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A Treatment Effect Method for Merger Analysis with an Application to Parking Prices in Paris*

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Abstract

Most retrospective merger studies resort to the treatment effect approach, comparing the price dynamics in a treatment group and in a control group. We propose a systematic method to construct the groups, which applies to any industry with spatial competition. The method is consistent with the fact that mergers alter oligopolistic equilibria in complex ways, and thus that seemingly distant entities may be affected through indirect channels. An illustration based on a merger in the Parisian parking market is provided.

Keywords: Merger retrospective analysis; treatment effect models.

JEL codes: L1, L4

Résumé

La majorité des études rétrospectives sur les fusions utilisent des approches de l'effet des traitements, comparant la dynamique des prix dans un groupe de traitement à celle d'un groupe de contrôle. Nous proposons une méthode systématique pour construire de tels groupe qui s'applique à toute industrie où la concurrence est spatiale. La méthode est cohérente avec le fait que les fusions modifient l'équilibre oligopolistique par des voies complexes, et qu'ainsi, des entités qui semblent éloignées de la fusion peuvent être affectées à travers des canaux indirects. Une illustration, basée sur une fusion entre parkings parisiens, est proposée.

Mots clefs: Analyse rétrospective des fusions, .

Classification du *JEL* : L1, L4

1 Introduction

The demand for merger evaluation is increasing. Antitrust agencies commission retrospective studies to assess the effectiveness of merger control (LLP. (2005) and Lear (2006)) and initiate in-house studies to estimate the price effects of certain mergers (see for instance Taylor and Hosken (2007) and Simpson and Taylor (2008) on two mergers in the U.S. petroleum industry). Yet the supply of merger retrospectives remains low, most likely because of data limitations, as illustrated by Taylor, Kreisle, and Zimmerman (2010) and Hastings (2010). With a few exceptions, notably Hastings (2004), the academic literature has focused on waves of mergers rather than on single merger events.[1]

The vast majority of retrospective studies resort to the treatment effect methodology, comparing price variations in a treatment group and in a control group. As a general rule, the treatment (control) group consists of firms, outlets or geographical areas that are supposedly affected (unaffected) by the merger.

Drawing the line between affected and unaffected entities is particularly difficult in industries where firms compete spatially through retail outlets. Insider outlets, which were rivals prior to the merger and are operated by the same entity after the merger, have less incentives to compete. Beyond this direct effect, however, mergers translate into new oligopolistic equilibria, with all outlets and firms endogenously reacting to the new market structure. In particular, when the prices charged at the various outlets are strategic complements, an outlet increases its price in response to price rises by neighboring outlets. Thus, a merger alters the incentives not only of nearby insiders, but also of outlets that are close to such insiders, and, by iteration, of outlets that could seem, at first glance, little concerned by the merger. Indirect effects make the treatment effect methodology hard to apply to merger evaluation and, in theory at least, call for developing structural methods in retrospective studies. In practice, however, reduced-form methods remain ubiquitous, perhaps because of weaker data requirements.[2]

The main purpose of this note is to propose a method to build treatment and control groups in a systematic way. The method potentially applies to any market with spatial competition (fast food restaurants, supermarkets, movie theaters, gasoline stations, etc.). It is based on an accurate description of how a merger alters the ownership structure at the local level, given the market geography. The constructed groups are indexed by two parameters: a distance or radius, and an "iteration parameter" that expresses the idea that a merger can affect an outlet in a more or less direct way.

We apply the method to a parking merger in Paris. The empirical results highlight the crucial role of the control group and suggest that the researcher should keep in mind that a

[1] Focarelli and Panetta (2003) examine the consolidation of the Italian banking sector during the 1990s, highlighting the interplay between market power effects and efficiency gains at various time horizons. Dafny (2009) considers the wave of merger activity experienced by the general acute-care hospital industry in the United States during the 1990s. She is concerned that merging and nonmerging hospitals might differ in unobserved ways, and designs an instrumental variable method to address the potential selection bias. Borenstein (1990) and Kim and Singal (1993) show how airline mergers during 1985-1988 have caused prices to rise for affected routes (relative to unaffected ones). Hastings and Gilbert (2005) and Hortaçsu and Syverson (2007) look at waves of vertical mergers in respectively the gasoline and cement industries.

[2] Structural methods are more commonly used to run ex ante simulations or counterfactual experiments, with somewhat mixed results according to Peters (2006). Froeb, Tschantz, and Crooke (2003) describe the data that would be required to estimate a structural model of parking merger. Thomadsen (2005) illustrates indirect effects by simulating the effect of counterfactual mergers in the California fast food industry.

merger alters the oligopolistic equilibrium as a whole, and thus should not restrict attention to direct effects when constructing treatment and control groups.

The article is organized as follows. Section 2 presents the methodology in a general setting. The remainder of the note is devoted to an illustrative example. Section 3 presents the merger and the data. Section 4 builds a number of control and treatment groups. Section 5 presents and discusses the estimation results. Section 6 concludes.

2 The methodology

We consider a horizontal merger in an industry where firms compete locally through retail outlets. First, we provide a systematic method to describe, in a qualitative manner, the extent to which a given outlet is affected by the merger. Next, we construct various groups of outlets and explain how to use them in a difference-in-differences estimation. Finally, we sketch out a number of possible extensions and robustness checks.

For a given radius r, an outlet is said to be directly affected by the merger, or "affected at order zero" if, prior to the merger, it was operated by one of the merging firms and an outlet located within distance r was operated by the other party. We note $L^0(r)$ the corresponding dummy variable: $L^0(r)$ equals one for outlet i if and only if that outlet had a rival j within radius r prior to the merger and both outlets are operated by the new entity after the merger. Prior to the merger, outlets i and j did not coordinate their pricing strategy, unless some form of collusion prevailed; in contrast, the same firm –the merged entity– operates the two outlets after the merger.

An outlet is said to be "affected at order one" by the merger if a directly affected parking is located within distance r. We note $L^1(r)$ the corresponding dummy variable. An outlet operated by a merging firm (an "insider outlet") may be affected at order one but not at order zero. This may occur if a nearby, directly affected outlet is operated by the same merging party.

By iterating the process, we construct a sequence of dummy variables $L^k(r)$. An outlet is directly affected if and only if $L^0(r) = 1$. An outlet has $L^{k+1}(r) = 1$ if and only if an outlet with $L^k(r) = 1$ is located within distance r. By construction, the variable $L^k(r)$ is nondecreasing in k and in r. Since the number of outlets is finite, the sequence $L^k(r)$ converges as k tends to infinity, and is actually constant beyond a finite iterative level k. For any given value of r, we note $L^\infty(r)$ the limit and maximum value of $L^k(r)$ as k grows: $L^\infty(r)$ equals $L^k(r)$ for large k. Finally, let $N(r)$ be a dummy variable that equals one if and only if an outlet has a neighbor within radius r (regardless of which firms operates that neighboring outlet). We have:

$$L^0(r) \leq L^1(r) \leq L^2(r) \leq \cdots \leq L^\infty(r) \leq N(r).$$

By construction, outlets with $L^\infty(r) = 1$ have a neighbor within radius r, which explains the last inequality. That inequality may be strict, as many outlets can be close together in an area where the merging parties have no outlets or only one party is present.

If one believes that outlets less than r meters apart compete in price, outlets with $L^0(r) = 1$ are certainly affected. Under strategic complementarity, an outlet increases its price in response to price rises by neighboring outlets. Hence, nearby outlets, with $L^1(r) = 1$, may follow price rises by directly affected outlets. Thus, the oligopolistic equilibrium as a whole is altered, and any outlet with $L^{\infty}(r) = 1$ may potentially be affected. On the other hand, assuming that competitive interactions cannot significantly affect price behaviors beyond distance r, outlets with $L^{\infty}(r) = 0$ are certainly not affected by the merger, even in an indirect way, and thus constitute a well-founded control group.

