When do Better Schools Raise Housing Prices? Evidence from Paris Public and Private Schools*

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August 2008

Abstract

In this paper, we investigate how housing prices react to the quality of education offered by neighboring public and private schools. The organization of secondary schooling in the city of Paris, which combines residence-based assignment to public schools with a well-developed and almost entirely publicly funded private school system, offers a valuable empirical context for analyzing how private schools affect the capitalization of public school performance in housing prices. Using comprehensive data on both schools and real estate transactions over the period 1997-2004, we develop a matching framework to carefully compare sales across school attendance boundaries. We find that a standard deviation increase in public school performance raises housing prices by 1.5 to 2.5%. Moreover, we show that the capitalization of public school performance in the price of real estate shrinks as the availability of private schools increases in the neighborhood. Our results confirm the predictions of general equilibrium models of school choice that private schools, by providing an advantageous outside option to parents, tend to mitigate the impact of public school performance on housing prices.

JEL Classification H41, I21, I28, R21
Keywords School attendance zones, private schools, housing markets, residential segregation

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1 Introduction

Motivation In France, as in many other countries, there is an ongoing debate on how residence-based assignment to schools affects both educational and residential segregation. Theoretical models (including Bénabou, 1993; Fernández and Rogerson, 1996) have shown that the existence of peer effects in education yields income and residential sorting in equilibrium. One of the key parameters of these models is the willingness of parents to pay for school performance. The higher the value of this parameter, the higher the level of sorting when admission to schools is tied to residence. However, these effects might be mitigated in the presence of private schools, which operate under different rules of admission. In this paper, we test the theoretical predictions of models of housing markets in which public and private schools coexist (Nechyba, 1999, 2000, 2003). We estimate the impact of school performance on housing prices and investigate how this effect varies with the availability of private schools in the neighborhood.

Related literature Several empirical papers have sought to test the empirical prediction that housing prices should be higher in areas where schools perform better. Earlier papers have estimated hedonic regressions in which housing prices are regressed on school performance, controlling for housing and neighborhood characteristics[1]. Unfortunately, these early estimates are plagued by endogeneity problems, since better schools tend to be located in wealthier neighborhoods and pupils drawn from privileged socio-economic backgrounds have higher academic achievement. If the estimation strategy fails to correct for observable and unobservable neighborhood characteristics, potentially correlated both with housing prices and school performance, then the estimated marginal willingness to pay for a better school will suffer from severe biases. In her 1999 paper, Black proposed a method to solve this problem by comparing housing prices across primary school attendance district boundaries. The identifying assumption is that changes in school performance are discrete at boundaries, while changes in neighborhood characteristics are smooth. The difference in mean housing prices located on opposite sides of attendance district boundaries can therefore be related to differences in school test scores only. When restricting the sample to the set of sales located within 0.15 mile of a boundary, Black finds that a 5% increase in primary schools' test scores (approximately one standard deviation) is associated with a 2.1% increase in housing prices, which is half the value of the "naive" OLS estimate. On UK data and using an alternative estimation strategy to correct for spatial fixed effects[2], Gibbons and Machin (2003,

[1]In the French context, Gravel and Trannoy (2006) have conducted the first study using data from a Parisian suburb. For a review of other earlier papers, see Black (1999).

[2]In the UK, the estimation strategy cannot rely on school boundary fixed effects, since school catchment areas are not strictly defined. Proximity to primary schools is only one criterion among

2006) find an effect of the same order of magnitude for primary schools. A study by Bayer et al. (2003) yields similar results using a discrete choice model instead of a hedonic model. Furthermore, these authors provide evidence of significant heterogeneity in the marginal willingness of households to pay for school performance. A few papers have exploited changes in school boundaries over time. Bogart and Cromwell (2000) measure the effect of reshaping school catchment areas and introducing school busing and find a negative impact of these policy changes on housing prices. Reback (2005) exploits the adoption of open enrolment for public schools in Minnesota and finds that housing prices tend to increase in school districts where pupils are able to transfer to their preferred schools, while they decline in districts that receive these transfer pupils.

Some papers have looked more precisely at which components of school quality are most valued by parents[3]. The results of these studies are mixed, but the most recent papers, including Downes and Zabel (2002) and Brasington and Haurin (2006), suggest that parents react to school performance measures based on average test scores but not to value-added measures of school quality. In addition, Clapp et al. (2008) find that school demographic composition, such as the percentage of Hispanic students, also affects housing prices.

A few papers have investigated whether the release of new information about school quality yields changes in housing prices. Figlio and Lucas (2004) study the introduction of a new school accountability system in Florida and find that housing markets first respond strongly to the new letter grading of schools but that the effect dissipates after a few months. Indeed, the new grading appears to provide relatively noisy information on school quality, with a lot of fluctuation of school letter grades over time. Using the introduction of a similar school accountability system based on test scores and value-added measures in the Charlotte-Mecklenburg county in North Carolina, Kane et al. (2003) do not find any significant impact of the release of new measures of school performance on housing prices, but a significant impact of the long-run test scores averages. Finally, Kane et al. (2006) argue that the effect of school quality on housing prices does not only reflect differences in school performance, but also differences in neighborhood characteristics arising from households sorting along school attendance boundaries. Using data on the Charlotte-Mecklenburg county, they show that neighborhood characteristics change discontinuously at boundaries when school quality differentials are sufficiently large. These differences across boundaries might be particularly important in this county, which was operating under a court-imposed desegregation order that drew school boundaries so that students living in the same neighborhood were sent to differ-

others for admission in schools and Cheshire and Sheppard (2004) point out that living in a house near a boundary might render admission to a school more uncertain than living in a house located in the immediate vicinity of a school.

[3]For a comprehensive review of these papers, see Brasington and Haurin (2006).

ent schools. However, these results suggest that it is important to compare sociodemographic characteristics across boundaries when studying the impact of school performance on housing prices.

Almost all of these studies focus on public schools and although many acknowledge that the presence of private schools might affect the premium paid for public schools, none of them has studied this question in depth. To our knowledge, our paper is the first to investigate the effect of private schools on the housing price premium attached to public school performance.

The paper's focus In respect to this existing literature, our paper innovates in two main directions. First, we improve the estimation strategy originally proposed by Black (1999) to deal with the endogeneity of school performance in the housing price equation. We do so by developing a matching framework which consists in the careful comparison of sales across public middle school attendance boundaries. We also investigate the validity of this identification strategy by checking precisely if other neighborhood characteristics vary discontinuously across boundaries.

Second, we investigate whether private school choice reduces the capitalization of public school performance in housing prices. We use comprehensive data on both schools and real estate transactions in the city of Paris over the period 1997-2004 to study how the availability of private schools locally affects the willingness to pay for better public schools. The organization of middle schooling in the city of Paris, which combines residence-based assignment to public schools with a well-developed and almost entirely publicly funded private school system, offers a valuable empirical context for analyzing this issue.

Using different measures of school performance, we find that a standard deviation increase in school performance raises housing prices by 1.5 to 2.5%. The size of this effect is similar to existing estimates in the US and UK contexts and can explain roughly 5% of the observed difference in housing prices between adjacent school zones. We also find that the price premium attached to good public schools exhibits spatial heterogeneity and varies with the availability of private schools in the neighborhood. In line with the theoretical predictions of general equilibrium models of school choice, the presence of good private schools in certain neighborhoods tends to attenuate the capitalization of public school performance in housing prices, by providing an advantageous outside option to parents.

The remainder of this paper is as follows: section 2 describes the baseline estimation strategy of the impact of public school performance on housing prices; section 3 briefly presents the French educational system and school admission rules; section 4 gives a description of the data; section 5 presents the basic results; section 6 performs some robustness checks and section 7 evaluates the impact of private schools on the capitalization of public school performance in housing prices.

2 Estimating the impact of public school performance on housing prices

In this section, we present our empirical framework to assess the impact of public school performance on housing prices. We start by discussing the bias induced by the endogeneity of school performance in the classic hedonic models before describing the boundary fixed effect approach that has been proposed to overcome it. We then present our method, which consists in matching sales across common middle school attendance boundaries.

2.1 The baseline model

Within a city, the price per square meter (taken in natural logarithm) of a transaction i located in neighborhood n, belonging to school zone s during school year t, is assumed to depend linearly on a school performance z_s index, a vector of observable features of the flat (floor, age of the building, number of rooms, etc.), a time-varying neighborhood effect $\theta_{n,t}$ and an error term $\epsilon_{i,n,s,t}$:

$$\ln p_{i,n,s,t} = \alpha + \beta . z_s + X_{i,n,s,t}\gamma + \theta_{n,t} + \epsilon_{i,n,s,t} \tag{1}$$

In this relatively flexible housing equation, the school performance index z_s is assumed to capture the medium-run characteristics of the local public middle school that are valued by households when making their residential choice. The time-varying neighborhood effect $\theta_{n,t}$ captures local factors, such as local amenities or the neighborhood's socio-demographic composition, that affect prices on the housing market. They are supposed to vary through space. Finally, the error term $\epsilon_{i,n,s,t}$ includes all the unobservable characteristics that influence the price of a particular sale i. The coefficient β, which measures the impact of school performance on housing prices, is our parameter of interest.

In our model, neighborhood time-varying effects $\theta_{n,t}$ are not necessarily independent of school performance z_s. In particular, $\theta_{n,t}$ incorporates the socio-economic composition of a particular neighborhood, which can influence both school performance through peer quality and housing prices by making an area more or less enjoyable to live in. However, the crucial assumption that will be maintained throughout the paper is that within a common neighborhood n observed in year t and given a flat's observable features $X_{i,n,s,t}$, the unobservable component of housing prices $\epsilon_{i,n,s,t}$ is mean-independent of school quality:

$$E(\epsilon_{i,n,s,t} \big| z_s, X_{i,n,s,t}, \theta_{n,t}) = 0$$

Importantly, the unobservable component of housing prices $\epsilon_{i,n,s,t}$ is not assumed to be i.i.d.. Unobservable shocks that determine housing prices in addition to flat, neighborhood and school characteristics are indeed most likely to exhibit serial and spatial correlation.

2.2 The endogeneity of school performance

The standard hedonic housing price function describes the price of a particular sale as a function of the flat's observable features, which include its intrinsic characteristics (size, floor, etc.) as well as its neighborhood characteristics. The corresponding coefficients are supposed to measure the marginal purchaser's willingness to pay for each specific characteristic. The typical hedonic function for housing prices takes the following form:

$$\ln p_{i,c,s,t} = a + b.z_s + X'_{i,c,s,t}c + N'_{i,c,s}d + L'_t e + u_{i,c,s,t} \tag{2}$$

where $p_{i,c,s,t}$ is the price of sale i, located in census district c, in school attendance zone s during school year t; z_s is the performance index of school s, $X_{i,c,s,t}$ the vector of the flat's features, $N_{i,c,s}$ the vector of neighborhood socio-demographic characteristics (at the census district level), L_t a vector of time dummies and $u_{i,c,s,t}$ is the error term. The OLS estimate of parameter b is supposed to measure β, the marginal willingness to pay for a better performing school.

As pointed out by Black (1999), this methodology will produce upwardly biased estimates if the error term $u_{i,c,s,t}$ includes unobservable neighborhood characteristics that are correlated with school performance z_s and have an independent effect on housing prices. If the true underlying model of housing prices is described by equation (1), the hedonic model will suffer from omitted variable bias as long as the variables included in the right hand side of the regression equation fail to fully account for the time-varying neighborhood fixed effect $\theta_{n,t}$.

Black (1999)'s estimation strategy consists in focusing exclusively on the set of sales that take place in the vicinity of a school attendance boundary. Under the assumption that unobservable determinants of housing prices vary continuously through space, the causal impact of school performance on housing prices can be estimated by comparing sales across common school attendance boundaries, which create spatial discontinuities in school performance.

However, this strategy implies several restrictions. The characteristics of flats are assumed to have the same impact on prices in all neighborhoods and school attendance boundary fixed effects are assumed to be constant across years. An additional feature of the school boundary fixed effect strategy is that the comparison of sales located on both sides of a common attendance boundary does not take into account the distance between these sales. In particular, this methodology assumes that whatever the length of a particular border, flats located on both sides but at opposite ends of a particular boundary share the same unobservable characteristics. This may not be true in the case of very long boundaries passing through relatively different neighborhoods. In that case, a more efficient estimation strategy would consist in restricting a sale's comparison group to the set of transactions that are located within a certain radius from that sale.

2.3 The paper's estimation strategy

In order to circumvent the limitations of the boundary fixed effect estimation strategy, we adopt a matching framework that restricts a transaction's comparison group to a carefully constructed counterfactual sale located on the other side of the common school attendance boundary and within a given radius of that specific transaction. The principles governing our estimation strategy are explained below and figure 1 shows how it applies for a particular set of sales.

First, to account for the fact that the price premium attached to a specific flat feature may vary throughout the area under study, we correct the prices of all sales for area-specific flat features effects, these areas being known to be relatively homogenous and to follow similar trends in prices[4]. The prices of all sales are homogenized in the sense that there are expressed in terms of a "typical flat equivalent price"[5]. We call "hedonic prices" these corrected housing prices[6]. Appendix A explains in detail how they are computed.

We suppose that the price per square meter (taken in log) of a transaction i, assigned to public middle school s, located in the vicinity of a school attendance boundary b and completed during school year t is determined by the following equation:

$$\ln p_{i,b,s,t} = \alpha + \beta.z_s + X_{i,b,s,t}\gamma + \theta_{b,t} + \epsilon_{i,b,s,t} \tag{3}$$

where the subscript b indicates that the sale is located in the vicinity of school boundary b. We call "reference" sales all housing transactions that are located within a certain distance d of a school attendance boundary[7]. For each reference sale i, we construct a fictive "counterfactual" sale i' which is located on the other side

[4]In the city of Paris, we have defined 18 such areas.

[5]In the case of Paris, the typical flat has two rooms, belongs to a building constructed between 1850 and 1913, is located on the ground floor, has one bathroom and average size rooms, has no maid's room nor parking space and was sold during the fourth quarter of a particular year.

[6]While this correction is not essential to our estimation strategy (since flats located on both sides of common attendance boundaries should share similar features on average), it will increase the precision of our estimates by reducing the noise associated with the heterogeneity of flats' observable characteristics.

[7]Note that a given reference sale could potentially be matched with different counterfactual sales located along distinct school attendance boundaries. This would be the case in particular for sales in the "corners" of school attendance zones. To avoid using the same references sales in different matches (a feature that would induce serial correlation in housing prices across different boundaries), we decided to assign each sale to its closest boundary. Hence as long as they belong to distinct boundaries, our matches will be constructed using different sales.

of the common school attendance boundary (s, s'). The price of this counterfactual sale is supposed to measure the amount for which the reference transaction would have been sold, had it been located in school attendance area s' rather than in school attendance area s, everything else being equal.

The price of the counterfactual transaction i' cannot be observed and has to be estimated. We do so by calculating the weighted geometric mean of the prices of all transactions j that took place in the vicinity and during the same school year t as the reference sale i, but that were assigned to school s' rather than to school s. More precisely, we define the set $H_{i',s',b,t}$ of sales used to construct the counterfactual sale i' as:

$$H_{i',s',b,t} = \left\{ j : d_{i,j} \leqslant d,\ s' \neq s \right\}$$

This set includes all the sales located within a radius d of the reference sale i, completed in year t and assigned to school s'.

The transactions used to construct the counterfactual sale are weighted by the inverse of their distance $d_{i,j}$ to the reference sale i, in order to give more importance to the sales that are located nearby relatively to the more distant ones. Hence, the counterfactual sale's estimated price per square meter $p_{i',b,s',t}$ is calculated as:

$$\ln p_{i',b,s',t} = \sum_{j=1}^{J} w_{i,j} \ln p_{j,b,s',t}$$

where $J = \text{Card}(H_{i',s',b,t})$ and the weights $w_{i,j}$ are defined as:

$$w_{i,j} = \frac{\frac{1}{d_{i,j}}}{\sum_{j=1}^{J} \frac{1}{d_{i,j}}}$$

By definition, the price of each counterfactual sale i' can be written as:

$$\ln p_{i,b,s',t} = \alpha + \beta.z_{s'} + \theta_{b,t} + \epsilon_{i',b,s',t}$$

where the disturbance term $\epsilon_{i',b,s',t}$ is a weighted average of the disturbance terms of the sales used to construct the counterfactual:

$$\ln \epsilon_{i',b,s',t} = \sum_{j=1}^{J} w_{i,j} \ln \epsilon_{j,b,s',t}$$

The identification of the "public middle school effect" relies on the crucial assumption that the counterfactual sale i' and the reference sale i share the same unobservable time-varying neighborhood effect $\theta_{b,t}$. Under this assumption, the housing price differential between the reference sale and the constructed counterfactual can be written:

$$\ln p_{i,b,s,t} - \ln p_{i',b,s',t} = \beta(z_s - z_{s'}) + \epsilon_{i',b,s',t} - \epsilon_{i,b,s,t} \quad (4)$$

Parameter β can be estimated by running an OLS regression of the price differential between the reference and the counterfactual sale on the corresponding school performance differential. Since the identifying assumption is more likely to hold for matches that are geographically close[8], we perform weighted OLS regressions, the weight given to a particular match being equal to the inverse of the distance between its components.

