Do Good Schools or Good Neighbors Raise Property Values?

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Why this paper?

Excellent, recent example of the role of *research design* in a spatial context.

What is "research design"?

It is *not* the fancy econometrics

It is:

-clarifying the question

-deciding what data to collect, what regression to run, what the regression results really mean, how to clarify their meaning.

Bottom line:

Thinking about research design is an excellent way to encourage and foster general critical thinking skills and does not require much technical skill or mathematical/statistical background.

Empirical Questions in this paper:

1. What are the Effects of Good Schools on Property Values?

2. What *Aspects* of Schools (Peers vs. Staff/Facilities) affect Property Values?

Discussion Plan:

1. Data

2. Pitfalls of Naïve Estimates.

3. Some alternative solutions:

    (a) Regression-discontinuity design

    (b) Fixed-effect approaches

4. (Time permitting) Sorting.

1. Data

Census of home sales prices in Mecklenburg County, NC, 1994-2001

Court-ordered desegregation plan caused busing to schools in noncontiguous areas; school boundaries often divided neighborhoods; school boundaries changed quite frequently.

Figure 1. School Assignments in Four Elementary Schools in 1997

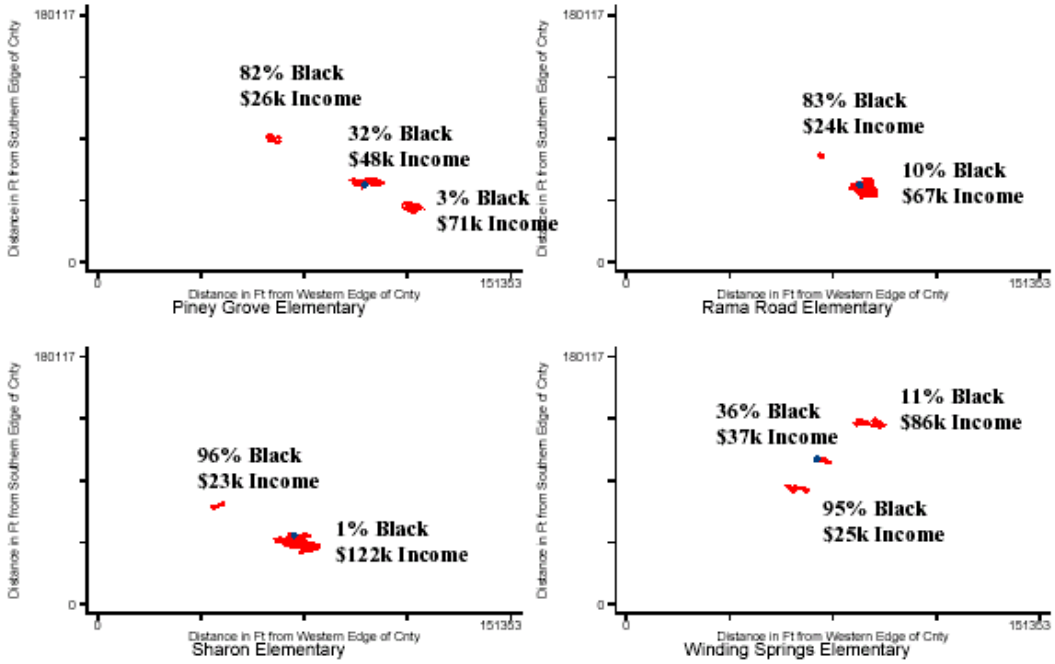


Figure 2.

