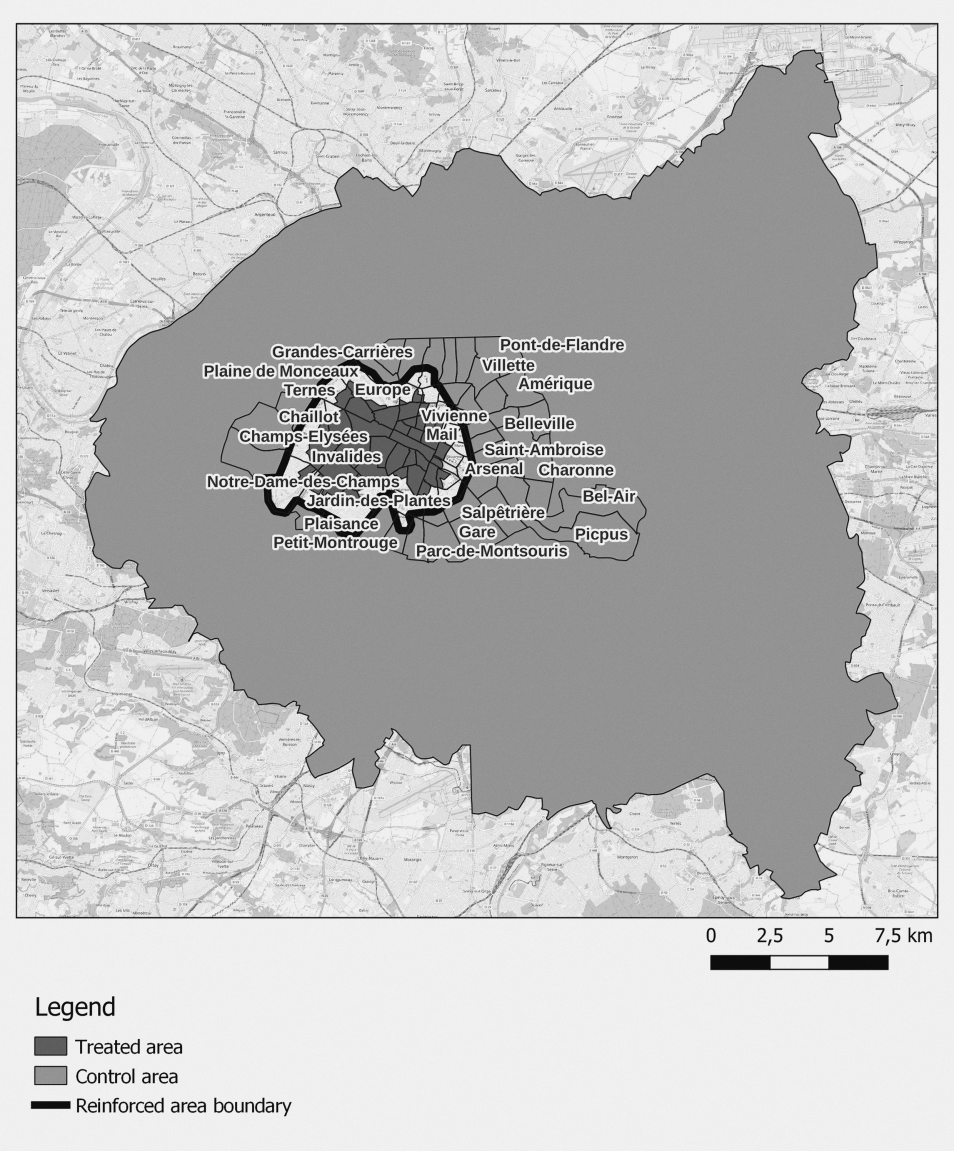
The SDID strategy is still estimated from Equation (1) with PPML and aim to estimate as previously the coefficients $\beta_{[2009,2019]}$, $\beta_{[2011,2019]}$ and $\beta_{[2014,2019]}$.[21]

Considering the buffer area that has its limit at 600 m of the treatment zone, we take as treated the districts that are inside the reinforced area but not in this buffer zone. Figure (6) presents this example for the year 2014, the treated districts are shown in dark gray, the synthetic control is built on districts located in the bright gray area.