An important feature of the housing price differential equation (4) is that by construction, the composite error term $(\epsilon_{i',b,s',t} - \epsilon_{i,b,s,t})$ is not i.i.d.. In this equation, serial correlation arises for two reasons. First, as emphasized earlier, the unobservable housing price component of the reference sales $\epsilon_{i,b,s,t}$ may exhibit spatial and serial correlation. Second, the counterfactual error term $\epsilon_{i',b,s',t}$ is itself a weighted average of the unobservable housing price components of the different sales that are used to construct it. The error terms $\epsilon_{i',b,s',t}$ will therefore exhibit spatial correlation along a given boundary because the same sales will be used in the construction of several counterfactuals. Note however that spatial correlation in the error term will only affect the matches that belong to the *same* school attendance boundary. Hence, provided that we standard errors are clustered at the school attendance boundary level, the serial correlation in equation (4) will be entirely accounted for. We will do so in the rest of our analysis.

In the next section, we emphasize the features of the French educational system that are relevant to the present analysis as well as the rules that govern public and private school admission in the city of Paris.

3 Public and private middle schooling in Paris

3.1 The French educational system

3.1.1 General organization

The French educational system is highly centralized an fairly homogenous until pupils reach the age of 14. Children spend 5 years in primary school (age 6 to 10), 4 years in middle school or *Collège* (age 11 to 14) and 3 years in high school or *Lycée* (age 15 to 17).

Education in France is predominantly public, public schools accounting for 86%

[8]For each match, the distance between the reference and the counterfactual sale is computed using their respective geographic coordinates. The geographic coordinates of the reference sale are known. The counterfactual's geographic coordinates are computed as the weighted average coordinates of the sales that were used to construct it, with weights equal to the inverse of their distance to the reference sale.

of primary school enrollment and 79% of secondary school enrollment[9]. Public education is centrally financed[10] and supervised at the local level by 35 Local Education Authorities (LEAs) called *Académies*. They are in charge of managing human and financial resources and of implementing the official educational programs produced by the Ministry of Education. Importantly for our study, the city of Paris is under the supervision of one unique *Académie*, which decides how to allocate pupils and resources to schools. Human and financial resources are for the most part allocated to schools on the basis of enrollment, so spending per pupil is fairly similar across different institutions[11] as well as the characteristics of teachers.

Private education in France is predominantly religious, 90% of private schools being Catholic. However, several institutional features of French private schools make them very different from their UK or US counterparts and should be kept in mind when interpreting our results.

A first specificity of French private schools is that most of them are publicly funded, especially at the primary and middle school levels[12]. Publicly funded private schools are subject to State supervision: they follow the national curriculum and appoint qualified teachers who are paid by the State[13]. Schools are authorized to set fees, but only to pay the costs that are not publicly funded such as optional courses, which often include religious education. As a result, private education is usually not free but the fees are modest and usually in the range of 500 to 2,000 euros per annum, plus small additional costs.

A second specificity of private education in France is that the State exerts a direct control over the size of the subsidized private sector, through two main channels. First, the opening of new private schools is subject to very tight restrictions. New private institutions cannot be publicly financed without the approval of an *ad hoc* board (composed of members of the Ministry of Education, representatives of local communities and representatives of private schools) and must meet a "recognized need for education" (*"besoin scolaire reconnu"*)[14]. Second, the Ministry of Education can decide to keep the size of the private sector within certain limits by imposing a cap on the number of positions that are offered every year in the competitive examination for the recruitment of private school teachers. Indirect evidence seems to point out that the actual size of the private sector is kept smaller than needed to

[9]See de Monredon (2008) and Jaspar (2008).

[10]This aspect of the French educational system implies that contrary to the US system, public school finance does not depend on local taxation.

[11]It has been shown that even the French *Zones d'Education prioritaire* program, which was supposed to channel additional resources to schools in disadvantaged areas, translated only into a 10% increase in spending per middle school pupil (Bénabou et al., 2005).

[12]We therefore decided to exclude from our analysis the few very particular schools that are privately funded at the middle school level (3 out of 68 in Paris).

[13]There is a specific competitive exam for recruiting private school teaching (called *CAFEP-CAPES*), which is very similar to the competitive exam for recruiting public school teachers.

[14]See art. L442-5 to L442-11 of the *Code de l'Éducation*.

satisfy the demand for private education, especially in large cities[15].

3.2 Public and private school admission rules

The rules governing school admission are probably the most important feature that distinguishes public middle schools from private middle schools in France.

During the period under study (1997-2004), primary and middle school assignment was purely residence-based[16]. It was also "strict" in the sense that each school catchment area contained one school only, which means that in principle parents could not choose their child's public school. However rigid this system may appear, it allowed some exceptions. There were basically two ways parents could get round school catchment areas without actually changing residence. First, they could ask the LEA for a dispensation that entitled them to send their children to a school located outside their attendance zone. These dispensations could be granted on several grounds: if specific options or "rare" languages (*e.g.* Russian or Japanese) were not taught in the local school, if a child's sibling was enrolled in a different school or exceptionally if the local school was located much further away from home than a school belonging to an adjacent zone[17]. Every year, dispensations were granted to about 8% of Parisian pupils entering middle schooling, the rate of rejection being around 40%. While a substantial fraction of these dispensations had true practical justifications, some parents may have used them to avoid what they perceived as low-performing local middle schools. The second way of getting round the zoning system was to use the outside option provided by the extensive network of highly subsidized private middle schools.

Private schools in France are not subject to any zoning scheme. Because they can select their pupils from anywhere in the city, private schools offer a relatively cheap (but subject to rationing) outside option to parents who are willing to avoid the constraints of strict school zoning. This particular feature explains that although private schools are predominantly Catholic, the choice of private education is now driven by educational rather than by purely religious motives[18] (Langouët and Léger, 1997). The rules for admission in private schools are not always explicitly stated[19]

[15]According to the President of the French National Association of Private Catholic Schools, over 25,000 applications to Catholic schools had to be rejected before the start of academic year 2006-2007 because of oversubscription (*"L'école privée affiche toujours complet"* ["Private schools are still over-subscribed"], *Le Figaro*, October 15, 2007).

[16]This system came to an end in 2007 through a series of reforms that were aimed at giving parents more freedom to choose their child's public school.

[17]This might happen when the local school is not located in the center of its catchment area.

[18]As an indication of this, families do not hesitate to switch between public and private sectors, especially when their children reach the middle or high school level. For example, during school year 2004, about a quarter of pupils enrolled in Parisian private middle schools came from public Parisian primary schools (and 3% of pupils enrolled in public middle schools came from a private primary school).

[19]It should mentioned however that over the past few years, an increasing number of private

and vary from school to school. The most commonly used criteria are academic excellence, presence of an older sibling in the school, good behavior and commitment to the school's values[20].

While most existing empirical studies of the impact of school performance on housing prices have focused on primary schools, we investigate what happens during the first part of secondary education. The main reason for taking this approach is that in the French school system, middle schooling is the educational stage that is most likely to have the largest influence on housing markets.

The conjunction of strict middle school zoning and relatively wide high school choice explains the important role played by middle schooling among other determinants of residential choice. At the end of middle schooling, families can send applications to any particular high school located within their attendance area, the city being divided into 4 large attendance areas (North, South, East and West), which all contain both high and low performing high schools. Competition to enter the best institutions is quite vivid, and parents are conscious of the importance of sending their children to a good middle school as a means of increasing their chances of being admitted into a good high school. Given the stringency of public middle school zoning, there are reasons to believe that the school performance factor should act as an important determinant of residential choice in the Parisian context.

4 Data and summary statistics

To estimate the impact of school performance on housing sales in Paris, we have collected data on school zones, school characteristics, individual property sales and local socio-demographic characteristics during school years 1997-2004.

4.1 Schools

4.1.1 School catchment areas in Paris

Data on school zones was provided by the Paris LEA (*Rectorat de l'Académie de Paris*). During the period under study, the LEA was in charge of drawing the assignment zones of primary and middle schools. Because of their central role in our estimation strategy, school catchment areas are worth examining in some detail.

School catchment areas are released every school year in the form of booklets that indicate, for each street section, the assigned public middle school. Using the complete set of geolocalized addresses of the city of Paris, we were able to map each of the 108 public middle school catchment areas for every school year between

schools have decided to publish their selection policies and procedures on their websites.

[20]Note that applicants to Catholic middle schools are usually not required to be baptized or to have been previously enrolled in a religious primary school.

1997 and 2003. Figure 2 displays the particular layout of school catchment areas that prevailed in 2003-2004. This map shows that in most cases, middle school zones are contiguous, even if sometimes they can be splitted into two or three parts (see for example the Henri Bergson middle school zone in figure 3). A closer look reveals that that many school zone boundaries are not straight, but rather have a zigzag shape. Given our estimation strategy, middle school boundaries thus seem to share two highly desirable properties: first, they tend to split otherwise similar neighborhoods, a feature that is needed for credible identification; second, they are numerous enough to yield precise estimates.

A serious concern that has been raised about using school zone boundaries as an exogenous source of variation in public school performance is that they are likely to coincide with other administrative divisions, which might be associated with other discontinuities than school performance. In the Parisian context, school catchment areas can be clearly distinguished from other administrative divisions. The first thing to note is that the Paris LEA covers a single municipality: local tax rates are therefore equal throughout the covered area. Moreover, each of the 20 administrative subdivisions of the city of Paris (*arrondissements*), which may differ at the margin in terms of public goods provision, comprises several school attendance zones. To ensure that these administrative subdivisions do no contaminate our estimations, we decided to exclude from the data all school attendance boundaries that coincide with *arrondissements* boundaries. We also checked that the middle school boundaries do not coincide with primary or high school catchment areas[21].

A final important issue raised by school zone boundaries is their degree of stability over time. Very unstable boundaries would represent a serious threat to our estimation strategy, since public school performance would then have little chance of showing up in property prices on the borderline between adjacent school zones. The information that we gathered through informal talks with the LEA officials in charge of school catchment areas in Paris revealed that the reassignment process is essentially driven by demographic reasons and is highly unpredictable by parents. However, they cannot be considered as exogenous events, since they usually coincide with underlying demographic trends that may affect the housing market independently from school performance. Hence we decided not to use these reassignments and to restrict our estimations to non-reassigned areas. Our data show that over the period 1997-2004, school catchment areas in Paris remained largely unchanged, since

[21]By definition, our exclusion rule also eliminates the middle school boundaries that match high school attendance boundaries, since the limits of the four Parisian high school catchment areas happen to follow exactly the *arrondissements* borders. Although we do not have data on the precise layout of primary school catchment areas, we are confident that their boundaries do not coincide with middle school boundaries. First, primary school catchment areas are much smaller than those of middle schools, since the number of public primary schools is three times larger than the number of public middle schools. Second, our data indicates that in the city of Paris, children enrolled in a given public primary school are not assigned to a unique middle school.

less than 10% of all Parisian addresses were reassigned over this period of 7 years. It seems therefore unlikely that the instability of school attendance boundaries could invalidate our identification strategy.

4.1.2 School performance and school characteristics

We retrieved information on school characteristics and computed measures of school performance from several datasets, all of which were provided by the Statistical Department of the French Ministry of Education[22].

Our empirical analysis requires information on the performance of public and private schools. The exact characteristics that parents value in schools are subject to an extensive debate in the literature. A number of studies have produced evidence that parents' school choices react to test-based school rankings (Black, 1999; Figlio and Lucas, 2004; Hastings et al., 2007). However, as pointed out by Mizala and Urquiola (2008) the problem with this evidence is that test scores are highly correlated both with peer group composition and, to a lesser extent, with school effectiveness (or "value added"). While disentangling these two components is a difficult task, recent research suggests that peer quality could well be the dominant factor (Rothstein, 2006). Mizala and Urquiola (2008) reach the same conclusion using data on Chile's SNED program[23].

The institutional features of the French educational system outlined in section 3, as well as anecdotical evidence, suggest that parental perception of middle school performance relies heavily on peer quality. There are two main reasons for that. First, as previously noted, the highly centralized organization of middle schooling and the partially randomized allocation of teachers to the different establishments are unlikely to produce big differences in school effectiveness. Second, value-added measures of school performance have never been publicly released for middle schools, whereas they have long been available for high schools. The information that parents can use to rank middle schools thus relies exclusively of exam scores and peer composition. Official league tables showing the average exam scores at the middle school level were only recently introduced in France[24] and are now widely accessible[25]. It must be noted however that to satisfy parents' demand for information about middle school performance, rankings of Paris middle schools were regularly

[22] *Direction de l'Évaluation, de la Prospective et de la Performance du Ministère de l'Éducation nationale (MEN-DEPP).*

[23] This program was aimed at helping parents identify the most effective schools, the information provided being quite different from that conveyed by a simple test-based ranking of schools. The authors' key finding is that schools' market outcomes were unaffected by the SNED program.

[24] The official justification for not publishing average exam scores was that doing so would have contradicted the very nature of strict school zoning, which theoretically prohibits parents to choose a publics middle school outside of their local catchment area.

[25] Examination results at the school level are consultable via the Internet (See for instance http://f23.www.france-examen.com).

published in the local press as from the beginning of the 1990s. For the period under study (1997-2004), parents living in the city of Paris can thus be considered to have a relatively good knowledge of how middle schools compare to each other in terms of pupil performance.

In our empirical analysis, we will use three distinct indexes to measure school performance: the average scores at the school level of a national exam (*Diplôme National du Brevet*) taken at the end of middle school (DNB SCORE), the fraction of middle school pupils who are admitted into the high school general curriculum as opposed to vocational studies (GENERAL CURRICULUM) and the proportion of middle school pupils coming from privileged socio-economic backgrounds (PRIVILEGED BACKGROUND). The first measure is available only for school year 2003-2004, whereas over measures are averaged over school years 1997-2004 (for a detailed description of the construction of our school performance indicators, see appendix B). These three indexes are standardized by dividing each school's value by the corresponding standard deviation of school averages (including both public and private schools).

General information about the characteristics of public and private middle schools operating in the Paris LEA can be found for school year 20003-2004 in the *IPES*[26] dataset. We used this dataset to compute indicators regarding school size and the characteristics of pupils and teachers.

4.1.3 Summary statistics

Table 1 compares the characteristics of Parisian public and private schools during school year 2003-2004. Public middle schools account for 68% of total enrollment. Unsurprisingly, private school pupils enjoy much more favorable characteristics than their public school counterparts. The higher peer quality of private schools naturally translates into better pupil performance. With an average score of 10.97 points out of 20 on the *DNB* exam, private school pupils outperform their public school peers (9.42 points) by almost a standard deviation of distribution of the *DNB* score averaged at the school level.

The last four columns of table 1 show that public schools are very heterogenous in their pupils' characteristics. Their performance is very highly correlated with peer quality: pupils enrolled in schools belonging to the top quartile of 2004 average *DNB* exam score come in majority from privileged socio-economic background, are much less likely to be of foreign nationality and almost systematically enter general curriculum high schools. The comparison of school size and teachers' characteristics in the bottom and top quartiles of school performing shows much less variation, which is consistent with the idea that school peer group composition is the primary

[26] *Indicateurs pour le Pilotage des Établissements Secondaires.*

source of variation in French public middle school performance. If teachers working in the bottom quartile schools are younger than their colleagues working in the top quartile schools, they are only slightly less qualified, as one would expect given the partially randomized process that governs the allocation of teachers to schools. Finally, the pupil-to-teacher ratio is larger by about half a standard deviation in the top quartile relatively to the bottom quartile.

Table 2 shows the correlation between our three standardized indexes of school performance: the school average score at the 2004 *DNB* exam, the fraction of middle school pupils entering general curriculum high schools and the proportion of pupils that come from privileged socio-economic backgrounds, these two last measures being averaged over years 1997-2004. As expected, these three indexes are very highly correlated, the correlation coefficients ranging from 0.84 to 0.90. These figures indicate that during the period under study, the performance of public middle schools was very stable. This is an important feature in the Parisian context, since school performance can be assumed to be capitalized in prices only if it is not too volatile across school years.

