Does school quality affect neighborhood development? Evidence from a redistricting reform.

Daniel Tannenbaum

Department of Economics

The University of Nebraska

March 23, 2017

Introduction

- U.S. public school assignment historically based on home residence.

- Residential claims to schools are valuable; households sort into neighborhoods.

Introduction

- U.S. public school assignment historically based on home residence.

- Residential claims to schools are valuable; households sort into neighborhoods.

- Question: How do changes in school quality affect the *dynamics of neighborhood development?*

  - Outcomes: building construction (residential and commercial), extensive and intensive margin.

Introduction

- U.S. public school assignment historically based on home residence.

- Residential claims to schools are valuable; households sort into neighborhoods.

- Question: How do changes in school quality affect the *dynamics of neighborhood development?*

  - Outcomes: building construction (residential and commercial), extensive and intensive margin.

- Policy relevance: school policies act as neighborhood policies

Introduction II

- Empirically challenging to move beyond correlations
  - Schools affect neighborhoods; neighborhoods affect schools

Introduction II

- Empirically challenging to move beyond correlations
    - Schools affect neighborhoods; neighborhoods affect schools
- This paper:
    - Exploits a redistricting reform to recover causal effect of schools on neighborhood development:
        - Charlotte-Mecklenburg (CMS) redrew assignment boundaries abruptly following a court ruling.
        - Empirical strategy: differences-in-differences along **new** and **destroyed** assignment boundaries.

Introduction II

- Empirically challenging to move beyond correlations
  - Schools affect neighborhoods; neighborhoods affect schools
- This paper:
  - Exploits a redistricting reform to recover causal effect of schools on neighborhood development:
    - Charlotte-Mecklenburg (CMS) redrew assignment boundaries abruptly following a court ruling.
    - Empirical strategy: differences-in-differences along **new** and **destroyed** assignment boundaries.
- Main finding: an increase in school quality raises size and building quality of new construction

Contribution

- Schools affect **house prices** (Black, 1999; Kane, Riegg, Staiger, 2006; Bayer, Ferreira, McMillan, 2007), **demographics** (Weinstein, 2014), **crime** (Baum-Snow and Lutz, 2011; Deming, 2011; Lochner and Moretti, 2004; Billings, Deming, Rockoff, 2014), and **households sort along attendance boundaries** (Kane, Riegg, Staiger, 2006; Bayer, Ferreira, McMillan, 2007)

Contribution

- Schools affect **house prices** (Black, 1999; Kane, Riegg, Staiger, 2006; Bayer, Ferreira, McMillan, 2007), **demographics** (Weinstein, 2014), **crime** (Baum-Snow and Lutz, 2011; Deming, 2011; Lochner and Moretti, 2004; Billings, Deming, Rockoff, 2014), and **households sort along attendance boundaries** (Kane, Riegg, Staiger, 2006; Bayer, Ferreira, McMillan, 2007)

- This paper contributes in two ways:

    - Focus on neighborhood construction: residential and commercial building

    - Methodological contribution (can be applied to other geographic boundary contexts)

        - Use temporal variation + newly created, newly destroyed boundaries
        - **Explicitly test identification of prior work** (Black, 1999; Kane et al., 2005; Bayer et al., 2007): are boundaries drawn to separate neighborhoods based on unobservables?

Outline

- Background on Charlotte-Mecklenburg
- Data
- Empirical strategy (first pictures, then math)
- Results
- Conclusion

Background: Charlotte-Mecklenberg, NC

- 18th largest U.S. school district ($\sim 135{,}000$ students; 178 schools); 53% eligible for free and reduced-priced lunch; 33% white, 41% African-American, 16% Hispanic, 5% Asian

- From 1971-2002, CMS relied on satellite school zones $+$ busing to integrate schools
    - September 2001: court orders the district to dismantle it's desegregation plan
    - December 2001: district redraws school boundaries and expands school choice for 2002-2003

- To mitigate re-segregation in 2002-2003 CMS introduced school choice plan

Data sources

- Home sales data from Mecklenburg county public records, 1994-2007
  - All sales transactions, includes exact address and characteristics of the building/housing unit