[20] We also present results with the nonparametric synthetic control method developed by Cerulli (2020) in the Online Appendix.

[21] Synthetic control and classical difference-in-differences estimations have been performed in Appendix E.

Figure 6: Treated and Control Areas in the Synthetic Difference-in-Differences (bandwidth: 600 meters)



Our testable hypothesis is that the law of 2009 had a more concentrated effect in the center of Paris due to its restrictive implementation in this area.

Figure 7 presents the change in number of m² for the synthetic region (in red) and for the treated in the central area (in green). We notice a significant rise after 2009 in the treated region, which however experiences a hiatus when the 2011 law is implemented. Between 2012 and 2014, the conversion of HLM in both the counterfactual area and the treated zone appears to progress similarly. After 2014, the

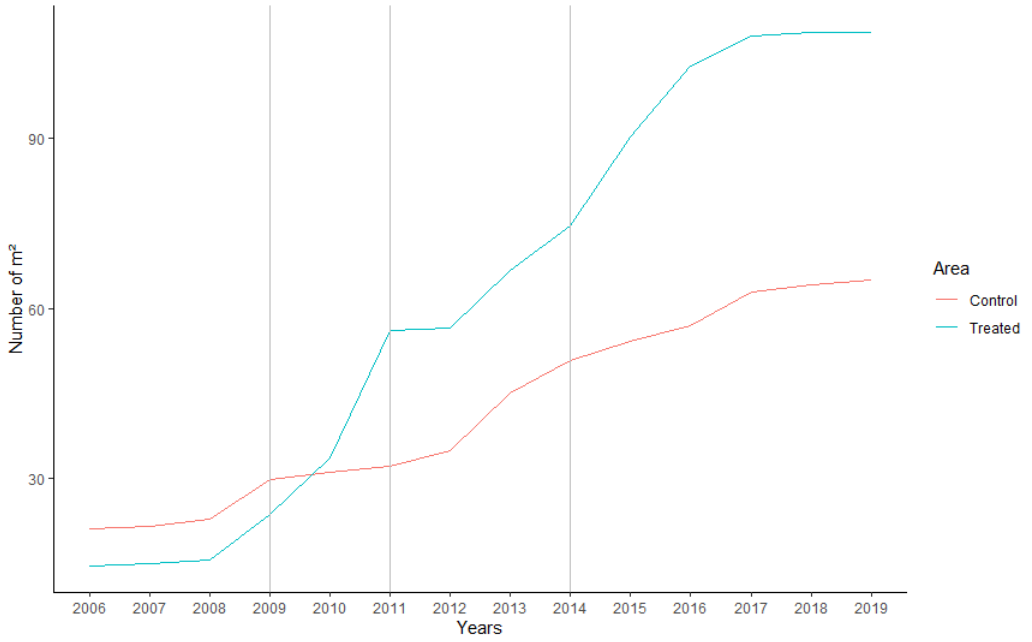
pace of increase in the synthetic region seems to decelerate in comparison to the area where the 2014's law has been implemented.[22] Maybe one of the most striking result of this Figure is the reversal between the control group and the treated group in the redevelopment of social housing after the 2009's law. While the square meter was initially higher in the synthetic center than in the treated one at the start of the period, the situation was reversed by the end of the period.

It is important to note that such a reversal is not observed for other characteristics of these two groups. For instance, housing prices were consistently higher in the treated group than in the control group throughout the period. Similarly, unemployment was structurally higher in the synthetic center than in the treated center, and incomes were also always higher in the treated group than in the control group, among other differences (see Appendix B for a description). To account for these structural differences, fixed effects were systematically introduced in all our estimations.[23]

[22] We have also led a different strategy where three different synthetic groups are built before each laws then analyzed separatly (see online appendix). We find similar results.

[23] We have also included several control variables such as the total number of conversions, median income, school added value, and the number of Airbnb listings (see online appendix). These controls are problematic due to potential multicollinearity and endogeneity biases and are therefore not reported here. However, it is worth noting that our results remained robust with these additional controls.