Figures 4 to 6 display the spatial distribution of public middle school performance across the different school catchment areas in Paris. Given the high degree of correlation between our three indexes of school performance, these three maps share a very similar pattern: the best public middle schools tend to be located in the central and western parts of the city while the lowest-performing schools are usually found in the north-eastern quarter. However, these maps also indicate that the transition between different levels of school performance is not smooth and that many adjacent schools perform very unequally (especially in the eastern part of the city). Given our identification strategy, this is a desirable feature because large school performance differentials should yield more precise estimates.

4.2 Housing prices and neighborhood characteristics

Data on property sales come from the *BIEN*[27] dataset which is produced by the Notary Chamber of Paris and the Île-de-France[28]. The dataset is almost comprehensive and contains between 80 and 90% of all the transactions that took place since 1997[29]. For each transaction, we have information on the price for which the property was sold, along with its detailed characteristics (size, number of bedrooms and bathrooms, date of construction, etc.) and its precise spatial location (Lambert II grid coordinates) with a precision of the order of 5 meters. Our sample is

[27] *Base d'Informations Économiques Notariales.*

[28] *Chambre des Notaires de Paris et d'Île-de-France.*

[29] In the early 1990s, when the Notary Chamber started to collect the data, not all Notary offices succeeded in transmitting their own data. However, the coverage rate has continuously improved since.

restricted to all arm's-length sales of second hand Parisian flats[30] that took place between September 1997 and August 2004. The first two columns of table 3 displays the characteristics of Parisian flats in the full sample of sales. The mean flat price in our sample is 183,054 euros and the mean size 52 m^2.

By combining the precise geographic coordinates of each sale in Paris and the mapping of school catchment areas, we were able to identify each transaction's assigned public middle school between 1997 and 2004. Figure 7 shows how the price per square meter (in 2004 euros) of sales that took place during school year 2003-2004 varies across the 108 corresponding public middle school catchment areas. The spatial distribution of housing prices across the city is fairly close to the spatial distribution of school performance displayed in figures 4 to 6. It is however much more continuous, the housing prices decreasing gradually as we move away from the central and western parts of the city. This feature suggests that housing prices and school performance are highly correlated, although no causal interpretation can yet be given to this phenomenon.

We use the 1999 French National Census[31] at the district level (*Iris*) to control for the socio-demographic characteristics of Parisian neighborhoods. Summary statistics on socio-demographic characteristics are reported in the first two columns of table 4. These figures indicate that the population living in the city of Paris is rather socially privileged but also cosmopolitan, the proportion of foreigners among household heads amounting to about a quarter. Finally, about one third of households own their apartment. The size of the standard deviations reveals however that the socio-economic composition of the city is far from being homogenous across the different neighborhoods.

5 Results

In this section, we apply our matching framework to estimate the impact of school performance on housing quality in the city of Paris. To investigate the magnitude of the bias induced by the endogeneity of school performance in the housing price equation, we start by computing the naive estimates using the traditional hedonic framework, before showing the results obtained when sales are matched across school attendance boundaries.

[30] We dropped newly-built property sales because their price differs greatly from the price of second-hand sales and because new properties represent only a very small share of overall property sold in Paris. For the same reasons, we excluded the few houses that were present in the sample. We also dropped transactions when the price or the number of rooms was missing. Finally, we decided to exclude the Île Saint-Louis and Île de la Cité islands, because of their very specific location and pattern of housing prices. We further excluded sales belonging to the top and bottom percentiles of housing prices per square meter each year. We are left with a sample of about 200,000 transactions.

[31] *Recensement de la Population française 1999.*

5.1 Naive estimates

The first two columns of table 5 show the results of estimating the hedonic housing price equation (2), with and without controlling for the socio-demographic characteristics of the census district, using our three indexes of public middle school performance.

Column 1 indicates that when no controls are added except for year and quarter, the naive estimation of the impact of school performance on housing prices yields a strong apparent positive impact: for every standard deviation increase in the local public middle school's *DNB* score, the housing price per square meter goes up by 21.8%. For the other two indexes (fraction of pupils entering general curriculum high schools and proportion of pupils from privileged socio-economic backgrounds), a standard deviation increase in school performance is associated with respectively a 16.1% and a 19.0% increase in housing prices.

Column 2 shows that the coefficients are not particularly affected when one adds controls for the flats' characteristics, which seems to indicate that in the city of Paris, sales located in the attendance area of high-performing schools do not share on average more desirable features than those assigned to low-performing schools. However, because the best schools tend to be located in the most privileged neighborhoods, the coefficients associated with school performance indexes in the housing price equation drop dramatically when we control for detailed neighborhood characteristics at the district level. In column 3, a standard deviation increase in the school performance index is now associated with a 2.6% (DNB SCORE), 2.2% (GENERAL CURRICULUM) and a 3.6% (PRIVILEGED BACKGROUND) increase in housing prices.

Although the set of controls included in the right hand side of the hedonic regression equation is large, we cannot ensure that it is adequate to solve the endogeneity problem. To isolate precisely the causal impact of school performance on housing prices, we need to restrict our sample to sales located in the vicinity of a school attendance boundary.

To ensure that our results are not too sensitive to a particular value of the chosen bandwidth (*i.e.* the maximum distance to the school attendance boundary), we decided to use three different samples of sales that differ in the maximum admitted distance between a transaction and its closest school attendance boundary. The selected values for the maximum distance to boundary are 250, 300 and 350 meters, to ensure enough statistical power to our estimation strategy and to provide sufficiently large intervals (50 meters) for testing the stability of our results. Columns 3 to 8 of table 3 show how the features of the flats included in our three samples and the associated neighborhood characteristics compare with those of the full sample of sales. Reassuringly, these statistics indicate that along both these dimensions, the sales included in our sample are hardly different from those of the full sample.

The last three columns of table 5 show that the naive estimates obtained when running the simple hedonic regression (controlling for time trends, flat features and neighborhood characteristics) on the subsample of sales located within 250 meters (column 4), 300 meters (column 5) and 350 meters (column 6) are in the same order of magnitude as the full sample estimates (column 4), even if they appear slightly larger.

5.2 Matching sales across school attendance boundaries

A way of solving the endogeneity problem of the school performance variable in the housing price equation is to compare sales that can be assumed to share the same unobserved characteristics corresponding to "neighborhood effects". We do so by applying the matching strategy that was presented in section 2.3.

The three columns of table 6 display the results of our matching strategy for each of our three indexes of school performance. The average school performance differentials across boundaries are reported at the bottom of the table. In line with the pattern observed in figures 4 to 6, we see that public middle school attendance boundaries induce substantial discontinuous variations in school performance. The average cross-boundary performance differential is equal to 0.60 of a standard deviation (of schools' averages) for the *DNB* score, 0.86 for the fraction of pupils admitted into general curriculum high schools and 0.72 for the proportion of pupils coming from privileged socio-economic backgrounds.

The estimates obtained using the *DNB* exam score as a measure of school performance are significant at the 5% level. Moreover, they are remarkably stable across the different choices of maximum distance to boundary. The results displayed in the three columns show that a standard deviation increase in the average exam score raises the price per square meter by about 1.5%, which is roughly half the size of the naive estimate when we controlled for flat features and neighborhood socio-demographic characteristics (see column 3 of table 5).

The estimates obtained using the other two indexes of school performance are fairly similar across three different values chosen for the maximum distance to school attendance boundary and are larger in magnitude than the coefficient on the *DNB* exam score. A standard deviation increase in the fraction of middle school pupils who are admitted into general curriculum high schools is estimated to raise housing prices by about 2%, whereas the coefficient on the proportion of pupils coming from privileged socio-economic backgrounds is close to 2.5%. Hence, our results appear robust to different definitions of school performance and are in the range of 1.5 to 2.5%.

To see how our results compare with those obtained using the boundary fixed effects approach that has been used since Black (1999), we performed a series of regressions in which we replaced the vector of neighborhood characteristics in the basic hedonic equation (2) by a full set of school attendance boundary dummies. The estimates are reassuringly very similar in magnitude to our previous matching estimates[32].

5.3 How large is the effect?

Our estimates of the impact of middle school performance on housing prices in Paris are of the same order of magnitude as existing estimates for primary schools in other countries: similar to the 2.1% effect for every standard deviation increase in school performance for Boston suburbs (Black, 1999); slightly smaller than the 3.7% effect obtained by Gibbons and Machin (2003) for the UK.

In order to interpret these results, it is worth getting some sense of the size of the measured effect. First, we calculate that other things being equal, moving from the worst to the best public middle school (which corresponds to 4.8 times the standard error of the average *DNB* exam score at the school level) would imply a price premium of 7.2% (13,180 euros for the average flat price). Second, we estimate the fraction of the housing price differential between school zones that can be explained by differences in school performance. In order to do so, we calculate the observed difference in the average flat price (taken in logs) between each adjacent pair of school zones and relate it to the flat price differential predicted by the corresponding difference in school performance. We find that the difference in school performance explains roughly 5% of the observed difference in housing prices between adjacent school zones.

These calculations indicate that although school performance plays a non-negligible role in the formation of housing prices, it is not the main driving force in the real estate market. However, our results do not imply that the way school performance determines parents' residential location should be neglected when school zone policies are designed. What is estimated is indeed an average effect of school performance on housing prices over the entire population of households, which might be lower than the effect for the subpopulation of parents living with school-age children.

6 Robustness checks

In this section, we perform two series of robustness checks. First, we ensure that flats located on either side of common school attendance boundaries share similar observable features; second, we address the issue of socio-demographic sorting across school attendance boundaries to determine whether observable patterns can be credibly explained by school performance differentials.

[32]For the sake of brevity, we do not present the results, but they are available upon request in a longer version of this paper, with a detailed discussion of some of the limitation of the boundary fixed effects approach.

6.1 Testing the validity of the identifying assumption

Our estimation strategy relies on the assumption that on average, sales located on either side of a common attendance boundary share the same flat features and neighborhood characteristics so that price differentials are purely attributable to school performance differentials. Yet this hypothesis might be violated if apartments located on the "good" side of school attendance boundaries tend to display certain features (*e.g.* more housing units with a parking space) that are valued by buyers independently from school performance. If such characteristics tend to attract wealthier households, whose children's educational attainment will mechanically drive up the performance of the local school, then one might worry that our approach could produce upwardly biased estimates.

First, we test whether the observable characteristics of flats such as the age of building, the number and size of rooms, the number of bathrooms, the presence of a parking space or a maid's room, are similarly distributed on either sides of common attendance boundaries. Table 7 compares the features of apartments located on either side of common school attendance boundaries, within a distance of 250, 300 and 350 meters to these boundaries. The "good" side of a particular boundary corresponds to where the school's average *DNB* exam score is the largest and the "bad" side where it is the smallest. Within each sample considered separately, the characteristics on the "good" side and the "bad" side of boundaries appear almost exactly similar. Moreover, the numbers show no obvious pattern that could explain that flats located on the "good" side of the boundary are more desirable on average than flats located on the "bad" side. In addition to these comparisons, we performed our matching regressions without controlling for flat features, and found the same results[33]. Hence our findings do not seem to be driven by differences in observable flat features. One might still argue that some unobservable flat features (*e.g.* one side gets more sun than the other) might bias the results, but there is no particular reason to believe that such characteristics should be distributed differently across school zones.

A more serious issue is that household sorting might occur at boundaries, even if apartments share the same features on average. Several papers using US data (Bayer et al., 2005, 2003; Kane et al., 2006) have shown that not only school performance, but also several socio-demographic characteristics (such as household income) could vary discontinuously between adjacent school catchment areas. In this case, comparing sales across boundaries would lead to overestimate the causal effect of school performance on housing prices.

To investigate the issue of sorting across attendance boundaries, we compare the observable socio-demographic characteristics of neighborhoods (at the district level)

[33] The results are not displayed since they are basically the same as the initial regressions. The table is available upon request.

located on the "good" *versus* the "bad" side of school boundaries. Table 8 shows that within each of our three samples (250, 300 and 350 meters), neighborhoods socio-demographic characteristics are remarkably similar on both sides of boundaries and that households living on the "good" side of a boundary do not appear more privileged on average than households living on the "bad" side. This simple exercise does not support the view that in the case of Paris, school attendance boundaries mirror other preexisting lines of separation between distinct neighborhoods. Given the very irregular trace of school catchment areas (see figure 2), it seems rather plausible to consider that in our particular empirical context, school boundaries run through otherwise similar neighborhoods.

If large and general sorting effects across school attendance boundaries would presumably represent a threat to our identification strategy, one would still expect school boundaries to generate a limited amount of sorting among households that are likely to take school performance into account when making their residential choice. Most existing models of school-related sorting (reviewed by Fernández, 2003) argue that under the single-crossing condition, wealthier parents have a stronger incentive to sort into neighborhoods assigned to high-performing schools than poorer parents. School attendance boundaries could therefore induce some sorting within the sub-population of families. We examined this question by looking separately at families (*i.e.* households with at least one child under the age of 25) and households with no children at home. The only dimension along which these two groups of households can be compared in the Census is the occupation of the household head. In order to detect eventual school-related sorting across attendance boundaries, we restricted our sample of sales to those located near boundaries with school performance differentials larger than half a standard deviation (using the average *DNB* exam score index). Within each of our three original samples, we were left with roughly half the number of observations.

Table 9 compares the distribution of household head occupations on both sides of school attendance boundaries, separately for families and for households with no children at home. While the patterns are identical when we consider households without children, they are somewhat different for families: the average fraction of managers on the "good" side of the boundary is 42% *versus* 39% on the "bad" side and the fraction of manual workers is 11% on the "bad side" *versus* 13% on the "good" side. Although these differences are not very large, they are significant and consistent with the claim that if sorting occurs at school attendance boundaries, it is entirely driven by families. We are therefore confident that our estimation strategy captures the effect of school performance on housing prices and that socio-demographic differences across boundaries are solely caused by school performance differentials.

So far, we have established that parents care about public school performance when they make their residential choices. In the next section, we investigate whether the availability of private schools influences the housing price premium attached to public school performance.

7 The mitigating effect of private schools

Previous studies have mainly focused on public schools, ignoring the other options provided by private schools in their analysis[34]. However, recent papers on school vouchers (Nechyba, 2003; Ferreyra, 2007) argue that private schools constitute an outside option that parents take into account when deciding in which area to buy. In this section, we exploit the combination of strict public school residence-based assignment and private school choice in the Parisian context to test whether private school availability influences residential choices. Indeed, the presence of a good network of private schools in some neighborhoods should lower the price premium that parents are ready to pay for a flat located in a good public school zone, or at least set an upper bound for that premium.

7.1 Theoretical predictions of school choice models

The way housing markets react to school performance when public and private schools coexist has been extensively analyzed by Nechyba in a series of theoretical papers (Nechyba, 1999, 2000, 2003). A number of testable predictions can be derived from his general equilibrium models of school finance, which include multiple school districts (either state of locally financed), multiple neighborhoods within school districts and different housing qualities. In the set-up defined by Nechyba, local public schools are subject to zoning and coexist with private schools that can freely select their pupils. The model is too complex to yield analytic solutions and it is calibrated to predict the effect of alternative school assignment policies. In the benchmark equilibrium in which no private school operates, peer effects yields substantial residential sorting[35]. Private school choice decreases residential stratification and increases peer stratification in schools[36]. The decrease in residential stratification is reflected in housing prices. In this section we test whether, in line with these predictions, the presence of private schools in the neighborhood mitigates the effect of local public school performance on housing prices.

[34]Gibbons and Machin (2003) include religious schools in their analysis, since they are publicly financed, but do not investigate whether these school have a specific impact and do not include other private schools in their analysis.

[35]There is only incomplete stratification because of exogenous heterogeneity in housing quality.

[36]The overall effect on the performance of public schools varies with the type of school finance and on whether per public spending increases enough to compensate for the decrease in peer quality.

As explained in section 3, private schools offer an attractive outside option to parents who wish to avoid sending their children to a poor-performing local public school. In Paris, about a third of middle school pupils were enrolled in a private school during the period under study (see table 1). Contrary to public middle schools, the spatial distribution of private institutions is not even throughout the city. Therefore, under the assumption that parents don't usually want to enroll their children in a school that is located too far away from home, the impact of public school performance on housing prices should depend on the availability of local private schools in the neighborhood. The assumption that distance to school matters to parents who consider sending their children to a private institution can be indirectly tested by looking at how far away private middle school pupils reside from their school. Although we cannot calculate this distance precisely because we lack information on the home address of pupils, we know in which of the 20 Parisian *arrondissements* they reside. Table 10 shows that among Parisian pupils enrolled in a private school in 2003-2004, 53% attended a school located in their *arrondissement* of residence and 28% a school located in an adjacent *arrondissement*[37], so 81% of private school pupils can be considered as living reasonably close to their school. Other things being equal, the availability of private schools in a given area should therefore raise the probability of parents enrolling their children in the private sector and should lower the capitalization of public school performance in local housing prices.

