Creative Destruction: Barriers to Urban Growth and the Great Boston Fire of 1872

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Urban Destruction in American Cities

Catastrophic urban fires a feature of 19th and early-20th centuries

- Fire-prone buildings
- Primitive firefighting technology

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Contemporaries and historians discuss rapid recovery and benefits

> "Occurrences calamitous in their first effects sometimes result in important material good.... That great fire ... furnished the opportunity for rebuilding the metropolis at its very center of operation on a comprehensive scale."
> (Boston Daily Advertiser 1873)

Research Questions

1. Did the Boston Fire create "important material good"?
2. If so, through what potential channels?
3. What can we learn about rigidities in urban growth?

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   - Baseline model with durable buildings
   - Extended model with neighborhood externalities
   - Other potential channels (plot consolidation, owner concentration, industry agglomeration, public infrastructure)

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3. Plot-level data collection
4. Results
   - Baseline impacts on land values
   - Exploration of channels

Background: Boston Fire of 1872

In November 1872, a small fire spread through a large section of the business district

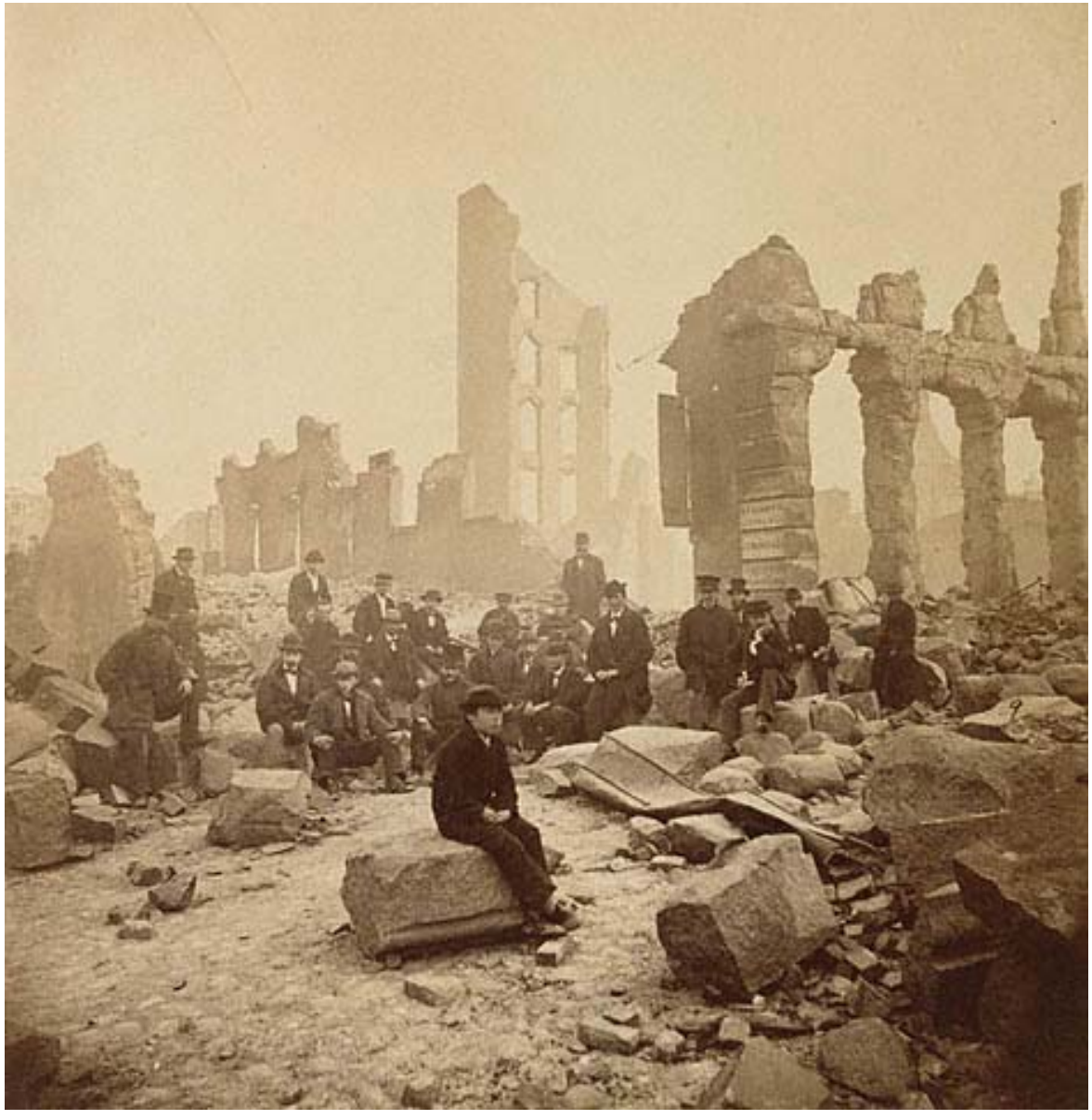
- 776 buildings in 65 acres destroyed
- 75.3 million dollars in damages, 20 deaths

Why did the fire spread?

