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Acknowledgments

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1 Introduction

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; Epple and Romano, 2003; Rothstein, 2006) have shown that the existence of peer effects in education yields income and residential sorting in equilibrium. One of these models' key parameters 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, this sorting process can be reversed once school choice is introduced (Epple and Romano, 2003; Rothstein, 2006). In particular, private schools, which operate under different admission rules, expand educational choices and might mitigate sorting effects. 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.

Several empirical papers have sought to test the empirical prediction that housing prices should be higher in areas where schools perform better. The estimation is complicated by the endogeneity of school performance in the housing price equation, since better schools tend to be located in wealthier neighborhoods and pupils drawn from privileged socio-economic backgrounds generally have higher academic achievement. Traditional hedonic regressions in which housing prices are regressed on school performance, controlling for housing and neighborhood characteristics, are therefore likely to be biased[1]. In her 1999 paper, Black proposed a method to solve this problem by comparing the price of houses located near primary school attendance boundaries and sufficiently close to share the same neighborhood characteristics. Across these boundaries, mean differences in housing prices are assumed to reflect differences in school test scores only. Restricting the sample to sales located within 0.15 mile of a boundary, Black finds that a 5% increase in primary schools' test scores (approximately one standard deviation) raises housing prices by 2.1%. On UK data and using an alternative estimation strategy to correct for spatial fixed effects[2], Gibbons and Machin (2003, 2006) find an effect of the same order of magnitude for primary schools. A study by Bayer et al. (2007) yields similar results using a discrete choice model instead of the usual hedonic approach. Furthermore,

[1] In the French context, Gravel et al. (2006) implemented this hedonic approach 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 because school catchment areas are not strictly defined. Proximity to primary schools is only one criterion among others for admission to schools and Cheshire and Sheppard (2004) point out that living in a house located near a boundary might render admission to a school more uncertain than living in a house located in the immediate vicinity of a school.

these authors provide evidence of significant heterogeneity in the marginal willingness of households to pay for school performance. A few papers have also exploited changes in school boundaries over time (Bogart and Cromwell, 2000; Reback, 2005) and show that housing prices responded to these reforms. In the longer run, however, Kane et al. (2006) stress the difficulty of separately identifying the effect of school performance from the effect of household sorting along school attendance boundaries.

In order to better understand the policy implications of such findings, several papers (including Downes and Zabel, 2002; Kane et al., 2003; Figlio and Lucas, 2004; Brasington and Haurin, 2006; Clapp et al., 2008; Gibbons et al., 2009) have sought to identify more precisely the kind of educational inputs and the type of information on schools which are most valued by parents. Empirical findings suggest that parents are more sensitive to student peer quality than to the quantity of school ressources. The evidence is more mixed as to whether information on school effectiveness (essentially in the form of valued added measured of school performance) affects school markets(Kane and Staiger, 2002; Hastings et al., 2007; Mizala and Urquiola, 2008).

If parents strongly value the peer quality of their children's classmates, then school admission rules can serve as an important policy tool to influence educational inequalities. However, a proper evaluation of the potential effects of alternative school allocation schemes requires the inclusion of both public and private schools in the analysis. While most authors acknowledge the possibility that private schools are likely to affect residential and educational choices, almost all existing studies have restricted their analysis to sorting into public schools. To the best of our knowledge, our paper is the first to investigate the effect of private schools on the housing price premium attached to public school performance.

With 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 test 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 local availability of private schools 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 1.4 to 2.4%. The size of this effect is similar to existing US and UK estimates and can explain roughly 5% of observed differences in housing prices between adjacent school zones. We also find that the price premium attached to better performing 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 estimation strategy used to measure 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 regarding the capitalization of public school performance in housing prices while section 6 evaluates how this capitalization varies with the local density of private schools.

2 Estimating the impact of public school performance on housing prices

Economists have traditionally relied on hedonic models to estimate the impact of school performance on housing prices. The standard hedonic housing price function describes the price of a particular sale as a function of the flat's observable characteristics, which include its intrinsic features (size, floor, etc.) as well as its neighborhood characteristics. The corresponding coefficients are interpreted as measuring the marginal purchaser's willingness to pay for each specific characteristic. The typical hedonic function for housing prices takes the following form:

$$\ln p_{i,c,s,t} = a + b.z_s + X'_{i,c,s,t}c + N'_{i,c,s}d + L'_t e + u_{i,c,s,t} \quad (1)$$

where $p_{i,c,s,t}$ is the price of sale i, located in census block 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 block 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 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. To circumvent this problem, Black'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.

Although Black's solution solves the endogeneity problem that undermines the traditional hedonic approach, her school attendance boundary fixed effects specifications embody three relatively strong restrictions. First, 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. The problem here is that the valuation of features such as the age of the building, the number of rooms or the presence of a parking space is likely to differ noticeably across the different parts of a city[3]. Second, 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 this boundary share on average the same unobservable characteristics. This may not be true in the case of very long boundaries passing through relatively dissimilar neighborhoods. Finally, in Black's estimations, standard errors are clustered at the school attendance level to account for the fact that unobservable shocks affecting housing prices may exhibit spatial and serial correlation within a given school catchment area. Hence it is implicitly assumed that unobservable shocks are uncorrelated across common school attendance boundaries, which seems a fairly restrictive assumption since sales located on both sides of a common boundary typically belong to the same neighborhood.

In order to circumvent the limitations of the boundary fixed effect estimation strategy, we adopt a matching framework that enables us to correct housing prices for local-specific flat features effects, restrict a transaction's comparison group to sales located in its immediate vicinity and cluster the standard errors at the school boundary rather than at the school attendance level.

To account for the fact that the price premium attached to observable flat characteristics may vary throughout the area under study, we compute regression-adjusted residuals obtained from specifications that include the full vector of flat features[4], school year and quarter fixed effects, which are estimated separately for each of

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[3]For instance, the presence of a parking space may increase the price of a flat by a larger amount in the city center (where parking spaces are scarce) than in the periphery (where they are more common).

[4]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).

Paris's 20 municipal *arrondissements*, which are the city's main administrative units. The matching approach described below is performed using these residuals rather of the raw housing prices[5].

The second step of our estimation strategy involves matching sales across common school attendance boundaries. The basic principles of this approach are illustrated in the graphical example displayed in figure 1. This map represents the immediate vicinity of a particular school attendance boundary which located in the 16^{th} *arrondissement* of Paris. This boundary separates the catchment areas of two public middle schools: *Janson de Sailly* and *Eugène Delacroix*. All sales that took place in a given school year and within a particular radius of that boundary are selected. To ensure that our results are not too sensitive to a particular value of the chosen bandwidth, we use three distinct values to set the maximum distance between the included sales and the school attendance boundaries (250, 300 and 350 meters). These values are chosen to reach sufficient statistical power and to provide wide enough intervals (50 meters) to test the stability of our results. Each sale located on one side of the boundary, which we call a "reference sale", is matched with all transactions that took place in the same school year, on the other side of the boundary and within a given radius (250, 300 or 350 meters) from the reference sale. In the particular example depicted in figure 1, the reference sale is located on the even side of the *rue des Sablons* street (number 38), which is assigned to the *Janson de Sailly* middle school. This reference sale is matched with three sales located on the opposite side of the same street (numbers 23, 27 and 33) and assigned to the *Eugène Delacroix* middle school. We use these three sales to construct a "counterfactual" sale whose price per square meter is computed as the weighted geometric mean of their prices, with weights equal to the inverse of the distance between each of these sales and the reference sale, in order to give more importance to the sales that are located nearby relatively to the more distant ones. The impact of public school performance on housing prices is then estimated by regressing the price differential between the reference and the counterfactual sale on the corresponding school performance differential.

