Team 40: Mortality Prediction in ICU
CSE 6250 Final Project

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Presentation Outline

1. **Research Question**
2. Brief Review of Existing Literature and Background
3. Data
4. Theoretical Framework
5. Empirical Design
6. Results
7. Future Considerations

Research Question

- Overall: Capitalization of School Quality onto Housing Prices
- Specific: What is the causal effect of increase in school quality (as measured by standardized test scores) on local housing prices?

Research Question

- Why do we care?
  - We believe better schools/teachers improve students' future outcomes (Chetty et. al, 2013)
  - What about homeowners?
- What is the true effect of schools on housing prices?
  - Be careful! Omitted Variables Bias problem!
  - Abundant existing literature that presents solutions to these problems

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Review of Existing Literature

Instrumental Variables

- Rosenthal (2003)

Regression Discontinuity

- Black (1999) popularized the RD approach
- Kane, Reigg, and Staiger (2006)
- Fack and Grenet (2010)
- Black and Machin (2010) – Survey Study

Review of Existing Literature

Instrumental Variables

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- Black and Machin (2010) – Survey Study

Background: Boston Public School District (BPS)

Quick Facts:

- Population of Boston (2012): 636,479
- Land Area (2010): 48.28 mi^2
- Total Schools (2012 - 2013): 127
- Total Students Enrolled in BPS: $\approx$ 57,000 (74 % of student age population)
- Total Schools Serving Fourth Grade: 71
- Total Fourth Grade Students Enrolled in BPS: $\approx$ 4,000

Background: Boston Public School District (BPS)

Registration Mechanism: System of Priorities

1. Sibling + Walk Zone
2. Sibling
3. Walk Zone

Walk Zone (Elementary Schools): "1 mile radius around the school, calculated by drawing a circle with 1-mile radius centered at the school and adding the entirety of any geocode the circle touches" (Pathak and Shi, 2013).

Any student could apply to any school within his/her walk zone, regardless of actual school zone.

Background: Boston Public School District (BPS)

Walk Zone Facts

- 50% of each school's seats are reserved for walk zone students.
- (2012-2013) 86% of BPS families listed a walk zone school as one of their top three choices.

Charter Schools

- Not part of BPS, do not follow the same registration/priority mechanism (Lottery Based)
- We exclude charter schools from this study.

Pilot Schools

- Technically part of BPS, occupy the middle ground between traditional public schools and charter schools
- Follows the same student assignment policy

MCAS

Massachusetts Comprehensive Assessment System (MCAS): 4th Grade Tests

1. Mathematics
2. English Language Arts and Reading Comprehension (ELA)

Performance Levels (Raw Score Totals)

1. Advanced (260 - 280)
2. Proficient (240 - 259)
3. Needs Improvement (220 - 239)
4. Warning/Failing (200 - 219)

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Data

Housing Data

- 2009 - 2013 Boston Residential Sales provided by the City of Boston Assessing Department
- Includes all residential real estate "arms-length" transactions. Total: 20,932
- Includes a large vector of housing characteristics

School Data

- Massachusetts Department of Education Statewide Reports
- MCAS Results from 1998 - 2013
- Also obtained vectors of student/teacher characteristics

Data

VARIABLES	(1) Mean	(2) SD	(3) # Obs.
School Characteristics			
ELA Proficient or Higher	25.95	12.32	71
ELA Advanced	3.023	2.882	71
ELA Proficient	22.93	10.01	71
ELA Needs Improvement	47.35	7.090	71
ELA Warning/Failing	26.75	11.93	71
ELA Composite Performance Index	65.41	10.42	71
ELA Student Growth Percentile	44.16	11.96	68
Math Proficient or Higher	23.67	12.58	71
Math Advanced	5.945	4.997	71
Math Proficient	17.74	8.161	71
Math Needs Improvement	45.73	7.492	71
Math Warning/Failing	30.66	11.75	71
Math Composite Performance Index	65.00	10.45	71
Math Student Growth Percentile	49.94	13.21	68
Total Number of Classes	111.3	74.17	71
Average Class Size	17.93	2.370	71
Total Number of Students	420.2	192.7	71
Percentage Black	31.96	20.19	71
Percentage White	14.57	14.87	71
Percentage Male	52.37	3.743	71
Percentage Students Limited English	32.42	17.67	71
Percentage Students Low Income	73.07	12.74	71
Total Number of Teachers	30.37	15.06	71
Percentage of Teachers Licensed	95.74	2.904	71

Data

School Data

- Prior to 2001, 4th Grade MCAS also include SCI section. Excluded these results from our study
- Primary measure of school quality is percentage of students scoring proficient or advanced
- Combine Math and ELA performance by simply summing the two, consistent with Black (1999)

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Theoretical Background

Initial Hypothesis

- Increasing the quality of the best walk zone school is associated with higher housing prices