In terms of our housing price model, the impact of private school availability on the capitalization of public school performance in housing prices can be viewed as changing the magnitude of parameter β which we now consider as a function of private school availability in the neighborhood (denoted a_b):

$$\ln p_{i,n,s,t} = \alpha + \beta(a_b).z_s + X_{i,n,s,t}\gamma + \theta_{n,t} + \epsilon_{i,n,s,t} \tag{5}$$

Under the assumption that both sales of a common match are sufficiently close to enjoy the same private school availability, the housing price differential equation can be rewritten:

$$\ln p_{i,b,s,t} - \ln p_{i',b,s',t} = \beta(a_b)(z_s - z_{s'}) + \mu_{i,i',b,s,s',t}$$

where $\mu_{i,i',b,s,s',t}$ is an error term which is clustered at the public school attendance boundary level[38].

[37]Because of school zoning, the corresponding percentages for public schools are logically higher. Two reasons can potentially explain that not all public middle school pupils are enrolled in a school located in their *arrondissement* of residence. First, as explained in section 3, a number of pupils have been granted a dispensation by the LEA or cheat on their address. Second, some public middle school catchment areas overlap several *arrondissements*.

[38]In terms of our previous notation, $\mu_{i,i',b,s,s',t} = \epsilon_{i,b,s,t} - \epsilon_{i',b,s',t}$.

With respect to the previous model, the impact of public school performance on housing prices is no longer spatially homogenous but is allowed to vary with private school availability. Within this framework, the estimated parameter $\hat{\beta}$ is the average impact of school performance on housing prices within the area covered by the sample. If private schools tend to mitigate the impact of public school performance on housing prices, we would expect the estimated coefficient to vary with the level of private school availability.

In addition, the analysis of the mitigating effect of private schools provides us with an indirect way of testing the validity of our identification strategy. If our estimation of the price premium paid for flats located on the "good" side of a boundary was solely due to unobservable differences in neighborhood characteristics and was not driven by school quality, this premium should remain significant in all areas, irrespective of the density of private schools in the neighborhood. On the contrary, if we find that this premium is lowered by the proximity to private schools, we would have good reasons to believe that the price premium is not driven by unobservable differences across schools boundaries.

7.2 Estimation strategy

To test the hypothesis that private school availability influences the capitalization of public school quality in housing prices, we construct two different indexes of private school availability in a particular location. Our first index is aimed at capturing local private school proximity while the second is designed to measure local private school density.

For each transaction i, our index or local private school proximity (denoted PSP_i) is computed as the inverse of the distance between a sale and its closest private middle school:

$$PSP_i = \frac{1}{\min_j(d_{i,j})} \quad \forall i$$

where $d_{i,j}$ denotes the distance between transaction i and private school j. The higher the value of PSP_i, the closer the private middle school is to transaction i.

Our samples of sales located in the vicinity of a school attendance boundary are then splitted into four groups of equal size. Each sale is allocated to one of the four quartiles depending on the value of its private school proximity index[39]. Figure 8 shows how corresponding areas are distributed in the city of Paris for the full set of existing Parisian adresses[40]. Reassuringly, our index of private school

[39]Note that choosing the inverse of the distance between the transaction and the private school rather than a power of that distance (*e.g.* distance squared) has no incidence on the distribution of sales in each of the four quartiles, since it leaves the rank ordering of sales unchanged.

[40]Since sales were not necessarily completed in all Parisian adresses during the period under study, the full set of existing adresses in larger the set of sales included in the *BIEN* dataset.

proximity is well distributed among neighborhoods and does not cut Paris into four geographically distinct zones, a feature that could bias our estimates.

Although simple and intuitive, this index of private school proximity may not be full adequate to reflect the availability of private schools in a particular area. Since the value of this index depends only on the distance between a sale and its closest private school, it does not take into account the local density of the private school network. The presence of a private institution in a given neighborhood does not in itself guarantee to prospective owners that they will be able to enroll their children in this particular private school, especially if it is oversubscribed. Hence it is reasonable to assume that the outside option provided by the private sector will be more attractive in neighborhoods where a large number of schools operate than in neighborhoods where they are scarce. To take this dimension into account, we construct an index of local middle school density (denoted PSD_i). For each transaction i, we calculate the average value of the inverse of its distance (squared) to every private middle school in Paris:

$$PSD_i = \sum_{j=1}^{N_j} \frac{1}{d_{i,j}^2} \quad \forall i$$

where N_j denotes the total number of private middle schools that operate in the city of Paris (65) and $d_{i,j}$ is the distance between transaction i and private school j. The higher the value of this index, the higher the density of private schools in a transaction's neighborhood. Using the inverse of the distance squared allows us to give much more weight to the closest private schools relatively to the more distant ones. We then split our samples of sales into four groups depending on the value taken by the index for each particular sale. Figure 9 shows the corresponding spatial distribution of private school density. Logically, this map appears very similar to the map displaying the quartiles of local private school proximity (figure 8). However, some differences arise in certain neighborhoods: in particular, some areas which are classified as having a low level of private school proximity because the closest private school is far away are now classified as having a higher level of public school density because they are surrounded by many private schools.

To estimate the mitigating effect of private schools, we allow the index of public middle school performance to vary with the quartile of private middle school availability (proximity or density). The regression of the log price differential between sale i and its counterfactual i' in time t on the corresponding school performance differential thus takes the following form:

$$\log p_{i,b,s,t} - \log p_{i',b,s',t} = \beta_1 Q_1.\Delta z + \beta_2 Q_2.\Delta z + \beta_3 Q_3.\Delta z + \beta_4 Q_4.\Delta z + \mu_{i,i'b,s,s't}$$

where Δz is the school performance differential between sale i and sale i''s assigned public schools s and s', Q_j ($j \in \{1, 2, 3, 4\}$) are dummy variables that indicate to which quartile of private school availability the reference sale belongs and $\mu_{i,i'b,s,s't}$ is the error term clustered at the school attendance boundary level.

7.3 Results

Table 11 shows the results obtained when we measure private school availability using the index of private school proximity. Column 1 displays the baseline coefficient on school performance in the housing price equation already presented in table 6. The coefficients on the interaction terms between school performance and each of the four quartiles of private school proximity are displayed in columns 2 to 5. Each panel corresponds to a particular choice of the maximum distance to public school attendance boundary: 250 meters (panel A), 300 meters (panel B) and 350 meters (panel C). Within each panel, the results are displayed separately for our three indexes of public middle school performance.

The coefficients show a very distinctive pattern and are remarkably consistent across the different choices of school performance indexes and maximum distance to boundary. Columns 2 to 5 indicate that as private school proximity increases, the impact of public school performance on housing prices becomes smaller. While for the bottom quartile of private school proximity, the coefficient on the *DNB* exam score is about 3.0%, it falls to about 2.0% for the middle lower quartile and becomes small and insignificant (0.3-0.8%) for the upper quartiles (columns 4 and 5).

The results are very similar when we use the other two indexes of school performance. A standard deviation increase in the fraction of public middle school pupils who are admitted into general curriculum high schools raises housing prices by about 3.0% in areas belonging to the bottom quartile of private school proximity and only 1.4% in areas belonging to the top quartile. The difference is even larger when the fraction of pupils coming from privileged socio-economic backgrounds is used to measure school performance: the coefficient falls from 4.2-4.7% to 0.8-1.4% when we move from the bottom to the top quartile of private school proximity.

As emphasized in the previous section, the degree to which private schools serve as an advantageous outside option to avoid the local public middle school could be better captured by our second measure of private school availability which uses the density rather than the proximity of private schools. In table 12, we use our alternative index of private school availability (PSD index). The results are very similar to those obtained previously but the contrast between the areas belonging to the lower and upper quartiles of private school density is sharper: for sales located within 250 meters of a public school attendance boundary (panel A), the impact of a standard deviation increase in the local public school's average *DNB* score raises housing prices by 3.4% in the bottom quartile of private school density but is insignificant and close to zero in the top quartile (column 5). Similar conclusions can be drawn when choosing different values of the distance to boundary and alternative indexes of school performance.

On the whole, these results support the theoretical prediction that the impact public school performance on housing prices varies with the availability of private schools. When parents have the opportunity to send their children to local private schools, then housing prices do not seem to depend on the performance of the local public middle school; on the contrary, when there are few private schools available in the neighborhood, then the local public middle school performance appears to be capitalized into housing prices.

These results are also interesting as they suggest that our previous estimates of the impact of school quality on housing prices are unlikely to be driven by differences in neighborhood characteristics that are unrelated to school quality. The finding that the housing price premium shrinks and becomes insignificant in areas with a dense network of private schools is rather reassuring, as it shows that the housing price differential disappears when we do not expect to find a price premium attached to public school quality.

Given these estimates, one can perform the simple exercise that consists in comparing the cost of attending a private school with the cost of moving into the catchment area of a better-performing public school. For an average private school tuition fee of 1,000 euros per year in Paris, four years of private middle schooling cost about 4,000 euros to parents. In areas belonging to the top quartile of private school density, the average *DNB* exam score is 9.59 for public schools and 10.85 for private schools (see table 14). This difference of 1.26 point is equal to two thirds of a standard deviation in the school average *DNB* exam score. According to our estimates, the housing price premium to be paid for a similar increase in public school performance in areas belonging to the bottom quartile of private school density would be equal to about 2.5%, which is about 4,500 euros at the average flat price. The housing price premium attached to public school performance in neighborhoods where private schools are scarce is therefore in the same order of magnitude as the individual cost of a private school four-year tuition fee in areas where they are many. These figures indicate that the valuation of public school performance is comparable to the cost of the outside option provided by private education.

7.4 Robustness of findings to alternative interpretations

For our estimation strategy to credibly identify the mitigating effect of private schools on the capitalization of public school performance in housing prices, we need to show that our results are not driven by other confounding factors.

The first concern that needs to be addressed is that the availability of private schools could be correlated with a number of socio-demographic characteristics that tend to lower the taste for public school performance in a given area. For instance, if private schools are on average concentrated in poorer areas, the apparent insignificant impact of public school performance on housing prices could derive from the weaker willingness of economically disadvantaged households to pay for better schools. To investigate this issue, we use the 1999 Census to compare households across the quartiles of private school availability. To save space, we present our results for the sample of sales located within 250 meters of a school attendance boundary only[41], using successively proximity (table 13) and density (table 14) as our measures of private school availability. Overall, these figures tend to show that the neighborhoods included in each quartile of private school availability share very similar socio-demographic characteristics. Most census variables, including the distribution of occupations, have almost the exact same values across the different areas, especially when we use proximity to measure private school availability. Table 14 shows that small differences appear when use private school density instead of proximity, as areas belonging to the upper quartiles of private school density are slightly more wealthy than those belonging to the lower quartiles (more graduates, less public housing, etc.). However, these differences seem too small to explain our results and, in any case, cannot account for the estimates reported in table 11 since (as shown in table 13) socio-demographic characteristics are essentially identical across the four quartiles of private school proximity.

A second concern is that the mitigating effect of private schools could be driven by local variations in the average cross-boundary public school performance differential. This would be the case in particular if public school differentials are lower in areas where a large number of private schools operate and if small differentials tend to have no impact on housing prices. We examine this issue by comparing average cross-boundary performance differentials across the different quartiles of private school availability. To do so, we compute the average *DNB* score premium of the public school located on the "good" side of the boundary over the the *DNB* score of the school located on the "bad" side[42]. The results are reported at the bottom of tables 13 and 14. Average cross-boundary school performance premiums show no particular association with private school availability: in table 13, the average premium is 11% for the bottom quartile of private school proximity, 12% for the middle lower quartile, 11% for the middle upper quartile and 10% for the upper quartile. Taken together, these results do not support the idea that our results

[41]The tables corresponding to the other samples of sales yield similar results and are available upon request.

[42]For a particular school attendance boundary, the performance premium of the best of the two public middle schools is computed as:

$$\text{PUBLIC PREMIUM} = \frac{\text{DNB1} - \text{DNB2}}{\text{DNB2}}$$

where DNB1 is the *DNB* exam score of the school located on the "good" side of the boundary and DNB2 is the *DNB* score of the school located on the "bad" side of the boundary.

could be capturing an effect of local variations in the average cross-boundary public school performance differential.

A final concern is that our estimates could in fact reflect the impact of local public-private performance differentials rather than the availability of private schools *per se*. This would be the case if areas where a large number of private schools operate are also those that experience the largest performance premiums of private schools over public schools. To test this alternative explanation, we compare the average performance premium of local private schools in each of our four quartiles of private school availability. When private school availability is measured using proximity to the closest private school, the premium is computed as follows:

$$\text{PRIVATE PREMIUM} = \frac{\text{DNBP} - 0.5(\text{DNB1} + \text{DNB2})}{0.5(\text{DNB1} + \text{DNB2})}$$

where DNBP, DNB1 and DNB2 denote the *DNB* exam scores of respectively the closest private middle school, the public middle school assigned to the "reference" sale and the public middle school assigned to the "counterfactual" sale. The formula is the same when we use private school density instead of proximity, except that DNBP is now computed as a weighted average of all private school *DNB* scores, the weights being equal to the inverse of their distance (squared) to the reference sale[43]. The results are reported at the bottom of table 13 (using private school proximity) and table 14 (using private school density). In both tables, the average *DNB* premium of local private schools over local public schools appears remarkably stable (around 15%) across quartiles and shows no particular association with the level of private school availability. Thus, these results tend to rule out the idea that the mitigating effect of private schools could be essentially driven by local variations in the performance premium of private schools over public schools rather than by the availability of these private schools.

Overall, these investigations suggest that our results are not driven by the confounding factors reviewed in this section and that the outside option provided by private education appears to be the main reason why public middle school cross-boundary price differentials tend to disappear when the number of private schools

[43]For a particular reference sale i, the local private school performance is therefore computed as:

$$\text{DNBP} = \sum_{j=1}^{J} w_{i,j} \text{DNBP}_j$$

where J denotes the number of private middle schools operating in the city of Paris, DNBP_j is the *DNB* score of each private schools and the weights $w_{i,j}$ are defined as:

$$w_{i,j} = \frac{\frac{1}{(d_{i,j})^2}}{\sum_{i=1}^{J} \frac{1}{(d_{i,j})^2}}$$

where $d_{i,j}$ is the distance between sale i and private school j.

operating in a particular area increases.

8 Conclusion

Using comprehensive data on school and housing sales in Paris over the period 1997 to 2004, we find that the performance of public schools has a significant impact on housing prices by comparing price and school performance differentials across school attendance boundaries. A standard deviation increase in the average exam score at the school level raises prices by 1.5 to 2.5% depending on the chosen index of school performance. The size of this effect is similar to existing estimates in the US and UK contexts and can explain roughly 5% of the observed in housing prices differences between adjacent school zones.

We also find evidence that, following the predictions of theoretical models of school choice, private schools tend to attenuate the capitalization of public school performance in housing prices by providing an advantageous outside option to parents. The estimated impact of school performance in neighborhoods belonging to the top quartile of private school density is twice the size of the average effect whereas the coefficient is close to zero in areas belonging to the bottom quartile.

Finally, our results suggest that the coexistence of public and private schools is an important dimension to take into account when designing school assignment policies. In particular, the effect of alternative public school admission rules (strict residence-based assignment, relaxed school zoning, school choice, etc.) on school and residential segregation, pupil performance and educational inequalities will crucially depend on how the housing market incorporates public and private school performance.

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Appendix A: computation of "hedonic" prices

To apply our estimation strategy, we need to compare the evolution of housing prices in adjacent school attendance zones. Unfortunately, it not possible to compare prices of transactions directly, as two flats rarely share the exact same features.

Because we do not have enough transactions taking place in a given year and within a given zone to be able to match housing units that share the same features, we adopt a hedonic method to construct series of comparable housing prices. We follow the methodology defined by the Insee (the French national statistical agency) to compute a hedonic price index[44]. First, we define large zones (18 in the case of Paris[45]) where prices are known to be fairly homogenous. We then regress the log of housing prices on observable flat features separately for each zone and use the estimated coefficients to compute a "typical flat equivalent price" for each sale. The "typical flat" is defined as a two-room flat located on the ground floor, with one bathroom and medium-sized rooms, without a parking space nor a maid's room, constructed between 1850 and 1914 and sold during the fourth quarter of the year. Once they are expressed in terms of the "typical flat", housing prices can be compared across sales because price differences related to structural differences in observable features of the properties are now corrected for.