More formally, 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:

$$\ln p_{i,b,s,t} = \alpha + \beta.z_s + X_{i,b,s,t}\gamma + \theta_{b,t} + \epsilon_{i,b,s,t} \tag{2}$$

[5]While this correction is not essential to yield unbiased estimates of the impact of school performance on housing prices (since flats located on both sides of common attendance boundaries should share similar features on average), it nevertheless increases the precision of our estimates by reducing the noise associated with the heterogeneity of flats' observable characteristics.

"Reference" sales are all housing transactions located within a certain distance d of a school attendance boundary b. For each reference sale i, we construct a fictive "counterfactual" sale i' which is located on the other side of the common school attendance boundary (s, s'). The price of this counterfactual 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[6].

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 within a radius d (250, 300 or 350 meters) and in the same school year t as the reference sale i, but were assigned to school s' rather than 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. Hence, the counterfactual sale's estimated price per square meter $p_{i',b,s',t}$ is calculated as:

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

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 is written[7]:

$$\ln p_{i,b,s,t} - \ln p_{i',b,s',t} = \beta(z_s - z_{s'}) + \epsilon_{i',b,s',t} - \epsilon_{i,b,s,t} \tag{3}$$

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

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[6]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 located 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 are constructed using different sales.

[7]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 that are used to construct the counterfactual.

[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.

its components.

The final step of our estimation strategy involves clustering the standard errors at the school attendance boundary levels. Indeed, an important feature of the housing price differential equation (3) is that by construction, the composite error term $(\epsilon_{i',b,s',t} - \epsilon_{i,b,s,t})$ exhibits serial correlation along common attendance boundaries[9]. Standard errors need therefore to be clustered at the school attendance boundary level.

3 Public and private middle schooling in Paris

3.1 The French educational system

The French educational system is highly centralized an fairly homogenous until pupils reach the age of 14. Children spend five years in primary school (age 6 to 10), four years in middle school or *Collège* (age 11 to 14) and three years in high school or *Lycée* (age 15 to 17). The minimum school leaving age is 16 years.

Education in France is predominantly public[10], centrally financed 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 assign pupils and resources to schools. Human and financial resources are for the most part allocated on the basis of school enrollment, so spending per pupil and teacher characteristics are fairly similar across schools.

As in the US or UK , private education in France is predominantly religious, but several institutional features of French schools make them very different from their foreign 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. Publicly funded private schools are subject to State supervision: they follow the national curriculum and appoint qualified teachers who are paid by the State[11]. These schools can charge fees provided that they do not exceed the amount needed to cover the costs which

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[9]Serial correlation arises for two reasons. First, the unobservable housing price component of the reference sales $\epsilon_{i,b,s,t}$ may exhibit spatial and time 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 are used in the construction of several counterfactuals. Note, however, that serial correlation in the error term only exists for sales that are assigned to the *same* school attendance boundary.

[10]Public schools account for 79% of secondary school enrollment at the national level (de Monredon, 2008; Jaspar, 2008).

[11]Unfunded private schools are not subject to State supervision and usually offer alternative teaching methods for specific groups of children, in particular those with learning difficulties.

are not publicly funded, such as religious education classes. As a result, the fees charged by private educational instituions are usually modest, in the range of 500 to 2,000 euros per annum.

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 educational need" (*"besoin scolaire reconnu"*). 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. Anecdotal evidence suggests that the actual size of the private sector is kept smaller than needed to satisfy the demand for private education, especially in large cities.

3.2 Public and private school admission rules

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

During the period under study (1997-2004), primary and middle school assignment was purely residence-based[12]. It was also "strict" in the sense that each school catchment area contained one school only, which means that in principle parents had no control over the choice of 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 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. 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[13]. 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[14].

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[12]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.

[13]If anything, the existence of these dispensations would tend to slightly mitigate the capitalization of public middle school performance in housing prices.

[14]Besides these two "legitimate" ways of getting round school catchment areas, there is anecdotal

Private schools in France are not subject to any zoning scheme. Because they can freely select their pupils from anywhere in the city, publicly funded 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[15] (Langouët and Léger, 1997). The rules for admission in private schools are not always explicitly stated 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[16].

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. A number of empirical studies by sociologists suggest that parents living in the Paris region care a lot about educational performance at the middle school level (Oberti, 2007). This is a direct consequence of the strong competition that arises in the final year of middle schooling to enter the best high schools, a process over which parents have some degree of choice since they can send applications to any particular high school located within one of four large attendance areas.

4 Data and summary statistics

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

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evidence that some parents would choose to cheat the system by providing a wrong home address to the Local Education Authority (typically using that of a relative sharing the same family name). However, we understood from informal discussions with Paris LEA officials that only a very small fraction of well-connected parents actually used this kind of strategy. We therefore have good reasons to believe that this form of non-compliance is unlikely to strongly mitigate the impact of school performance on housing prices.

[15] 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).

[16] Note that applicants to Catholic middle schools are usually not required to be baptized nor to have been previously enrolled in a religious primary school.

4.1 Schools

The Paris LEA administered 108 public middle school during the period of study, which account for two-thirds of total enrollment. Among the third of pupils enrolled in private schools, the vast majority attended publicly funded institutions since only 3% were enrolled in non-publicly funded schools. This latter type of institutions being targeted to very specific groups of pupils, we decided to exclude them from the analysis[17]. We therefore only considered in our analysis the 63 publicly funded private schools that were operating in the city of Paris between 1997 and 2004.

4.1.1 School catchment areas in Paris

Data on school zones was provided by the Paris LEA, which was in charge of delimiting the catchment areas of primary and middle schools during the period under study. 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 1997 and 2004. Figure 2 displays the particular layout of school catchment areas that prevailed in 2003-2004 in the 19$^{\text{th}}$ *arrondissement* of Paris. This map shows that in most cases, middle school zones are contiguous although they are sometimes split into two or three parts (see for example the catchment area of the *Henri Bergson* middle school). 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 *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

[17]Moreover, there is currently little statistical information on the characteristics and performance of non-publicly funded private schools.

attendance boundaries that coincide with *arrondissements* boundaries. We also checked that the set of middle school boundaries included in the analysis were not confounded with primary or high school attendance boundaries[18].

A final important issue raised by school zone boundaries is their degree of stability over time. 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. Moreover, reassignments often take place in the same neighborhoods and some streets constantly experience school zone changes. Because current school boundaries in these areas are often modified, parents might not take them into account. 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 less than 10% of all Parisian addresses were reassigned over this period of seven years. It seems therefore unlikely that the instability of school attendance boundaries would invalidate our identification strategy.

4.1.2 School performance and school characteristics

Our empirical analysis requires information on the performance of public and private schools. The exact characteristics that parents use to rank 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).

The institutional features of the French educational system outlined in section 3, as well as anecdotal 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

[18] Although we do not have data on the precise layout of primary schools' catchment areas, our data shows that in most cases, pupils from a particular primary school are not assigned to a single middle school but at least to two different ones, which suggests that primary school boundaries seldom follow middle school boundaries. In the case of high schools, excluding *arrondissements* boundaries from the analysis mechanically eliminates middle school attendance boundaries that match those of high schools, since the limits of the four Parisian high school catchment areas happen to follow exactly those of the *arrondissements*.

and teacher allocation is unlikely to produce large differences in school effectiveness. Second, value-added measures of school performance have never been publicly released for middle 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 and are now widely accessible[19]. It must be noted however that to satisfy parents' demand for information about middle school performance, rankings of Paris middle schools were regularly 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.