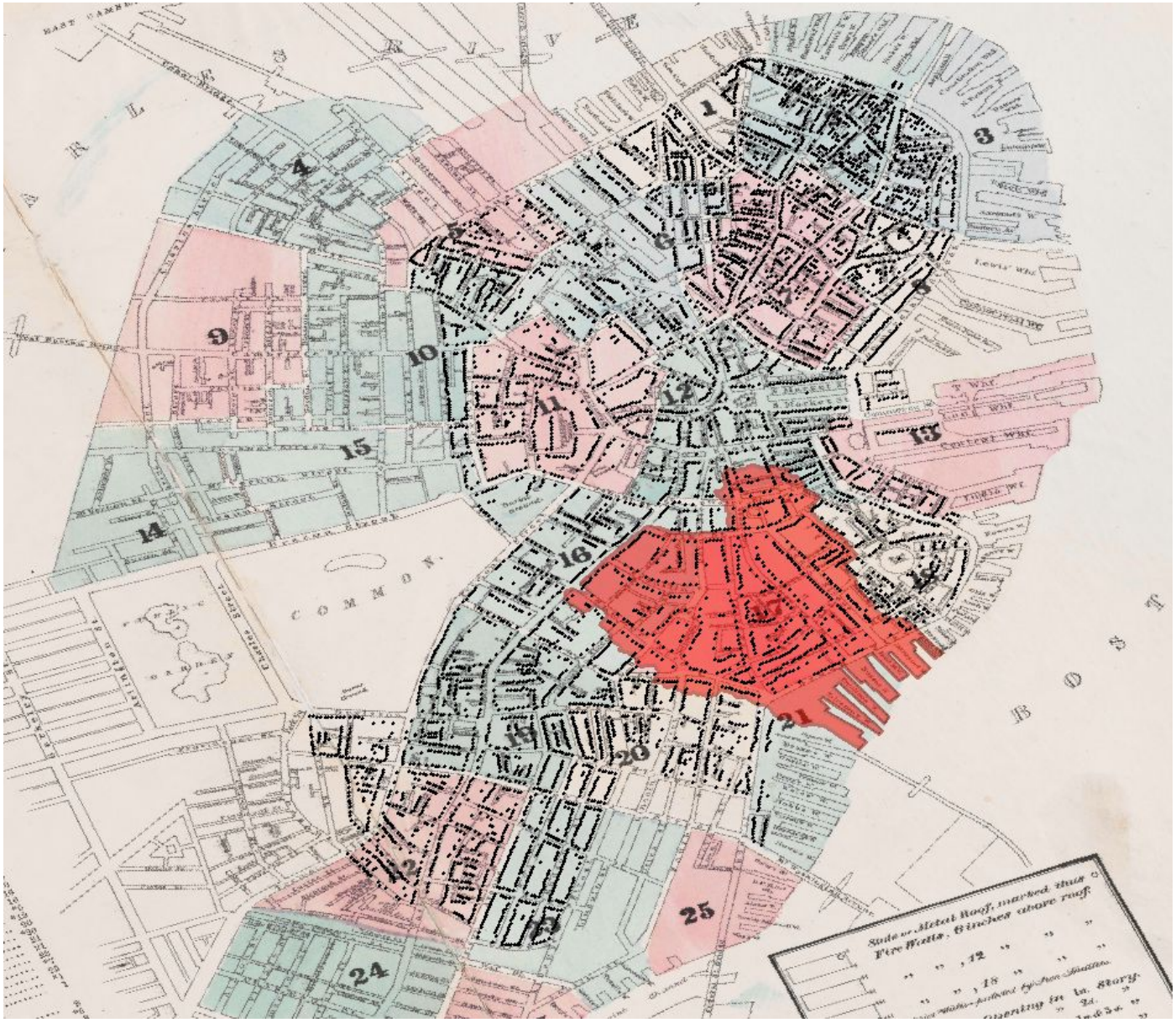
- High urban density and flammable building materials
- Delayed deployment of fire-fighting resources

Why did the fire stop?