Figure 7: Treated and Control Areas in the Synthetic difference-in-differences in the Core (bandwidth: 600 meters)



4.2 Results in the Center

Table 6 presents the SDID results with different bandwidths. Our objective is to assess the distinct spatial impacts of these policies. The 2009 policy, by enforcing a compensation rule within each district, may exert a more substantial influence in the central areas compared to other reforms, mainly because the 2011 and 2014 laws facilitate compensation through HLM situated on the outskirts of the compensation zone. Both of our estimations corroborate this observation, as solely the 2009 law significantly affects social housing construction in central Paris.

This is a second validation of Proposition 1, now for the Core. However, we still have in that case a wide definition of the Core. By reducing this definition, the coefficient first doubles as we approach the center (0.6 in Column 1 compared to 1.2 in Column 2).[24] To provide a measure of economic significance, this indicates robust growth in the redevelopment of social housing, increasing from 85.89 % ($\approx (\exp(0.62) - 1) \times 100$) in the wide center (300m) to 244.18% ($\approx (\exp(0.62) - 1) \times 100$)

[24]Regarding Column 3 (using the MSE optimal bandwidth with an upper limit at 1314, which is even more centered on the center), it is possible that we do not have enough observations in these limited areas to reach an interesting (and statistically significant) conclusion. See the online appendix for further investigations with different bandwidths.

in the reduced area starting at 600m from the compensation border. These results align well with the stylized facts presented in the first section. Before the 2009 law, the number of redevelopments in social housing was particularly low. In many neighborhoods, this number was even zero. The proportion of square meters converted into social housing in total housing redevelopment was only 0.39% over the period 2006-2008 (within a 300m border) but increased to 9% in the year following the law.

Table 6: Social Housing Change from Synthetic Difference in Differences

Treated:	Core			
Bandwidth choice	ad-hoc		MSE-opt	CE-opt
Bandwidth (in meter)	]300-center]	]600-center]	[1314-center]	[461-center]
Treated in 2009	0.620**	1.236**	4.783	0.929**
	(0.291)	(0.620)	(3.320)	(0.469)
Treated in 2011	0.0567	-0.433	0.909	-0.411
	(0.255)	(0.406)	(2.742)	(0.299)
Treated in 2014	-0.184	-0.607	6.506	-0.470
	(0.425)	(0.720)	(4.764)	(0.598)
Constant	5.547***	5.719***	5.096***	5.641***
	(0.242)	(0.279)	(0.453)	(0.262)
Observations	7,910	7,574	6,930	7,714
R^2 adj.	0.833	0.847	0.865	0.836

Notes: . Standard errors are cluster at the neighborhood level in parentheses a: p<0.01, b: p<0.05, c: p<0.1. Results are obtained from a Synthetic difference in differences using the PPML estimator. Column (1) use 300m of bandwidth to the center. Column (2) use 600m bandwidth to the center. Column (3) use the MSE optimal bandwidth. Column (4) and (5) use the Coverage Error (CE) probability neighborhood method. Column (6) and (7) represent high demand neighborhoods. The dependent variable is the number/area of HLM conversions (in m^2). Each estimate includes neighborhood and year fixed effects

5 Effects on private housing and social diversity

5.1 Impact on social diversity

The ultimate aim of these laws is to foster social diversity in the city of Paris. We thus analyze here where these laws have had an impact on the spatial distribution of the socio-professional categories of residents.

The data comes from INSEE (National Institute of Statistics and Economic Stud-

ies, Classification of Professions and Socio-Professional Categories[25]) for the years 2006 to 2019 in each IRIS neighborhood. We use all the socio-professional categories (without farmers), namely artisans, merchants and business owners; executives and higher intellectual professions, intermediate professions, employees, workers and finally other individuals without professional activity.

The local entropy index is calculated based on the Theil and Finizza (1971) index and is computed as follows:

$$H = -\frac{\sum_1^{k_i} P_i^k ln P_i^k}{ln k_i},$$

where P_i^k is the share of socio-professional category k in neighborhood i and k_i the number of socio-professional categories present in neighborhood i. This index varies from 0 to 1. The higher the local entropy index, the more heterogeneous the neighborhood is in terms of Socio-Professional Categories representation.