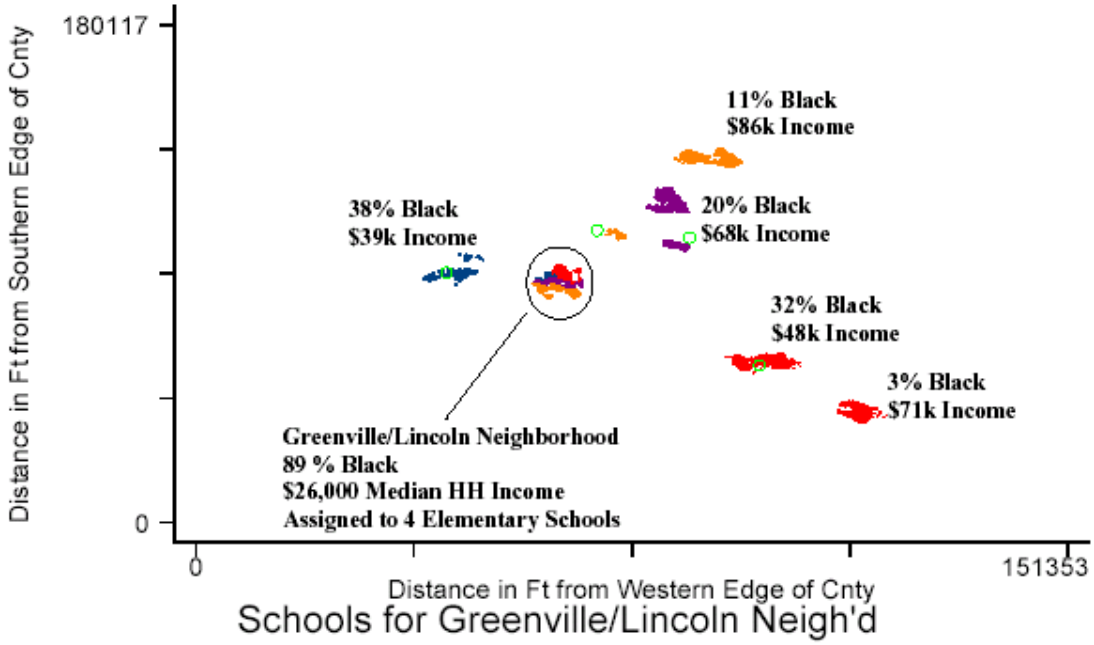
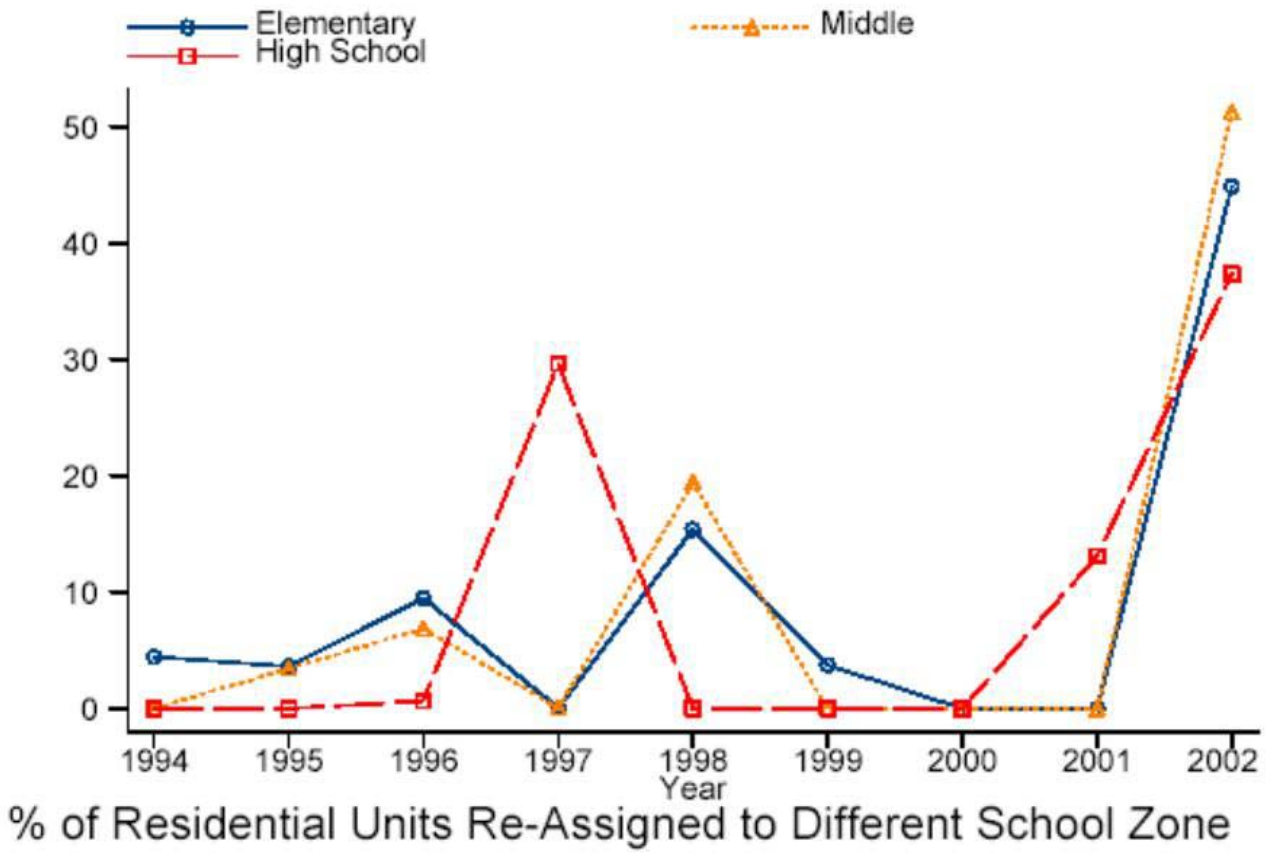