The French Ministry of Education provided us with statistical information on schools[20]. In our empirical analysis, we 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)(a detailed description of the construction of our school performance indicators is provided in the appendix). The first measure is available only for school year 2003-2004, whereas the other two measures are averaged over school years 1997-2004. 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). Unsurprisingly, the three indexes are very highly correlated, with correlation coefficients ranging from 0.84 to 0.90.

4.1.3 Summary statistics

Table 1 compares the characteristics of Parisian public and private schools during school year 2003-2004. Columns 2 and 3 show that private school pupils enjoy much more favorable characteristics than their public school counterparts, which translates into better pupil performance: the *DNB* score gap between private and public school pupils amounts to almost a standard deviation of the *DNB* score averaged at the school level.

The last four columns of table 1 reveal 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 the average

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

[20]We used three datasets that were provided by the *Direction de l'Évaluation, de la Prospective et de la Performance du Ministère de l'Éducation nationale (MEN-DEPP)*: *SCOLARITE* for students characteristics, *OCEAN* for exam results, and *IPES* for school characteristics.

DNB exam score come in majority from privileged socio-economic backgrounds, 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 performance shows much less variation, which is consistent with the idea that school peer group composition is the primary factor behind the unequal performance of Parisian middle schools. 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 and enjoy a somewhat lower pupil-to-teacher ratio.

Figure 3 displays the spatial distribution of public middle school performance (as measured by the average 2004 *DNB* exam score) across the different school catchment areas in Paris. This map reveals that 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[21]. It also indicates 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 yield more precise estimates.

4.2 Housing prices and neighborhood characteristics

Data on property sales come from the *BIEN*[22] dataset which is managed by the Notary Chamber of Paris and the Île-de-France. The dataset is almost comprehensive and contains between 80 and 90% of all the transactions that took place since 1997. 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 restricted to all arm's-length sales of second hand Parisian flats[23] that took place between September 1997 and August 2004.

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 4 shows how the

[21] The maps corresponding to the other two indexes of public middle school performance (fraction entering general curriculum high schools and fraction of pupils coming from privileged socio-economic backgrounds) show a very similar pattern.

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

[23] We dropped newly-built property sales as well as 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.

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 is fairly close to the spatial distribution of school performance displayed in figure 3. It is however much more continuous, the price per square meter 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[24] at the block level (*Iris*) to control for the socio-demographic characteristics of Parisian neighborhoods. Summary statistics on housing and socio-demographic characteristics are reported in the first two columns of table 2. These figures indicate that the population living in the city of Paris is rather socially privileged but that its socio-demographic characteristics exhibit a great degree of variation across neighborhoods.

5 The impact of public middle school performance on housing prices

In this section, we use the matching framework presented in the section 2 to estimate the extent to which the performance of Parisian public middle schools is capitalized in housing prices.

5.1 Naive estimates

As a preliminary step in the analysis, we performed traditional hedonic regressions to evaluate the severity of the bias induced by the endogenity of school performance in the housing price equation.

The first two columns of table 3 show the results of estimating the hedonic housing price equation (1), with and without controlling for the socio-demographic characteristics of the census block, using our three alternative indexes of public middle school performance. Column 1 indicates that when no controls are added except for year and quarter of the transaction, 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%. While the coefficient is not particularly affected when one adds controls for flats' characteristics, it drops dramatically once we control for detailed neighborhood characteristics at the block level, as better performing schools tend to be located in more privileged neighborhoods. In column 3, a

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

standard deviation increase in the DNB score is now associated with a 2.7% increase in housing prices. Similar results are obtained when using the other two indexes of school performance.

Although the set of controls included in the right hand side of the hedonic regression equation is large, it is not necessarily 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 (either 250, 300 or 350 meters). Columns 3 to 8 of table 2 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 figures indicate that along both these dimensions, the sales included in our restricted samples are hardly different from those of the full sample. The last three columns of table 3 show that the naive estimates obtained when running the simple hedonic regression (controlling for time trends, flat features and neighborhood characteristics) on these sales located within 250 to 350 meters 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

The results obtained when using our matching strategy are displayed in the three columns of table 4, for each of the three indexes of school performance. Average cross-boundary school performance differentials are reported at the bottom of the table and confirm, in line with the pattern observed in figure 3, that public middle school attendance boundaries induce substantial discontinuous variations in school performance[25].

Using the *DNB* exam score as a measure of school performance, we find a significant impact of school performance on housing prices. Our estimates are remarkably stable across the different choices of the maximum distance to boundary and show that a standard deviation increase in the average exam score raises the price per square meter by about 1.4%, which is roughly half the size of the naive estimate after controlling for flat features and neighborhood socio-demographic characteristics (see column 3 of table 3).

The estimates obtained using the two other indexes of school performance are fairly similar across the 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 1.6-1.9%, whereas the coefficient on the proportion of pupils coming from

[25]For instance, the average cross-boundary *DNB* score differential is equal to 0.6 of a standard deviation (of schools' averages).

privileged socio-economic backgrounds is around 2-2.5%. Hence, our results appear robust to different definitions of school performance and are in the range of 2.1 to 2.4%[26].

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 found by Black (1999) for Boston suburbs primary schools; slightly smaller than the 3.7% effect estimated by Gibbons and Machin (2003) for British primary schools.

Two simple computations can help us get 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 roughly 7% (around 13,000 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 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 certainly 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 designing school enrollment policies. 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.

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[26]To see how our results compare with those obtained using the boundary fixed effects approach of Black (1999), we performed a series of regressions in which we replaced the vector of neighborhood characteristics in the basic hedonic equation (1) by a full set of school attendance boundary dummies. Reassuringly, the results (available upon request) are very similar in magnitude to our previous matching estimates. The estimates are slightly larger (1.9% versus 1.4% for the *DNB* score, 2.2% versus 1.8% for the fraction of pupils entering general curriculum high schools and 2.9% versus 2.3% for the proportion of pupils coming from privileged socio-economic backgrounds at 300 meters), but are not significantly different. However, our results also show that clustering the standard errors at the school level rather than at the school attendance boundary level artificially inflates the estimates' t-statistics by about 20%.

5.4 Robustness checks

To assess the reliability of our results, 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.

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 5 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 implying that flats located on the "good" side of the boundary are more desirable on average than those located on the "bad" side. Hence our findings do not seem to be driven by differences in observable flat features[27].

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, 2007; 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 existence of sorting effects across school attendance boundaries, we compare the observable socio-demographic char-

[27]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 are distributed differently across school zones.

acteristics of neighborhoods (at the census block level) located on the "good" versus the "bad" side of school boundaries. Table 5 shows that for each of our three samples of sales (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.

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.

6 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[28]. Yet Epple and Romano (1998) show that it is crucial to take into account both public and private schools when studying sorting into schools. Recent papers on school vouchers (Nechyba, 2003; Ferreyra, 2007) argue that private schools act as an outside option when parents decide in which area to buy a house or a flat. 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 by lowering the price premium that parents are ready to pay for a flat located in the catchment area of a better-performing public middle school.

6.1 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 (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

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

pupils. The author's numerical simulations suggest that private schools tend to increase peer stratification in schools while reducing residential stratification[29], a feature which is reflected in housing prices. In this section, we test whether in line with these predictions, the presence of private schools in a particular neighborhood mitigates the effect of local public school performance on housing prices.