We also use the French classification of socio-professional categories by directly analyzing, on one hand, the proportion of workers, and on the other, higher intellectual professions (including managers[26]). These two distinct categories have been historically used in labor economics to differentiate between manual occupations and white collar jobs (e.g. Douglas, 1926, Goldin and Katz, 2009, Botton et al., 2020). We also analyze the location quotient (Isard, 1960) computed as follows:

$$QL = \frac{x_k^i / t_i}{X^k / T},$$

with k the socio-professional category in neighborhood i, x_k^i the number of socio-professional categories present in neighborhood i of the total population in the neighbourhood i represented by t_i related to the number of socio-professional categories present in the whole territoryX^k of the total population in the whole territory T. This index makes it possible to obtain an index of over- or under-representation of the population by neighborhood and by socio-professional category and thus to obtain a relative index. If the index is greater than 1, the socio-professional category is over-represented in the neighbourhood compared to the territory as a whole, if

[25]https://www.insee.fr/en/information/6049871

[26]Higher intellectual professions includes executives and managers in business or administration, engineers and other technical professionals, health professionals such as doctors and pharmacists, teaching professionals, including university professors, legal professionals, such as lawyers and judges, and finally artists, authors, journalists, and similar professions.

the index is less than 1, the socio-professional category is under-represented in the neighbourhood compared to the territory as a whole. These indicators have well known limitations (see Combes et al., 2009) but are still widely used to study residential segregation (e.g. Consolazio et al., 2023).

Finally, a third indicator, Social Relative Index (SRI) inspired by Duncan and Duncan's dissimilarity index (1955) is studied to compare the number of residents living in social housing compared to all residents living in each arrondissement. An index greater than 0 indicates that the proportion of residents living in social housing is greater than the proportion of residents living in other housing in the arrondissement where the neighborhood is located.

$$SRI = \frac{sh_k^i}{SH^k} - \frac{oh_k^i}{OH^k},$$

Where k is the arrondissement and i is the district. sh_k^i is the number of residents living in social housing in district i of arrondissement k, SH^k is the number of residents living in social housing in arrondissement k as a whole. oh_k^i is the number of residents living in housing other than social housing in district i of arrondissement k. Finally, OH^k is the number of residents living in housing other than social housing in arrondissement k as a whole.

In comparison to the previous sections we only use the SDID estimator for the center and the periphery. We have opted not to report difference-in-discontinuity in this section due to the absence of parallel trends in the pre-periods, which invalidates the relevance of this estimator.[27]

5.2 Results

In Table (7) we present the effects of these housing regulations on the location choice of the different social-economic categories.

[27] The results, not presented here, are generally consistent except for short distances in high intellectual professions, which show no significant effects in 2009 and 2011.

Table 7: Spatial Diversity of Socio-Professional Categories at the Periphery

Type	Higher Intellectual Professions		Workers		Index	
	Location quotient	Share	Location quotient	Share	Theil Index	SRI
	(1)	(2)	(3)	(4)	(5)	(6)
Treated in 2009	-0.021	-0.027*	0.0015	0.0003	0.0004	-0.0027
	(0.014)	(0.014)	(0.051)	(0.042)	(0.005)	(0.003)
Treated in 2011	-0.087***	-0.053***	0.121***	0.038	0.002	0.0025
	(0.026)	(0.015)	(0.046)	(0.041)	(0.005)	(0.002)
Treated in 2014	-0.081**	-0.118***	0.088	0.125**	0.005	0.0020
	(0.033)	(0.020)	(0.059)	(0.051)	(0.008)	(0.003)
Nb of conversion	-0.0001	-0.0001	-0.0008	7e-05	0.0001	0.0001*
	(0.000)	(0.0002)	(0.001)	(0.001)	(0.000)	(0.000)
Income (median)	0.0005**	0.0005***	-0.002***	-0.002***	-0.0001***	-1.81e-05
	(0.090)	(0.000)	(0.000)	(0.000)	(3.e-05)	(0.000)
Constant	0.314***	-0.885***	-0.413***	-2.525***	-0.183***	-0.0014
	(0.090)	(0.060)	(0.122)	(0.129)	(0.0115)	(0.003)
Neighborhood FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Observations	2,7876	33,558	32,634	28,800	31,486	33,642
R^2 adj.	0.910	0.932	0.819	0.777	0.739	0.915