180117
0
Distance in Ft from Southern Edge of Cnty
11% Black
$86k Income
38% Black
$39k Income
20% Black
$68k Income
32% Black
$48k Income
3% Black
$71k Income
Greenville/Lincoln Neighborhood
89 % Black
$26,000 Median HH Income
Assigned to 4 Elementary Schools
0
151353
Distance in Ft from Western Edge of Cnty
Schools for Greenville/Lincoln Neigh'd

Figure 3.


Elementary
Middle
High School
50
40
30
20
10
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
% of Residential Units Re-Assigned to Different School Zone

2. Pitfalls of Naïve (Cross-Section) Estimates.

Ideal Research Design:

> Random Assignment of Treatment vs. Control by Experimenter, observe results for both groups before and after.

Common Actual Research Design:

In a cross section of observations (in this case house sales), compare prices of those with good schools vs bad schools (the "treatment").

Results:

> Big differences

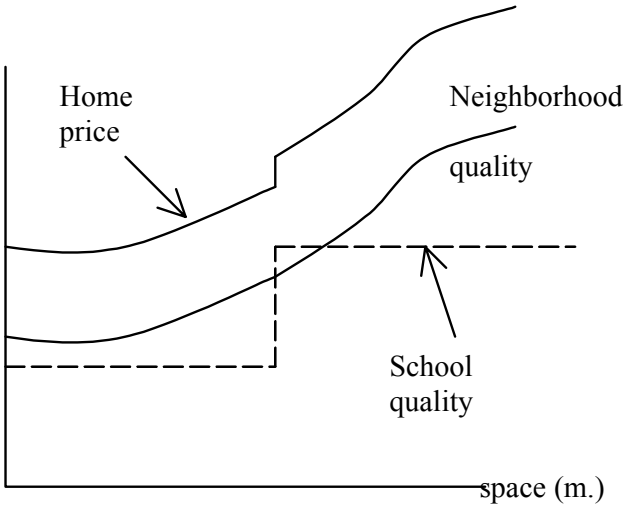
Problem: Homes with good schools differ in other ways that affect home values, usually positively.

"Solution": Control for these factors using multiple regression.

BUT: There is NO WAY to be sure you have held all such possible factors constant.

3a. A Regression-Discontinuity-Design Approach.

Fundamental idea/assumption: Unobserved aspects of housing/neighbourhood quality change continuously over space; regressor of interest (in this case school quality) changes discontinuously:



Implementation:

-restrict sample to homes near (elem.) school boundaries (2000 ft.)

-fixed effects for boundaries *and* neighborhoods (as defined by tax assessor's office), so the effect of school quality is measured by differences within neighborhoods "just" to either side of a boundary.

-concern: endogeneity of neighborhood boundaries could mean that similar-priced homes are grouped by tax assessors into the same neighborhood: this could bias the school quality coeff towards zero.

Solution: use arbitrary 2500-ft. square blocks instead of neighborhoods.