As explained in section 3, private schools offer an attractive outside option to parents who wish to avoid sending their children to a low-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 precise home address of pupils, we know in which of the 20 Parisian *arrondissements* they reside. According to our computations, 53% of Parisian pupils enrolled in a private school in 2003-2004 attended a school located in their *arrondissement* of residence and 28% a school located in an adjacent *arrondissement*, 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 that parents enroll 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):

$$\ln p_{i,n,s,t} = \alpha + \beta(a_b).z_s + X_{i,n,s,t}\gamma + \theta_{n,t} + \epsilon_{i,n,s,t} \tag{4}$$

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:

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

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[29]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.

where $\mu_{i,i',b,s,s',t}$ is an error term which is clustered at the public school attendance boundary level[30].

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 the level of 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 be higher in areas with few private schools than in areas where they are numerous.

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 public school quality, this premium should remain significant in all areas, irrespective of the local density of private schools. On the contrary, if we find that this premium is lowered by the availability of private schools, we have good reasons to believe that the price premium is not driven by unobservable differences across schools boundaries.

6.2 Estimation strategy

To test the hypothesis that private school availability influences the capitalization of public school quality in housing prices, we construct an index of local private school availability. For each transaction i, this index (denoted $PRIV_i$) is computed as the inverse of the distance between a sale and its closest private middle school:

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

where $d_{i,j}$ denotes the distance between transaction i and private school j. The higher the value of $PRIV_i$, 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 divided into four groups of equal size. Each sale is allocated to one of the four quartiles depending on the value of its private school availability index[31]. Figure 5 shows how corresponding areas are distributed in the city of Paris for the full set of existing Parisian adresses[32]. Reassuringly, our index is well distributed

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

[31] Note that choosing the inverse of the distance between the transaction and the private school rather than a monotonic transformation 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.

[32] Since sales were not necessarily completed in all Parisian adresses during the period under

across neighborhoods and does not cut Paris into four geographically distinct zones, a feature that could bias our estimates.

To measure 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. 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.

Although simple and intuitive, our index of private school availability depends only on the distance between a sale and its closest private school and is not the only way to measure the extent to which the network of private schools is developed in a particular area. Another possibility would be to use an index of density of private schools, which takes into account not only the distance to the closest private school, but also the distance to all other private schools operating in the city[33]. For that purpose, we constructed an alternative index of private school availability which is computed as the average value of a sales distance (squared) to every private middle school in Paris[34]:

$$PRIV2_i = \sum_{j=1}^{N_j} \frac{1}{d_{i,j}^2} \quad \forall i$$

where N_j denotes the total number of publicly funded private middle schools that operate in the city of Paris (63) 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. Despite their different definitions, the $PRIV_i$ and $PRIV2_i$ indexes produce almost identical quartiles of private school availability (Spearman's rank correlation coefficient between both measures of private school availability is in the range of 0.8 to 0.9 depending on the sample of included sales). The estimations obtained using both measures of private school availability are therefore very similar and, for the sake of brevity, we report only

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study, the full set of existing adresses in larger the set of sales included in the *BIEN* dataset.

[33]The presence of a private institution in a given neighborhood does not indeed guarantee to prospective owners that they will be able to enroll their children in this particular private school, especially if it is oversubscribed. In this situation, it may seem reasonable to consider that the outside option provided by the private sector is more attractive in neighborhood where a large number of schools operate than in neighborhoods where they are scarce.

[34]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.

those based on the first index[35].

6.3 Results

The regression results are reported in table 6. Column 1 displays the baseline coefficients on school performance in the housing price equation which were already presented in table 4. The coefficients on the interaction terms between school performance and each of the four quartiles of private school availability 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, results are shown separately for the 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 availability increases, the impact of public school performance on housing prices becomes smaller. While for the bottom quartile of private school availability, the coefficient on the *DNB* exam score is about 2.7%, it falls to about 1.7% for the middle lower quartile and becomes small and insignificant (0.6-1.0%) 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 2.5% in areas belonging to the bottom quartile of private school availability and only 0.8-1.2% 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 3.8-4.3% to 0.6-1.2% when we move from the bottom to the top quartile of private school availability.

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 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 public school performance 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

[35]Estimates obtained using the second index of private school availability are available upon request.

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 9.61 for public schools and 11.07 for private schools (see table 7). This difference of 1.46 point is equal to three quarters 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 2.1%, which is about 3,800 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 numerous. These figures indicate that the valuation of public school performance is roughly comparable to the cost of the outside option provided by private education.

6.4 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.

One first obvious concern is that the presence private schools in specific areas may be endogenous. This would happen in particular if private schools responded to changes in neighborhood characteristics and public school performance by strategically opening or closing some establishments. We argue, however, that the spatial pattern of private school location has been extremely stable over the last decades, mainly because of the very tight control exercised by the state over the creation of publicly private schools. Our data confirm that the flow of creation of private schools during the period under study was very limited, since only one publicly funded establishments was created between 1997 and 2004 while another one started to receive public funding after changing status[36]. In fact, the vast majority (83%) of Parisian private schools were created before 1980[37]. Data on the closure of private schools is less reliable but our investigations show no evidence of such events during the pe-

[36]Since both these publicly funded schools started to operate towards the end of the period under study, we decided to exclude them from the analysis.

[37]Available information on the date of creation of private schools comes from the BCE dataset (*Base Centrale des Établissements*). Dates of creation are censored at 1980 although most Parisian private schools were created several decades earlier.

riod under study. The corollary of this very stable geographical location of private schools in Paris is that parents are most likely to take the presence of private school as given when choosing their place of residence.

The second concern is that despite their very stable location, the availability of private schools may be correlated with a number of variables that lower the taste for public school performance in a given area. Below, we show that for a wide range of observable characteristics, our data does not support the view that areas with more private schools differ from those where they are scarce.

A first possibility is that high private school density areas exhibit flat features or neighborhood characteristics that could induce a lower capitalization of public school performance in housing prices. For instance, if private schools tend to be concentrated in poorer areas, the apparent insignificant impact of public school performance on housing prices could well derive from the weaker willingness of economically disadvantaged households to pay for better schools. To investigate this issue, we compared flat features and neighborhood socio-demographic characteristics across the four quartiles of private school availability. The figures, displayed in table 7 for the sample of sales located within 250 meters of a school attendance boundary[38] show no noticeable difference in flat characteristics across areas with different private school availability. In particular, housing prices show no particular monotonic pattern across the four quartiles of private school availability. The size of flats in high private school density areas does however appear to be slightly larger than in low density areas but the difference seems too small to explain our results. Moreover, the comparison of flat sizes across the four quartiles of our second index of private school availability, $PRIV2_i$ (not reported here) does not show this particular pattern. Furthermore, housing prices show no particular monotonic pattern across the four quartiles of private school availability. The comparison of census characteristics across quartiles suggests that private school availability is also uncorrelated with the socio-demographic profile of Parisian neighborhoods. Most variables, including the distribution of occupations, have almost the exact same values across the different quartiles.