Notes: Standard errors are cluster at the neighborhood level in parentheses [a] p<0.01, [b] p<0.05, [c] p<0.1. Results are obtained from a Synthetic difference in differences using the OLS estimator. Columns (1) and (2) present results for managers with the 300m bandwidth at the periphery and the Coverage Error (CE) probability neighborhood method. Columns (3) and (4) leads the same estimation for workers. Column (5) use the Theil index and Column (6) the Social Relative Index (SRI).

By utilizing the SDID at the border, we observed that these laws have resulted in a decrease in the proportion of high intellectual profession both in relative terms and in absolute term (Column 1 and 2). However, the outcomes are less definitive concerning workers, as the coefficients are mostly not significant (Column 3 and 4). Only the 2011 law is significant for the LQ coefficient but not for the share of workers. Finally, both the Theil index and the Social relative index (Column 5 and 6), indicates that these laws have not significantly contributed to reduce spatial inequality in occupation. In Table (8), we present the same estimate but for the city center. We get similar results, these laws have a significant negative effect on the proportion of higher intellectual professions, but no effect on the proportion of workers and overall we cannot reject the null hypothesis of no effect on social diversity. Except for workers share in Paris intra-muros from 2012 after the 2014 law, but which is only significant at the 10% level. The results are similar in the periphery for the Social Relative Index.

Table 8: Diversity in the Center

Type	Managers		Workers		Index	
	Location quotient	Share	Location quotient	Share	Theil	Social Relative
	(1)	(2)	(3)	(4)	(5)	(6)
Treated in 2009	-0.038***	-0.036**	0.030	0.069	0.003	-0.0013
	(0.01)	(0.016)	(0.040)	(0.052)	(0.007)	(0.003)
Treated in 2011	-0.072***	-0.071***	0.072*	0.0441	0.011	0.001
	(0.015)	(0.015)	(0.042)	(0.064)	(0.008)	(0.003)
Treated in 2014	-0.040***	-0.062***	0.006	0.0933	-0.005	-0.0022
	(0.015)	(0.017)	(0.05)	(0.07)	(0.008)	(0.006)
Nb of conversion	-0.0002	-0.0003	1e-05	-0.0002	0.0001	-0.0001
	(0.000)	(0.0002)	(0.000)	(0.0002)	(9e-05)	(0.000)
Income (median)	2.e-05	-5e-06	0.0002	0.0002	1e-05	-2.91e-04*
	(5e-05)	(6e-05)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.66***	-0.66***	-1.34***	-3.29***	-0.24***	0.0099**
	(0.02)	(0.021)	(0.075)	(0.074)	(0.008)	(0.005)
Neighborhood FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Observations	30,084	34,244	35,000	29,352	32,019	36,372
R^2 adj.	0.828	0.898	0.577	0.678	0.703	0.780

Notes: Standard errors are cluster at the neighborhood level in parentheses ^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1. Results are obtained from a Synthetic difference in differences using the OLS estimator. Columns (1) and (2) present results for managers with the 300m bandwidth at the periphery and the Coverage Error (CE) probability neighborhood method. Columns (3) and (4) leads the same estimation for workers. Column (5) uses the Theil index and Column (6) the Social Relative Index (SRI).

Not reported here we have also estimate the effect of these laws with the inter-decile ratio, i.e. the richest 10% over the poorest 10% of the population, as the dependent variable. We found similar results.