Within each zone, the estimated housing price equation is the following:

$$\ln p_{i,k,y,q} = a_k + X'_{i,k,y,q} b_k + Y_i.c_k + Q_i.d_k + u_{i,k,y,q} \tag{6}$$

where $\ln p_{i,k,y,q}$ is the log of the price per square meter of sale i located in zone k and completed during year y and quarter q; $X_{i,k,y,q}$ is the vector of flat i's features, Y_i and Q_i denote the year and quarter when the sale was completed and $u_{i,k,y,q}$ is the error term.

Regressions are run separately for each zone, to allow the coefficients a_k, b_k, c_k and d_k to vary across different parts of the city. Table 15 shows the output of such a regression for zone 1 (which groups the first to fourth *arrondissements*).

The "hedonic price" $\ln \widetilde{p}_{i,k,y,q}$ of sale i is then calculated as:

$$\ln \widetilde{p}_{i,k,y,q} = \ln p_{i,k,y,q} + (X'_0 - X'_{i,k,y,q})\hat{b}_k + (Q_0 - Q_i)\hat{c}_k$$

where $\ln p_{i,k,y,q}$ is the observed price and of sale i, $X_{i,k,y,q}$ is the vector of its observed features, X_0 is the vector of the "typical" flat's features, Q_i is the quarter when sale i was completed and Q_0 is the quarter of reference for the "typical" flat (fourth quarter). This procedure "converts" the price of sale i into the price it would have been sold to had it shared the same features as the "typical" flat.

[44]The methodology is described in details in Laferrère (2005).

[45]We used geographic and price criteria to define the 18 zones, from the 80 administrative districts of Paris. Zones do not necessarily correspond to the 20 Parisian *arrondissements*.

Appendix B: computation of school performance indexes

We used several datasets provided by the Statistical Department of the French Ministry of education to construct three measures school performance: the average exam scores at the school level (DNB SCORE), the fraction of middle school pupils who are admitted into the high school general curriculum as opposed to vocational studies (GENERAL CURRICULUM) and the proportion of middle school pupils coming from privileged socio-economic backgrounds (PRIVILEGED BACKGROUND).

Individual exam score data could be retrieved for the entire Paris *Académie* from the *OCEAN*[46] national exam results database. Unfortunately, we could only use information for school year 2003-2004 since the exam results of previous years were not available. The *OCEAN* dataset records the individual score obtained by every pupil enrolled in the Paris LEA at the *Diplôme National du Brevet* (*DNB*). This exam is taken by all French pupils in their final year of middle school (*Troisième*). Individual scores are a equally weighted combination of a continuous assessment and a final national examination, which is graded anonymously at the LEA level and consists in three parts: Math, French and History & Geography. Each section is scored out of 20. To ensure that our measure of performance is comparable across schools, we use only the national exam component of the *DNB* score. The performance of any particular school is therefore computed as the average Math, French and History & Geography score obtained by pupils at the *DNB* exam.

Because our exam score-based index is computed using a single year of data, one cannot exclude that it acts a noisy measure of the medium-run school performance, which arguably determines parents' school choices. While the pitfalls associated with the use of short-run measures of school performance have been extensively discussed in the literature (Kane and Staiger, 2002; Chay et al., 2007; Mizala et al., 2007), we believe that they are likely to be less severe for middle schools, because their enrollment is typically larger than that of primary schools, a feature that mechanically reduces year-to-year variation in a school's average score. The median number of pupils taking the *DNB* exam in each middle school belonging to the Paris LEA in 2004 was 125, which is three to four times larger than the median enrollment used in studies that have called into question the reliability of school accountability measures. In any case, we decided to use an alternative index of school performance that would better reflect the medium-run performance of schools over the period 1997-2004. Using the *SCOLARITE* dataset[47], we were able to calculate for each

[46] *Organisation des Concours et Examens Académiques et Nationaux.*

[47] The *SCOLARITE* dataset is available every year over the period 1997-2004. It contains individual information on all French pupils enrolled in public or private middle and high schools. The datasets contains information on each pupil's age, gender, citizenship, occupation of the household head, *arrondissement* of residence, school attended in the current (t) and previous ($t-1$)

school and each year the percentage of pupils in their final year of middle school who are admitted into general curriculum high schools the following year, as opposed to those who start vocational studies. These annual figures are then averaged at the school level over the period 1997-2004. In the French context, this variable can be considered as a good indirect measure of school performance, since it is closely linked to educational attainment and varies greatly across schools. It should nonetheless be noted that admission into general curriculum high schools is not tied to any particular threshold in the *DNB* exam score, but rather to a global assessment of individual performance by the teachers.

Our final and third index of school performance is a direct measure of peer quality. As explained earlier, there are many reasons to believe that in the French context, parents are highly concerned about peer group composition in their valuation of middle schools[48]. Using the *SCOLARITE* dataset, we computed the fraction of pupils in each middle school that come from privileged socio-economic backgrounds, averaged over school years 1997 to 2004.

year as well as current and previous school educational level. However, this very rich dataset suffers from two limitations. First, the panel dimension of the data cannot be exploited because access to the pupil identifier is restricted. Second, this dataset does not contain the pupils' results to examinations and cannot be individually matched with the previously mentioned *OCEAN* national exam results database.

[48]A rather striking symptom of this parental concern for peer quality, especially in the Parisian context, is that maps showing how middle schools compare in their socio-economic composition have been regularly published in the local press.

Figure 1: *Matching sales across boundaries: an example.*

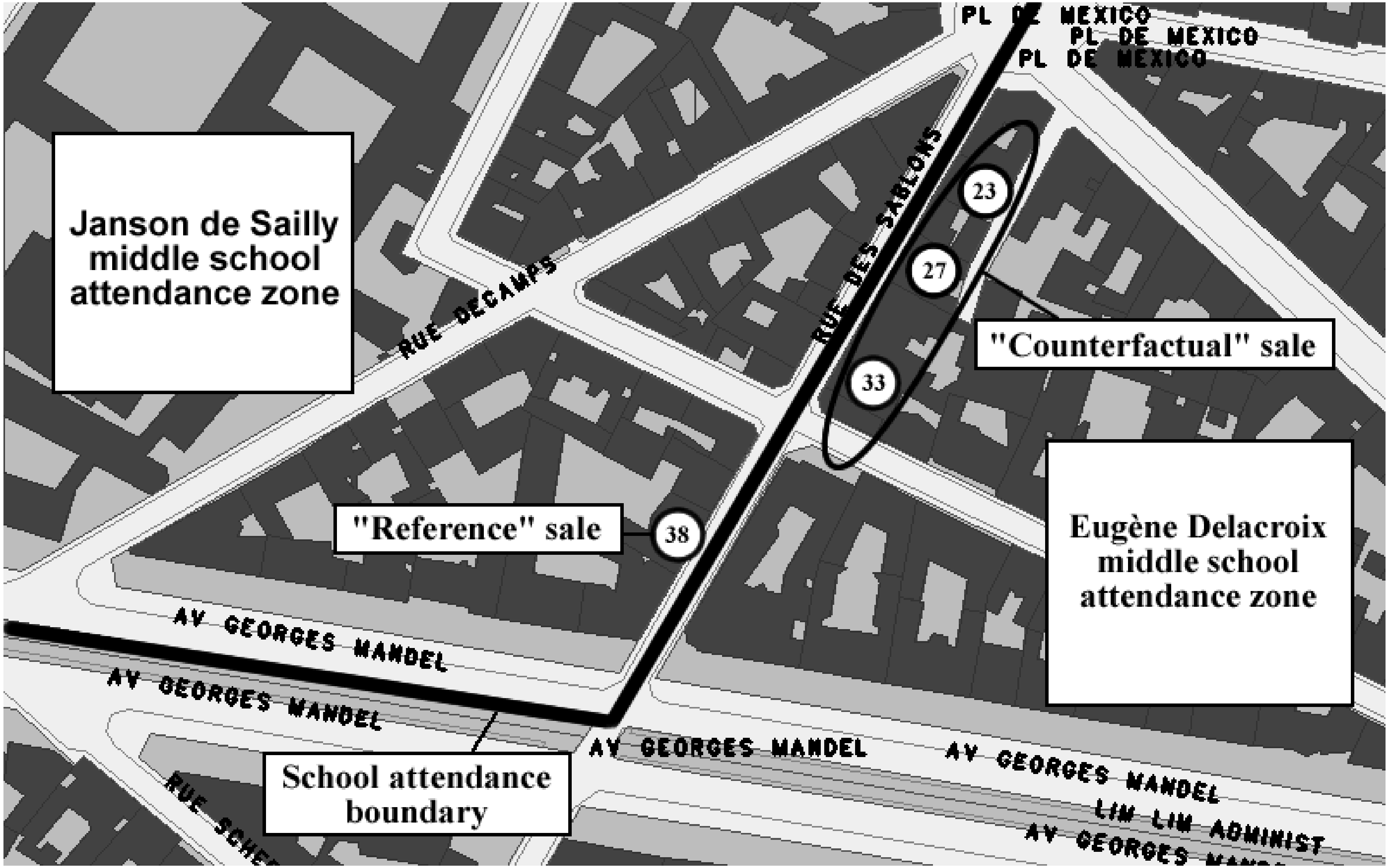

Figure 2: *School catchment areas in Paris during school year 2003-2004.*

Figure 3: *School catchment areas in the 19^{th} arrondissement of Paris. School year 2003-2004.*

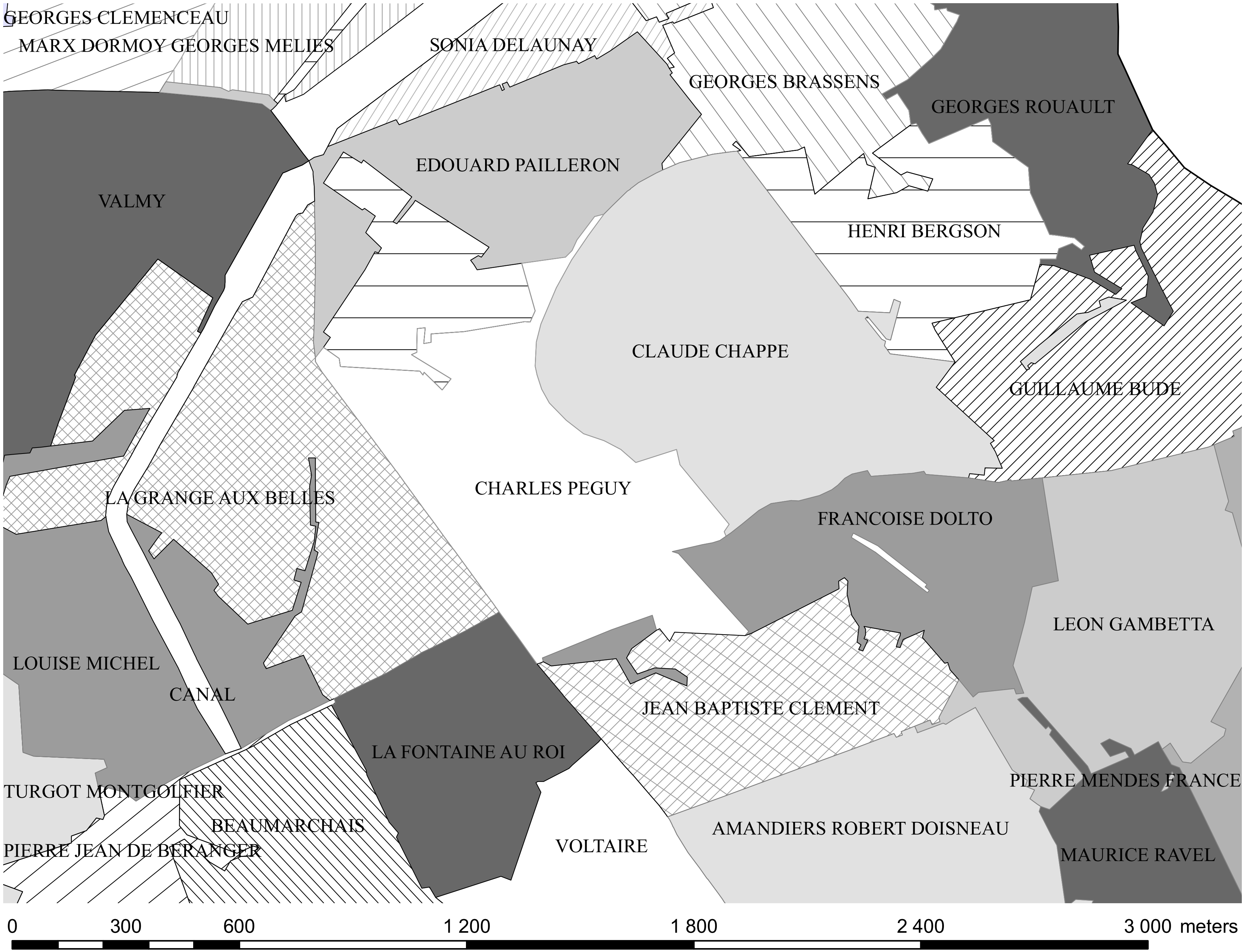

Figure 4: *Spatial distribution of the quartiles of public middle school performance as measured by the average Diplôme National du Brevet exam score in 2004. Source: OCEAN national examinations database (2004).*

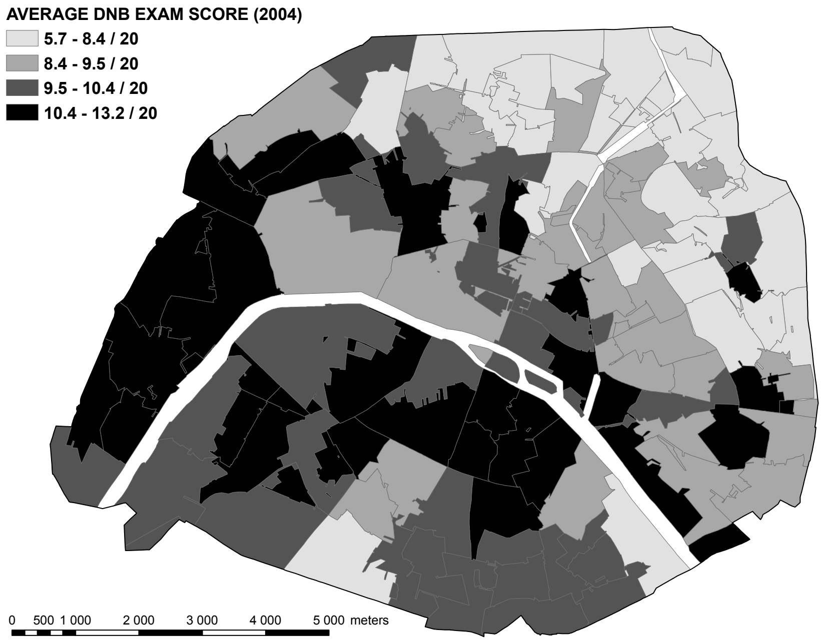

Figure 5: *Spatial distribution of the quartiles of public middle school performance as measured by the fraction of pupils admitted into general curriculum high schools (averaged over the period 1997-2004). Source: SCOLARITE pupil database (1997-2004).*

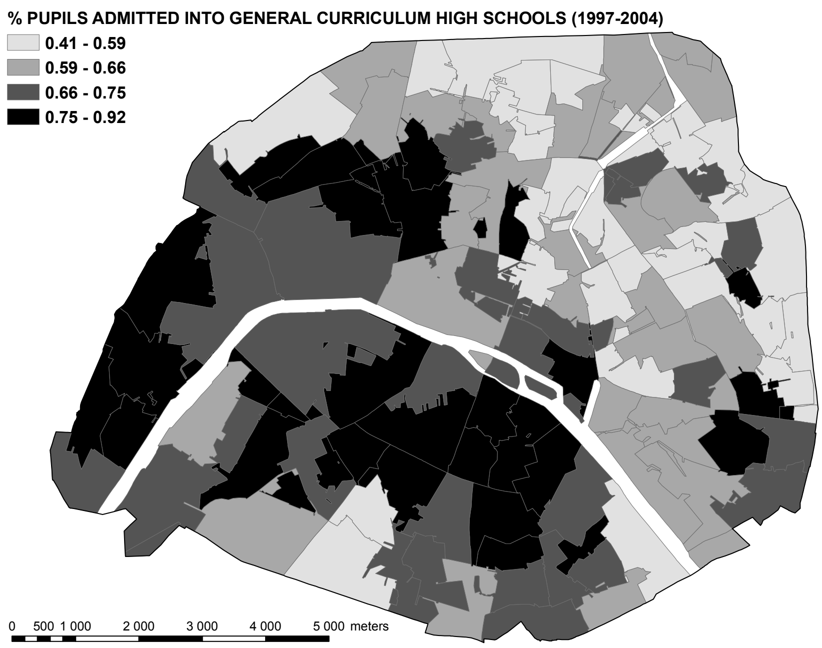

Figure 6: *Spatial distribution of the quartiles of public middle school performance as measured by the fraction of pupils from privileged socio-economic backgrounds (averaged over the period 1997-2004). Source: SCOLARITE pupil database (1997-2004).*