- Arrival of massive fire-fighting resources
- No previous discontinuity at burned boundary



Burned Area of Boston, 1872



Boston in 1872

Background: Reconstruction of Boston

Rapid reconstruction

- Inflow of private capital
- Insurance payouts covered half the damages
- Pre-empted major changes in plots and roads

Key features of the Boston context

- Strong demand for Boston real estate
- No zoning regulations
- No change in building codes

Connection to related research

- Fire impacts (Rosen 1986, Siodla 2013, Siodla 2014)
- Urban renewal (Jacobs 1961, Collins and Shester 2013)
- Boundaries (Libecap and Lueck 2011, Brooks and Lutz 2012)

Theory Roadmap

1. Baseline Model with Durable Buildings
   - Why there may only *appear* to be benefits
2. Extended Model with Neighborhood Externalities
   - Why there may *actually* be benefits
3. Other Potential Mechanisms
   - Plot Consolidation
   - Industry Agglomeration
   - Public Goods

Baseline Model: Setup

Durable buildings in a growing city

- City wealth w_t grows over time
- Landowners build quality q buildings, convex cost $c(q)$
- Buildings generate rent $r(q, w_t)$ and $\frac{\partial^2 r(q,w_t)}{\partial q \partial w_t} > 0$
- Buildings must be replaced with probability d

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Landowners replace buildings following Bellman equation:

$$V(q, w_t) = \max \begin{cases} r(q, w_t) + \beta \mathbb{E}_{w_{t+1}} [V(q, w')] \\ r(q^*, w_t) + \beta \mathbb{E}_{w_{t+1}} [V(q^*, w')] - c(q^*) \end{cases}$$