We assume that panel data are available. The researcher has price data at the outlet level over time. The difference-in-differences estimation proceeds by comparing the price dynamics in a control group and in a treatment group. The identification assumption is that unobserved variables (e.g. cost or demand shocks) affect prices similarly in both groups, and thus that prices would have evolved similarly in both groups but for the merger (see e.g. Wooldridge (2002)).

The baseline model contrasts the dynamics of prices in a group of outlets with the evolution in the complementary group (all the other outlets in the sample). For a given iterative order k and a given radius r, we estimate the following regression equation:

$$\ln p_{it} = \mu + \alpha_i + \delta_t + \phi\, L^k(r) \times \text{POST}_t + \varepsilon_{it}. \tag{1}$$

The regression includes fixed effects α_i for each outlet. Accordingly, the constant, dummy variable $L^k(r)$ is not included in the regression. The fixed effects capture all characteristics of the outlets that do not vary over time. The variable POST_t is a time dummy that equals one if the date is posterior to the merger.[3] Thus, the parameter of interest, ϕ, compares the price evolution of outlets that are affected at order k for radius r with that of outlets that are not affected at this order. According to the above analysis, the baseline regression with $k < \infty$ may lead to underestimate the price effect of the merger as outlets affected at orders higher than k might experience price rises following the merger because of indirect, strategic effects and should therefore be included in the treatment group rather than in the control group. Hence, our preferred regression has $k = \infty$. As a variant, one may want to compare the control group $L^{\infty}(r) = 0$ to treatment groups smaller than $L^{\infty}(r) = 1$, for instance the set of outlets affected at some finite order.[4]

The baseline model relies on a partition of the set of all outlets into two complementary subsets: the control group, $L^k(r) = 0$, and the treatment group, $L^k(r) = 1$. One may want to use more sophisticated partitions, for instance by incrementally introducing the variables L^k in the equation:[5]

$$\ln p_{it} = \mu + \alpha_i + \delta_t + \left[\phi_0\, L^0 + \phi_1\, (L^1 - L^0) + \ldots + \phi_k\, (L^k - L^{k-1})\right] \times \text{POST}_t + \varepsilon_{it}. \tag{2}$$

As in equation (1), the control group is constituted of outlets unaffected at order k. The coefficient ϕ_1, for instance, estimates the effect of being affected at order one, but not at order zero, relative to being unaffected at order k. As argued above, the control group $L^{\infty}(r) = 0$ is well-founded, provided that there is no strategic interaction beyond distance r. The estimation of regression (2) with $k = \infty$ allows to analyze the pattern of the sequence ϕ_0, ϕ_1, $\ldots$, ϕ_{∞}. Intuitively, we expect the sequence to be nonincreasing as the merger treatment can be thought of as stronger for more directly affected outlets. The pattern may be more or less steep depending on the strength of the aforementioned strategic effects. Absent

[3] Given the difficulty to date a merger, it is necessary to run a number of variants as regards the definition of the POST_t variable.

[4] In the empirical application below, this variant is implemented in Table 4.

[5] For simplicity, the radius r is omitted in equation (2).

any indirect effect, only the coefficient ϕ_0 should be positive and statistically different from zero: $\phi_0 > 0$ and $\phi_1 = \cdots = \phi_\infty = 0$. When indirect effects are present, and particularly under strategic complementarity, one can expect other coefficients than ϕ_0 to be positive. The stronger the indirect effects, the flatter the pattern of the sequence of coefficients.

The fundamental limitation of difference-in-differences methods is the identification assumption. There exists an inevitable tension between the two requirements the treatment and control groups are supposed to meet: on the one hand, the two groups must be sufficiently far apart for one group to be deemed affected and the other to be deemed unaffected; on the other hand, the two groups must be sufficiently close together for being subject to similar unobserved shocks. If one suspects that some unobserved variables could play differently in different geographic subareas, one can interact time and subarea dummies, and check whether the difference-in-differences coefficient remains statistically significant.[6] The magnitude of the coefficient, however, is difficult to interpret.

The above methodology extends straightforwardly to horizontal mergers involving more than two firms, or to successive mergers. Apart from horizontal mergers, the method can be adapted to any event that affects a particular group of outlets. Consider for instance a vertical merger whereby formerly independent retailers are acquired by an upstream supplier. In contrast with the horizontal setting, the corresponding dummy variable L^0 does not involve any distance: an outlet is directly affected if and only if it is involved in the vertical merger. Another difference with the horizontal setting is that an outlet with $L^0 = 0$ cannot be operated by a merging firm. For higher iterative levels, our construction can be implemented in the very same manner as above.

3 Merger and data

On 19th December 2000, the shareholders extraordinary meetings of Gtm and Vinci approved the takeover of the former by the latter. The Ministry of the Economy approved the transaction on 22 June 2001 subject to a number of behavioral remedies. This has been a large-scale merger involving many industries and markets. We use the method described above to assess its effect in one particular industry and one particular geographic area.

The merging firms were conglomerates with activities in building and civil engineering, road construction, and concessions like turnpikes, underground parking lots, etc. As regards the parking industry, the merger gave rise to Vinci Park, by far the leading car park operator in France, with activities in 144 towns. The sole remedy imposed in this industry has consisted of restricting the merged entity's right to bid for long-term concessions of city-owned parking lots.

We investigate the effect of the merger in the Parisian parking industry. At the time of the merger, 214 lots were offering hourly parking in Paris. We know their exact location, as well as the identity of the companies that operated each of them before and after the merger. Except for Vinci and Gtm, parking lot operators have not changed between 2000 and 2001. As is common in merger retrospectives (see Hastings (2010) and Taylor, Kreisle, and Zimmerman (2010)), prices are available only for a sample of outlets. Our price sample consists of the 85 city-owned lots with hourly rates.[7]

[6] Wooldridge (2002), p.129: "In some cases we interact some explanatory variables with time dummies to allow partial effects to change over time. This procedure can be very useful for policy analysis".

[7] Hourly prices of city-owned lots have been provided by the City of Paris. Qualitative information for

As Table 1 shows, the pre-merger market shares of the merging parties were 35% and 20% in terms of parking capacity (fourth column). The merged entity operated 42% of the 214 parking lots and 55% of the total capacity. The third largest firm, SAEMES, was more than five time smaller. Moreover, other competitors were quite small, often operating a single lot. Based on capacity, the Herfindahl-Hirschman-Index increased from 1,714 to 2,975 following the merger.[8] Such a move is well above the usual thresholds considered in both the European and U.S. horizontal merger guidelines.

The last two columns of Table 1 report the average hourly price per firm. During the sample period, parking prices in Paris did not depend on the time in the day. Prices were typically changed a couple of times each year. They were about 2€ per hour at that time. Between 2000 and 2001, they rose by almost 4% in the whole price sample. Prices in lots operated by the acquirer firm, VINCI, rose by only 2%. Prices in lots operated by the target firm, GTM, rose by almost 4.7%.