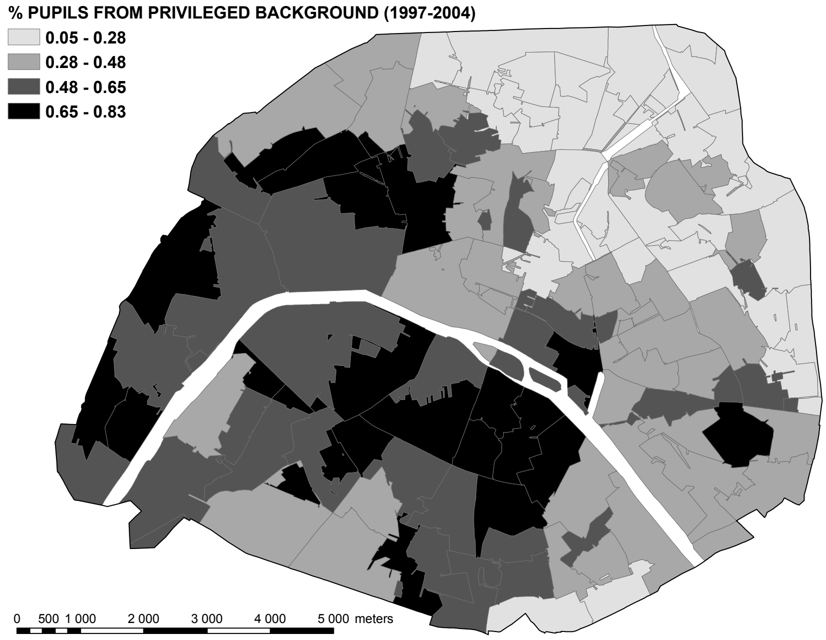

Figure 7: *Spatial distribution of the quartiles of average price per square meter (in 2004 euros) within each public middle school catchment area in school year 2003-2004.*

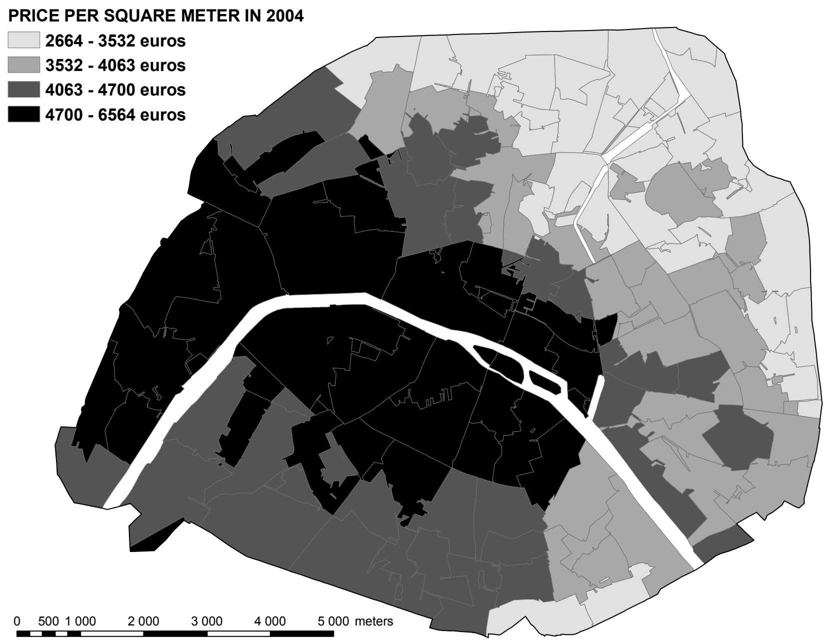

Figure 8: *Map of local private middle school proximity in Paris.*

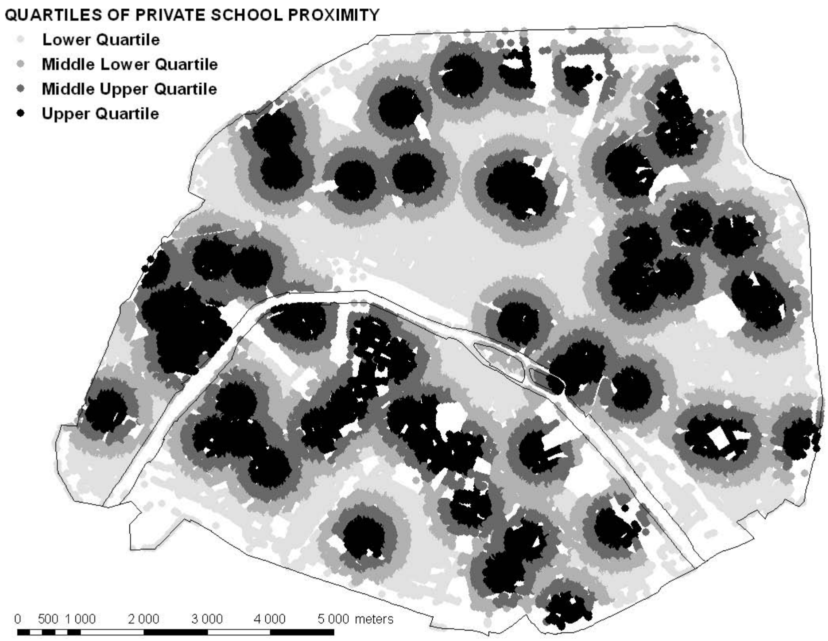

Figure 9: *Map of local private middle school density in Paris.*

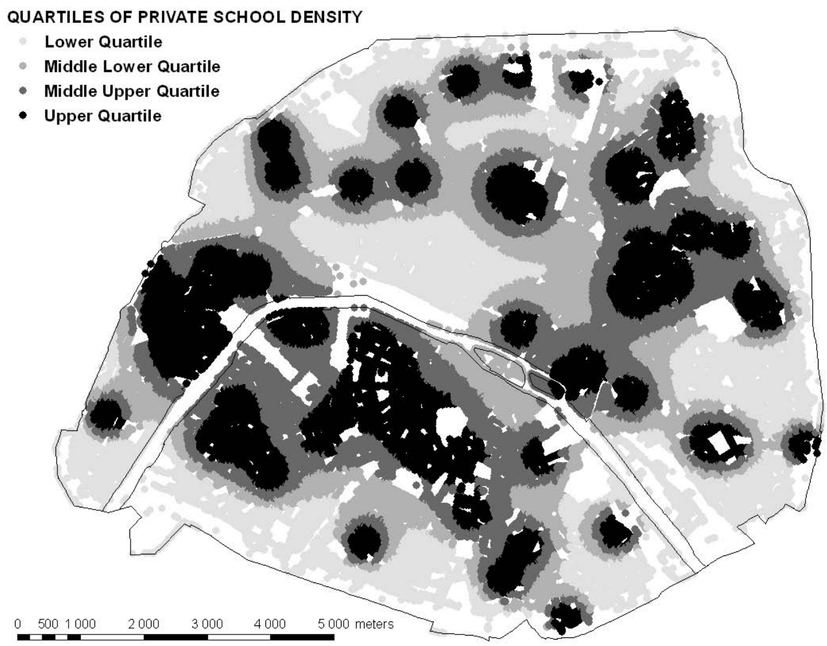

Table 1: *Summary statistics: Public and private middle schools in Paris in 2004. Sources: IPES dataset (2004) and OCEAN national examinations database (2004).*

Variables	All schools	Public schools	Private schools	Public schools			
				Quartiles of mean *DNB* exam score			
				Q1	Q2	Q3	Q4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
School size							
Total enrolment	85,237	57,918	27,319	13,042	14,040	13,794	17,042
Average enrolment	490	531	420	483	520	511	609
	(196)	(145)	(246)	(131)	(113)	(121)	(179)
Pupil-to-teacher ratio		14.5		12.1	13.6	14.6	17.5
		(7.0)		(3.5)	(6.6)	(5.3)	(10.1)
Pupils' characteristics							
% female	0.48	0.49	0.48	0.48	0.48	0.49	0.50
	(0.11)	(0.03)	(0.18)	(0.03)	(0.03)	(0.02)	(0.04)
% with privileged socio-economic background	0.41	0.32	0.57	0.11	0.24	0.35	0.56
	(0.24)	(0.20)	(0.22)	(0.07)	(0.12)	(0.14)	(0.12)
% foreign	0.13	0.18	0.04	0.27	0.20	0.15	0.09
	(0.11)	(0.10)	(0.05)	(0.11)	(0.09)	(0.07)	(0.05)
% grade repetition in first year	0.07	0.06	0.08	0.09	0.06	0.06	0.05
	(0.09)	(0.04)	(0.13)	(0.04)	(0.04)	(0.04)	(0.03)
% going into general curriculum	0.71	0.67	0.78	0.49	0.64	0.72	0.84
	(0.17)	(0.15)	(0.18)	(0.09)	(0.08)	(0.06)	(0.09)
Mean *DNB* exam score (out of 20)	9.99	9.42	10.97	7.28	8.94	10.01	11.38
	(1.89)	(1.62)	(1.94)	(0.83)	(0.31)	(0.30)	(0.70)
Teachers' characteristics							
% female		0.70		0.62	0.70	0.73	0.72
		(0.08)		(0.08)	(0.08)	(0.06)	(0.07)
% aged under 40		0.36		0.50	0.36	0.29	0.28
		(0.13)		(0.10)	(0.10)	(0.09)	(0.09)
% with high qualification		0.12		0.10	0.10	0.12	0.16
		(0.06)		(0.05)	(0.05)	(0.05)	(0.08)
% with intermediary qualification		0.70		0.69	0.70	0.70	0.70
		(0.08)		(0.08)	(0.08)	(0.09)	(0.08)
% with low qualification		0.18		0.21	0.20	0.18	0.14
		(0.08)		(0.08)	(0.08)	(0.08)	(0.06)
Number of schools	174	109	65	27	27	27	28

Notes: The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level is computed from the *Organisation des Concours et Examens Académiques et Nationaux* (*OCEAN*) national examinations database. School size, pupils' and teachers' characteristics are computed from the *Indicateurs pour le Pilotage des Établissements Secondaires* (*IPES*) dataset (2004). Standard deviations are in parenthesis.

Table 2: *Correlation between the three standardized indexes of public middle school performance. Sources: OCEAN (2004) national examinations database and SCOLARITE pupil database (1997-2004).*

Public middle school performance index	DNB	GENERAL	PRIVILEGED
DNB SCORE	1.00		
(p-value)	<.0001		
GENERAL CURRICULUM:	0.84	1.00	
(p-value)	<.0001	<.0001	
PRIVILEGED BACKGROUND:	0.86	0.90	1.00
(p-value)	<.0001	<.0001	<.0001
Number of public middle schools		108	

Notes: The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level (DNB SCORE) is computed from the *Organisation des Concours et Examens Académiques et Nationaux* (*OCEAN*) national examinations database. The proportion of middle school pupils entering general curriculum high schools (GENERAL CURRICULUM) and the fraction of pupils coming from privileged socio-economic backgrounds (PRIVILEGED BACKGROUND), averaged over school years 1997-2004, are computed from the annual *SCOLARITE* dataset of French pupils (1997-2004).

Table 3: *Summary statistics: characteristics of flats located within 250, 300 and 350 meters from a school attendance boundary and sold during school years 1997 to 2004. Source: BIEN dataset.*

Distance to boundary	All sales		< 250 m		< 300 m		< 350 m	
	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Price (in 2004 Euros)	183,054	(180,832)	181,915	(168,997)	183,516	(171,867)	184,804	(175,152)
Flat size (in m^2)	52	(35)	51	(34)	52	(34)	52	(35)
Price per m^2 (in 2004)	3,284	(1,287)	3,320	(1,242)	3,325	(1,255)	3,330	(1,263)
FLAT CHARACTERISTICS								
Age of building (percent)								
Unknown	0.11		0.11		0.11		0.11	
Before 1850	0.05		0.05		0.05		0.05	
1850-1913	0.42		0.41		0.41		0.41	
1914-1947	0.15		0.16		0.16		0.16	
1948-1969	0.13		0.13		0.13		0.13	
1970-1980	0.11		0.11		0.11		0.11	
After 1981								
Floor (percent)								
Ground floor	0.10		0.11		0.11		0.11	
First	0.16		0.16		0.16		0.16	
Second	0.16		0.16		0.16		0.16	
Third	0.16		0.15		0.16		0.15	
Fourth	0.14		0.14		0.14		0.14	
Fifth	0.12		0.12		0.12		0.12	
Sixth or more	0.16		0.15		0.15		0.15	
Number of rooms (percent)								
One	0.24		0.24		0.24		0.24	
Two	0.37		0.36		0.36		0.36	
Three	0.22		0.22		0.22		0.22	
Four	0.10		0.10		0.10		0.10	
Five or more	0.07		0.07		0.07		0.07	
% without ind. bathroom	0.21		0.21		0.21		0.21	
% with maid's room	0.04		0.04		0.04		0.04	
% with lift	0.90		0.90		0.90		0.90	
% with parking space	0.13		0.12		0.12		0.12	
Number of sales	196,815		99,917		113,531		124,608	

Notes: The features of flats sold during school years 1997 to 2004 are computed from the *BIEN* (*Base d'Informations Économiques Notariales*) dataset, which is managed by the Notary Chamber of Paris and the Île-de-France. The sample is restricted to all arm's-length sales of second hand Parisian flats that took place between September 1997 and August 2004. Sales located on the Île Saint-Louis and Île de la Cité islands were excluded from the sample because of their very specific location and pattern of housing prices.

Table 4: *Summary statistics: Neighborhood characteristics and average public middle school performance at the district level for all sales and sales located within 250, 300 and 350 meters of a school attendance boundary, sold during school years 1997 to 2004. Sources: 1999 National Census and school catchment areas in academic year 1998-1999.*

Distance to school boundary	All sales		< 250 m		< 300 m		< 350 m	
	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<u>Census variables</u>								
Nb of census districts	900		726		761		785	
Nb of individuals per district	2,292	(790)	2,345	(718)	2,343	(735)	2,333	(740)
Nb of households per district	1,204	(424)	1,244	(389)	1,240	(398)	1,234	(401)
Nb of persons per flat	1.89	(0.25)	1.87	(0.23)	1.87	(0.23)	1.88	(0.23)
<u>All households</u>								
% families with children under 25	0.22	(0.08)	0.22	(0.07)	0.22	(0.07)	0.22	(0.07)
% female-headed households	0.06	(0.03)	0.06	(0.02)	0.06	(0.02)	0.06	(0.03)
% owners	0.30	(0.11)	0.31	(0.10)	0.31	(0.10)	0.31	(0.10)
% public housing	0.15	(0.22)	0.13	(0.19)	0.13	(0.19)	0.13	(0.20)
% with graduate degree	0.39	(0.11)	0.40	(0.09)	0.40	(0.09)	0.40	(0.09)
% foreigners	0.23	(0.06)	0.22	(0.05)	0.22	(0.06)	0.22	(0.06)
% unemployed	0.12	(0.04)	0.11	(0.04)	0.11	(0.04)	0.12	(0.04)
Occupation:								
% managers	0.22	(0.07)	0.23	(0.06)	0.23	(0.06)	0.23	(0.06)
% self-employed workers	0.04	(0.02)	0.04	(0.02)	0.04	(0.02)	0.04	(0.02)
% intermediary occupation	0.15	(0.05)	0.14	(0.04)	0.14	(0.04)	0.15	(0.04)
% employees	0.14	(0.04)	0.14	(0.04)	0.14	(0.04)	0.14	(0.04)
% manual workers	0.06	(0.04)	0.06	(0.04)	0.06	(0.04)	0.06	(0.04)
% retired	0.18	(0.05)	0.18	(0.04)	0.18	(0.04)	0.18	(0.04)
% economically inactive	0.21	(0.05)	0.21	(0.05)	0.21	(0.05)	0.21	(0.05)
<u>School performance</u>								
Average score at the 2004 *DNB* exam	9.40	(1.62)	9.47	(1.56)	9.47	(1.56)	9.47	(1.56)
% entering general curriculum high schools	0.66	(0.12)	0.67	(0.12)	0.67	(0.12)	0.67	(0.12)
% with privileged backgrounds	0.44	(0.20)	0.44	(0.20)	0.44	(0.20)	0.44	(0.20)
Number of public schools	108		105		105		105	

Notes: Neighborhood characteristics are computed at the district level from the French 1999 National Census. The city of Paris is composed of 970 distinct districts (*Iris*), some of which are uninhabited. The average population living in a census district is 2,191 residents. Flat prices are expressed in 2004 euros. Distance to school attendance boundaries is computed by combining the Lambert II geocoding of sales with the mapping of school catchment areas in academic year 1998-1999. The average school performance indexes within each school are computed from the *OCEAN* national examination database (2004) and the *SCOLARITE* pupil database (1997-2004).