Table 1. Sensitivity of Regression Discontinuity Estimates to Neighborhood and Housing Characteristic Controls

Dependent Variable:Ln(Sales Price)

	(1)	(2)	(3)	(4)	(5)
Elem Math & Read Score 1993-99	0.527	0.311	0.138	0.098	0.128
(in student-level s.d. units)	(0.073)	(0.050)	(0.046)	(0.040)	(0.038)
Distance to Elem School (miles)	-0.042	-0.032	-0.009	-0.005	-0.009
	(0.011)	(0.009)	(0.007)	(0.008)	(0.005)
Other Covariates:					
Base Covariates	Yes	Yes	Yes	Yes	Yes
Boundary Fixed Effects		84			
Boundary-by-Neigh'd Fixed Effects			496	496	
2500 Sq. Foot Area Fixed Effects					556
Block Group Characteristics and Building Quality Dummies				Yes	Yes
R-Squared	0.82	0.84	0.88	0.89	0.89
Observations	23,084	23,084	23,084	23,084	23,084

Note: The dependent variable is ln(sales price). Sample was limited to existing home sales, on parcels with stable school assignments from 1993 through 2001, which were within 2000 feet of a school boundary, and where minimum distance at boundary was less than 500 feet. Base covariates included academic year dummies, month dummies, dummies for municipality, dummies for middle school and high school, number of bedrooms, bathrooms and half-baths, acreage, heated square feet, age, age^2 and dummies for basement, garage and air conditioning. Columns (4) and (5) also include 36 building quality dummies and percent black and median household income in the census block group in 2000. Huber-White standard errors allow for clustering at the school level.

Table 2. Similar Results using Other Measures of Elementary School Characteristics

Dependent Variable:
Ln(Sales Price)

	(1)	(2)	(3)	(4)	(5)
Percent Proficient on State Test (/10)	0.122 (0.021)	0.049 (0.016)	0.028 (0.013)	0.016 (0.011)	0.021 (0.010)
Median Household Income in Elem School Zone (/100000)	1.054 (0.208)	0.567 (0.104)	0.448 (0.117)	0.261 (0.122)	0.179 (0.081)
Population Percent Black in Elem School Zone (/100)	-0.753 (0.126)	-0.352 (0.098)	-0.286 (0.091)	-0.264 (0.087)	-0.016 (0.101)
"Value-Added" Test Score '94-'99 (in student-level s.d. units)	0.377 (0.252)	0.043 (0.106)	-0.017 (0.099)	0.052 (0.096)	-0.140 (0.085)
Other Covariates:					
Base Covariates	Yes	Yes	Yes	Yes	Yes
Boundary Fixed Effects		84			
Boundary-by-Neighborhood Fixed Effects			496	496	
2500 Sq. Foot Area Fixed Effects					556
Building Quality Dummies & Block Group Characteristics				Yes	Yes
Observations	23,084	23,084	23,084	23,084	23,084

Note: Sample was limited to those parcels with stable school assignments from 1993 through 2001, which were within 2000 feet of a school boundary, and where minimum distance at boundary was less than 500 feet. Base covariates included academic year dummies, month dummies, dummies for municipality, dummies for middle school and high school, number of bedrooms, bathrooms and half-baths, acreage, heated square feet, age, age^2 and dummies for basement, garage and air conditioning. Columns (4) and (5) also include 36 building quality dummies and percent black and median household income in the census block group in 2000. Huber-White standard errors allow for clustering at the school level.

Specification Testing:

Does neighborhood quality vary continuously over space?

Note: the real problem of course is *unmeasured* aspects of neighborhood quality, which we cannot test for. Some idea of whether this is likely can however be gleaned by examining the spatial variation of observed neighborhood characteristics near boundaries:

Table 3. Sensitivity of Regression Discontinuity Estimates to Choice of Subsample

Dependent Variable: Ln(Sales Price)	< 2000' to Boundary	< 1000' to Boundary	< 500' to Boundary	Block Group < 12% Black	Block Group >30% Black
	(1)	(2)	(3)	(4)	(5)
Elem Math & Read Score 1993-99	0.138	0.153	0.086	0.366	0.011
(in student-level s.d. units)	(0.046)	(0.045)	(0.043)	(0.078)	(0.036)
Distance to Elem. School (miles)	-0.009	-0.008	-0.009	-0.010	0.007
	(0.007)	(0.005)	(0.007)	(0.012)	(0.006)
Other Covariates:					
Base Covariates	Yes	Yes	Yes	Yes	Yes
Boundary-by-Neigh'd Fixed Effects	Yes	Yes	Yes	Yes	Yes
R-Squared	0.88	0.89	0.87	0.85	0.72
Observations	23,084	9,757	3,028	9,279	7,770

Note: The dependent variable is ln(sales price). Sample was limited to existing home sales, on parcels with stable school assignments from 1993 through 2001, which were within 2000 feet of a school boundary, and where minimum distance at boundary was less than 500 feet. Base covariates included academic year dummies, month dummies, dummies for municipality, dummies for middle school and high school, number of bedrooms, bathrooms and half-baths, acreage, heated square feet, age, age^2 and dummies for basement, garage and air conditioning. Huber-White standard errors allow for clustering at the school level.