Table 1: Pre-merger market structure and evolution of prices between 2000 and 2001

	2000					2001
Operator	Nb (%)	Nb City-owned (%)	Capacity (%)	Av. capa.	Av. price	Av. price ($\Delta p/p$)
VINCI	62 (28.97%)	31 (36.9%)	39636 (35.18%)	639	1.99	2.03 (2.01%)
GTM	27 (12.62%)	27 (32.14%)	22172 (19.68%)	821	1.93	2.02 (4.66%)
SAEMES	19 (8.88%)	14 (16.67%)	10299 (9.14%)	542	1.89	1.97 (3.93%)
SCETA	8 (3.74%)	1 (1.19%)	2414 (2.14%)	302	2.13	2.26 (6.06%)
INTERPARKING	7 (3.27%)	1 (1.19%)	3825 (3.4%)	546	2.13	2.2 (3.13%)
PARK HEULIN	4 (1.87%)	3 (3.57%)	3293 (2.92%)	823	2.19	2.24 (2.61%)
REDELE	4 (1.87%)	0	1020 (0.91%)	255	.	.
All	214 (100%)	84 (100%)	112662 (100%)	526	1.96	2.04 (3.96%)

Source: Mairie de Paris and Guide des parkings de Paris.
Except for VINCI and GTM, parking lot operators have not changed between 2000 and 2001.
Firms operating less than 4 lots are not shown, explaining why the line "All" is not the sum of the above lines. In 2001, the average hourly price of the formerly GTM lots is 2.02 Euros.

4 Building control and treatment groups

Throughout the paper, the metric is based on the walking distance, which differs from both the distance as the crow flies and the driving distance (due to one-way and pedestrian streets). We collected the walking distances between any two lots using an online map interface.[9] Next, we computed the dummy variables $L^k(r)$ and $N(r)$ in the set of the 214 Parisian parking lots, for all possible iterative levels k and for various radiuses r.

Table 7 in appendix reports the number of lots affected and unaffected at any order for radiuses between 250m. and 1650m. From the first column, we learn that only two lots are directly affected by the merger for a 250m. radius. In other words, only one GTM lot and one VINCI lot were less than 250m. apart. For r=1650m., 66 lots are directly affected by the merger; for an intermediate radius, r=900m., 36 lots are directly affected.

Examining the table allows to check that $L^k(r)$ is nondecreasing in k and r. For r=250m., the sequence is constant from $k = 1$ onwards. Only five lots are affected at

all the Parisian lots has been found in a practical guide for motorists, *"Le guide des parkings de Paris"*, Com3000 edition.

[8]For each firm j, let K_j denote the total capacity of all the lots it operates. The HHIs pre- and post-merger are computed as $10,000 \sum_j (K_j/K)^2$, with $K = \sum_j K_j$.

[9]As indicated above, there are 214 hourly parking lots in Paris. Thus the computation of distances involved $22,791 = 214 \times 213/2$ pairs of lots.

any order for such a small radius. For r=900m., convergence is reached for a higher iterative level, namely $k = 6$. The vast majority of lots (176 among 214) are affected at that order. Note also that 28 lots have a neighbor within 900m., but are unaffected at any order for that distance.[10] Only 10 lots have no neighbor within 900m.

Table 8 reports the number of city-owned lots affected and unaffected at any order. We insist that the dummy variables $L^k(r)$ and $N(r)$ are the same as above: they are computed in the whole set of lots that offer hourly prices. The only difference with Table 7 is that the numbers of zero values and one values of the dummy variables are counted for city-owned lots only. Comparing the two tables allows to check whether the explanatory variables $L^k(r)$ are distributed similarly in the whole set of hourly parking lots and in the price sample. When reading the estimation results, it will prove useful to refer to Table 8, as regressions are run for city-owned lots only. Due to the intersection with the price sample, convergence of the sequence $L^k(r)$ is reached for a lower iterative level k in Table 8 than in Table 7. For instance, for r=900m., convergence is reached for $k = 4$ in the price sample and for $k = 6$ in the whole set of hourly parking lots.

Figures 1, 2 and 3 present on a Paris map the lots affected and unaffected at order k, respectively for $k = 0$, $k = 1$ and $k = \infty$. The maps illustrate the tension suggested above. Affected lots, by definition, tend to be located in the same areas, in particular in the vicinity of the Champs-Elysees (8th and 16th *arrondissement*).

5 The price effect of the merger

In this section, we implement the method described in Section 2, based on the variables $L^k(r)$. For the sake of comparison, we also run difference-in-differences estimations using preexisting market areas, as is common in the merger analysis literature. In the former case, one looks at each outlet, wondering whether it is affected by the merger at a given order for a given radius. In the latter case, one examines the market structure of administrative districts that form an exogenous partition of the market.

In all the presented regressions, the dependent variable is the logarithm of hourly prices of city-owned lots for each quarter in the period 2000-2001. Although the merger has been formally authorized in July 2001, the regulatory approval had largely been anticipated by the operators.[11] In the estimation results presented below, two quarters around the merger date are removed from the sample period; doing so affects the results very little. As explained above, we control for parking lot heterogeneity through fixed effects. All regressions contain quarterly dummies. We cluster standard errors by parking lots to account for any temporal correlation in unobservables.[12]

5.1 Using affected lots at any order

We start with the baseline regression (1), comparing lots that are affected at a given order with lots that are not. Next, we investigate more closely the role of the iterative level, for a given radius. Then, we examine the role of the radius. Finally, we include time-varying, local dummies to account for possible local shocks.

[10] Formally, we have: $L^\infty(900) < N(900)$ for these 28 lots.

[11] The merger under study is a friendly takeover. The public exchange offer has been opened in July 2000 and closed in October 2000.

[12] See Bertrand, Duflo, and Mullainathan (2004).

Table 2 reports the estimation results for the baseline model. Results are presented for a 900m. radius[13] and for all possible iterative levels k. As Table 8 shows, the sequence of variables $L^k(900)$ is constant in the price sample from $k = 4$ onwards, implying $L^4(900) = L^\infty(900)$ for city-owned lots. Accordingly, we investigate iterative orders zero to four. In the first column ($k = 0$), we compare price variations following the merger for the directly affected lots and for all the other lots. The difference-in-differences coefficient is weak and statistically insignificant, even at the 10 percent level. As explained in Section 2, this may be due to the fact that the control group contains lots affected at positive orders, which may therefore have experienced price rises following the merger. For iterative orders one and two, hourly prices increase by about 2% in the treatment group relative to the control group, but the difference-in-differences coefficient is either insignificant or significant only at the 10 percent level. Again, this might be due to lots affected at higher order being included in the control group while they should belong to the treatment group. Finally, for iterative orders three and four, estimates are close as only three lots have a different status for $k = 3$ and $k = 4$ (see Table 8). We find that the hourly prices of affected lots have risen by 3.4% relative to lots unaffected at any order.

In contrast, using the lots with at least one neighbor within 900m. (regardless of that neighbor's operator) as treatment group and the lots with no neighbor within this radius as control group yields a lower, statistically insignificant estimated price effect (sixth column).

Table 2: Comparing lots that are affected at order k with lots that are not (r=900m.)

	(I)	(II)	(III)	(IV)	(V)	(VI)
$L^0 \times \text{POST}_t$	0.004					
	(0.01)					
$L^1 \times \text{POST}_t$		0.022†				
		(0.01)				
$L^2 \times \text{POST}_t$			0.023			
			(0.01)			
$L^3 \times \text{POST}_t$				0.033*		
				(0.01)		
$L^\infty \times \text{POST}_t$					0.034*	
					(0.02)	
$N \times \text{POST}_t$						0.025
						(0.03)
Intercept	0.719**	0.709**	0.657**	0.657**	0.657**	0.657**
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
R^2	0.349	0.365	0.365	0.375	0.373	0.354
Number of obs.	510	510	510	510	510	510

Source: Mairie de Paris and Guide des parkings de Paris.
Dependent variable: Logarithm of hourly prices. All quarters of 2000 and 2001 but Q4-2000 and Q1-2001. Parking lot fixed effects and quarterly dummies are not shown. Standard errors are clustered by parking lots.
†, * , ** Significant at the ten, five, one percent levels.