Data sources

- Home sales data from Mecklenburg county public records, 1994-2007
    - All sales transactions, includes exact address and characteristics of the building/housing unit

- Building permits data from Mecklenburg county, 1994-2007, includes commercial and residential

Data sources

- Home sales data from Mecklenburg county public records, 1994-2007
  - All sales transactions, includes exact address and characteristics of the building/housing unit

- Building permits data from Mecklenburg county, 1994-2007, includes commercial and residential

- School data: Charlotte-Mecklenburg Schools (CMS)
  - Rich longitudinal data on students, teachers, schools in CMS
  - Assignment boundary shapefiles before and after the reform (use elementary zones)

Data sources

- Home sales data from Mecklenburg county public records, 1994-2007
  - All sales transactions, includes exact address and characteristics of the building/housing unit

- Building permits data from Mecklenburg county, 1994-2007, includes commercial and residential

- School data: Charlotte-Mecklenburg Schools (CMS)
  - Rich longitudinal data on students, teachers, schools in CMS
  - Assignment boundary shapefiles before and after the reform (use elementary zones)
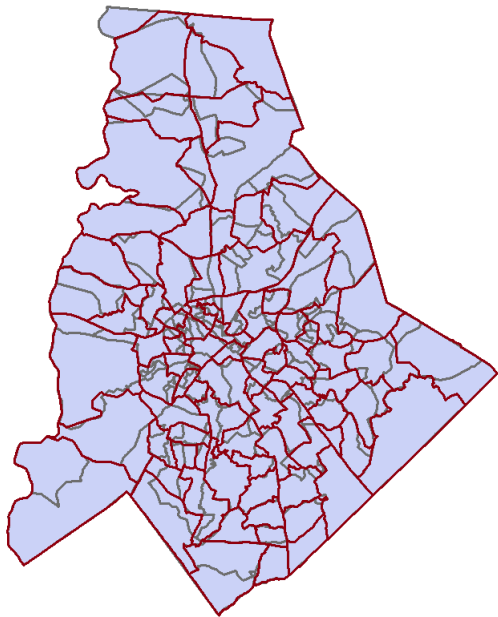
- 2000 U.S. census (**prior** to CMS reform) block group-level data (race, education, household income)