Figure 5.

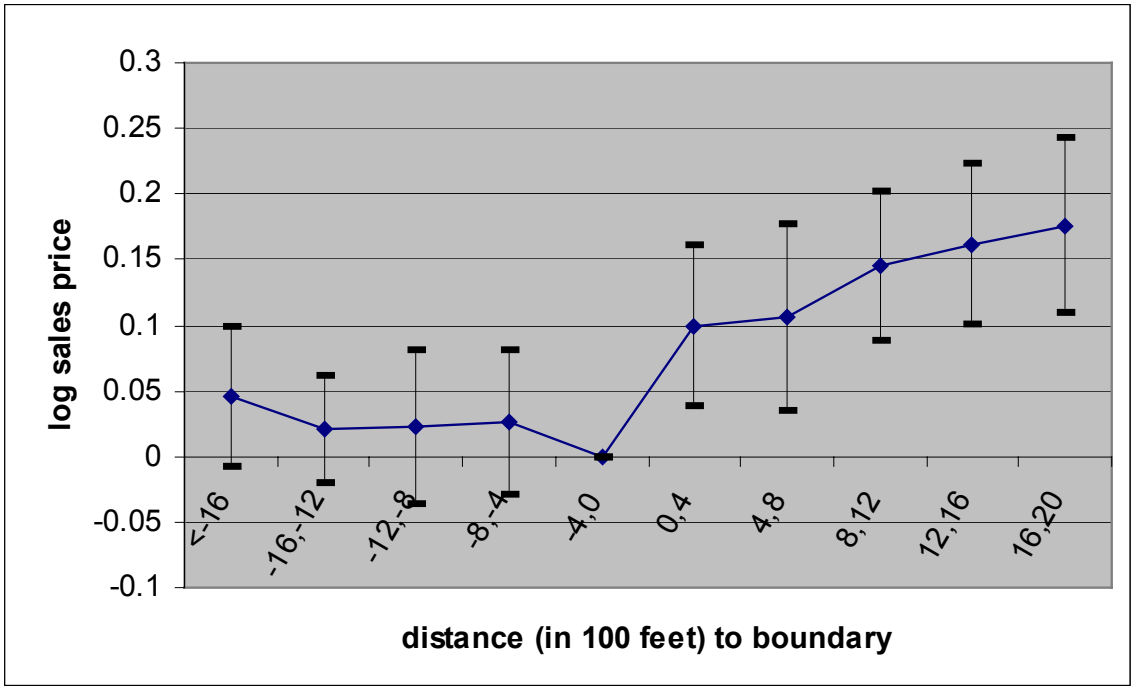

0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
log sales price
<-16
-16,-12
-12,-8
-8,-4
-4,0
0,4
4,8
8,12
12,16
16,20
distance (in 100 feet) to boundary

Figure 6.