We report in Table 3 the estimation results for equation (2) with a 900m. radius. The first column is the same as that of Table 2. The prices of the directly affected lots do not evolve differently from those of all the other lots. The second column takes as control group the set of lots that are unaffected at order one. Relative to this control group, prices

[13] As we shall see shortly, the 900m. radius lies in the middle of a range of distance values for which estimated effects are statistically significant and of the same order of magnitude.

seem to increase more for lots affected at order one but not at order zero than for directly affected lots, which would go against intuition. In fact, the corresponding coefficients, .014 and .032, are not significantly different (the p-value from the two-tailed comparison test is 28%). Moreover, as the p-value from the one-tailed test is 14%, we cannot reject, even at the 10 percent level, the assumption that, in accordance with intuition, prices have risen more for directly affected lots than for lots affected only at order one. The same observation holds when the control group is $L^k(900) = 0,\ k = 2, 3, 4$ (columns III to V of Table 3). Furthermore, for each of the presented models, we cannot reject the assumption that all the coefficients are equal.[14] The results shown in the fourth and fifth columns suggest that affected lots, irrespective of their iteration levels, have experienced price rises of about 3% relative to lots unaffected at any order. In other words, in the particular merger under study, the pattern of coefficients $\phi_0,\ \phi_1,\ \ldots,\ \phi_\infty$ turns out to be flat, suggesting strong indirect, strategic effects (see the discussion in Section 2).

As already seen in Table 2, lots with a neighbor within 900m. and lots with no neighbor within this radius do not experience statistically different price changes. The sixth column of Table 3 allows to understand this observation better, showing that lots unaffected at any order do not behave differently from lots with no neighbor at all (the coefficient -.005 in column VI is insignificant). Specifically, 11 parking lots among the 85 lots in the price sample have at least one neighbor within 900m. while being unaffected at any order (see Table 8). According to the analysis of Section 2, these lots should be included in the control group rather than in the treatment group. Empirically, here, the price evolution of these 11 lots turns out to be not significantly different from that of lots without any neighbor, corroborating the view that the lots unaffected at any order ($L^\infty(r) = 0$) constitute an appropriate control group.

Table 3: Incrementally increasing the iterative level (r=900m.)

	(I)	(II)	(III)	(IV)	(V)	(VI)
$L^0 \times \text{POST}_t$	0.004	0.014	0.019	0.028†	0.030†	0.027
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)
$(L^1 - L^0) \times \text{POST}_t$		0.032†	0.036†	0.045*	0.047*	0.044
		(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
$(L^2 - L^1) \times \text{POST}_t$			0.013	0.022	0.024	0.021
			(0.02)	(0.02)	(0.02)	(0.03)
$(L^3 - L^2) \times \text{POST}_t$				0.036	0.037	0.034
				(0.03)	(0.03)	(0.04)
$(L^\infty - L^3) \times \text{POST}_t$					0.012	0.008
					(0.03)	(0.04)
$(N - L^\infty) \times \text{POST}_t$						-0.005
						(0.03)
Intercept	0.719**	0.709**	0.704**	0.695**	0.693**	0.697**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)
R^2	0.349	0.370	0.373	0.383	0.384	0.384
Number of obs.	510	510	510	510	510	510

Source: Mairie de Paris and Guide des parkings de Paris.
Dependent variable: Logarithm of hourly prices. All quarters of 2000 and 2001 but Q4-2000 and Q1-2001. Parking lot fixed effects and quarterly dummies are not shown. Standard errors are clustered by parking lots.
†, * , ** Significant at the ten, five, one percent levels.

[14] For instance, in column V of Table 3, the p-value when testing the assumption that the five coefficients are equal is 65%.

Next, we investigate the role of the radius, running regressions for a range of radius values and different treatment groups. Each cell in Table 4 correspond to a different regression. All the regressions use the lots unaffected at any order ($L^{\infty}(r) = 0$) as control group. The columns of the table correspond to different radiuses, while the rows correspond to different treatment groups, namely the lots affected at order k, $k = 0, \ldots, 3$ and $k = \infty$. Thus, the first line of the table compares directly affected lots with lots that are unaffected at any order, whereas the last line compares lots affected at some order with lots unaffected at any order. Hence, except in this last line, the control and treatment groups do not include all the lots in the price sample. Table 4 reports the difference-in-differences coefficients, the standard errors, the coefficients of determination R^2, and the numbers of observations, which vary across cells. The coefficient of interest is significant for radiuses 850m. and 900m. (as well as for r=950m. and $k > 0$, but only at the 10% level). In line with the above results, Table 4 confirms that, for such radiuses, hourly prices of affected lots (whatever the iteration level) have risen by about 3% relative to lots unaffected at any order.

Table 4: The effect of the radius

	650m.	700m.	750m.	800m.	850m.	900m.	950m.	1000m.
$L^0 \times \text{POST}_t$	-0.012	-0.013	0.010	0.017	0.031†	0.030†	0.030	0.028
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
R^2	0.306	0.314	0.276	0.285	0.306	0.317	0.327	0.316
N	282	276	252	264	246	246	234	228
$L^1 \times \text{POST}_t$	-0.004	-0.006	0.006	0.021	0.033*	0.036*	0.034†	0.034†
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
R^2	0.319	0.330	0.339	0.357	0.372	0.396	0.404	0.407
N	438	420	378	378	366	384	366	372
$L^2 \times \text{POST}_t$	-0.005	-0.010	0.018	0.023	0.036*	0.034*	0.036†	0.034
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
R^2	0.336	0.336	0.333	0.340	0.357	0.377	0.379	0.370
N	396	408	402	414	420	450	456	462
$L^3 \times \text{POST}_t$	-0.007	-0.012	0.012	0.018	0.036*	0.035*	0.032†	0.032
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
R^2	0.342	0.342	0.330	0.350	0.372	0.377	0.366	0.366
N	426	450	480	504	492	492	498	486
$L^{\infty} \times \text{POST}_t$	-0.011	-0.013	0.013	0.018	0.036*	0.034*	0.032†	0.031
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
R^2	0.352	0.354	0.353	0.357	0.377	0.373	0.368	0.364
N	510	510	510	510	510	510	510	510

Source: Mairie de Paris and Guide des parkings de Paris.
Dependent variable: Logarithm of hourly prices. All quarters of 2000 and 2001 but Q4-2000 and Q1-2001. Parking lot fixed effects and quarterly dummies are not shown. Standard errors are clustered by parking lots.
†, * , ** Significant at the ten, five, one percent levels.

Finally, one may question the assumption that parking lots located in high-end arrondissements of central-western Paris, e.g. 1st, 8th, and 16th arrondissements, are subject to the same unobserved shocks as lots located in less valued districts, e.g. in the vicinity of the Parisian ring road. One can wonder whether parking prices in so different areas would have evolved similarly but for the merger. This fundamental limitation of the difference-in-differences approach can not be simply overcome. Yet, as a robustness check, we now interact time and local dummies and include in the regression time-varying dummies for the ring road area, for inner Paris, and for each arrondissement:[15]

$$\ln p_{it} = \mu + \alpha_i + \delta_{t,\text{inner}} + \delta_{t,\text{ring}} + \delta_{t,\text{arrond}} + \phi\, L^k(r) \times \text{POST}_t + \varepsilon_{it}. \qquad (3)$$

Rather than a single dummy variable for each quarter as in regression (1), equation (3) includes a number of time dummies at the local level.[16] The coefficients reported in Table 5 are somewhat higher than those of the baseline model (Table 2). The magnitude of the coefficient, however, is difficult to interpret as the difference-in-differences variable interacts with the time-varying local dummies in a complex manner. It is interesting, however, to check that Tables 2 and 5 show a similar pattern. In particular, prices of directly affected lots do not behave differently when compared to all the other lots; the same is true for prices of the lots with a neighbor within 900m. when compared to the lots with no neighbor within this radius. The highest estimates are obtained for iterative orders $k = 3$ and $k = 4$.