Pre-reform boundaries
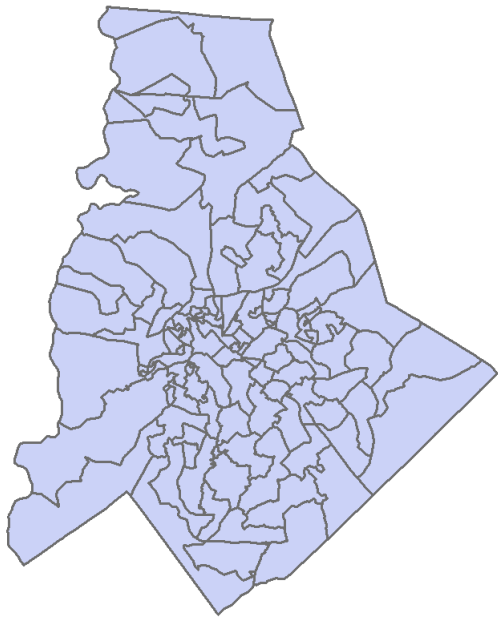
Now with post-reform boundaries overlaid
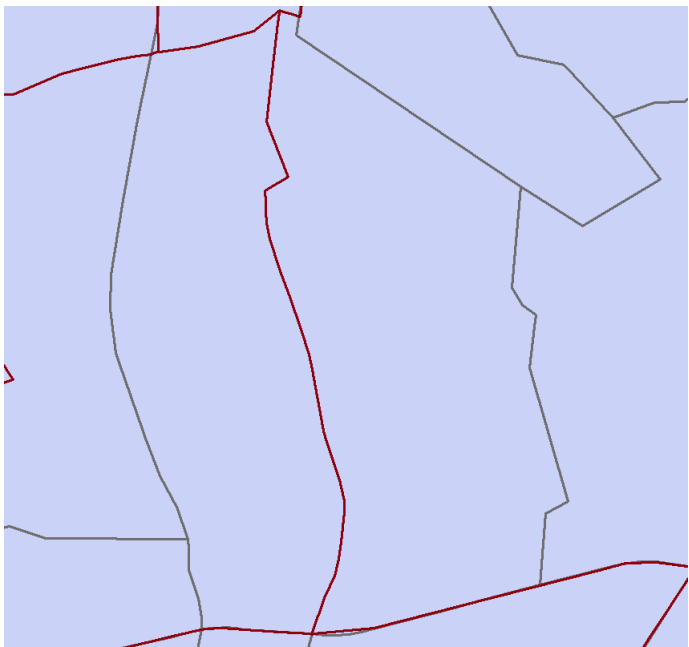
Now with building permits
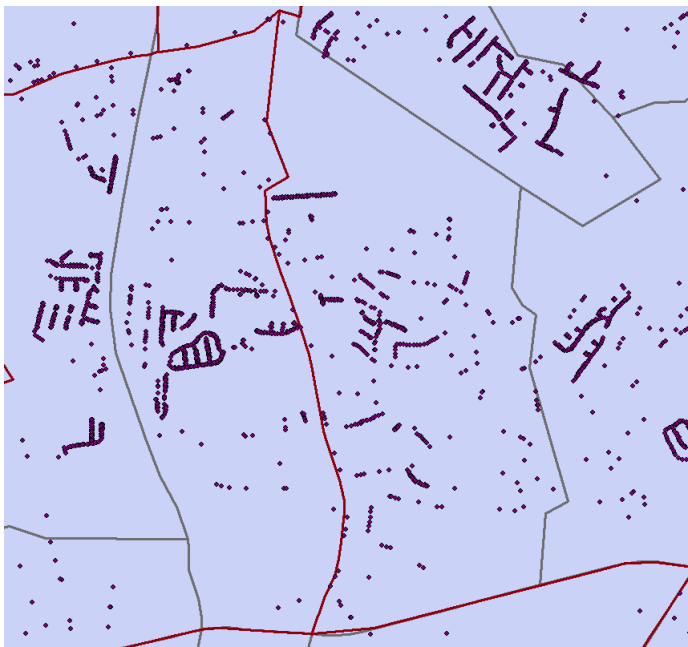
Regression sample
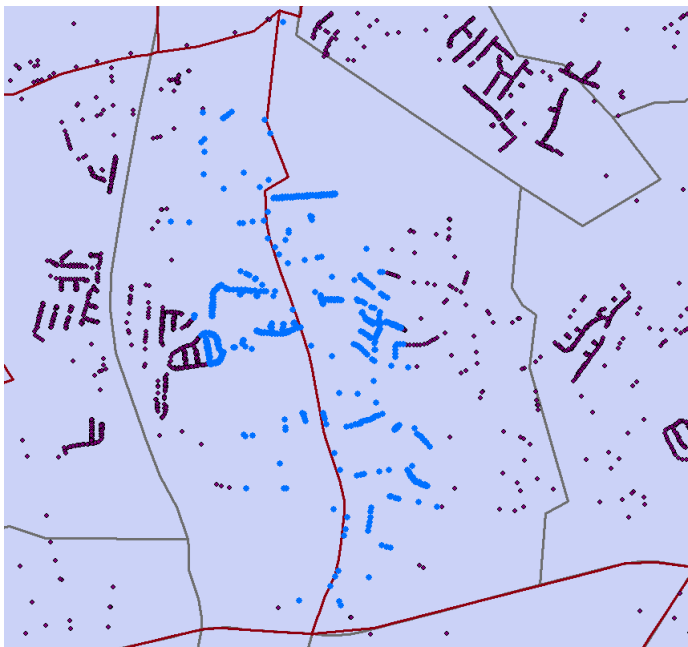
Empirical strategy: new boundaries

$$y_{ijt} = \beta_0 q_j^{post} + \beta_1(post_{it} \cdot q_j^{post}) + n_i'\gamma + \nu_t + \theta_{ib} + \epsilon_i$$