6 Conclusion

To paraphrase Hirschman (1970), the silent exit of the working class from inner cities has accompagned the price increase in many global cities. In some places, voices of opposition to gentrification have been raised[28] and several local policies have been implemented. In this study, we examine three successive laws implemented in 2009, 2011, and 2014 that promote the conversion of offices and other commercial premises into private or social housing. A certain amount of trial and error can be observed in the policy imposed by these laws. The 2009 law was enacted in the particular political context of the 2008 re-election campaign of a socialist candidate. Although this law was not explicitly a promise, it can be viewed as the main tool to fulfill the commitment to provide more than 40,000 social housing units in the capital, including in the center of Paris, between 2008 and 2014. According to our estimate less than 4,000 units have been converted to social housing due to compensation laws. Perhaps the 2009 regulation appeared too restrictive after its enforcement, or, in the absence of any assessment, it was considered ineffective. Regardless of the reason, the 2011 law completely relaxed the district compensation constraint. Finally, the 2014 law has represented a compromise that remains in effect today.

Our analysis shows that the 2009 law did, in fact, significantly encourage the re-development of social housing in the city center. In contrast, the 2011 and 2014 laws have only a significant effects at the border of the compensation area but not in the city center. Our analysis thus shows that the stipulations regarding where redevelopment is permitted can significantly shape the distribution of social housing. We further reinforced this interpretation through various robustness checks using different estimators and control groups. The fact that the most recent laws only have an effect on districts located in the periphery, which is a relatively small area, and

[28]The YIMBY movement in particular has organized several demonstrations in California to protest against areas significantly disrupted by rapid gentrification. In France, the "Yellow Vest" movement has also been driven by individuals considering that they have been excluded from the economic prosperity of metropolitan areas. See Brown-Saracino (2017) which surveys the literature in sociology that analyzes the public resistance to gentrification.

not in the broadly defined center, signifies a failure of these regulations in terms of their primary objective. This is all the more worrying as the 2014 law seems to have no effect. We reinforce this interpretation by finding a lack of impact from these redevelopments on the Theil's index of social diversity.

Although our analysis presents an internal validity, it obviously lacks the external one. More research needs to be conducted in various cities and across different periods to gain a deeper understanding of how redevelopment influences the spatial and social fabric of cities.

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Appendix A: Some details about the compensation laws

Compensation rights

The compensation can be carried out directly by the applicant, who offers as compensation a unit that he owns or buys (as in our previous examples), or indirectly, by purchasing a compensation title/right (called "droit de commercialité") from a third

party that transforms the OC unit into housing. To obtain titles of compensation, the applicant can turn to specialized companies or to social landlords, who carry out operations of transformation of offices/shops (and so on) into housing and can thus propose premises in compensation.

This transfer of commerciality from a property for use other than housing to a residential property, allowing the applicant to obtain a change that is permanent. For him the compensation title looks like an administrative cost to convert its building.

It is important to notice that there is no official price for these titles, the prices are negotiated between the buyer and the seller. They vary depending on the location of the property. According to the Housing and Habitat Department of the Paris city,[29] the average price over the period is around 1,600 € per square meter, with very significant variations, from about 400 € per square meter up to 3,000 € per square meter in the western and central districts of the capital where demand is highest. Artigalas and Richaud (2018) and Morel (2017) confirm that the cost of compensation title is smaller than the housing prices but still significant.

Exceptions and implementation

Since the origin, the law has taken into account exceptions (i.e. no conversion) for liberal professions, first floors, organizations exercising a mission of general interest. The team in charge of the implementation of this regulation is relatively small (twenty people in 2014 according to Plottin, 2016) but composed of inspectors with wide-ranging prerogatives who carry out on-site investigations. Infractions are severely repressed, the amount of the fine has been set at €25000 in 2009 and has been doubled in 2016.[30] The president of the court orders the return to the previous use for the housing converted without authorization within a given period of time. At the end of this period, the court can impose a fine of up to €1,000 per day and per square meter of the unlawfully converted housing. A fine of €80000 and one year imprisonment are also included in the law for false declarations.

[29] https://cdn.paris.fr/paris/2021/06/11/e22f26b33f762b28aae60e1866c10041.pdf

[30] Article L651-2 of the "Code de la construction et de l'habitation"

Appendix B: Descriptive Statistics

Table (10) presents the descriptive statistics for the SDID. As already mentioned in the text, the center and the synthetic center differ in various characteristics. Incomes are significantly higher in the treated center, as are prices, the level of employment, and the tourism demand approximated by the number of Airbnbs. All these structural differences between the two areas are accounted for by fixed effects at the IRIS level. What matters for our empirical analysis is that these characteristics have not evolved in radically different ways that could bias our identification strategy. It appears they have not; for instance, there is a 4% difference in the unemployment rate between the treated and the control, both before and after the year 2009. Similarly, the growth rates of housing prices have been very similar on average in the two areas (less than 1% in both cases).