- Increasing the quality of multiple walk one schools (increase school choice) is associated with lower housing prices.
  - This is perhaps unintuitive
  - Explained by application of Tiebout Model

Theoretical Background: Tiebout Model

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Empirical Regression Equation

$$\mathit{lnPrice}_{it} = \beta_0 + \beta_1 \mathit{School\ Quality} + \beta_2 \mathbf{X}_{it} + \phi + \gamma + \mu_{it}, \quad (1)$$

- *lnPrice*: Natural log of the sales price of the property
- *School Quality*: Measure of local school quality
- $\mathbf{X}_{it}$: Vector of property-related characteristics
- ϕ: Time Dummies
- γ: Vector of Neighborhood and School Characteristics

Empirical Regression Equation

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However, omitted variables/endogeneity Problems remain.

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Empirical Design: Regression Discontinuity Approach

Empirical Design: Regression Discontinuity Approach

Empirical Regression Equation

$$InPrice_{it} = \beta_0 + \beta_1 Test_i + \beta_2 X_{it} + K + \phi + \mu_{it}, \qquad (2)$$

- *InPrice*: Natural log of the sales price of the property
- $Test_i$: MCAS Result of a walk zone school for house i
- $\mathbf{X}_{it}$: Vector of property-related characteristics
- ϕ: Year Dummies
- K Square Block Dummies

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Results: Baseline Regression

Table: Effect of MCAS Scores on Housing Prices. Dependent Variable: Natural Log of Sale Price. SE Clustered by Walk Zone Groups

VARIABLES	(1) All Houses	(2) All Houses	(3) 0.5 Sq. Mile Blocks	(4) 0.4 Sq. Mile Blocks	(5) 0.3 Sq. Mile Blocks
Best % Prof or Adv	0.121*	0.0840*	0.0380*	0.0414***	0.0503**
	(0.0618)	(0.0450)	(0.0194)	(0.0129)	(0.0202)
Constant	12.60***	12.21***	12.14***	12.09***	12.07***
	(0.169)	(0.138)	(0.0861)	(0.0716)	(0.0799)
Observations	20,716	20,320	20,320	20,320	20,320
R-squared	0.034	0.404	0.733	0.746	0.747
House Controls[a]	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES
Square Block FE	NO	NO	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[a] House Controls include: total # bedrooms, total # bathrooms, total # bathrooms^2, size (in sq ft.), age of building, age of building^2. These are the same controls that Black (1999) uses.

Results: Specification Test

Table: Specification Tests. Effect of MCAS Scores interacted with number of bedrooms on Housing Prices. Dependent Variable: Natural Log of Sale Price.

VARIABLES	(1) All Houses	(2) All Houses	(3) 0.5 Sq. Mile Blocks	(4) 0.4 Sq. Mile Blocks	(5) 0.3 Sq. Mile Blocks
(Best % Prof or Adv)×	0.117**	0.0976**	0.0674***	0.0683***	0.0798***
(Dummy $\geq$ 2 Bedrooms)	(0.0552)	(0.0481)	(0.0218)	(0.0146)	(0.0222)
(Best % Prof or Adv)×	0.0392	0.0596	-0.00406	-0.00508	0.00859
(Dummy $\leq$ 1 Bedrooms)	(0.0484)	(0.0428)	(0.0196)	(0.0137)	(0.0202)
Constant	12.68***	12.29***	12.27***	12.23***	12.19***
	(0.133)	(0.127)	(0.0735)	(0.0656)	(0.0702)
Observations	20,716	20,320	20,320	20,320	20,320
R-squared	0.064	0.410	0.753	0.767	0.767
House Controls[a]	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES
Square Block FE	NO	NO	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[a] House Controls include: total # bedrooms, total # bathrooms, total # bathrooms^2, size (in sq ft.), age of building, age of building^2. These are the same controls that Black (1999) uses.

Results

Table: Effect of MCAS Scores on Housing Prices. Dependent Variable: Natural Log of Sale Price. Restrict Sample to where difference between Best % Prof or Adv in WZ and Second Best % Prof or Adv in WZ falls in the 75th to 100th percentile. SE Clustered by Walk Zone Groups

VARIABLES	(1) All Houses	(2) All Houses	(3) 0.5 Sq. Mile Blocks	(4) 0.4 Sq. Mile Blocks	(5) 0.3 Sq. Mile Blocks
Best % Prof or Adv	0.0490	0.0235	0.0458*	0.0805***	0.0837***
	(0.129)	(0.0687)	(0.0249)	(0.0133)	(0.0201)
Constant	13.14***	12.34***	12.22***	12.08***	12.10***
	(0.465)	(0.235)	(0.105)	(0.0638)	(0.0874)
Observations	6,221	6,170	6,170	6,170	6,170
R-squared	0.003	0.584	0.782	0.783	0.787
House Controls[a]	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES
Square Block FE	NO	NO	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[a] House Controls include: total # bedrooms, total # bathrooms, total # bathrooms^2, size (in sq ft.), age of building, age of building^2. These are the same controls that Black (1999) uses.