where q^* maximizes: $r(q, w_t) + \beta \mathbb{E}_{w_{t+1}} [V(q, w')] - c(q)$

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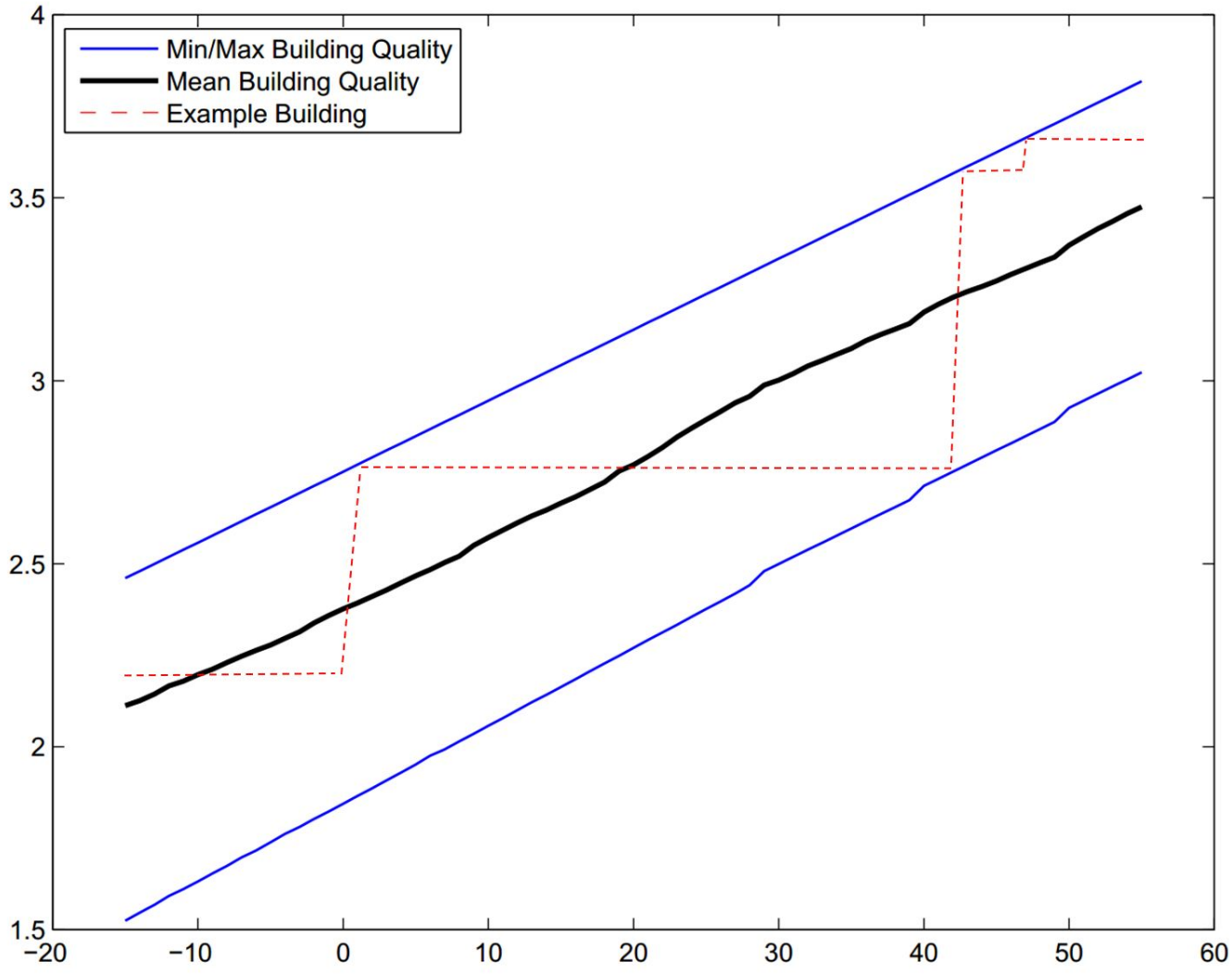
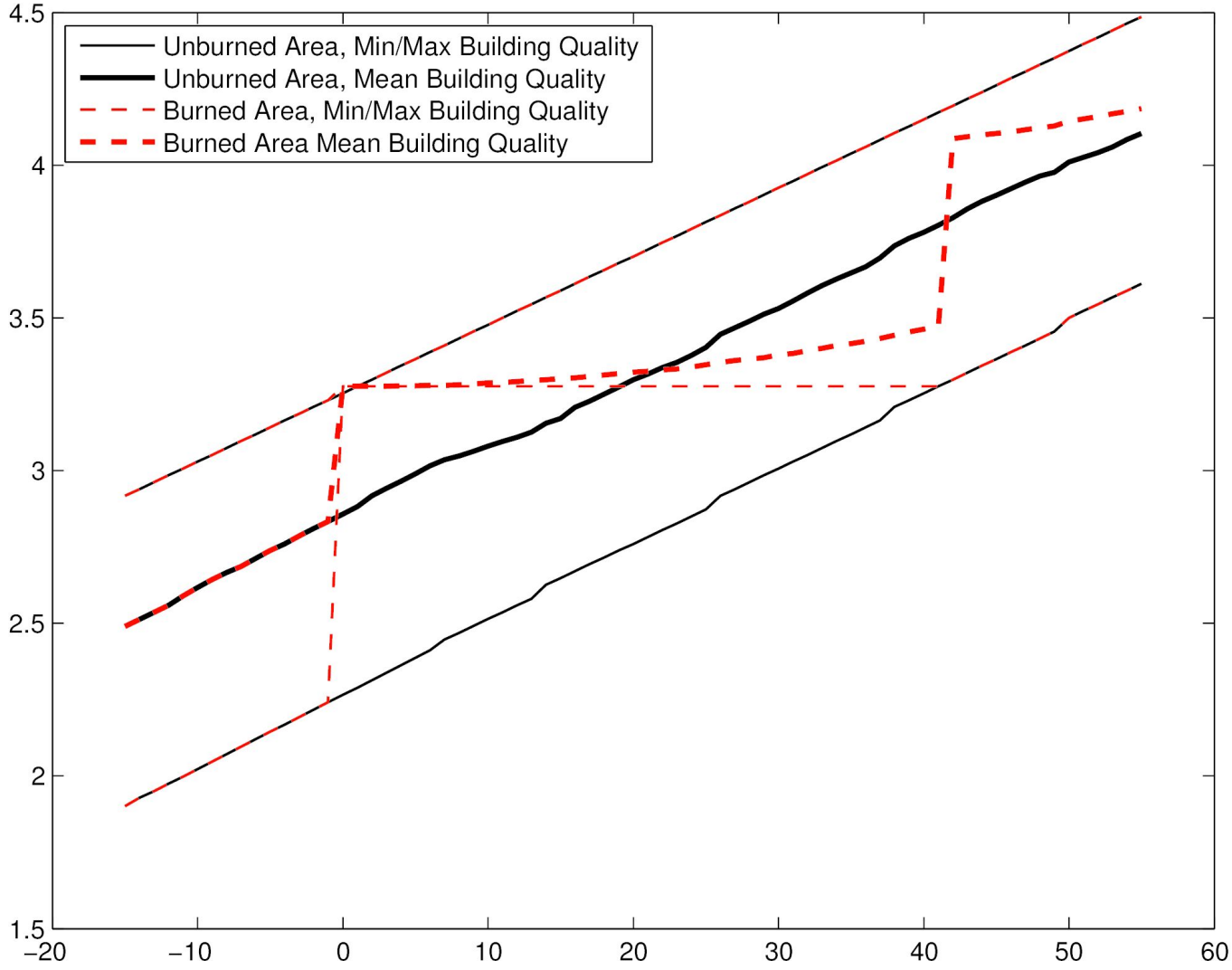
Numerical example:

- $r(q, w) = q^{0.5} w^{0.5}$; $c(q) = 3q^2$
- City growth rate (0.06); discount factor (0.9); replacement probability (0.01)



Simulated Steady-State Evolution of the Building Quality Distribution, Benchmark Model



Benchmark Model: Burned and Unburned Areas after a Great Fire in Period 0

Baseline Model: Testable Predictions

1. Land values, $V(0, w_t)$, unchanged
2. Increased building values, convergence over time
3. Impact on building values decreasing in quantile, zero at highest quantiles
4. Great Fire has the same impact on building value as individual building fires
5. Building values unaffected in unburned areas