Another possibility is that the location of private schools might be correlated with political or religious views that would themselves influence the parental valuation of public school performance. For instance, if the choice of private education was primarily based on political or religious motives with little concern for the relative performance of public schools, then are results could be explained by neighborhood sorting along these preferences. We investigated this issue by relying on two proxies for political views and religious practice. Our political index is computed as the fraction of right-wing voters in each of the city's 80 administrative subdivisions

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

during the national parliamentary elections that took place in June 2002. In the absence of any direct statistics on religious practice in Parisian neighborhoods, we decided to use as a proxy the number of places of worship within a radius of 1 kilometer of each sale[39]. The results, reported in table 7, show that the quartiles of private school availability are very similar in terms of political views and do not seem to differ greatly in terms of religious activity.

A third possibility 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 percentage 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.[40]. The results are reported in table 7. Average cross-boundary school performance premiums show no particular association with private school availability: the average premium is very close to 11% for all quartiles. Taken together, these results do not support the idea that our results could be capturing an effect of local variations in the average cross-boundary public school performance differential.

The final possibility that we explore 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. The premium is computed as follows:

$$\text{PRIVATE PREMIUM} = \frac{\text{DNB}_P - 0.5(\text{DNB}_1 + \text{DNB}_2)}{0.5(\text{DNB}_1 + \text{DNB}_2)}$$

where DNB_P, DNB_1 and DNB_2 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 results are reported at the bottom of table 7. The average *DNB* premium of local

[39]Our results are robust to the size of the area within which places of worship are counted.

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

$$\text{PUBLIC PREMIUM} = \frac{\text{DNB}_g - \text{DNB}_b}{\text{DNB}_b}$$

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

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, the location of private school does not seem to be correlated with variables that could potentially bias our results, including flat features, socio-demographic neighborhood characteristics, political views and religious practice as well as public school performance or the average performance premium of private schools over public schools. Our investigations thus suggest that the outside option provided by private education is be the main reason why public middle school cross-boundary price differentials tend to disappear when the number of private schools operating in a particular area increases.

7 Conclusion

Using comprehensive data on middle schools 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 housing prices by 1.4 to 2.4% 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 availability 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: 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 Local Education Authority from the *OCEAN*[41] 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 an 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[42], we were able to calculate for each

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

[42] 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 in 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[43]. 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.

Unsurprisingly, our three indexes of school performance are highly correlated, the correlation coefficients ranging from 0.84 to 0.90.

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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.

[43]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: illustrative example.*

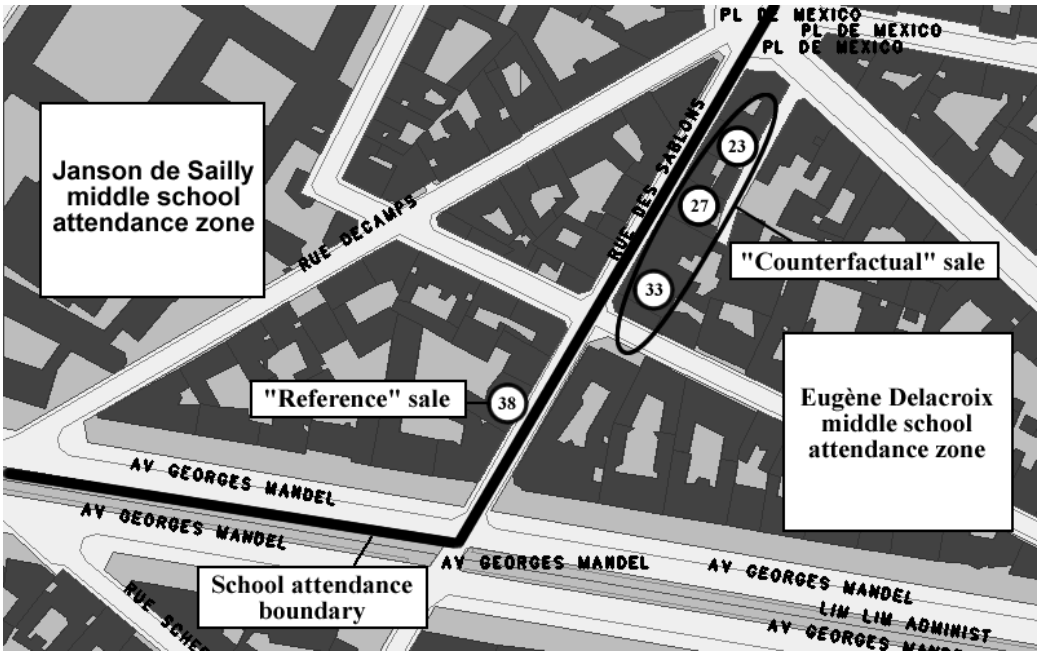


Figure 2: *School catchment areas in the 19th* arrondissement *of Paris. School year 2003-2004.*

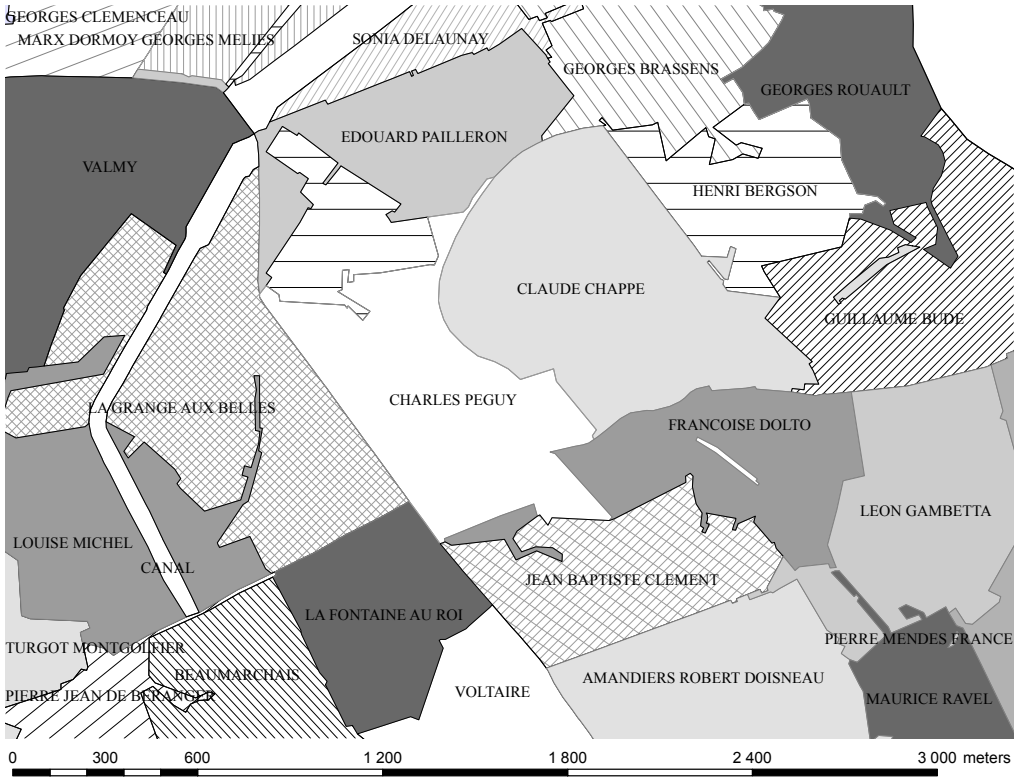


Figure 3: *Spatial distribution of the quartiles of public middle school performance as measured by the average* Diplôme National du Brevet *exam score in 2004. Source:* OCEAN *national examinations database (2004).*