Table 5: Interacting time and local dummies ($r = 900$m.)

	(I)	(II)	(III)	(IV)	(V)	(VI)
$L^0 \times \text{POST}_t$	-0.006					
	(0.02)					
$(L^1 - L^0) \times \text{POST}_t$		0.031				
		(0.02)				
$(L^2 - L^1) \times \text{POST}_t$			0.035†			
			(0.02)			
$(L^3 - L^2) \times \text{POST}_t$				0.069*		
				(0.03)		
$(L^\infty - L^3) \times \text{POST}_t$					0.057†	
					(0.03)	
$(N - L^\infty) \times \text{POST}_t$						0.021
						(0.03)
Intercept	0.677**	0.660**	0.655**	0.642**	0.652**	0.688**
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
R^2	0.523	0.534	0.538	0.567	0.548	0.525
Number of obs.	510	510	510	510	510	510

Source: Mairie de Paris and Guide des parkings de Paris.
Dependent variable: Logarithm of hourly prices. All quarters of 2000 and 2001 but Q4-2000 and Q1-2001. Parking lot fixed effects and quarterly dummies at the ring road and arrondissements levels are not shown. Standard errors are clustered by parking lots.
†, * , ** Significant at the ten, five, one percent levels.

5.2 Using preexisting market areas

A number of merger studies resort to preexisting markets areas. For instance, Focarelli and Panetta (2003) use Italian provinces and Hortaçsu and Syverson (2007) use "component economic areas" created by the Bureau of Economic Analysis. Yet, as observed by Froeb, Tschantz, and Crooke (2003), "*market boundaries represent bright lines where there are only shades of gray*". The method presented above can be adapted to use a preexisting partition of the geographic market. We stress, however, that doing so entails serious limitations, from both a practical and a methodological point of view.

Based on a given partition of the market area into subareas, we say that an outlet is directly affected by the merger if, prior to the merger, it was operated by a merging firm

[15] See Footnote 6 in Section 2.
[16] Some local time dummies must be dropped for identification.

and a lot located in the same subarea was operated by the other party. We note Q^0 the corresponding dummy variable. Next, we say that an outlet is affected at order one by the merger if a directly affected outlet is located in the same subarea. We note Q^1 the corresponding dummy variable.[17]

On the methodological side, it is worthwhile noticing that the use of preexisting areas does not allow to reach iterative levels higher than one. More specifically, suppose we say that an outlet is affected at the order two if an outlet affected at order one is located in the same district. Such a definition would be irrelevant as the outlets affected at the orders one and two would be exactly the same. It is thus impossible to define variables Q^k, $k \geq 2$, in a similar way as we did above for variables L^k.

To illustrate the limitations of this approach in practice, we use two administrative partitions of Paris to build the above defined variables: the partition into the 20 Parisian *arrondissements* and the partition into 80 administrative districts.[18]

The first and second columns of Table 6 presents estimation results based on the arrondissements. Among the 85 lots in the price sample, 40 are directly affected and 53 are affected at the order one when the Parisian arrondissements are used. The difference-in-differences estimation yield counterintuitive results. In particular, prices of lots affected at order one but not at order zero increase more rapidly than those of directly affected lots (the estimated coefficients .007 and .075 are statistically different).

The third and fourth columns of Table 6 are based on a partition of Paris into 80 administrative districts.[19] Under this partition, 24 parking lots are directly affected and 28 lots are affected at order one. Building the groups on a district basis yields no statistically significant differences in differences. This might be due to the relatively small number of affected lots.

Overall, the results based on the two preexisting partitions of the Parisian market appear to be unreliable. The partitions have no economic relevance and do not allow to describe accurately how the merger has altered the market structure locally.

[17] The variables $Q^0 \times \text{POST}_t$ and $(Q^1 - Q^0) \times \text{POST}_t$ correspond to the variables INMERGE and RIVAL used by Focarelli and Panetta (2003).

[18] The total surface of Paris is 105km^2. The surfaces of the arrondissements range from 1km^2 to 8.5km^2. On average, a district is about 1.3km^2, the surface of a circle of 645m. radius. In Table 6, the variables Q^0 and Q^1 are labeled A^0 and A_1 when we use the partition into arrondissements and D^0 and D^1 when we use the partition into districts.

[19] Among the 80 districts, 71 have at least one city-owned parking lot, 55 districts have at least two, and 50 districts had at least two distinct operators prior to the merger.

Table 6: Using preexisting market areas (arrondissements and districts)

	(I)	(II)	(III)	(IV)
$A^0 \times \text{POST}_t$	-0.015	0.007		
	(0.01)	(0.01)		
$(A^1 - A^0) \times \text{POST}_t$		0.075**		
		(0.02)		
$D^0 \times \text{POST}_t$			0.004	0.005
			(0.01)	(0.01)
$(D^1 - D^0) \times \text{POST}_t$				0.022
				(0.03)
Constant	0.727**	0.706**	0.719**	0.718**
	(0.01)	(0.01)	(0.01)	(0.01)
R^2	0.356	0.439	0.349	0.351
Number of obs.	510	510	510	510

Source: Mairie de Paris and Guide des parkings de Paris. Dependent variable: Logarithm of hourly prices. All quarters of 2000 and 2001 but Q4-2000 and Q1-2001. Parking lot fixed effects and quarterly dummies are not shown. Standard errors are clustered by parking lots.

†, * , ** Significant at the ten, five, one percent levels.

5.3 Discussing the effect of the merger on parking prices in Paris

The results presented in Section 5.1 suggest that the Vinci/Gtm merger caused the hourly prices of affected lots to increase by about 3% relative to unaffected lots. Such a weak effect seems at odds with the large market share additions and HHI variations presented in Section 3.

A couple of reasons may explain the apparent paradox. First, the capacity constraints of the merging firms could attenuate the merger impact by more than the capacity constraints of nonmerging firms amplify them, in accordance with Froeb, Tschantz, and Crooke (2003). Second, and we think more importantly, the weak effect could be explained by the spatial distribution of the parking lots.

Since the merger involved many industries and many markets, the competition authorities could not proceed to an in-depth analysis of the Parisian parking market. They argued that relevant markets are generally monopolies in the parking industry as catchment areas are small and consumers walking costs are high, implying that the merger was likely to have little effect on parking prices. In the particular case of the Parisian market, this assertion is questionable. As Table 7 shows, 76 parking lots have a neighbor within 250m. and 144 lots have a neighbor within 500m. What really matters is that the lots operated by Vinci and Gtm tended to be located in distant areas. As regards the parking market in Paris, the retrospective analysis is rather supportive of the decision to clear the merger, even though the precise mechanism at stake had perhaps been overlooked at the time of the decision.

6 Conclusion

The methodology suggested in this note allows the practitioner to build control and treatment groups with the purpose of assessing the price effect of horizontal or vertical mergers. The iterative construction is consistent with the fact that mergers alter oligopolistic equilibria in complex ways, and thus that seemingly distant entities (outlets, firms, markets areas) may be affected through indirect channels. We argued that entities unaffected at any iterative order constitute the most pertinent control group.

The method provides a systematic construction of the groups. It is simple and ready to use, and requires less detailed data than structural approaches. On the other hand, it is subject to the usual limitations of reduced-form methods.

As the above example has shown, relying on preexisting partitions constrains the construction of the groups, thereby preventing the researcher from achieving robust results. In contrast, our method is flexible enough to run a large number of variants and robustness checks.

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A Appendix

Table 7 reports the number of lots affected and unaffected at any order for various radiuses. Table 8 provides the same information for city-owned lots. See Section 4 for details.