Table 9: Descriptive statistics for treated and control districts at the center (600m)

	Treated	Control
Average median income between 2006 and 2019	31759.31	26461.51
Share of workers	5.13%	8.11%
Share of higher intellectual professions	50.05%	42%
Price by m² (between 2012 and 2014)	8764.5€/m²	5068.77€/m²
Unemployment rate (before 2009)	10.14%	14.79%
Unemployment rate (after 2008)	9.16%	13.61%
Number of Airbnb on total housing (after 2009)	0.43%	0.12%
Average growth rate in unemployment 2006 and 2019	0.71%	0.79%
Average growth rate of housing 2006-2019	0.47%	0.76%
Average growth rate of housing price 2012-2019	1,97%	2,01%
Number of observations	770	6804

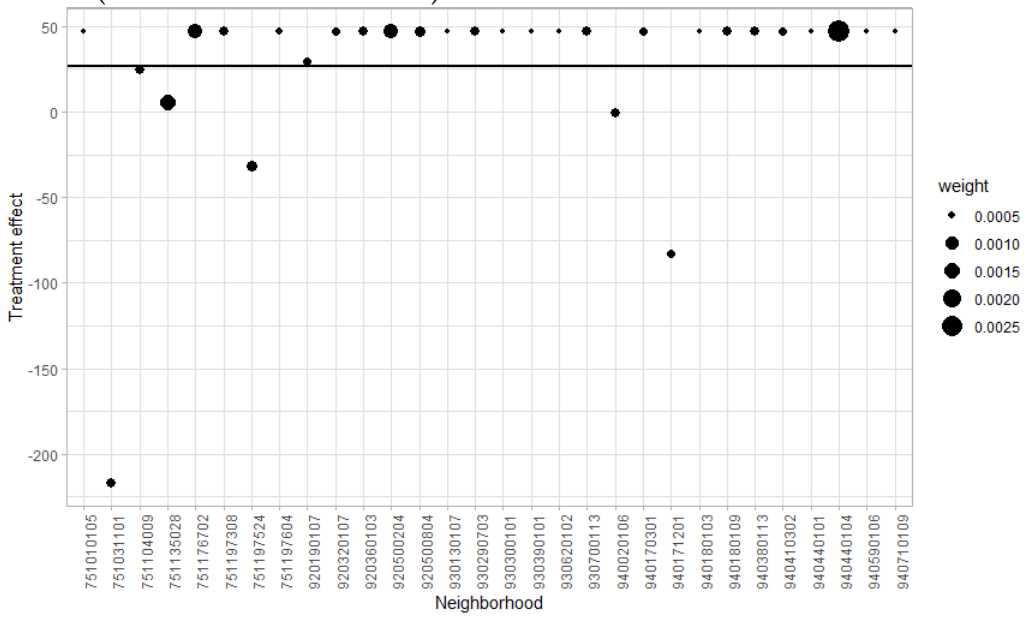
Table 10: Descriptive statistics for treated and control districts at the periphery (600m)

	Treated	Control
Average median income between 2006 and 2019	30631.62	24865.61
Share of workers	5.67%	8.81%
Share of higher intellectual professions	47.16%	39.81%
Price by m² (between 2012 and 2014)	5224.74€/m²	4599.8€/m²
Unemployment rate (before 2009)	10.07%	11.65%
Unemployment rate (after 2008)	10.66%	11.65%
Number of Airbnb on total housing (after 2009)	0.44%	0.34%
Average growth rate in unemployment 2006 and 2019	0.17%	-0.14%
Average growth rate of housing 2006-2019	0.26%	0.47%
Average growth rate of housing price 2012-2019	4.64%	2.06%
Number of observations	910	1442

Appendix C: Size of Weights

The weights used to build the synthetic controls are presented in Figure 8 and present relatively few extreme values.