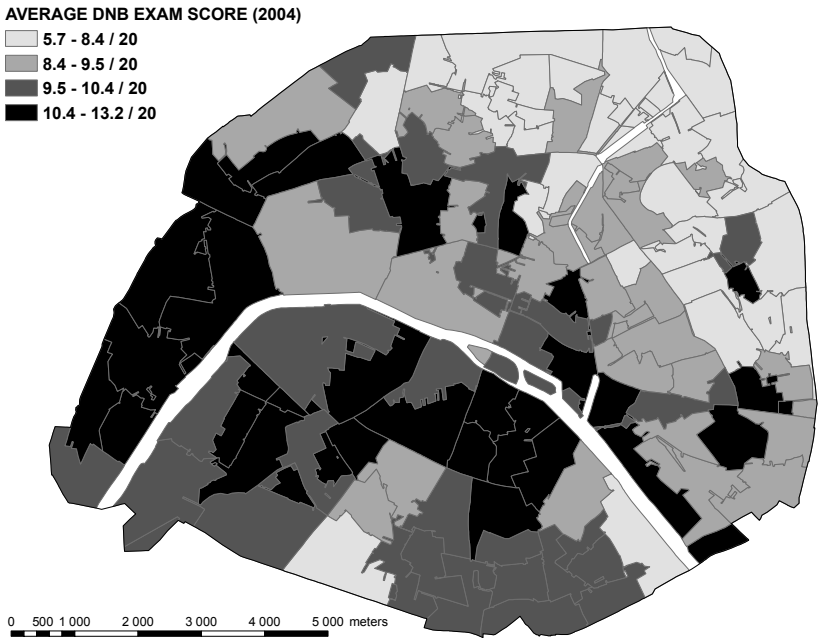


Figure 4: *Spatial distribution of the quartiles of average price per square meter (in 2004 euros) within each public middle school catchment area in school year 2003-2004.*

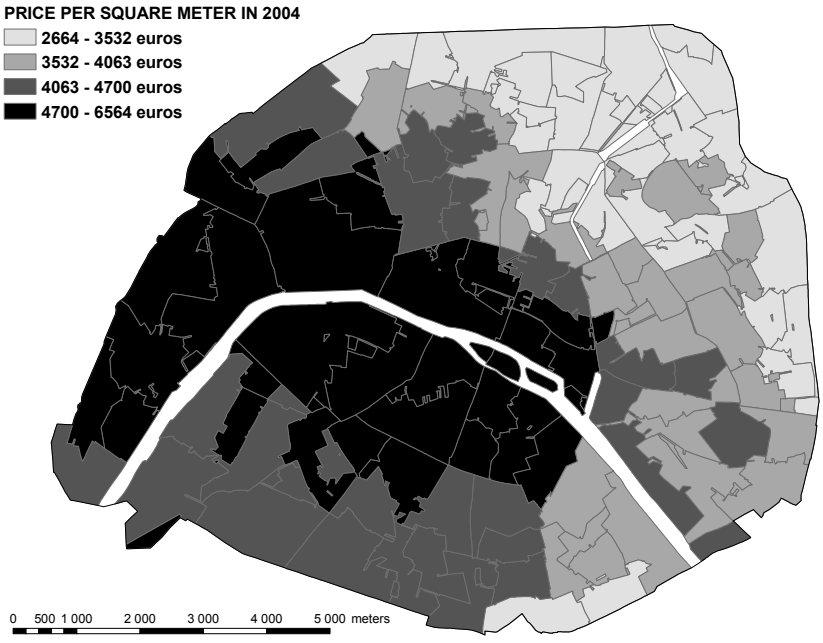
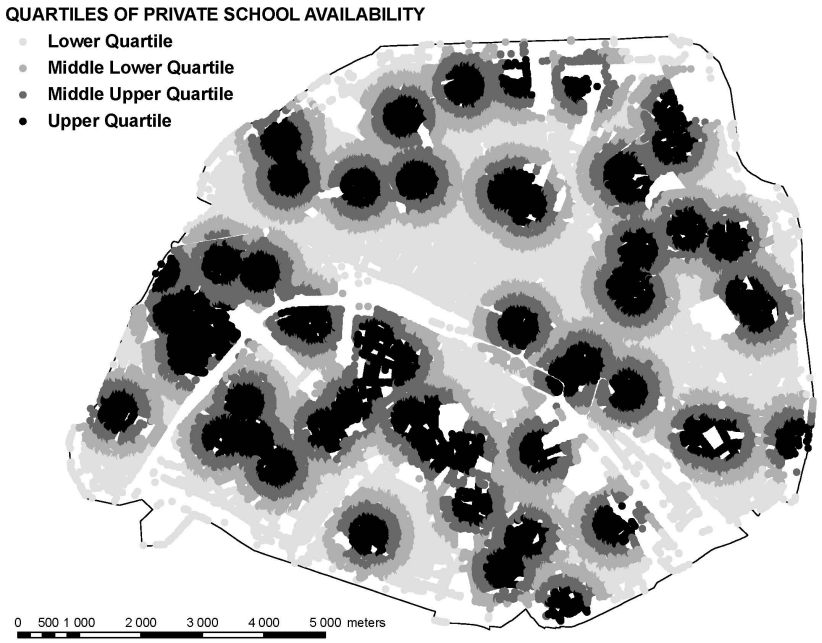


Figure 5: *Map of local private middle school availability in Paris.*



Notes: The index of private school proximity 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; sales in the bottom quartile are far away from the closest private school while sales in the top quartile are in the vicinity of the closest private school.

Table 1: *Summary statistics. Public and private middle schools in Paris in 2003-2004. 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	84,738	57,716	27,022	13,042	14,040	13,784	16,850
Average enrolment	496	534	429	483	520	511	624
	(193)	(142)	(245)	(131)	(113)	(121)	(163)
Pupil-to-teacher ratio		14.5		12.1	13.6	14.6	17.6
		(7.1)		(3.5)	(6.6)	(5.3)	(10.2)
Pupils' characteristics							
% female	0.49	0.49	0.50	0.48	0.48	0.49	0.49
	(0.10)	(0.03)	(0.17)	(0.03)	(0.03)	(0.02)	(0.03)
% from privileged socio-economic backgrounds	0.41	0.31	0.58	0.11	0.24	0.35	0.55
	(0.24)	(0.20)	(0.21)	(0.07)	(0.12)	(0.14)	(0.11)
% foreign	0.13	0.18	0.04	0.27	0.20	0.15	0.10
	(0.11)	(0.10)	(0.06)	(0.11)	(0.09)	(0.07)	(0.05)
% grade repetition in first year	0.07	0.06	0.09	0.09	0.06	0.06	0.05
	(0.09)	(0.04)	(0.14)	(0.04)	(0.04)	(0.04)	(0.03)
% going into general curriculum	0.71	0.67	0.78	0.49	0.64	0.72	0.83
	(0.17)	(0.15)	(0.18)	(0.09)	(0.08)	(0.06)	(0.09)
Mean *DNB* exam score (out of 20)	9.99	9.40	10.99	7.28	8.94	10.01	11.38
	(1.90)	(1.62)	(1.95)	(0.83)	(0.31)	(0.30)	(0.72)
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	0.29
		(0.12)		(0.10)	(0.10)	(0.09)	(0.08)
% 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	0.69
		(0.08)		(0.08)	(0.08)	(0.09)	(0.08)
% with low qualification		0.18		0.21	0.20	0.18	0.15
		(0.08)		(0.08)	(0.08)	(0.08)	(0.05)
Number of schools	171	108	63	27	27	27	27

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 parentheses.