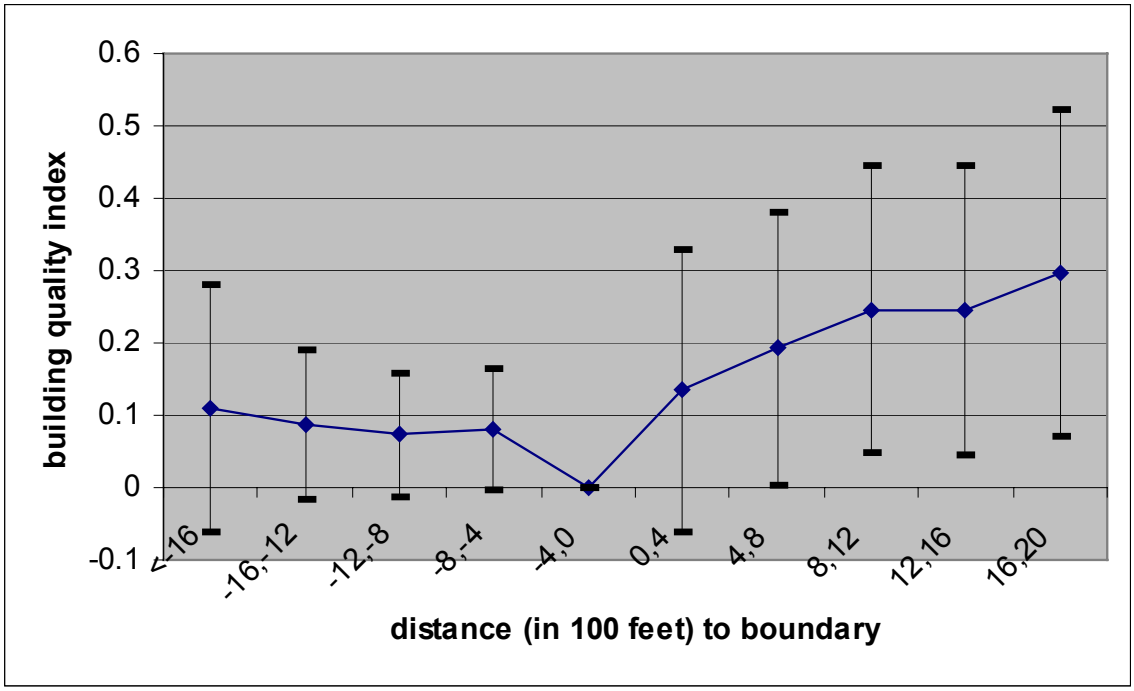
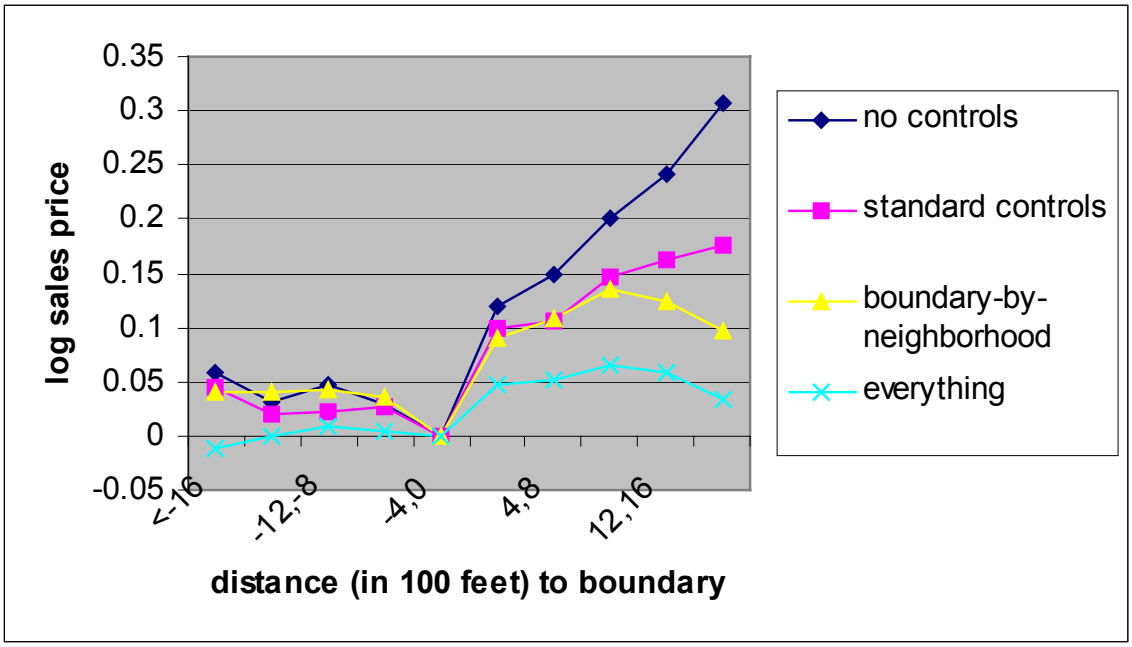
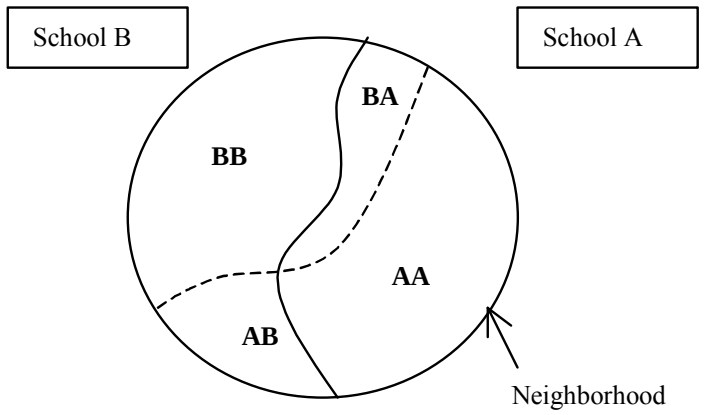