- y_{ijt}: attribute of permit i in school zone j at time t
- q_j: school quality (proxied by average End-of-Grade exam, given to all NC students, standardized to have mean 0, s.d. 1)
- n_i : neighborhood characteristics (census block-group) and distance to school
- θ_{ib}: a full set of boundary dummies interacted with pre-reform school assignment.
    - Absorbs mean unobservables shared by houses along assignment boundaries

Empirical strategy: new boundaries

$$y_{ijt} = \beta_0 q_j^{post} + \beta_1(post_{it} \cdot q_j^{post}) + n_i'\gamma + \nu_t + \theta_{ib} + \epsilon_i$$

- y_{ijt}: attribute of permit i in school zone j at time t
- q_j: school quality (proxied by average End-of-Grade exam, given to all NC students, standardized to have mean 0, s.d. 1)
- n_i : neighborhood characteristics (census block-group) and distance to school
- θ_{ib}: a full set of boundary dummies interacted with pre-reform school assignment.
  - Absorbs mean unobservables shared by houses along assignment boundaries
- Identification assumption: trends in building attributes are uncorrelated with high/low test score side of the boundary.

Results: new boundaries, building permits

	(1)	(2)	(3)	(4)
(A) Log Total Cost				
Elem. test score	0.050	0.026	0.030	-0.067
	(0.050)	(0.048)	(0.047)	(0.058)
After reform * Elem. test	0.218*	0.171*	0.179*	0.241**
	(0.126)	(0.087)	(0.090)	(0.106)
Boundary dummies	Yes	Yes	Yes	
Neighborhood controls		Yes	Yes	
Baseline neigh. * time			Yes	Yes
Boundary-by-census dum.				Yes
Observations	8,694	8,694	8,694	8,694
R^2	0.632	0.644	0.645	0.695

	(1)	(2)	(3)	(4)
(B) Total Area				
Elem. test score	-0.006	-0.074	-0.080	-0.060
	(0.109)	(0.139)	(0.125)	(0.156)
After reform * Elem. test	0.616**	0.507**	0.519**	0.521*
	(0.309)	(0.240)	(0.254)	(0.276)
Boundary dummies	Yes	Yes	Yes	
Neighborhood controls		Yes	Yes	
Baseline neigh. * time			Yes	Yes
Boundary-by-census dum.				Yes
Observations	8,685	8,685	8,685	8,685
R^2	0.083	0.084	0.084	0.088

Results: new boundaries, new housing sales

	(1)	(2)	(3)	(4)
(A) Log house price				
Elem. test score	0.010	-0.001	0.003	0.009
	(0.039)	(0.045)	(0.038)	(0.038)
After reform * Elem. test	0.244**	0.170**	0.164**	0.143**
	(0.120)	(0.071)	(0.065)	(0.056)
(B) Building High Quality				
Elem. test score	-0.005	-0.026	-0.032	0.011
	(0.018)	(0.021)	(0.029)	(0.021)
After reform * Elem. test	0.104*	0.084**	0.083**	0.003
	(0.057)	(0.038)	(0.039)	(0.024)
(C) Brick exterior				
Elem. test score	0.017	0.003	-0.007	0.004
	(0.025)	(0.029)	(0.032)	(0.009)
After reform * Elem. test	-0.000	-0.016	-0.002	0.012
	(0.028)	(0.029)	(0.032)	(0.014)
Boundary dummies	Yes	Yes	Yes	
Neighborhood controls		Yes	Yes	
Baseline neigh. * time			Yes	Yes
Boundary-by-census dum.				Yes
Observations	13,375	13,375	13,375	13,375

Estimation equation: $y_{ijt} = \beta_0 q_j^{post} + \beta_1(post_{it} \cdot q_j^{post}) + n_i' \gamma + \nu_t + \theta_{ib} + \epsilon_i$. Standard errors clustered at post- school level.