Table 2: *Summary statistics. Features of flats, census characteristics and average public middle school performance for all sales located within 250, 300 and 350 meters of a school attendance boundary and sold in school years 1997 to 2003. Sources:* BIEN *dataset and 1999 National Census.*

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)
FLAT CHARACTERISTICS								
Price (in 2004 Euros)	183,041	(180,828)	181,916	(168,998)	183,518	(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)
Age of building (percent)								
Unknown	0.11		0.11		0.11		0.11	
Before 1914	0.47		0.47		0.46		0.46	
After 1914	0.42		0.43		0.43		0.43	
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	
% with lift	0.90		0.90		0.90		0.90	
% with parking lot	0.13		0.12		0.12		0.12	
CENSUS CHARACTERISTICS								
Nb of census blocks	898		726		761		785	
Nb of individuals per census block	2,509	(681)	2,499	(659)	2,498	(664)	2,491	(665)
Nb of households per census block	1,362	(370)	1,365	(362)	1,361	(364)	1,357	(366)
Nb of persons per flat	1.82	(0.19)	1.81	(0.18)	1.82	(0.18)	1.82	(0.18)
% families with children under 25	0.21	(0.06)	0.20	(0.05)	0.20	(0.05)	0.20	(0.05)
% female-headed households	0.05	(0.02)	0.05	(0.02)	0.05	(0.02)	0.05	(0.02)
% owners	0.33	(0.08)	0.33	(0.08)	0.33	(0.08)	0.33	(0.08)
% public housing	0.09	(0.14)	0.09	(0.13)	0.09	(0.13)	0.09	(0.13)
% with graduate degree	0.40	(0.08)	0.41	(0.08)	0.41	(0.08)	0.41	(0.08)
% foreigners	0.23	(0.06)	0.22	(0.05)	0.22	(0.05)	0.22	(0.05)
% unemployed	0.12	(0.04)	0.12	(0.04)	0.12	(0.03)	0.12	(0.04)
Occupation:								
% managers	0.23	(0.06)	0.24	(0.05)	0.24	(0.05)	0.23	(0.05)
% self-employed workers	0.04	(0.01)	0.04	(0.01)	0.04	(0.01)	0.04	(0.01)
% intermediary occupation	0.14	(0.04)	0.14	(0.04)	0.14	(0.04)	0.14	(0.04)
% employees	0.14	(0.03)	0.14	(0.03)	0.14	(0.03)	0.14	(0.03)
% manual workers	0.06	(0.04)	0.06	(0.03)	0.06	(0.03)	0.06	(0.03)
% retired	0.18	(0.04)	0.18	(0.04)	0.18	(0.04)	0.18	(0.04)
% economically inactive	0.21	(0.05)	0.21	(0.04)	0.21	(0.04)	0.21	(0.04)
PUBLIC SCHOOL PERFORMANCE								
Average 2004 *DNB* exam score	9.59	(1.44)	9.73	(1.38)	9.73	(1.38)	9.73	(1.38)
% entering gen. curric. high schools	0.67	(0.11)	0.68	(0.11)	0.68	(0.11)	0.68	(0.11)
% from privileged socio-economic backgrounds	0.46	(0.19)	0.48	(0.18)	0.48	(0.18)	0.48	(0.18)
Number of public schools	108		105		105		105	
Number of sales	196,799		99,915		113,530		124,608	

Notes: The sample of housing transactions comes from the *BIEN* dataset and is restricted to arm's-length sales of second hand Parisian flats that took place between September 1997 and August 2004 and were not reassigned to different public middle school catchment areas. Flat prices are expressed in 2004 euros. Census characteristics are computed at the block level from the French 1999 National Census. Distance to school attendance boundaries is computed by combining the Lambert II geocoding of sales with the mapping of school catchment areas. The average school performance indexes within each school are computed from the *OCEAN* national examination database (2004) and the *SCOLARITE* pupil database (1997-2004) (see appendix).

Table 3: *Regressions results. Naive estimates of the impact of public 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***	0.027***	0.031***	0.034***	0.033***
Cluster robust standard error	(0.017)	(0.016)	(0.009)	(0.009)	(0.009)	(0.009)
GENERAL CURRICULUM (1997-2004)	0.161***	0.142***	0.023***	0.024***	0.026***	0.026***
Cluster robust standard error	(0.015)	(0.014)	(0.006)	(0.006)	(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	196,799	196,799	196,799	99,915	113,530	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 sample of housing transactions comes from the *BIEN* dataset and is restricted to arm's-length sales of second hand Parisian flats that took place between September 1997 and August 2004 and were not reassigned to different public middle school catchment areas. The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level (DNB SCORE) is computed from the *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 census block level (the city of Paris comprises 970 census blocks, some of which are inhabited). Standard errors are clustered at the public middle school attendance level.

Table 4: *Regression of cross-boundary housing price differentials on corresponding public middle 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)	0.014**	0.014**	0.014**
Cluster robust standard error	(0.007)	(0.007)	(0.007)
Δ GENERAL CURRICULUM (1997-2004)	0.016***	0.018***	0.019***
Cluster robust standard error	(0.004)	(0.004)	(0.004)
Δ PRIVILEGED BACKGROUND (1997-2004)	0.021***	0.023***	0.024***
Cluster robust standard error	(0.008)	(0.008)	(0.007)
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	99,915	113,530	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. The sample of housing transactions comes from the *BIEN* dataset and is restricted to arm's-length sales of second hand Parisian flats that took place between September 1997 and August 2004 and were not reassigned to different public middle school catchment areas. To account for the fact that the price premium attached to specific flat features may vary throughout the city of Paris, we compute regression-adjusted residuals obtained from specifications that include the full vector of flat features (age of building, number of bathrooms, presence of a parking space, of a maid's room, floor, number of rooms and average room size), school year and quarter fixed effects, which are estimated separately for each of Paris's 20 municipal *arrondissements*. The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level (DNB SCORE) is computed from the *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. 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 5: *Comparison of flat features and census 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
FLAT CHARACTERISTICS						
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)
Age of building (percent)						
Unknown	0.11	0.11	0.11	0.11	0.11	0.11
Before WWI	0.47	0.46	0.47	0.46	0.47	0.46
After WWI	0.42	0.43	0.42	0.43	0.42	0.43
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
% with lift	0.90	0.90	0.90	0.90	0.90	0.90
% with parking lot	0.12	0.12	0.12	0.13	0.12	0.13
CENSUS CHARACTERISTICS						
Nb of census blocks	554	548	584	570	602	584
Nb of individuals per census block	2,484	2,517	2,485	2,513	2,479	2,505
Nb of households per census block	1,362	1,368	1,360	1,364	1,355	1,358
Nb of persons per flat	1.81	1.82	1.81	1.83	1.81	1.83
% families with children under 25	0.20	0.21	0.20	0.21	0.20	0.21
% female-headed households	0.05	0.05	0.05	0.05	0.05	0.05
% owners	0.33	0.33	0.33	0.33	0.33	0.33
% public housing	0.09	0.08	0.09	0.09	0.09	0.09
% with graduate degree	0.41	0.42	0.41	0.42	0.41	0.42
% 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	0.24	0.23	0.24	0.23	0.24
% 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	0.14	0.14
% employees	0.14	0.15	0.14	0.15	0.14	0.14
% manual workers	0.06	0.05	0.06	0.05	0.06	0.05
% retired	0.18	0.18	0.18	0.18	0.18	0.18
% economically inactive	0.20	0.21	0.21	0.21	0.21	0.21
PUBLIC SCHOOL PERFORMANCE						
Average DNB exam score	9.22	10.31	9.23	10.30	9.23	10.31
(s.d.)	(1.20)	(1.33)	(1.21)	(1.33)	(1.21)	(1.34)
% entering general high schools	0.64	0.72	0.64	0.72	0.64	0.72
(s.d.)	(0.10)	(0.11)	(0.10)	(0.11)	(0.10)	(0.11)
% from privileged backgrounds	0.43	0.54	0.43	0.53	0.43	0.53
(s.d.)	(0.17)	(0.18)	(0.17)	(0.18)	(0.17)	(0.18)
Number of sales	53,181	46,734	60,672	52,858	67,014	57,594