Extended Model: Neighborhood Externalities

Building rent increasing in neighboring building quality

- $r(q, Q, w) = q^{0.5}(Q^{0.8}w^{0.2})^{0.5}$
- Returns to own building quality increasing in neighborhood quality $\frac{\partial^2 r(q_i,Q,w)}{\partial q \partial Q} > 0$
- Owners take neighborhood quality as given

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$$q^* = \arg\max_q \left\{ r(q^*, Q, w) + \beta \mathbb{E}\left[V\left(q', Q', w'\right) - c(q^*) \right] \right\}$$

$$Q = \{q_1, \ldots q_N\} \text{ where } N \text{ is the number of neighboring buildings}$$

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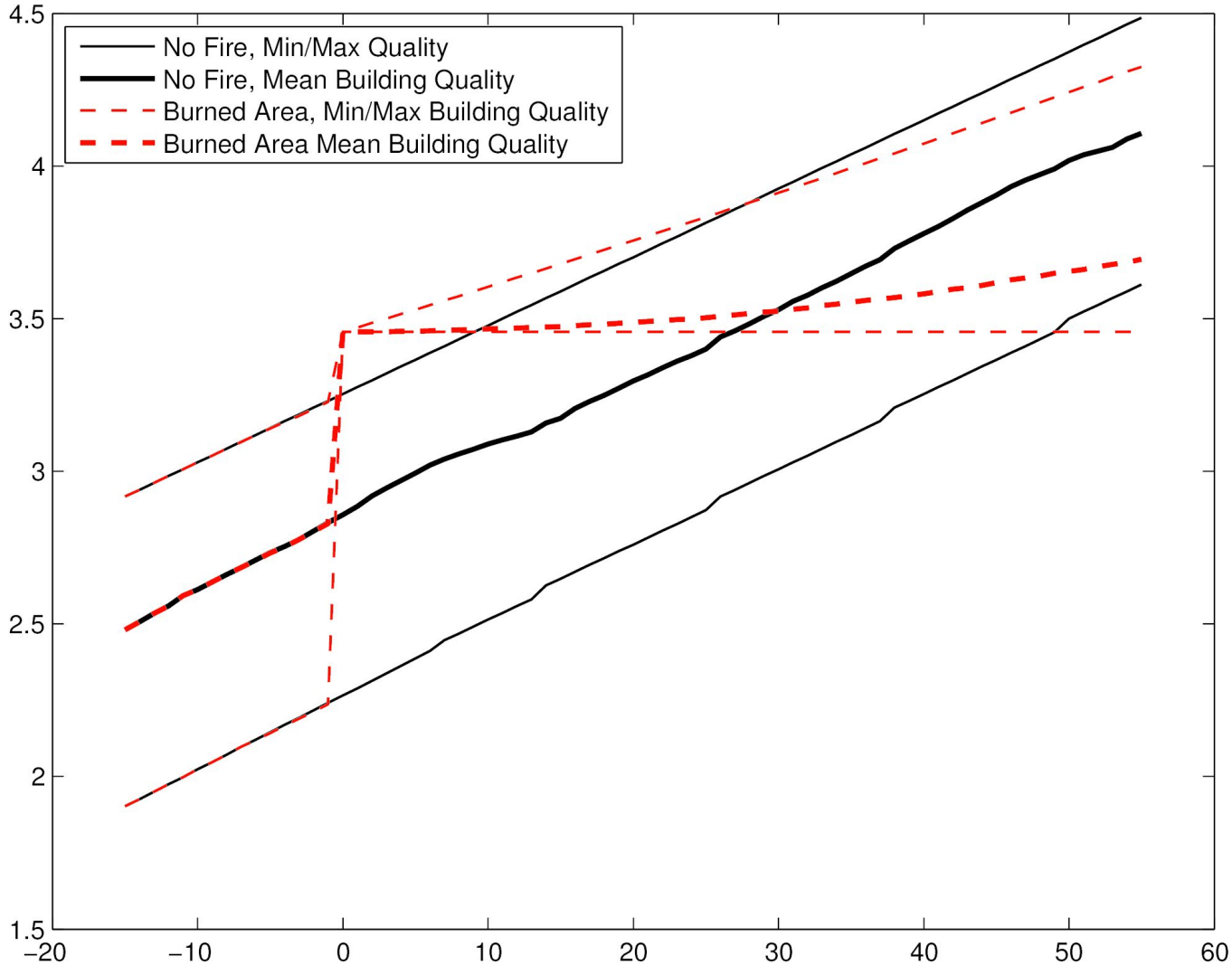
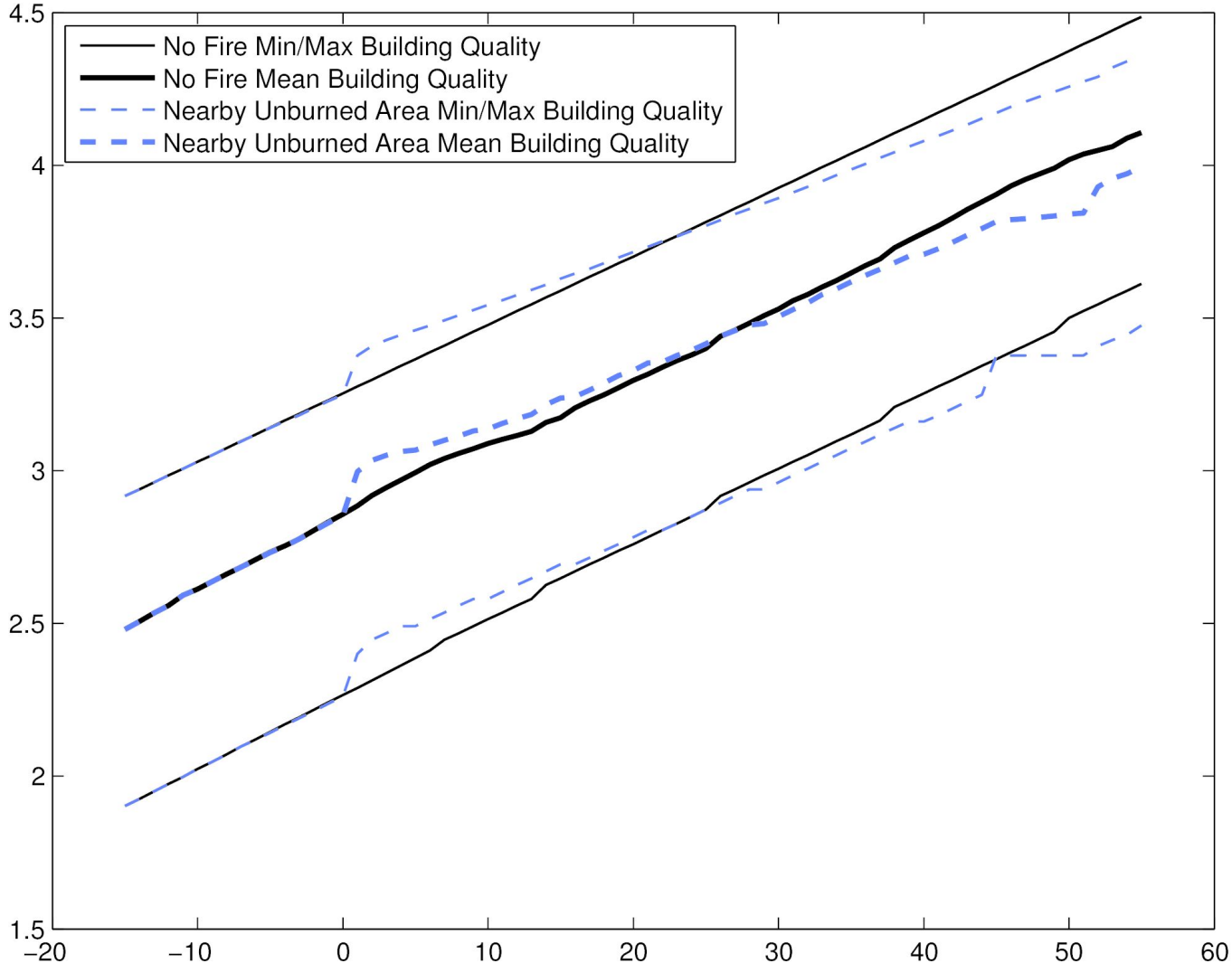
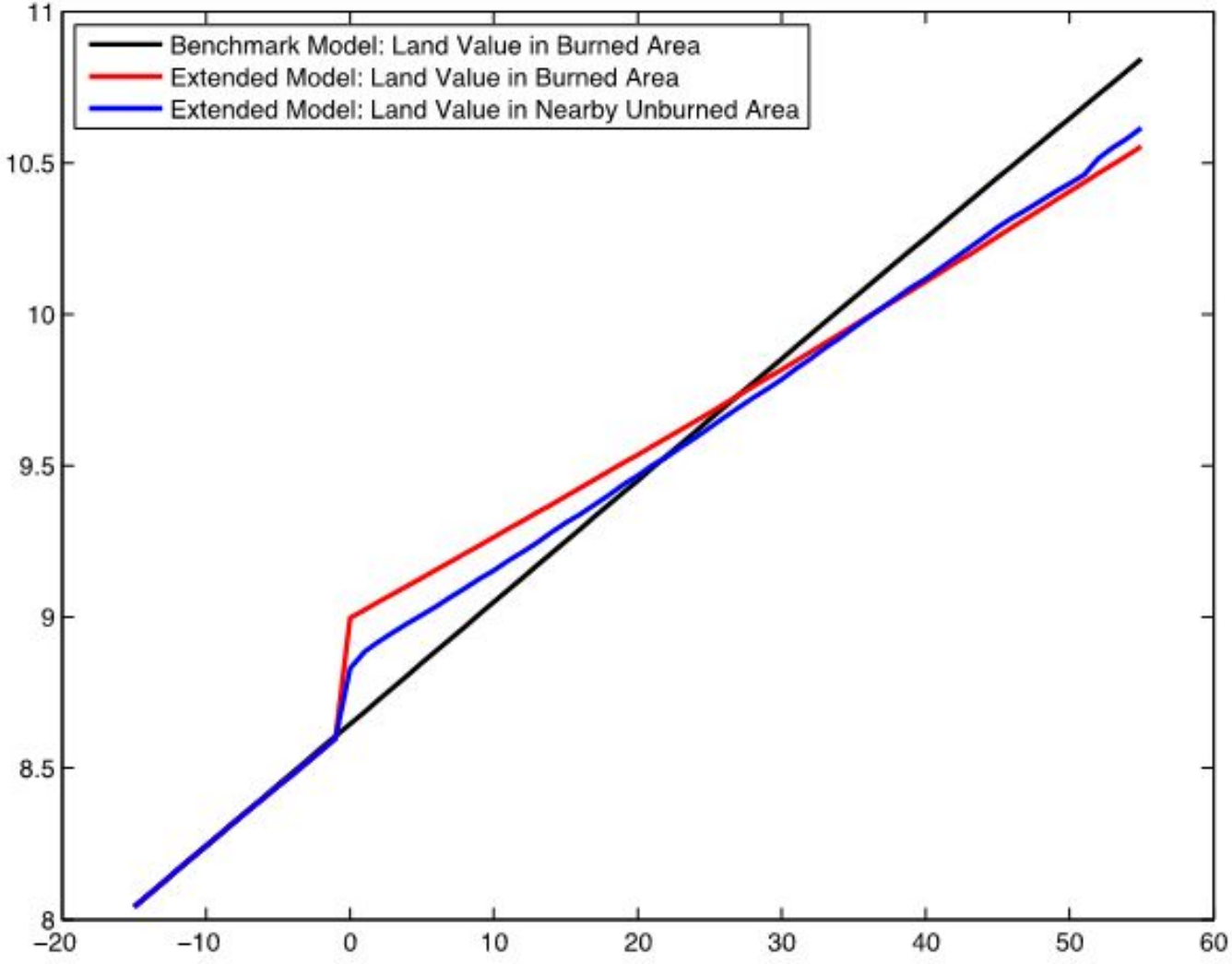
Fire provokes widespread and simultaneous reconstruction