Analysis of pre-trends

- Identification is based on the assumption that there are no differential pre-trends

Analysis of pre-trends

- Identification is based on the assumption that there are no differential pre-trends
  - i.e., opposite sides of new boundaries do not differ in preexisting trends in new construction patterns.
  - Potential threat: the school district may have drawn new assignment boundaries to incorporate developing neighborhoods on the high test score side

Analysis of pre-trends

- Identification is based on the assumption that there are no differential pre-trends

    - i.e., opposite sides of new boundaries do not differ in preexisting trends in new construction patterns.
    - Potential threat: the school district may have drawn new assignment boundaries to incorporate developing neighborhoods on the high test score side

- Regression test:

$$y_{ijt} = \beta_0 q_j^{post} + \beta_{95} \cdot q_j^{post} + \beta_{96} \cdot q_j^{post} + \cdots + \beta_{07} \cdot q_j^{post} + n_i^{'} \gamma + \nu_t + \theta_{ib} + \epsilon_h$$

Year-by-year regressions

Estimation equation: $y_{ijt} = \beta_0 q_j^{post} + \beta_{95} \cdot q_j^{post} + \beta_{96} \cdot q_j^{post} + \cdots + \beta_{07} \cdot q_j^{post} + n_i' \gamma + \nu_t + \theta_{ib} + \epsilon_i.$

Results: destroyed boundaries, building permits

	(1)	(2)	(3)	(4)
(A) Log Total Cost				
Elem. test score	0.288*	0.267	0.246	0.300
	(0.172)	(0.174)	(0.161)	(0.307)
After reform * Elem. test	-0.371**	-0.370**	-0.341**	-0.639*
	(0.150)	(0.165)	(0.156)	(0.340)
Boundary dummies	Yes	Yes	Yes	
Neighborhood controls		Yes	Yes	
Baseline neigh. * time			Yes	Yes
Boundary-by-census dum.				Yes
Observations	13,275	13,275	13,275	13,275
R^2	0.611	0.618	0.622	0.684

	(1)	(2)	(3)	(4)
(B) Total Area				
Elem. test score	0.915**	0.858*	0.805*	1.122
	(0.437)	(0.438)	(0.407)	(0.844)
After reform * Elem. test	-0.983***	-0.994**	-0.913**	-1.983**
	(0.335)	(0.385)	(0.361)	(0.905)
Boundary dummies	Yes	Yes	Yes	
Neighborhood controls		Yes	Yes	
Baseline neigh. * time			Yes	Yes
Boundary-by-census dum.				Yes
Observations	13,240	13,240	13,240	13,240
R^2	0.092	0.094	0.094	0.102

Results: destroyed boundaries, new housing sales

	(1)	(2)	(3)	(4)
(A) Log house price				
Elem. test score	0.397**	0.387**	0.396**	0.474
	(0.155)	(0.158)	(0.157)	(0.400)
After reform * Elem. test	-0.404**	-0.392*	-0.396*	-0.729
	(0.202)	(0.223)	(0.222)	(0.544)
(B) Building High Quality				
Elem. test score	0.669**	0.692**	0.673**	0.329
	(0.317)	(0.323)	(0.310)	(0.391)
After reform * Elem. test	-0.767**	-0.793**	-0.774**	-0.585
	(0.374)	(0.387)	(0.375)	(0.511)
(C) Brick				
Elem. test score	0.251**	0.269**	0.295***	0.364
	(0.104)	(0.104)	(0.109)	(0.230)
After reform * Elem. test	-0.129	-0.153	-0.170*	-0.425
	(0.091)	(0.097)	(0.098)	(0.263)
Boundary dummies	Yes	Yes	Yes	
Neighborhood controls		Yes	Yes	
Baseline neigh. * time			Yes	
Boundary-by-census dum.				Yes
Observations	18,420	18,420	18,420	18,420

Estimation equation: $y_{ijt} = \beta_0 q_j^{pre} + \beta_1 (post_{it} \cdot q_j^{pre}) + n_i^{'} \gamma + \nu_t + \theta_{ib} + \epsilon_i$. Standard errors clustered at post- school level.