Figure 8: Weights of the top 30 neighborhoods in the Synthetic Difference-in-Differences (bandwidth: 600 meters)



Appendix D: Placebo Test

Table (11) presents a placebo effect of the Differences-in-Discontinuities estimate with pre-treatment data. Instead of being treated in 2009, we consider a false treatment in 2007, and in 2008. The point of this falsification test is to consider the potential impact of all the policies decided at either the national or municipal level before 2009 that may have influenced the provision of socail housing. Indeed, as described by Goujard (2011) in an analysis of the externalities of social housing in Paris over the period 1995 to 2005, the arrival of the socialist administration in 2002 is correlated with an increase in the number of social housing units. It is thus possible that specific laws, that were implemented before our study period but within our compensation areas, have had long-lasting effects that systematically biased our results. In such a case, a treatment effect for the years 2007 and/or 2008 should be significant. However, as shown in Table (11), these false treatments are never significant, indicating that it is indeed the conversion laws implemented from 2009 that matters.

Table 11: Placebo tests

Dependent variable	Social Housing Change		
Bandwidth (in meter)	[0-461]		
	Differences-in-discontinuities		
Treated in 2007	-0.0993	-0.0153	
	(0.0905)	(0.133)	
Treated in 2008	0.116		0.0500
	(0.118)		(0.137)
Nb of conversion	0.00452	0.00432	0.00448
	(0.00323)	(0.00324)	(0.00322)
Income (median)	-1.19e-05	-7.33e-07	-1.03e-05
	(0.000)	(0.000)	(0.000)
Constant	7.587***	7.377***	7.550***
	(0.744)	(0.621)	(0.701)
Observations	474	474	474
R^2 adj.	0.961	0.960	0.961

Notes: Standard errors are cluster at the neighborhood level in parentheses [a] p<0.01, [b] p<0.05, [c] p<0.1. Each estimate includes neighborhood and year fixed effects.

Appendix E: Other estimations (synthetic control, difference-in-differences and synthetic difference-in-differences)

This table presents the results for synthetic control (SC), difference-in-differences (DID), and synthetic difference-in-differences (SDID) estimations. We find similar results with the three different methods.

Table 12: Social housing change according to different estimators in the center and at the periphery

Dependent variable	Social housing change					
Bandwidth (in meter)	Center			Periphery		
	(1)	(2)	(3)	(4)	(5)	(6)
	SC	DID	SDID	SC	DID	SDID
Treated in 2009	1.3454***	0.8062***	1.236***	-0.0108	0.2158*	0.0632
	(0.628)	(0.292)	(0.620)	(0.164)	(0.115)	(0.156)
Treated in 2011	-0.4119	0.0047	-0.4330	0.5665***	0.2598*	0.4990*
	(0.463)	(0.140)	(0.406)	(0.279)	(0.149)	(0.289)
Treated in 2014	-0.5514	0.0838	-0.6069	0.4234***	0.2438***	0.4672***
	(0.734)	(0.172)	(0.720)	(0.188)	(0.113)	(0.188)
Constant	5.6328 ***	6.4741***	5.7188***	6.0509***	6.4351***	5.1461***
	(0.432)	(0.039)	(0.279)	(0.077)	(0.021)	(0.199)
Observations	7,574	7,574	7,574	7,714	7,714	7,714
R^2 adj.	0.8528	0.8549	0.8469	0.8303	0.8490	0.7602

Notes: Standard errors are cluster at the neighborhood level in parentheses [a] p<0.01, [b] p<0.05, [c] p<0.1. Results are obtained from a Synthetic difference in differences, synthetic control and difference in differences using the PPML estimator. Columns (1) in the center and (4) at the periphery use 600m bandwidth and represent social housing change from Synthetic control. Columns (2) in the center and (5) at the periphery use 600m bandwidth and represent social housing change from difference-in-differences. Column (3) in the center and (6) at the periphery use 600m bandwidth and represent social housing change from Synthetic difference-in-differences. Each estimate includes neighborhood and year fixed effects.