Table 5: *Regressions results - Naive estimates of the impact of middle school performance on housing prices. School years 1997-2004.*

Dependent variable: log of price per square meter (in 2004 euros)

Distance to school attendance boundary:	All sales (1)	All sales (2)	All sales (3)	< 250 meters (4)	< 300 meters (5)	< 350 meters (6)
MIDDLE SCHOOL PERFORMANCE INDEX:						
DNB SCORE (2004)	0.218***	0.194***	0.026***	0.031***	0.034***	0.033***
Cluster robust standard error	(0.017)	(0.016)	(0.008)	(0.009)	(0.009)	(0.009)
GENERAL CURRICULUM (1997-2004)	0.161***	0.142***	0.022***	0.024***	0.026***	0.026***
Cluster robust standard error	(0.015)	(0.014)	(0.005)	(0.005)	(0.005)	(0.005)
PRIVILEGED BACKGROUND (1997-2004)	0.190***	0.173***	0.036***	0.037***	0.039***	0.038***
Cluster robust standard error	(0.013)	(0.012)	(0.006)	(0.006)	(0.006)	(0.006)
CONTROL VARIABLES:						
School year & quarter fixed effects	YES	YES	YES	YES	YES	YES
Flat features	NO	YES	YES	YES	YES	YES
Census socio-demographic variables	NO	NO	YES	YES	YES	YES
Number of sales	195,845	195,845	195,845	99,917	113,531	124,608
Number of clusters (middle schools)	108	108	108	105	105	105

Notes: *: significant at the 10% level; **: significant at the 5% level; ***: significant at the 1% level. The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level (DNB SCORE) is computed from the *Organisation des Concours et Examens Académiques et Nationaux* (*OCEAN*) national examinations database. The proportion of middle school pupils entering general curriculum high schools (GENERAL CURRICULUM) and the fraction of pupils coming from privileged socio-economic backgrounds (PRIVILEGED BACKGROUND), averaged over school years 1997-2004, are computed from the annual *SCOLARITE* dataset of French pupils (1997-2004). Flat features include a set of dummy variables for the age of the building (before 1850, 1850-1913, 1914-1947, 1948-1969, 1970-1980, after 1981), the number of bathrooms (1, 2 or more), the presence of a parking space, of a maid's room, the floor (first to fourth or more with and without a lift), the number of rooms (from 1 to 5 or more) and the average room size (small, medium, large). Socio-demographic neighborhood characteristics are taken from the 1999 French Census and are available at the district level. They include the following variables: average number of persons per flat, % public housing apartments, % owners, % families (*i.e.* household with at least one child), % single-parent families, % foreign, % unemployed and occupation of the household head (manager, self-employed, intermediary occupation, employee, manual worker, retired and economically inactive). Standard errors are clustered at the public middle school attendance level.

Table 6: *Regression of cross-boundary housing price differentials on corresponding school performance differentials. Sales are matched across public middle school attendance boundaries. School years 1997-2004.*

Dependent variable: Cross-boundary differential in the log of housing price (in 2004 euros)

Distance to school attendance boundary:	< 250 meters (1)	< 300 meters (2)	< 350 meters (3)
MIDDLE SCHOOL PERFORMANCE INDEX:			
Δ DNB SCORE (2004)	0.015**	0.015**	0.015**
Cluster robust standard error	(0.007)	(0.007)	(0.007)
Δ GENERAL CURRICULUM (1997-2004)	0.019***	0.021***	0.021***
Cluster robust standard error	(0.005)	(0.005)	(0.005)
Δ PRIVILEGED BACKGROUND (1997-2004)	0.024***	0.026***	0.027***
Cluster robust standard error	(0.008)	(0.008)	(0.008)
Average Δ DNB SCORE	0.60	0.60	0.61
(s.d.)	(0.48)	(0.48)	(0.48)
Average Δ GENERAL CURRICULUM	0.86	0.86	0.86
(s.d.)	(0.64)	(0.63)	(0.63)
Average Δ PRIVILEGED BACKGROUND	0.72	0.72	0.72
(s.d.)	(0.56)	(0.56)	(0.56)
Average distance between matched sales (in meters)	155	182	207
(s.d.)	(54)	(65)	(75)
Number of sales	99,917	113,531	124,608
Number of clusters (school attendance boundaries)	169	171	172

Notes: *: significant at the 10% level; **: significant at the 5% level; ***: significant at the 1% level. To account for the fact that the price premium attached to specific flat features may vary throughout the city of Paris, we correct the prices of all sales for zone-specific flat features effects. The prices of all sales within a given zone (out of 18) are homogenized in the sense that there are now expressed in terms of the typical flat's characteristics (The typical flat has two rooms, belongs to a building constructed between 1850 and 1913, is located on the ground floor, with one bathroom and average size rooms, without a maid's room or a parking space and was sold during the fourth quarter). Appendix A explains the exact steps that we have followed to compute these so-called "hedonic" prices. The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level (DNB SCORE) is computed from the *Organisation des Concours et Examens Académiques et Nationaux* (*OCEAN*) national examinations database. The proportion of middle school pupils entering general curriculum high schools (GENERAL CURRICULUM) and the fraction of pupils coming from privileged socio-economic backgrounds (PRIVILEGED BACKGROUND), averaged over school years 1997-2004, are computed from the annual *SCOLARITE* dataset of French pupils (1997-2004). Details on the matching of sales across public middle school attendance boundaries are given in section 2.3. The regressions are weighted by the inverse of the distance between each match's components (*i.e.* the reference sale and the constructed counterfactual sale). The average distance between matched sales is the average distance between the reference sale and its constructed counterfactual. The geographic coordinates of the counterfactual are given by the average coordinates of the sales that are used to construct it, weighted by the inverse of their distance to the reference sale. Standard errors are clustered at the public middle school attendance boundary level.

Table 7: *Comparison of flat features on the "good" and "bad" side of school attendance boundaries (in terms of the school's average DNB exam score in 2004). School years 1997-2004.*

Distance to boundary	< 250 meters		< 300 meters		< 350 meters	
	"Bad" side	"Good" side	"Bad" side	"Good" side	"Bad" side	"Good" side
Flat size (in m^2)	51	52	51	52	51	52
(s.d.)	(34)	(34)	(34)	(34)	(34)	(35)
Price per m^2 (in 2004)	3,305	3,338	3,306	3,346	3,313	3,350
(s.d.)	(1,247)	(1,236)	(1,262)	(1,246)	(1,271)	(1,253)
<u>FLAT CHARACTERISTICS</u>						
Age of building (percent)						
Unknown	0.11	0.11	0.11	0.11	0.11	0.11
Before 1850	0.05	0.05	0.05	0.05	0.05	0.05
1850-1913	0.42	0.41	0.42	0.40	0.42	0.40
1914-1947	0.16	0.17	0.16	0.17	0.16	0.16
1948-1969	0.13	0.13	0.13	0.13	0.13	0.13
1970-1980	0.11	0.11	0.11	0.11	0.11	0.11
After 1981	0.02	0.03	0.02	0.03	0.02	0.03
Floor (percent)						
Ground floor	0.10	0.11	0.10	0.11	0.10	0.11
First	0.16	0.16	0.16	0.16	0.16	0.16
Second	0.16	0.16	0.16	0.16	0.16	0.16
Third	0.15	0.16	0.15	0.16	0.15	0.16
Fourth	0.15	0.14	0.15	0.14	0.15	0.14
Fifth	0.12	0.12	0.12	0.12	0.12	0.12
Sixth or more	0.15	0.15	0.15	0.15	0.15	0.15
Number of rooms (percent)						
One	0.24	0.24	0.24	0.24	0.24	0.24
Two	0.37	0.36	0.37	0.36	0.37	0.36
Three	0.22	0.23	0.22	0.23	0.22	0.23
Four	0.10	0.10	0.10	0.10	0.10	0.10
Five or more	0.07	0.07	0.07	0.07	0.07	0.07
% without ind. bathroom	0.21	0.21	0.21	0.21	0.21	0.21
% with maid's room	0.04	0.04	0.04	0.04	0.04	0.04
% with lift	0.90	0.90	0.90	0.90	0.90	0.90
% with garage	0.12	0.12	0.12	0.13	0.12	0.13
<u>SCHOOL PERFORMANCE</u>						
Average DNB exam score	9.11	9.95	9.11	9.94	9.11	9.94
(s.d.)	(1.39)	(1.44)	(1.39)	(1.43)	(1.39)	(1.43)
% entering general high schools	0.64	0.70	0.64	0.70	0.64	0.70
(s.d.)	(0.11)	(0.12)	(0.11)	(0.12)	(0.11)	(0.12)
% with privileged background	0.41	0.49	0.41	0.49	0.41	0.49
(s.d.)	(0.19)	(0.20)	(0.19)	(0.20)	(0.19)	(0.20)
Number of sales	53,181	46,736	60,672	52,859	67,014	57,594

Notes: The features of flats sold during school years 1997 to 2004 are computed from the *BIEN* (*Base d'Informations Économiques Notariales*) dataset, which is managed by the Notary Chamber of Paris and the Île-de-France. The sample is restricted to all arm's-length sales of second hand Parisian flats that took place between September 1997 and August 2004. Sales located on the Île Saint-Louis and Île de la Cité islands were excluded from the sample because of their very specific location and pattern of housing prices. The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level (DNB SCORE) is computed from the *Organisation des Concours et Examens Académiques et Nationaux* (*OCEAN*) national examinations database. The proportion of middle school pupils entering general curriculum high schools (GENERAL CURRICULUM) and the fraction of pupils coming from privileged socio-economic backgrounds (PRIVILEGED BACKGROUND), averaged over school years 1997-2004, are computed from the annual *SCOLARITE* dataset of French pupils (1997-2004). For each boundary separating two public middle schools, the "bad" side corresponds to the school with the lowest average *DNB* exam score whereas the "good" side corresponds to the school with the highest average *DNB* exam score.

Table 8: *Comparison of socio-demographic characteristics of neighborhoods located on the "good" and "bad" side of school attendance boundaries (in terms of the school's average DNB exam score in 2004). School years 1997-2004.*

Distance to boundary	< 250 meters		< 300 meters		< 350 meters	
	"Bad" side	"Good" side	"Bad" side	"Good" side	"Bad" side	"Good" side
CENSUS VARIABLES						
Nb of census districts	554	548	584	570	602	584
Nb of individuals per district	2,384	2,343	2,389	2,339	2,376	2,341
Nb of households per district	1,271	1,241	1,270	1,235	1,263	1,236
Nb of persons per flat	1.86	1.88	1.86	1.88	1.86	1.88
All households						
% families with children under 25	0.22	0.22	0.22	0.22	0.22	0.22
% female-headed households	0.06	0.06	0.06	0.06	0.06	0.06
% owners	0.32	0.32	0.31	0.31	0.31	0.31
% public housing	0.12	0.12	0.13	0.12	0.13	0.12
% with graduate degree	0.40	0.41	0.40	0.41	0.40	0.41
% foreigners	0.22	0.22	0.22	0.22	0.22	0.22
% unemployed	0.12	0.11	0.12	0.11	0.12	0.11
Occupation:						
% managers	0.23	0.23	0.23	0.23	0.23	0.23
% self-employed workers	0.04	0.04	0.04	0.04	0.04	0.04
% intermediary occupation	0.14	0.14	0.14	0.14	0.15	0.14
% employees	0.14	0.14	0.14	0.14	0.14	0.14
% manual workers	0.06	0.06	0.06	0.06	0.06	0.06
% retired	0.18	0.17	0.18	0.17	0.18	0.17
% economically inactive	0.21	0.21	0.21	0.21	0.21	0.21
SCHOOL PERFORMANCE						
Average *DNB* exam (2004)	9.11	9.95	9.11	9.94	9.11	9.94
(s.d.)	(1.39)	(1.44)	(1.39)	(1.43)	(1.39)	(1.43)
% entering general high schools	0.64	0.70	0.64	0.70	0.64	0.70
(s.d.)	(0.11)	(0.12)	(0.11)	(0.12)	(0.11)	(0.12)
% with privileged backgrounds	0.41	0.49	0.41	0.49	0.41	0.49
(s.d.)	(0.19)	(0.20)	(0.19)	(0.20)	(0.19)	(0.20)
Number of sales	53,181	46,736	60,672	52,859	67,014	57,594

Notes: Socio-demographic neighborhood characteristics are taken from the 1999 French Census and are available at the district level. They include the following variables: average number of persons per flat, % public housing apartments, % owners, % families (*i.e.* household with at least one child), % single-parent families, % foreign, % unemployed and occupation of the household head (manager, self-employed, intermediary occupation, employee, manual worker, retired and economically inactive). The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level (DNB SCORE) is computed from the *Organisation des Concours et Examens Académiques et Nationaux* (*OCEAN*) national examinations database. The proportion of middle school pupils entering general curriculum high schools (GENERAL CURRICULUM) and the fraction of pupils coming from privileged socio-economic backgrounds (PRIVILEGED BACKGROUND), averaged over school years 1997-2004, are computed from the annual *SCOLARITE* dataset of French pupils (1997-2004). For each boundary separating two public middle schools, the "bad" side corresponds to the school with the lowest average *DNB* exam score whereas the "good" side corresponds to the school with the highest average *DNB* exam score.

Table 9: *Comparison of the occupation of the household head (computed separately for families and households without children) in neighborhoods located on the "good" and "bad" side of school attendance boundaries where the school performance differential is larger than half a standard deviation(in terms of the school's average DNB exam score in 2004). School years 1997-2004.*

Distance to boundary	< 250 meters		< 300 meters		< 350 meters	
	"Bad" side	"Good" side	"Bad" side	"Good" side	"Bad" side	"Good" side
Census variables						
% families with children under 25	0.22	0.22	0.22	0.22	0.22	0.22
Families only						
Occupation:						
% managers	0.39	0.42	0.39	0.42	0.39	0.41
% self-employed workers	0.10	0.10	0.10	0.10	0.10	0.10
% intermediary occupation	0.16	0.15	0.16	0.16	0.16	0.16
% employees	0.15	0.14	0.14	0.14	0.15	0.14
% manual workers	0.13	0.11	0.13	0.11	0.13	0.11
% retired	0.03	0.03	0.03	0.03	0.03	0.03
% economically inactive	0.04	0.04	0.04	0.04	0.04	0.04
Households with no children at home						
Occupation:						
% managers	0.19	0.19	0.19	0.19	0.19	0.19
% self-employed workers	0.03	0.03	0.03	0.03	0.03	0.03
% intermediary occupation	0.11	0.11	0.11	0.11	0.11	0.11
% employees	0.10	0.10	0.10	0.10	0.10	0.10
% manual workers	0.04	0.04	0.05	0.04	0.05	0.04
% retired	0.21	0.21	0.21	0.21	0.21	0.21
% economically inactive	0.10	0.10	0.10	0.10	0.10	0.10
School performance						
Average *DNB* exam (2004)	8.77	10.31	8.77	10.25	8.77	10.25
(s.d.)	(1.36)	(1.48)	(1.36)	(1.51)	(1.36)	(1.51)
% entering general high schools	0.63	0.72	0.63	0.72	0.63	0.72
(s.d.)	(0.10)	(0.13)	(0.10)	(0.13)	(0.10)	(0.13)
% with privileged backgrounds	0.38	0.54	0.38	0.53	0.38	0.53
(s.d.)	(0.17)	(0.21)	(0.17)	(0.21)	(0.17)	(0.21)
Number of Census districts	332	310	354	332	367	344
Number of sales	27,830	22,422	32,082	25,603	35,983	28,224

Notes: In the 1999 French Census, the occupation of the household head is available at the district level separately for families (i.e. households with a child under the age of 25) and for households with no children at home. The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level (DNB SCORE) is computed from the *Organisation des Concours et Examens Académiques et Nationaux* (*OCEAN*) national examinations database. The proportion of middle school pupils entering general curriculum high schools (GENERAL CURRICULUM) and the fraction of pupils coming from privileged socio-economic backgrounds (PRIVILEGED BACKGROUND), averaged over school years 1997-2004, are computed from the annual *SCOLARITE* dataset of French pupils (1997-2004). For each boundary separating two public middle schools, the "bad" side corresponds to the school with the lowest average *DNB* exam score whereas the "good" side corresponds to the school with the highest average *DNB* exam score.