Table 7: Number of lots affected at any order for various radiuses (all lots with hourly prices)

Radius	L^0	L^1	L^2	L^3	L^4	L^5	L^6	L^7	L^8	N
250	(212, 2)	(209, 5)	(209, 5)	(209, 5)	(209, 5)	(209, 5)	(209, 5)	(209, 5)	(209, 5)	(138, 76)
300	(212, 2)	(209, 5)	(208, 6)	(206, 8)	(202, 12)	(202, 12)	(202, 12)	(202, 12)	(202, 12)	(124, 90)
350	(208, 6)	(203, 11)	(202, 12)	(200, 14)	(196, 18)	(196, 18)	(196, 18)	(196, 18)	(196, 18)	(107, 107)
400	(208, 6)	(202, 12)	(197, 17)	(195, 19)	(194, 20)	(192, 22)	(191, 23)	(191, 23)	(191, 23)	(95, 119)
450	(206, 8)	(200, 14)	(194, 20)	(191, 23)	(191, 23)	(191, 23)	(191, 23)	(191, 23)	(191, 23)	(84, 130)
500	(205, 9)	(196, 18)	(189, 25)	(183, 31)	(182, 32)	(182, 32)	(182, 32)	(182, 32)	(182, 32)	(70, 144)
550	(200, 14)	(179, 35)	(164, 50)	(154, 60)	(152, 62)	(152, 62)	(152, 62)	(152, 62)	(152, 62)	(57, 157)
600	(197, 17)	(170, 44)	(153, 61)	(145, 69)	(139, 75)	(132, 82)	(119, 95)	(117, 97)	(113, 101)	(44, 170)
650	(196, 18)	(163, 51)	(147, 67)	(138, 76)	(131, 83)	(118, 96)	(112, 102)	(107, 107)	(105, 109)	(41, 173)
700	(194, 20)	(155, 59)	(138, 76)	(123, 91)	(105, 109)	(97, 117)	(95, 119)	(95, 119)	(95, 119)	(35, 179)
750	(186, 28)	(135, 79)	(115, 99)	(89, 125)	(78, 136)	(74, 140)	(71, 143)	(71, 143)	(71, 143)	(24, 190)
800	(182, 32)	(129, 85)	(108, 106)	(79, 135)	(70, 144)	(69, 145)	(69, 145)	(69, 145)	(69, 145)	(20, 194)
850	(180, 34)	(126, 88)	(97, 117)	(70, 144)	(59, 155)	(49, 165)	(45, 169)	(44, 170)	(44, 170)	(17, 197)
900	(178, 36)	(116, 98)	(80, 134)	(54, 160)	(45, 169)	(39, 175)	(38, 176)	(38, 176)	(38, 176)	(10, 204)
950	(177, 37)	(113, 101)	(72, 142)	(45, 169)	(36, 178)	(33, 181)	(32, 182)	(32, 182)	(32, 182)	(7, 207)
1000	(176, 38)	(110, 104)	(67, 147)	(45, 169)	(34, 180)	(31, 183)	(30, 184)	(30, 184)	(30, 184)	(7, 207)
1050	(175, 39)	(108, 106)	(63, 151)	(39, 175)	(30, 184)	(27, 187)	(25, 189)	(24, 190)	(24, 190)	(5, 209)
1100	(172, 42)	(96, 118)	(49, 165)	(33, 181)	(28, 186)	(26, 188)	(23, 191)	(22, 192)	(22, 192)	(4, 210)
1150	(166, 48)	(80, 134)	(35, 179)	(19, 195)	(15, 199)	(14, 200)	(14, 200)	(14, 200)	(14, 200)	(4, 210)
1200	(165, 49)	(75, 139)	(32, 182)	(19, 195)	(15, 199)	(14, 200)	(14, 200)	(14, 200)	(14, 200)	(4, 210)
1250	(161, 53)	(54, 160)	(22, 192)	(16, 198)	(15, 199)	(14, 200)	(14, 200)	(14, 200)	(14, 200)	(4, 210)
1300	(157, 57)	(38, 176)	(18, 196)	(14, 200)	(14, 200)	(14, 200)	(14, 200)	(14, 200)	(14, 200)	(4, 210)
1350	(156, 58)	(36, 178)	(17, 197)	(13, 201)	(8, 206)	(8, 206)	(8, 206)	(8, 206)	(8, 206)	(4, 210)
1400	(152, 62)	(32, 182)	(15, 199)	(5, 209)	(4, 210)	(4, 210)	(4, 210)	(4, 210)	(4, 210)	(4, 210)
1450	(150, 64)	(30, 184)	(14, 200)	(4, 210)	(2, 212)	(2, 212)	(2, 212)	(2, 212)	(2, 212)	(2, 212)
1500	(148, 66)	(29, 185)	(13, 201)	(3, 211)	(1, 213)	(1, 213)	(1, 213)	(1, 213)	(1, 213)	(1, 213)
1550	(148, 66)	(29, 185)	(13, 201)	(3, 211)	(1, 213)	(1, 213)	(1, 213)	(1, 213)	(1, 213)	(1, 213)
1600	(148, 66)	(26, 188)	(11, 203)	(2, 212)	(0, 214)	(0, 214)	(0, 214)	(0, 214)	(0, 214)	(0, 214)
1650	(148, 66)	(26, 188)	(10, 204)	(2, 212)	(0, 214)	(0, 214)	(0, 214)	(0, 214)	(0, 214)	(0, 214)

Note: For a 900m. radius, 134 parking lots are affected at order two, 80 are not. Only 10 lots have no neighbor at all within this distance.

Table 8: Number of city-owned lots affected at any order for various radiuses (price sample)