Year-by-year regressions

Estimation equation: $y_{ijt} = \beta_0 q_j^{pre} + \beta_{95} \cdot q_j^{pre} + \beta_{96} \cdot q_j^{pre} + \cdots + \beta_{07} \cdot q_j^{pre} + n_i' \gamma + \nu_t + \theta_{ib} + \epsilon_i.$

Conclusion

- Schools affect the dynamics of neighborhood development.

Conclusion

- Schools affect the dynamics of neighborhood development.

- An increase in school quality leads to: larger, higher quality construction

Conclusion

- Schools affect the dynamics of neighborhood development.

- An increase in school quality leads to: larger, higher quality construction

- When school quality discontinuities are eliminated: convergence in building characteristics, with limited evidence of persistence.

Conclusion

- Schools affect the dynamics of neighborhood development.

- An increase in school quality leads to: larger, higher quality construction

- When school quality discontinuities are eliminated: convergence in building characteristics, with limited evidence of persistence.
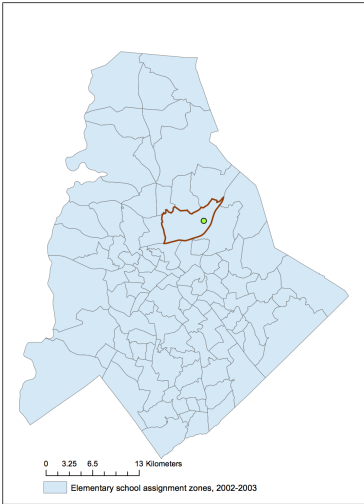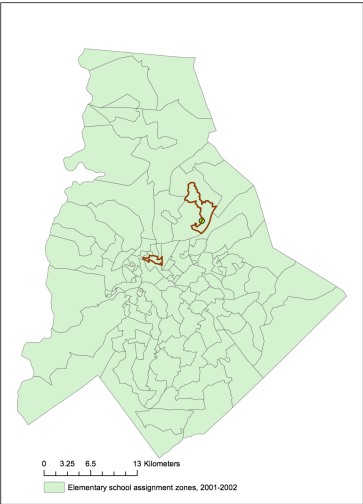
- Identification improvement over usual boundary fixed effects approach

  - Can explicitly test whether boundaries are drawn locally to separate neighborhoods by *unobservables.*
  - Can be applied to other settings.

Table: Summary statistics: residential permits

	Before reform			After reform		
	All	Dest. Bnd.	New Bnd.	All	Dest. Bnd.	New Bnd.
Total const. cost (1000s)	141.87	132.13	114.84	144.39	138.44	126.42
	(83.62)	(87.16)	(79.76)	(84.66)	(80.75)	(80.18)
Heated square feet (1000s)	1.89	1.78	1.56	2.23	2.16	2.01
	(1.14)	(1.07)	(1.04)	(0.98)	(0.96)	(0.91)
Unheated square feet (1000s)	0.40	0.41	0.41	0.42	0.36	0.34
	(2.06)	(4.73)	(6.11)	(0.42)	(0.35)	(0.32)
Bedrooms	3.53	3.40	3.43	3.43	3.47	3.31
	(0.63)	(0.61)	(0.68)	(1.20)	(2.08)	(0.66)
Bathrooms	2.37	2.28	2.17	2.61	2.61	2.44
	(1.47)	(0.98)	(0.60)	(1.15)	(1.08)	(0.84)
School characteristics						
School test score (standardized)	0.07	0.01	-0.07	0.09	0.03	-0.14
	(0.39)	(0.36)	(0.36)	(0.44)	(0.49)	(0.45)
Parent with college deg.	0.46	0.44	0.38	0.45	0.43	0.32
	(0.23)	(0.22)	(0.22)	(0.24)	(0.27)	(0.25)
Black students	0.36	0.42	0.44	0.35	0.40	0.49
	(0.22)	(0.21)	(0.19)	(0.24)	(0.26)	(0.24)
Free and reduced price lunch	0.33	0.37	0.41	0.37	0.43	0.52
	(0.20)	(0.20)	(0.19)	(0.25)	(0.29)	(0.26)
Distance to assigned school	2.30	2.48	1.89	1.64	1.43	1.47
	(1.70)	(1.75)	(1.42)	(0.96)	(0.78)	(0.76)
Neighborhood characteristics						
Fraction college	0.46	0.46	0.39	0.39	0.39	0.32
	(0.17)	(0.18)	(0.19)	(0.17)	(0.20)	(0.19)
Median hh income (1000s)	72.92	68.58	63.95	64.89	61.53	56.55
	(24.18)	(22.26)	(24.21)	(22.42)	(22.86)	(21.33)
Observations	41,977	7,730	4,632	38,630	7,524	5,859