Table 10: *Location of the school attended by public and private school Parisian pupils with respect to their arrondissement of residence. School year 2003-2004.*

Type of middle school attended	Location of attended middle school with respect to the arrondissement of residence	Percentage
PUBLIC	Same *arrondissement*	85%
	Adjacent *arrondissements*	8%
	Other *arrondissements* in Paris	6%
	Outside Paris (Île-de-France)	1%
PRIVATE	Same *arrondissement*	53%
	Adjacent *arrondissements*	28%
	Other *arrondissements* in Paris	13%
	Outside Paris (Île-de-France)	6%

Notes: Source: The location of the school attended by Parisian public and private school pupils with respect to their arrondissement of residence are computed from the *SCOLARITE* pupils dataset covering school year 2003-2004. Statistics are computed for all middle school students residing in Paris and enrolled in a middle school in Paris or elsewhere in the Île-de-France. The city of Paris is divided into 20 *arrondissements.* Among middle school students attending a private school, 53% attend a school located in their *arrondissement* of residence and 28% in an adjacent *arrondissement.*

Table 11: *Regression of cross-boundary housing price differentials on corresponding school performance differentials by quartile of proximity to the closest private middle school. Sales are matched across public middle school attendance boundaries. School years 1997-2004.*

Dependent variable: Cross-boundary differential in the log of housing price (in 2004 euros)

		Quartiles of proximity to the closest private middle school			
	All sales	Lower Quartile	Middle Lower Quartile	Middle Upper Quartile	Upper Quartile
	(1)	(2)	(3)	(4)	(5)
PANEL A: SALES <250 METERS OF BOUNDARY					
Δ DNB SCORE (2004)	0.015**	0.029*	0.019***	0.007	0.006
Cluster robust standard error	(0.007)	(0.017)	(0.007)	(0.008)	(0.011)
Δ GENERAL CURRICULUM (1997-2004)	0.019***	0.027***	0.022***	0.013**	0.010
Cluster robust standard error	(0.005)	(0.011)	(0.007)	(0.006)	(0.008)
Δ PRIVILEGED (1997-2004)	0.024***	0.042**	0.029***	0.014*	0.008
Cluster robust standard error	(0.008)	(0.018)	(0.009)	(0.008)	(0.009)
Number of observations	99,917	24,978	24,973	24,985	24,981
PANEL B: SALES <300 METERS OF BOUNDARY					
Δ DNB SCORE (2004)	0.015**	0.028*	0.020**	0.006	0.008
Cluster robust standard error	(0.007)	(0.017)	(0.008)	(0.008)	(0.010)
Δ GENERAL CURRICULUM (1997-2004)	0.021***	0.029***	0.026***	0.013***	0.014**
Cluster robust standard error	(0.005)	(0.011)	(0.007)	(0.005)	(0.007)
Δ PRIVILEGED (1997-2004)	0.026***	0.043**	0.032***	0.015**	0.012
Cluster robust standard error	(0.008)	(0.019)	(0.009)	(0.007)	(0.008)
Number of observations	113,531	28,377	28,388	28,380	28,386
PANEL C: SALES <350 METERS OF BOUNDARY -					
Δ DNB SCORE (2004)	0.015**	0.033**	0.022**	0.003	0.005
Cluster robust standard error	(0.007)	(0.015)	(0.009)	(0.008)	(0.010)
Δ GENERAL CURRICULUM (1997-2004)	0.021***	0.031***	0.028***	0.012**	0.014**
Cluster robust standard error	(0.005)	(0.011)	(0.007)	(0.005)	(0.007)
Δ PRIVILEGED (1997-2004)	0.027***	0.047***	0.033**	0.014**	0.014*
Cluster robust standard error	(0.008)	(0.018)	(0.009)	(0.007)	(0.008)
Number of observations	124,608	31,143	31,152	31,160	31,153

Notes: *: significant at the 10% level; **: significant at the 5% level; ***: significant at the 1% level. The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level (DNB SCORE) is computed from the *Organisation des Concours et Examens Académiques et Nationaux* (*OCEAN*) national examinations database. The proportion of middle school pupils entering general curriculum high schools (GENERAL CURRICULUM) and the fraction of pupils coming from privileged socio-economic backgrounds (PRIVILEGED BACKGROUND), averaged over school years 1997-2004, are computed from the annual *SCOLARITE* dataset of French pupils (1997-2004). The indicator of the proximity of private middle schools is constructed as follows: for each "reference" sale, we calculate the inverse of its distance to the closest private middle school; we then split this indicator into four quartiles, from the most distant to the closest local private school. Details on the matching of sales across public middle school attendance boundaries are given in section 2.3. The regressions are weighted by the inverse of the distance between each match's components (*i.e.* the reference sale and the constructed counterfactual sale). Standard errors are clustered at the public middle school attendance boundary level.

Table 12: *Regression of cross-boundary housing price differentials on corresponding school performance differentials by quartile of private school density. Sales are matched across public middle school attendance boundaries. School years 1997-2004.*

Dependent variable: Cross-boundary differential in the log of housing price (in 2004 euros)

	All sales	Quartiles of private middle school density			
		Lower Quartile	Middle Lower Quartile	Middle Upper Quartile	Upper Quartile
	(1)	(2)	(3)	(4)	(5)
PANEL A: SALES <250 METERS OF BOUNDARY					
Δ DNB SCORE (2004)	0.015**	0.034**	0.015*	0.007	0.002
Cluster robust standard error	(0.007)	(0.016)	(0.008)	(0.007)	(0.010)
Δ GENERAL CURRICULUM (1997-2004)	0.015**	0.028***	0.028***	0.010**	0.008
Cluster robust standard error	(0.007)	(0.010)	(0.007)	(0.004)	(0.007)
Δ PRIVILEGED (1997-2004)	0.015**	0.043***	0.029***	0.010*	0.005
Cluster robust standard error	(0.007)	(0.017)	(0.008)	(0.006)	(0.009)
Number of observations	99,917	24,979	24,964	24,994	24,980
PANEL B: SALES <300 METERS OF BOUNDARY					
Δ DNB SCORE (2004)	0.019***	0.035**	0.015*	0.006	0.004
Cluster robust standard error	(0.005)	(0.015)	(0.009)	(0.008)	(0.010)
Δ GENERAL CURRICULUM (1997-2004)	0.021***	0.030***	0.029***	0.012**	0.011*
Cluster robust standard error	(0.005)	(0.011)	(0.007)	(0.004)	(0.006)
Δ PRIVILEGED (1997-2004)	0.021***	0.044***	0.031***	0.012**	0.010
Cluster robust standard error	(0.005)	(0.016)	(0.009)	(0.006)	(0.008)
Number of observations	113,531	28,380	28,385	28,381	28,385
PANEL C: SALES <350 METERS OF BOUNDARY					
Δ DNB SCORE (2004)	0.024***	0.038***	0.017*	0.005	-0.001
Cluster robust standard error	(0.008)	(0.013)	(0.009)	(0.008)	(0.010)
Δ GENERAL CURRICULUM (1997-2004)	0.026***	0.032***	0.031***	0.011**	0.011*
Cluster robust standard error	(0.008)	(0.010)	(0.007)	(0.004)	(0.006)
Δ PRIVILEGED (1997-2004)	0.027***	0.046***	0.034***	0.011*	0.011
Cluster robust standard error	(0.008)	(0.016)	(0.009)	(0.007)	(0.008)
Number of observations	124,608	31,152	31,146	31,156	31,154

Notes: *: significant at the 10% level; **: significant at the 5% level; ***: significant at the 1% level. The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level (DNB SCORE) is computed from the *Organisation des Concours et Examens Académiques et Nationaux* (*OCEAN*) national examinations database. The proportion of middle school pupils entering general curriculum high schools (GENERAL CURRICULUM) and the fraction of pupils coming from privileged socio-economic backgrounds (PRIVILEGED BACKGROUND), averaged over school years 1997-2004, are computed from the annual *SCOLARITE* dataset of French pupils (1997-2004).The indicator of the density of private middle schools is constructed as follows: for each "reference" sale, we calculate the average of the inverse of its distance to every private middle school in Paris squared; we then split our indicator into four quarters, from the lowest density of private schools to the highest. Details on the matching of sales across public middle school attendance boundaries are given in section 2.3. The regressions are weighted by the inverse of the distance between each match's components (*i.e.* the reference sale and the constructed counterfactual sale). Standard errors are clustered at the public middle school attendance boundary level.

Table 13: *Comparison of the socio-demographic characteristics of the four quartiles of private school proximity for sales located within 250 meters of a public middle school attendance boundary. School years 1997-2004.*

Variables	Quartiles of proximity to the closest private middle school			
	Lower Quartile	Middle Lower Quartile	Middle Upper Quartile	Upper Quartile
<u>CENSUS VARIABLES</u>				
Nb of census districts	268	361	397	284
Nb of individuals per district	2,271	2,393	2,445	2,447
Nb of households per district	1,223	1,275	1,287	1,286
<u>All households</u>				
% families with children under 25	0.21	0.22	0.22	0.22
% female-headed households	0.06	0.06	0.06	0.06
% owners	0.32	0.31	0.32	0.33
% public housing	0.11	0.13	0.13	0.11
% with graduate degree	0.41	0.40	0.41	0.41
% foreigners	0.23	0.22	0.22	0.22
% unemployed	0.11	0.11	0.11	0.11
Occupation:				
% managers	0.23	0.23	0.23	0.23
% self-employed workers	0.04	0.04	0.04	0.04
% intermediary occupation	0.14	0.14	0.14	0.14
% employees	0.14	0.14	0.14	0.14
% manual workers	0.06	0.06	0.06	0.06
% retired	0.17	0.18	0.18	0.18
% economically inactive	0.21	0.21	0.21	0.22
<u>PUBLIC SCHOOL PERFORMANCE</u>				
Average score at the 2004 *DNB* exam	9.70	9.63	9.45	9.55
(s.d.)	(1.46)	(1.50)	(1.54)	(1.55)
% entering general curriculum high schools	0.68	0.68	0.67	0.68
(s.d.)	(0.11)	(0.11)	(0.12)	(0.12)
% with privileged backgrounds	0.47	0.46	0.45	0.46
(s.d.)	(0.19)	(0.20)	(0.20)	(0.20)
PUBLIC PREMIUM: Average cross-boundary DNB premium of the "good" over the "bad" public middle school	0.11	0.12	0.11	0.10
(s.d.)	(0.07)	(0.08)	(0.07)	(0.07)
<u>CLOSEST PRIVATE SCHOOL PERFORMANCE</u>				
Average *DNB* exam score of the closest private school	11.19	10.80	10.79	10.79
(s.d.)	(1.25)	(1.48)	(1.56)	(1.86)
PRIVATE PREMIUM: Average DNB premium of the closest private school over local public schools	0.16	0.13	0.15	0.14
(s.d.)	(0.19)	(0.20)	(0.21)	(0.23)
Number of sales	24,978	24,973	24,985	24,981

Notes: Socio-demographic neighborhood characteristics are taken from the 1999 French Census and are available at the district level. Public middle school performance indexes are computed from the 2004 OCEAN national examinations database and the annual *SCOLARITE* dataset of French pupils (1997-2004). The indicator of the proximity of private middle schools is constructed as follows: for each "reference" sale, we calculate the inverse of its distance to the closest private middle school; we then split this indicator into four quartiles, from the most distant to the closest local private school. The average DNB score of the local private school is the score the private school which is closest to the "reference" sale. For details on the computation of the *DNB* premium of the closest private school over local public schools, see section 7.4.

Table 14: *Comparison of the socio-demographic characteristics of the four quartiles of private school density for sales located within 250 meters of a public middle school attendance boundary. School years 1997-2004.*

Variables	Quartiles of local private middle school density			
	Lower Quartile	Middle Lower Quartile	Middle Upper Quartile	Upper Quartile
CENSUS VARIABLES				
Nb of census districts	254	330	342	269
Nb of individuals per district	2,289	2,418	2,440	2,446
Nb of households per district	1,207	1,300	1,292	1,285
All households				
% families with children under 25	0.22	0.21	0.22	0.22
% female-headed households	0.06	0.06	0.06	0.06
% owners	0.30	0.31	0.32	0.33
% public housing	0.16	0.12	0.12	0.10
% with graduate degree	0.39	0.41	0.41	0.42
% foreigners	0.22	0.22	0.22	0.22
% unemployed	0.12	0.12	0.11	0.11
Occupation:				
% managers	0.22	0.23	0.23	0.23
% self-employed workers	0.04	0.04	0.04	0.04
% intermediary occupation	0.16	0.14	0.14	0.13
% employees	0.14	0.15	0.14	0.13
% manual workers	0.07	0.06	0.06	0.05
% retired	0.18	0.18	0.18	0.18
% economically inactive	0.20	0.20	0.21	0.23
PUBLIC SCHOOL PERFORMANCE				
Average score at the 2004 *DNB* exam	9.48	9.60	9.57	9.59
(s.d.)	(1.40)	(1.48)	(1.59)	(1.61)
% entering general curriculum high schools	0.66	0.67	0.68	0.68
(s.d.)	(0.10)	(0.12)	(0.12)	(0.12)
% with privileged backgrounds	0.44	0.46	0.46	0.47
(s.d.)	(0.18)	(0.20)	(0.20)	(0.21)
PUBLIC PREMIUM: Average cross-boundary DNB premium of the "good" over the "bad" public middle school	0.12	0.11	0.11	0.11
(s.d.)	(0.09)	(0.08)	(0.07)	(0.07)
LOCAL PRIVATE SCHOOL PERFORMANCE				
Average DNB exam score of private schools	10.94	10.88	10.83	10.85
(s.d.)	(0.43)	(0.58)	(0.78)	(1.32)
PRIVATE PREMIUM: Average DNB premium of local private schools over local public schools	0.16	0.14	0.14	0.14
(s.d.)	(0.14)	(0.15)	(0.17)	(0.20)
Number of sales	24,979	24,964	24,994	24,980

Notes: Socio-demographic neighborhood characteristics are taken from the 1999 French Census and are available at the district level. Public middle school performance indexes are computed from the 2004 OCEAN national examinations database and the annual *SCOLARITE* dataset of French pupils (1997-2004). The indicator of the density of private middle schools is constructed as follows: for each "reference" sale, we calculate the average of the inverse of its distance to every private middle school in Paris squared; we then split our indicator into four quarters, from the lowest density of private schools to the highest. The average DNB score of the locals private schools is a weighted average of the DNB score of all Parisian private schools, the weights being equal to the inverse of their distance (squared) to the "reference" sale. For details on the computation of the *DNB* premium of local private schools over local public schools, see section 7.4.

Table 15: *Example of a hedonic regression for zone 1 (* arrondissements *1 to 4), used to convert observed housing prices into the "typical" flat equivalence prices. School years 1997-2004.*

Dependent variable: log of housing price per square meters

Variable	Coefficient	(Standard error)
Intercept	8.458	(0.019)
Age of Building		
Unknown	0.020	(0.009)
Before 1850	0.063	(0.007)
1850-1913	ref.	
1914-1947	-0.003	(0.012)
1948-1969	0.022	(0.015)
1970-1980	0.097	(0.023)
After 1981	0.061	(0.025)
Number of Bathrooms		
No bathroom	-0.167	(0.007)
1 bathroom	ref.	
2 bathrooms	0.067	(0.017)
Parking lot		
No parking lot	ref.	
1 parking lot	0.182	(0.024)
2 parking lot	0.205	(0.085)
Floot		
Ground floor	ref.	
First	0.046	(0.015)
Second	0.077	(0.014)
Third	0.085	(0.014)
Fourth or more (with a lift)	0.081	(0.013)
Fourth or more (without a lift)	0.054	(0.018)
Number of rooms		
One	-0.064	(0.008)
Two	ref.	
Three	0.029	(0.009)
Four	0.073	(0.012)
Five or more	0.032	(0.015)
Average room size		
Small	0.016	(0.007)
Average	ref.	
Large	0.036	(0.009)
Maid's room	0.068	(0.020)
Number of sales	10,338	

Notes: The features of flats sold during school years 1997 to 2004 are computed from the *BIEN* (*Base d'Informations Économiques Notariales*) dataset, which is managed by the Notary Chamber of Paris and the Île-de-France. The sample is restricted to all arm's-length sales of second hand Parisian flats that took place between September 1997 and August 2004. Sales located on the Île Saint-Louis and Île de la Cité islands were excluded from the sample because of their very specific location and pattern of housing prices. Log of housing prices are in 2004 euros. The Regression includes year and quarter fixed effects.