Radius	L^0	L^1	L^2	L^3	L^4	L^5	L^6	L^7	L^8	N
250	(84, 1)	(84, 1)	(84, 1)	(84, 1)	(84, 1)	(84, 1)	(84, 1)	(84, 1)	(84, 1)	(59, 26)
300	(84, 1)	(84, 1)	(84, 1)	(82, 3)	(82, 3)	(82, 3)	(82, 3)	(82, 3)	(82, 3)	(53, 32)
350	(80, 5)	(79, 6)	(79, 6)	(77, 8)	(77, 8)	(77, 8)	(77, 8)	(77, 8)	(77, 8)	(42, 43)
400	(80, 5)	(79, 6)	(76, 9)	(76, 9)	(75, 10)	(74, 11)	(73, 12)	(73, 12)	(73, 12)	(38, 47)
450	(79, 6)	(77, 8)	(75, 10)	(73, 12)	(73, 12)	(73, 12)	(73, 12)	(73, 12)	(73, 12)	(33, 52)
500	(78, 7)	(74, 11)	(74, 11)	(71, 14)	(71, 14)	(71, 14)	(71, 14)	(71, 14)	(71, 14)	(29, 56)
550	(74, 11)	(68, 17)	(64, 21)	(56, 29)	(56, 29)	(56, 29)	(56, 29)	(56, 29)	(56, 29)	(24, 61)
600	(71, 14)	(61, 24)	(55, 30)	(50, 35)	(46, 39)	(42, 43)	(37, 48)	(36, 49)	(36, 49)	(20, 65)
650	(71, 14)	(59, 26)	(52, 33)	(47, 38)	(42, 43)	(36, 49)	(34, 51)	(33, 52)	(33, 52)	(18, 67)
700	(71, 14)	(57, 28)	(49, 36)	(42, 43)	(37, 48)	(32, 53)	(32, 53)	(32, 53)	(32, 53)	(15, 70)
750	(66, 19)	(50, 35)	(41, 44)	(28, 57)	(25, 60)	(23, 62)	(23, 62)	(23, 62)	(23, 62)	(10, 75)
800	(63, 22)	(45, 40)	(38, 47)	(23, 62)	(22, 63)	(22, 63)	(22, 63)	(22, 63)	(22, 63)	(9, 76)
850	(62, 23)	(45, 40)	(33, 52)	(21, 64)	(19, 66)	(19, 66)	(19, 66)	(18, 67)	(18, 67)	(9, 76)
900	(61, 24)	(41, 44)	(27, 58)	(20, 65)	(17, 68)	(17, 68)	(17, 68)	(17, 68)	(17, 68)	(6, 79)
950	(60, 25)	(40, 45)	(23, 62)	(16, 69)	(14, 71)	(14, 71)	(14, 71)	(14, 71)	(14, 71)	(5, 80)
1000	(59, 26)	(39, 46)	(20, 65)	(16, 69)	(14, 71)	(13, 72)	(12, 73)	(12, 73)	(12, 73)	(5, 80)
1050	(58, 27)	(37, 48)	(19, 66)	(15, 70)	(11, 74)	(9, 76)	(9, 76)	(8, 77)	(8, 77)	(3, 82)
1100	(56, 29)	(31, 54)	(15, 70)	(12, 73)	(10, 75)	(8, 77)	(8, 77)	(7, 78)	(7, 78)	(3, 82)
1150	(52, 33)	(23, 62)	(9, 76)	(4, 81)	(3, 82)	(3, 82)	(3, 82)	(3, 82)	(3, 82)	(2, 83)
1200	(51, 34)	(22, 63)	(8, 77)	(4, 81)	(3, 82)	(3, 82)	(3, 82)	(3, 82)	(3, 82)	(2, 83)
1250	(49, 36)	(15, 70)	(7, 78)	(4, 81)	(3, 82)	(3, 82)	(3, 82)	(3, 82)	(3, 82)	(2, 83)
1300	(47, 38)	(12, 73)	(5, 80)	(3, 82)	(3, 82)	(3, 82)	(3, 82)	(3, 82)	(3, 82)	(2, 83)
1350	(46, 39)	(11, 74)	(5, 80)	(3, 82)	(3, 82)	(3, 82)	(3, 82)	(3, 82)	(3, 82)	(2, 83)
1400	(44, 41)	(11, 74)	(5, 80)	(2, 83)	(2, 83)	(2, 83)	(2, 83)	(2, 83)	(2, 83)	(2, 83)
1450	(42, 43)	(10, 75)	(5, 80)	(2, 83)	(2, 83)	(2, 83)	(2, 83)	(2, 83)	(2, 83)	(2, 83)
1500	(40, 45)	(9, 76)	(4, 81)	(1, 84)	(1, 84)	(1, 84)	(1, 84)	(1, 84)	(1, 84)	(1, 84)
1550	(40, 45)	(9, 76)	(4, 81)	(1, 84)	(1, 84)	(1, 84)	(1, 84)	(1, 84)	(1, 84)	(1, 84)
1600	(40, 45)	(7, 78)	(3, 82)	(1, 84)	(0, 85)	(0, 85)	(0, 85)	(0, 85)	(0, 85)	(0, 85)
1650	(40, 45)	(7, 78)	(3, 82)	(1, 84)	(0, 85)	(0, 85)	(0, 85)	(0, 85)	(0, 85)	(0, 85)

Note: For a 900m. radius, 58 city-owned lots are affected at order two, 27 are not. Only 6 city-owned lots have no neighbor at all within this distance.

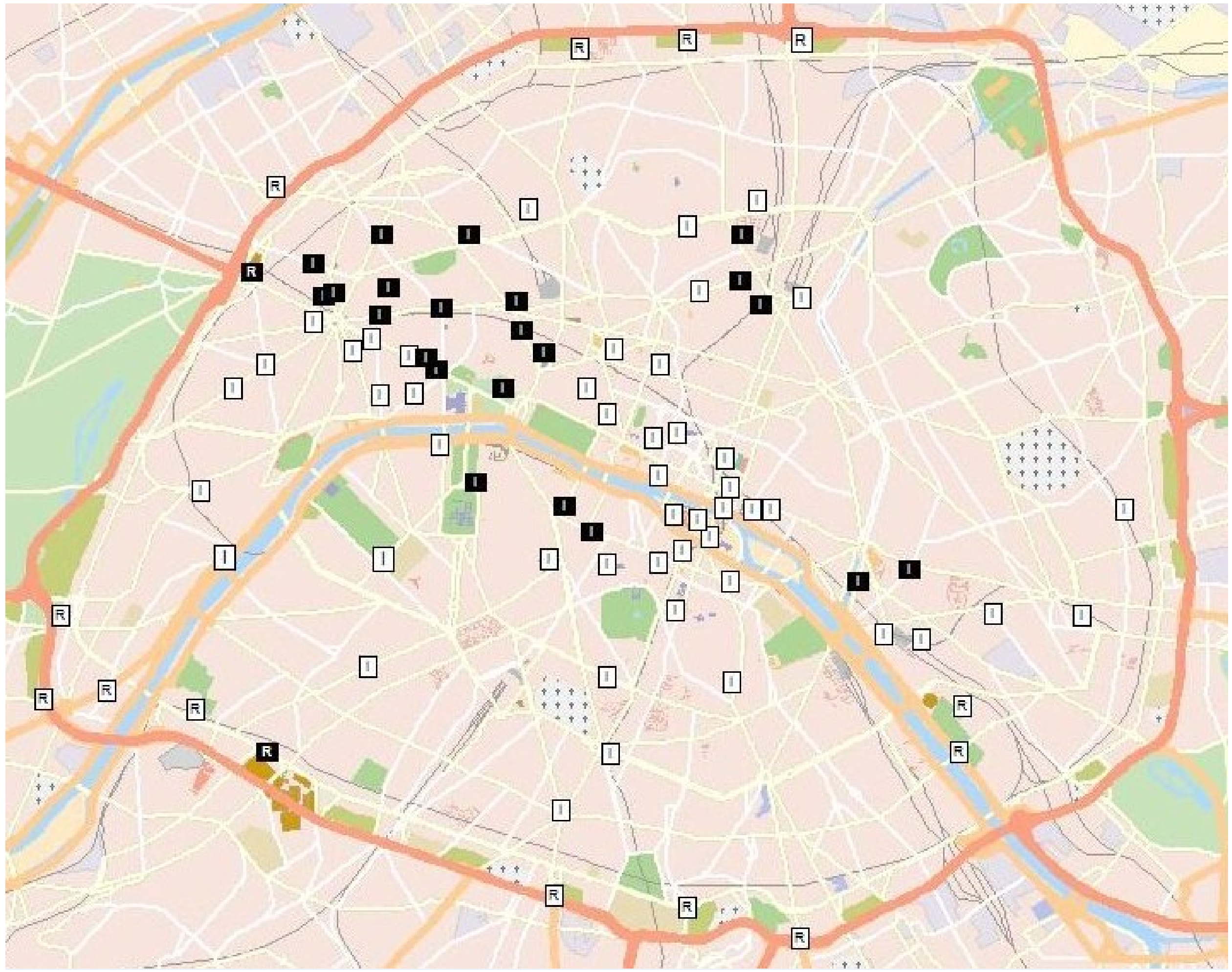

Figure 1: Black squares: Directly affected city-owned parking lots for r=900m. White squares: Other city-owned lots. The labels “I” and “R” stand for “Inner Paris” and “Ring road area” in equation (3).