CMS elem. assignment, before and after redistricting

0 3.25 6.5   13 Kilometers
Elementary school assignment zones, 2001-2002

0 3.25 6.5   13 Kilometers
Elementary school assignment zones, 2002-2003

Summary statistics: boundaries

	New boundaries	Destroyed boundaries
Boundary length (mi.)	0.85	0.87
	(0.79)	(0.86)
High test score side		
Elem. test score	-0.01	-0.07
	(0.43)	(0.28)
Parents with college	0.36	0.34
	(0.25)	(0.19)
African-American	0.44	0.45
	(0.23)	(0.16)
Free or reduced Lunch	0.51	0.45
	(0.26)	(0.18)
Low test score side		
Elem. test score	-0.36	-0.31
	(0.38)	(0.23)
Parents with college	0.20	0.22
	(0.21)	(0.16)
African-American	0.58	0.55
	(0.24)	(0.15)
Free or reduced Lunch	0.68	0.60
	(0.24)	(0.18)
Number	326	469

Summary statistics: residential permits

	1996-98	1999-2000	2001-02	2003-04	2005-07
Permit characteristics					
Total const. cost (1000s)	109.18	110.10	103.24	104.57	99.22
	(89.56)	(92.18)	(88.10)	(89.44)	(90.81)
Heated square feet (1000s)	1.73	1.62	1.55	1.58	1.42
	(1.19)	(1.19)	(1.16)	(1.22)	(1.23)
Unheated square feet (1000s)	0.38	0.38	0.35	0.34	0.30
	(0.35)	(3.07)	(0.37)	(0.39)	(0.41)
Bathrooms	1.94	1.93	1.87	1.83	1.69
	(1.37)	(1.36)	(1.35)	(1.33)	(1.45)
New single-family home	0.73	0.72	0.70	0.67	0.59
	(0.45)	(0.45)	(0.46)	(0.47)	(0.49)
New multi-family home	0.00	0.00	0.01	0.00	0.01
	(0.04)	(0.05)	(0.08)	(0.06)	(0.07)
Residence alteration	0.27	0.28	0.29	0.33	0.41
	(0.44)	(0.45)	(0.46)	(0.47)	(0.49)
Project completed	0.84	0.85	0.85	0.82	0.81
	(0.36)	(0.36)	(0.36)	(0.38)	(0.39)
Days to complete	189.50	171.84	166.07	212.72	206.66
	(128.16)	(143.96)	(179.28)	(257.39)	(221.00)
Neighborhood characteristics					
Black households	0.18	0.18	0.18	0.17	0.22
	(0.21)	(0.20)	(0.20)	(0.20)	(0.23)
Asian households	0.03	0.03	0.03	0.03	0.03
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)
Other race households	0.03	0.03	0.04	0.03	0.04
	(0.03)	(0.04)	(0.05)	(0.04)	(0.04)
Fraction college	0.48	0.45	0.42	0.43	0.43
	(0.19)	(0.19)	(0.19)	(0.19)	(0.21)
Median hh income (1000s)	73.59	70.40	67.45	68.42	65.03
	(28.10)	(27.02)	(25.20)	(26.20)	(28.81)