0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
building quality index
<-16
-16,-12
-12,-8
-8,-4
-4,0
0,4
4,8
8,12
12,16
16,20
distance (in 100 feet) to boundary

Figure 8.


0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
log sales price
<-16
-12,-8
-4,0
4,8
12,16
distance (in 100 feet) to boundary
no controls
standard controls
boundary-by-neighborhood
everything

3b: A Fixed-Effects Approach

Address the unobserved-neighborhood-quality problem by looking at the same neighborhood exposed to different treatments at different times.



suppose the school boundary changes within a neighborhood from the solid to the dotted line.

Suppose we then look within each of the four areas defined by AA, AB, BA, and BB. (by adding fixed effects for each of these "pre-post combinations of school assignments").

Then:

-homes in AB and BA change both their school assignments and peers.

-homes in AA and BB change only their peers.

Table 5. Housing Prices and Within-Neighborhood Changes in School Characteristics

	School Characteristic:			
Dependent Variable:	School Zone Percent Black	School Percent Black	School Zone Median Household Income	School Percent Proficient
Ln(Sales price)	(1)	(2)	(3)	(4)
Level of School:				
Elementary school	0.034	0.113	0.045	-0.237
	(0.066)	(0.061)	(0.099)	(0.140)
Middle school	-0.144	-0.026	0.083	-0.039
	(0.083)	(0.060)	(0.091)	(0.108)
High school	-0.419	-0.172	0.284	0.184
	(0.074)	(0.048)	(0.066)	(0.063)
School Assignment History Fixed Effects?	Yes	Yes	Yes	Yes
Observations	89548	89012	89548	87908
R-squared	0.88	0.88	0.88	0.88

Note: The dependent variable is ln(sales price). Sample included all existing home sales between 1994 and 2001. All specifications included base covariates (described in Table 1), 36 building quality dummies and percent black and median household income in the census block group. Also included were fixed effects for permutations of elementary, middle and high school assignments from 1993 through 2001. Huber-White standard errors allow for clustering at the permutation of school assignments level.

Table 6. Effects of Changes in School Assignments (1994-2001)

	Full Sample		Never Changed Own Schools (Peers Changed)		Changed Elem, Middle or H.S.	
	(1)	(2)	(1)	(2)	(1)	(2)
% Black in Zone:						
Elementary	0.034		-0.341		0.080	
	(0.066)		(0.298)		(0.056)	
Middle	-0.144		0.033		-0.135	
	(0.083)		(0.256)		(0.088)	
High School	-0.419		0.367		-0.384	
	(0.074)		(0.389)		(0.070)	
El, Mid & HS		-0.301		-0.480		-0.207
Combined		(0.135)		(0.580)		(0.125)
School Zone Fixed Effects	788	788	115	115	673	673
Observations	89,548	89,548	31,483	31,483	58,065	58,065
R-squared	0.88	0.88	0.87	0.87	0.89	0.89

Note: The dependent variable is ln(sales price). See note in Table 5 for additional details

4. Sorting:

What do we want to know?

(a) the extra amount *existing households* in a neighborhood are willing to pay for better schools/peers? (willingness-to-pay; important for policy purposes).

(b) the amount by which a given house's price will rise if the schools it gives access to improves? (this can rise even though existing households don't value the education at all because outside bidders are now willing to pay more for the house). (important for real estate investment purposes).

In general, (b) will exceed (a) if households move in response to school assignments. (geography ≠ people). Kane et al test for this by examining longer-run changes in observed characteristics of neighborhoods in response to school reassignments.

Result: much of the change in house prices occurs slowly and in response to demographic changes in the neighborhood induced by the assignment changes, rather than by the assignment changes themselves.