Results

Table: Effect of MCAS Scores on Housing Prices. Dependent Variable: Natural Log of Sale Price. SE Clustered by Walk Zone Groups

VARIABLES	(1) All Houses	(2) All Houses	(3) 0.5 Sq. Mile Blocks	(4) 0.4 Sq. Mile Blocks	(5) 0.3 Sq. Mile Blocks
Best % Prof or Adv	0.128**	0.0918**	0.0452**	0.0518***	0.0525**
	(0.0632)	(0.0464)	(0.0200)	(0.0151)	(0.0237)
Total # WZ	-0.0392**	-0.0374***	-0.0124	-0.0203**	-0.00403
	(0.0175)	(0.0141)	(0.0102)	(0.00953)	(0.0120)
Constant	12.73***	12.32***	12.16***	12.14***	12.07***
	(0.172)	(0.145)	(0.0878)	(0.0665)	(0.0703)
Observations	20,716	20,320	20,320	20,320	20,320
R-squared	0.050	0.418	0.733	0.747	0.747
House Controls[a]	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES
Square Block FE	NO	NO	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[a] House Controls include: total # bedrooms, total # bathrooms, total # bathrooms^2, size (in sq ft.), age of building, age of building^2. These are the same controls that Black (1999) uses.

Results

Table: Effect of MCAS Scores on Housing Prices. Dependent Variable: Natural Log of Sale Price. SE Clustered by Walk Zone Groups

VARIABLES	(1) All Houses	(2) All Houses	(3) 0.5 Sq. Mile Blocks	(4) 0.4 Sq. Mile Blocks	(5) 0.3 Sq. Mile Blocks
Best % Prof or Adv	0.213***	0.169***	0.0615***	0.0652***	0.0667***
	(0.0474)	(0.0380)	(0.0214)	(0.0156)	(0.0243)
Sec % Prof or Adv	-0.366***	-0.305***	-0.0804**	-0.0974***	-0.0877***
	(0.0434)	(0.0450)	(0.0331)	(0.0256)	(0.0215)
Total # WZ	0.0249*	0.0128	0.00714	0.00209	0.0152
	(0.0133)	(0.0128)	(0.0131)	(0.0103)	(0.0120)
Constant	12.93***	12.44***	12.20***	12.21***	12.13***
	(0.149)	(0.125)	(0.0923)	(0.0746)	(0.0745)
Observations	20,010	19,630	19,630	19,630	19,630
R-squared	0.209	0.519	0.736	0.750	0.750
House Controls[a]	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES
Square Block FE	NO	NO	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[a] House Controls include: total # bedrooms, total # bathrooms, total # bathrooms^2, size (in sq ft.), age of building, age of building^2. These are the same controls that Black (1999) uses.

Results

Table: Effect of MCAS Scores on Housing Prices. Dependent Variable: Natural Log of Sale Price.

VARIABLES	(1) All Houses	(2) All Houses	(3) 0.5 Sq. Mile Blocks	(4) 0.4 Sq. Mile Blocks	(5) 0.3 Sq. Mile Blocks
No. of Top Schools					
≥ 1	0.204*	0.112	0.0614	0.0901**	0.0713
	(0.122)	(0.0957)	(0.0479)	(0.0382)	(0.0596))
≥ 2	-0.323***	-0.235***	-0.0234	-0.0773***	-0.0379
	(0.104)	(0.0848)	(0.0292)	(0.0273)	(0.0390)
Constant	12.91***	12.46***	12.21***	12.17***	12.18***
	(0.0812)	(0.0752)	(0.0694)	(0.0612)	(0.0672)
Observations	20,932	20,536	20,536	20,536	20,536
R-squared	0.067	0.420	0.734	0.748	0.748
House Controls[a]	NO	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	YES
Square Block FE	NO	NO	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[a] House Controls include: total # bedrooms, total # bathrooms, total # bathrooms^2, size (in sq ft.), age of building, age of building^2. These are the same controls that Black (1999) uses.

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Conclusion

1. One SD increase in best walk zone school's % students scoring proficient or advanced on MCAS $\Rightarrow$ 5% increase in house sales price
   - Average Sales Price: \$535,645 $\approx$ \$26,000 premium

2. Presence of several good schools within walk zone mitigates (and reverses) this effect
   - Holding best school constant, improving second best school within walk zone leads to a decrease in sales price
   - Home buyers willing to pay 6 - 9% premium for houses with 1 good walk zone school. Only 2 - 4 % for houses with multiple good walk zone schools.

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Questions?

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