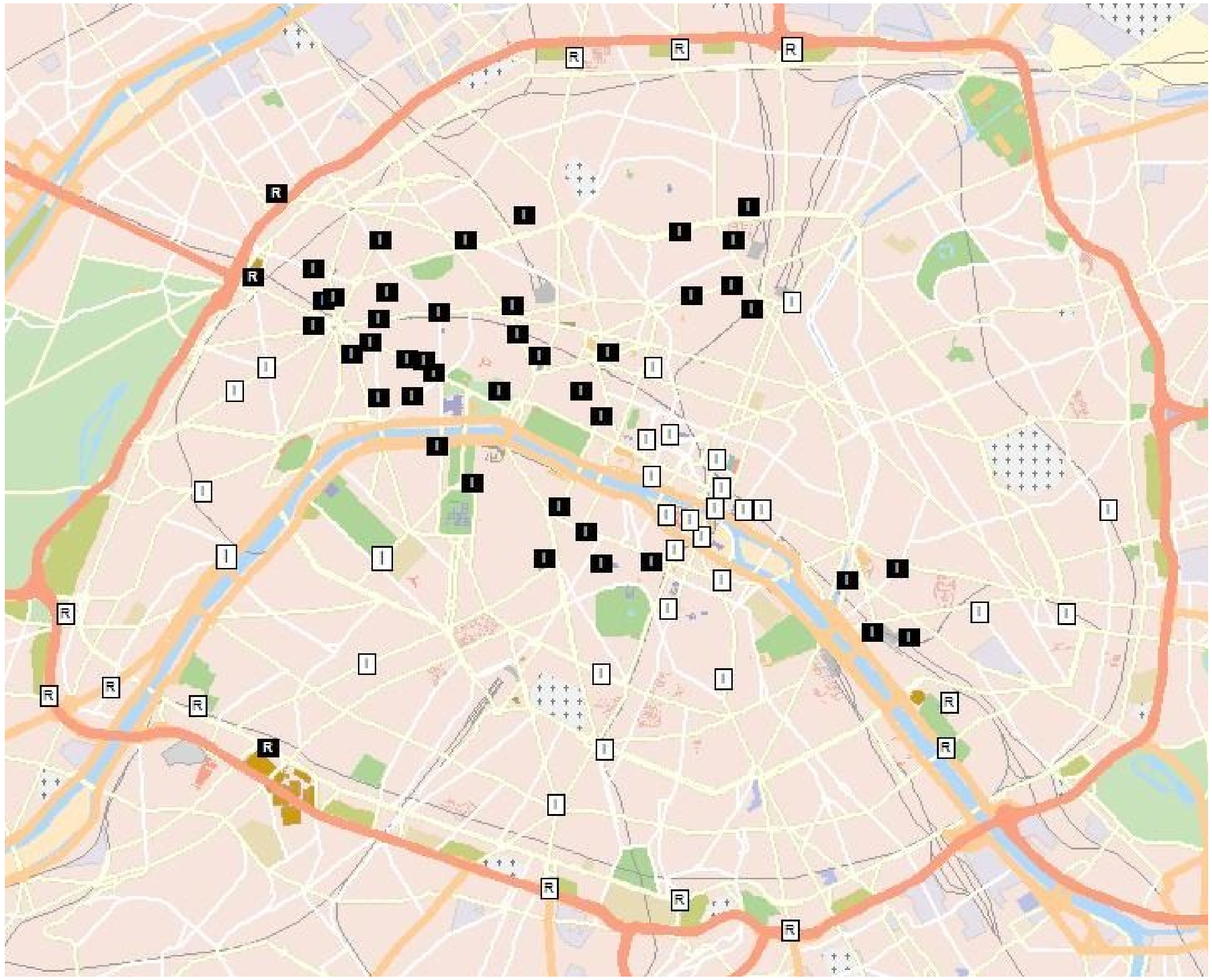

Figure 2: Black squares: City-owned lots affected at order one for r=900m. White squares: Other city-owned lots. The labels “I” and “R” stand for “Inner Paris” and “Ring road area” in equation (3).

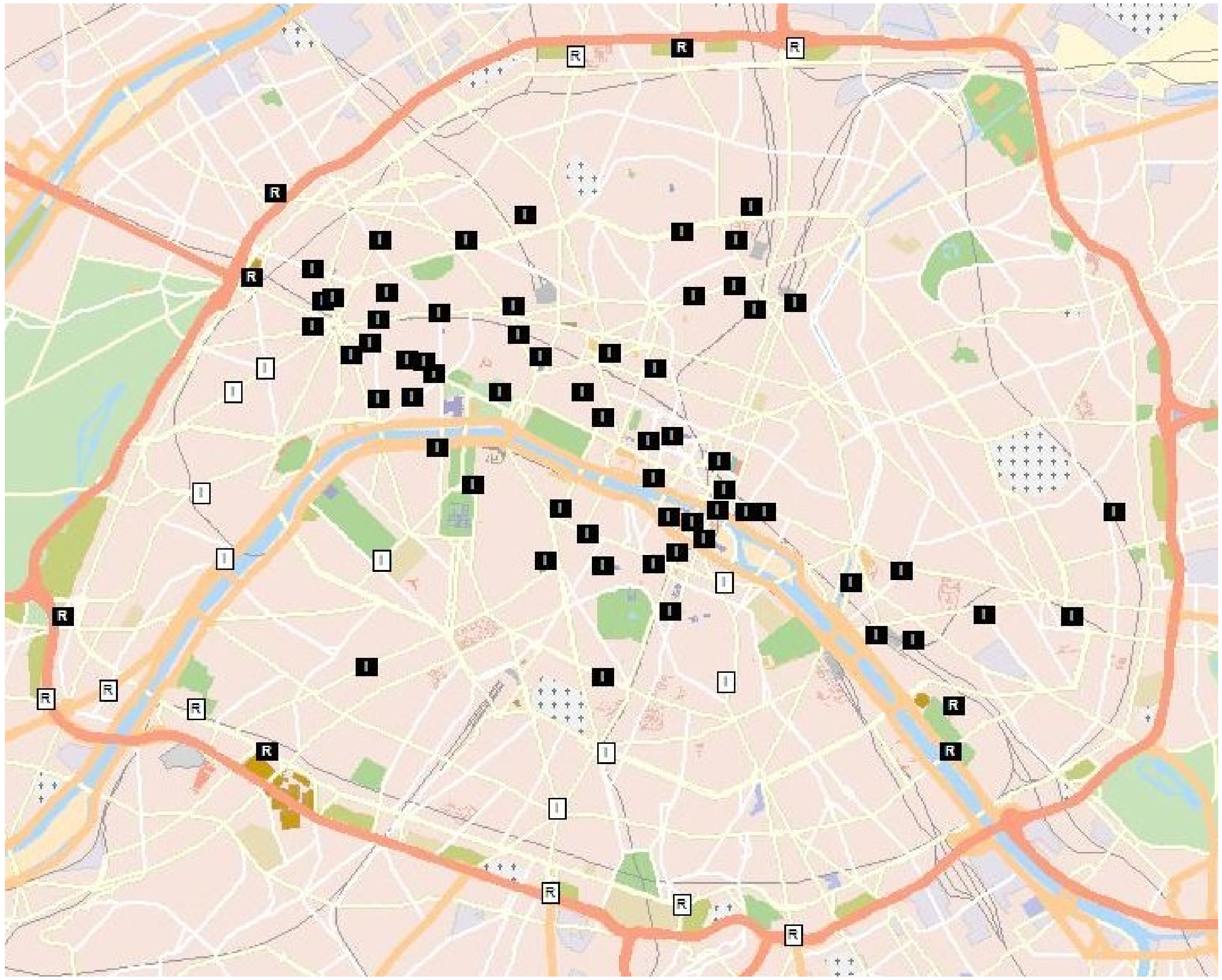

Figure 3: Black squares: City-owned lots affected at some order for r=900m. White squares: City-owned lots unaffected at any order for r=900m. The labels "I" and "R" stand for "Inner Paris" and "Ring road area" in equation (3).