Table 7. Coefficients on Leads and Lagged Values of Percent Black in High School Zone

Dependent Variable: Ln(Sales Price)	(1)	(2)	(3)	(4)	(5)
Current Year	-0.425	-0.086	-0.091	-0.094	-0.113
	(0.077)	(0.049)	(0.049)	(0.049)	(0.045)
Year - 1		-0.442	-0.219	-0.218	-0.217
		(0.071)	(0.053)	(0.053)	(0.053)
Year - 2			-0.287	-0.199	-0.196
			(0.057)	(0.058)	(0.059)
Year - 3				-0.135	-0.123
				(0.039)	(0.043)
Year + 1					0.024
					(0.030)
Year + 2					0.009
					(0.040)
Observations	89,548	89,548	89,548	89,548	89,548
R-squared	0.88	0.88	0.88	0.88	0.88

Note: The dependent variable is ln(sales price). See note in Table 5 for additional details.

Table 9. Identifying Effects of School Assignments on Population Characteristics

Dependent Variable: 2000-1990 Change in Block Group % Black

	(1)	(2)	(3)	(4)	(5)
%Black in Elem Zone:					
Change 2000-1991	0.272			0.147	
	(0.076)			(0.082)	
Baseline 1991	0.302			0.133	
	(0.050)			(0.081)	
%Black in M.S. Zone:					
Change 2000-1991		0.286		0.054	
		(0.166)		(0.107)	
Baseline 1991		0.396		0.017	
		(0.075)		(0.160)	
%Black in H.S. Zone:					
Change 2000-1991			0.300	0.216	
			(0.106)	(0.130)	
Baseline 1991			0.582	0.420	
			(0.113)	(0.151)	
%Black E,M,HS Comb					
Change 2000-1991					0.392
					(0.153)
Baseline 1991					0.463
					(0.063)
Diff from 91 Zone Mean:					
Block group-Elem Zone					
Block group-MS Zone					
Block group-HS Zone					
Block group-E,M,HS Comb					
Observations	224463	224463	224463	224463	224463
R-squared	0.11	0.11	0.14	0.15	0.14

Note: The dependent variable is the change in percent African American in the census block gorup between 1990 and 2000. Sample consists of all residential housing parcels. Also included were fixed effects for permutations of elementary, middle and high school assignments from 1993 through 2001. Huber-White standard errors allow for clustering at the permutation of school assignments level.

Table 9. Identifying Effects of School Assignments on Population Characteristics (Continued)

Dependent Variable: 2000-1990 Change in Block Group % Black

	(1)	(2)	(3)	(4)	(5)
%Black in Elem Zone:					
Change 2000-1991	0.233			0.205	
	(0.051)			(0.054)	
Baseline 1991	0.221			0.405	
	(0.031)			(0.062)	
%Black in M.S. Zone:					
Change 2000-1991		0.407		0.003	
		(0.151)		(0.074)	
Baseline 1991		0.345		-0.159	
		(0.067)		(0.103)	
%Black in H.S. Zone:					
Change 2000-1991			0.295	0.003	
			(0.070)	(0.086)	
Baseline 1991			0.499	0.049	
			(0.089)	(0.099)	
%Black E,M,HS Comb					
Change 2000-1991					0.182
					(0.120)
Baseline 1991					0.448
					(0.048)
Diff from '91 Zone Mean:					
Block group-Elem Zone	-0.395				
	(0.039)				
Block group-MS Zone		-0.237			
		(0.034)			
Block group-HS Zone			-0.209		
			(0.040)		
Block group-E,M,HS Comb				-0.389	-0.345
				(0.041)	(0.034)
Observations	224463	224463	224463	224463	224463
R-squared	0.47	0.31	0.30	0.48	0.45

Note: The dependent variable is the change in percent African American in the census block gorup between 1990 and 2000. Sample consists of all residential housing parcels. Also included were fixed effects for permutations of elementary, middle and high school assignments from 1993 through 2001. Huber-White standard errors allow for clustering at the permutation of school assignments level.

BOTTOM LINE:

In a context like this one, getting students to discuss:

-what kinds of data they would collect

-what comparisons they would make with this data

-what are the pitfalls of some simple comparisons one might make

-exactly what it is they want to learn from the data

Is a great way to foster critical thinking skills in general. It does not require a lot of mathematical/statistical preparation.

One way to implement it is to have the students prepare study/grant *proposals* and then critique each others' proposals.