Notes: The sample of housing transactions comes from the *BIEN* dataset and is restricted to arm's-length sales of second hand Parisian flats that took place between September 1997 and August 2004 and were not reassigned to different public middle school catchment areas. Flat prices are expressed in 2004 euros. Socio-demographic neighborhood characteristics are taken from the 1999 French Census and are available at the census block level (the city of Paris comprises 970 census blocks, some of which are inhabited). The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level (DNB SCORE) is computed from the *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 6: *Regression of cross-boundary housing price differentials on corresponding public middle 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)	0.014**	0.027*	0.017**	0.007	0.006
Cluster robust standard error	(0.007)	(0.017)	(0.007)	(0.007)	(0.012)
Δ GENERAL CURRICULUM (1997-2004)	0.016***	0.025**	0.021***	0.009**	0.008
Cluster robust standard error	(0.004)	(0.010)	(0.007)	(0.004)	(0.008)
Δ PRIVILEGED (1997-2004)	0.021***	0.038**	0.025***	0.010	0.006
Cluster robust standard error	(0.008)	(0.018)	(0.009)	(0.006)	(0.009)
Number of observations	99,915	24,977	24,978	24,976	24,984
Panel B: Sales <300 meters of boundary					
Δ DNB SCORE (2004)	0.014**	0.026*	0.017**	0.005	0.010
Cluster robust standard error	(0.007)	(0.016)	(0.008)	(0.007)	(0.010)
Δ GENERAL CURRICULUM (1997-2004)	0.018***	0.026**	0.024***	0.010**	0.012*
Cluster robust standard error	(0.004)	(0.011)	(0.007)	(0.004)	(0.007)
Δ PRIVILEGED (1997-2004)	0.023***	0.039**	0.029***	0.010*	0.012
Cluster robust standard error	(0.008)	(0.018)	(0.009)	(0.006)	(0.008)
Number of observations	113,530	28,380	28,378	28,283	28,489
Panel C: Sales <350 meters of boundary					
Δ DNB SCORE (2004)	0.014**	0.031**	0.019**	0.002	0.006
Cluster robust standard error	(0.007)	(0.015)	(0.008)	(0.007)	(0.010)
Δ GENERAL CURRICULUM (1997-2004)	0.019***	0.028***	0.025***	0.009**	0.012*
Cluster robust standard error	(0.004)	(0.010)	(0.007)	(0.004)	(0.006)
Δ PRIVILEGED (1997-2004)	0.024***	0.043**	0.029***	0.010*	0.012*
Cluster robust standard error	(0.007)	(0.018)	(0.009)	(0.006)	(0.008)
Number of observations	124,608	31,152	31,149	31,155	31,152

Notes: *: significant at the 10% level; **: significant at the 5% level; ***: significant at the 1% level. The sample of housing transactions comes from the *BIEN* dataset and is restricted to arm's-length sales of second hand Parisian flats that took place between September 1997 and August 2004 and were not reassigned to different public middle school catchment areas. The average 2004 *Diplôme national du Brevet* (*DNB*) score at the school level (DNB SCORE) is computed from the *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 index of private school proximity 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; sales in the bottom quartile are far away from the closest private school while sales in the top quartile are in the vicinity of the closest private school. Details on the matching of sales across public middle school attendance boundaries are given in section 2. 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.

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Table 7: *Observable 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
FLAT FEATURES				
Flat size (in m^2)	49	50	52	54
(s.d.)	(30)	(33)	(34)	(37)
Price per m^2 (in 2004)	3,257	3,348	3,319	3,358
(s.d.)	(1,218)	(1,242)	(1,239)	(1,265)
Age of building (percent)				
Unknown	0.11	0.11	0.10	0.12
Before WWI	0.49	0.48	0.45	0.43
After WWI	0.39	0.41	0.45	0.45
Number of rooms (percent)				
One	0.24	0.25	0.24	0.23
Two	0.38	0.36	0.36	0.35
Three	0.22	0.22	0.23	0.22
Four	0.09	0.10	0.10	0.11
Five or more	0.06	0.06	0.07	0.09
CENSUS CHARACTERISTICS				
% families with children under 25	0.19	0.20	0.21	0.21
% female-headed households	0.05	0.05	0.05	0.05
% owners	0.33	0.33	0.33	0.35
% public housing	0.08	0.09	0.10	0.07
% with graduate degree	0.41	0.41	0.41	0.42
% foreigners	0.23	0.22	0.22	0.22
% unemployed	0.12	0.12	0.11	0.11
Occupation:				
% managers	0.23	0.24	0.24	0.24
% self-employed workers	0.04	0.04	0.04	0.04
% intermediary occupation	0.14	0.14	0.14	0.14
% employees	0.15	0.15	0.14	0.14
% manual workers	0.06	0.06	0.06	0.05
% retired	0.17	0.17	0.18	0.18
% economically inactive	0.20	0.20	0.21	0.21
POLITICAL VIEWS & RELIGIOUS PRACTICE				
% voted right-wing in the 2002 parliamentary election	0.55	0.56	0.56	0.57
(s.d.)	(0.14)	(0.13)	(0.13)	(0.14)
Average number of places of worship within a 1 km radius	7.5	7.8	7.3	6.7
(s.d.)	(3.3)	(3.3)	(3.0)	(2.6)
PUBLIC SCHOOL PERFORMANCE				
Average 2004 *DNB* exam score	9.61	9.76	9.84	9.73
(s.d.)	(1.20)	(1.46)	(1.45)	(1.37)
% entering general curriculum high schools	0.67	0.68	0.69	0.68
(s.d.)	(0.10)	(0.11)	(0.12)	(0.12)
% from privileged backgrounds	0.46	0.49	0.50	0.48
(s.d.)	(0.17)	(0.19)	(0.19)	(0.18)
PUBLIC PREMIUM: Average cross-boundary DNB % premium of the "good" over the "bad" public middle school	0.10	0.11	0.12	0.10
(s.d.)	(0.08)	(0.08)	(0.09)	(0.08)
CLOSEST PRIVATE SCHOOL PERFORMANCE				
Average *DNB* exam score of the closest private school	11.07	11.10	10.85	11.00
(s.d.)	(1.70)	(1.95)	(2.29)	(2.22)
PRIVATE PREMIUM: Average DNB % premium of the closest private school over local public schools	0.15	0.15	0.13	0.14
(s.d.)	(0.20)	(0.23)	(0.27)	(0.27)
Number of sales	24,977	24,978	24,976	24,984

Notes: Census characteristics are taken from the 1999 French Census and are available at the census block 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 index of private school proximity 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; sales in the bottom quartile are far away from the closest private school while sales in the top quartile are in the vicinity of the closest private school. The average DNB score of the local private school is the score of the private school which is closest to the "reference" sale. For details on the computation of the *DNB* percentage premium of the closest private school over local public schools, see section 6.4.