Extended Model: Burned Area after a Great Fire in Period 0



Extended Model: Nearby Unburned Area after a Great Fire in Period 0



Land Value after a Great Fire

Extended Model: Testable Predictions

1. Land values increase temporarily in burned area and nearby unburned areas, convergence and switching as rigidities emerge again

2. Building values increase in burned area and (with some delay) in nearby unburned areas, convergence over time

3. Buildings rebuilt to higher quality than in unburned areas. Impact on building values decreasing in quantile, positive at highest quantiles

4. Building values increase more than after isolated fire

Other Potential Mechanisms

Plot Consolidation

- Returns to plot size
- Fire may remove rigidities in combining plots
- Plot consolidation after the fire, ownership concentration

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Industry Agglomeration

- Returns to agglomeration
- Fire reduces costs of moving and coordination
- Predict clustering of industries with agglomeration spillovers

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Public Goods

- Fire lowers construction costs (physical or political)
- Long-term improvements if fire presents unique opportunity

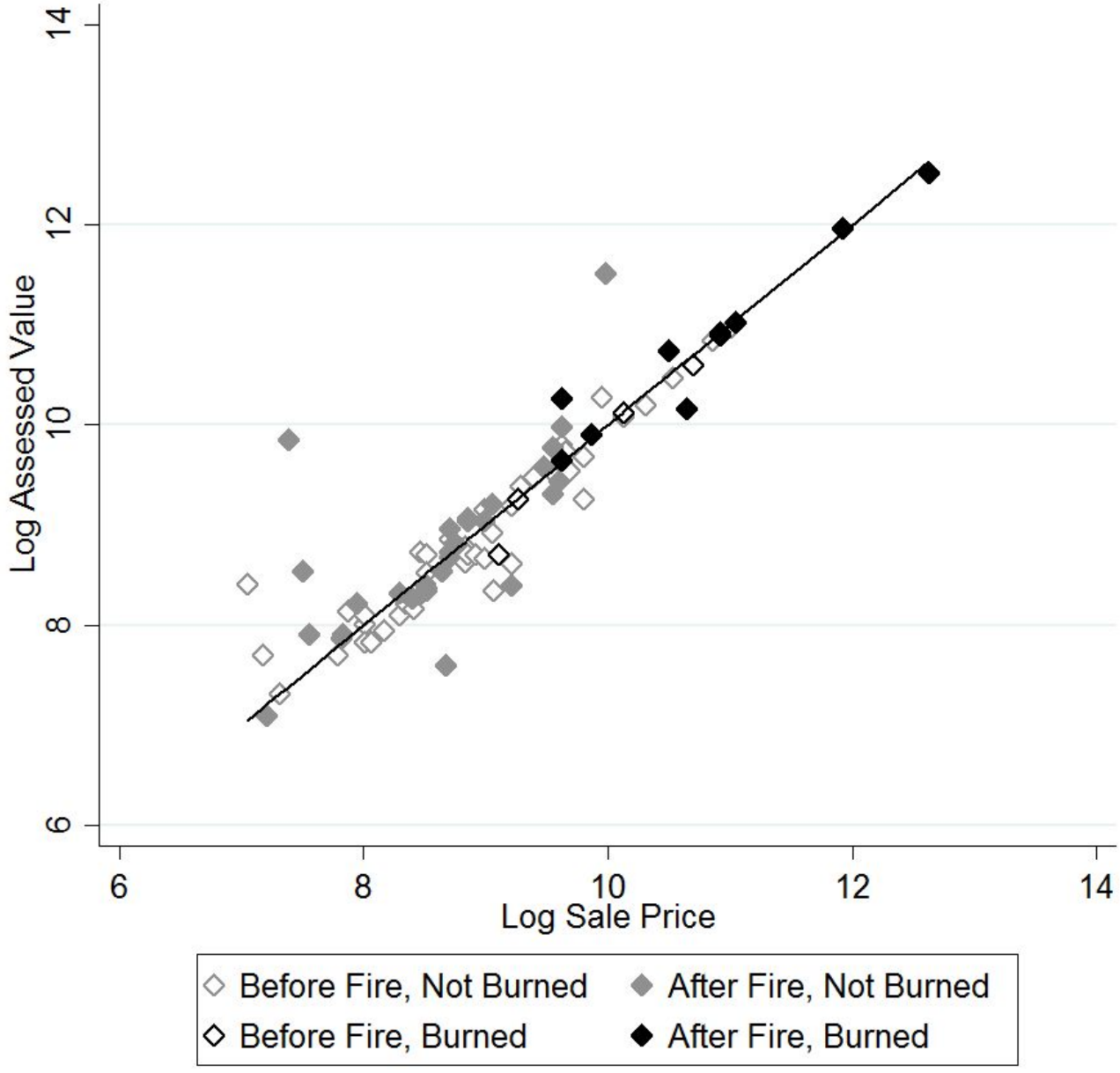
Data Construction

Annual property tax assessment ledgers

- Sampled years: 1867, 1872, 1873, 1882, 1894
- Sampled area: burnt zone and much of Boston

Real estate transactions (Registry of Deeds)

- Comparison to assessed valuations
- Before/after fire, inside/outside burned area



Plot Assessed Value vs. Plot Sale Price

Appendix Table 1. Average Log Sale Value Minus Log Assessed Value

	After Fire: 1882 and 1894 (2)	Before Fire: 1867 and 1872 (1)	Difference: (2) - (1) (3)
Burned Area	-0.042	0.083	-0.125
	[0.297]	[0.162]	(0.119)
Unburned Area	-0.143	0.030	-0.173
	[0.631]	[0.312]	(0.124)
Difference	0.102	0.054	0.048
	(0.151)	(0.078)	(0.169)

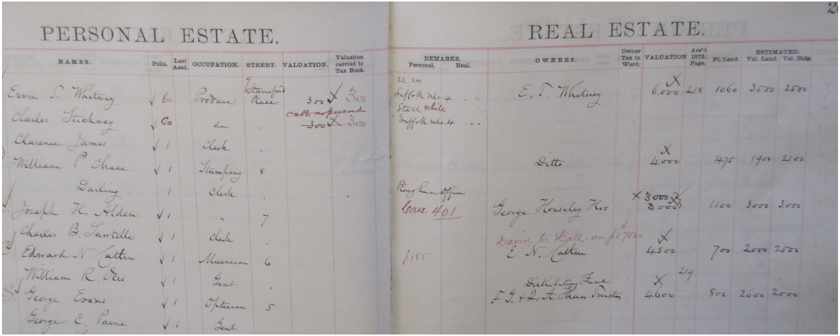
Data Construction

Data by street address

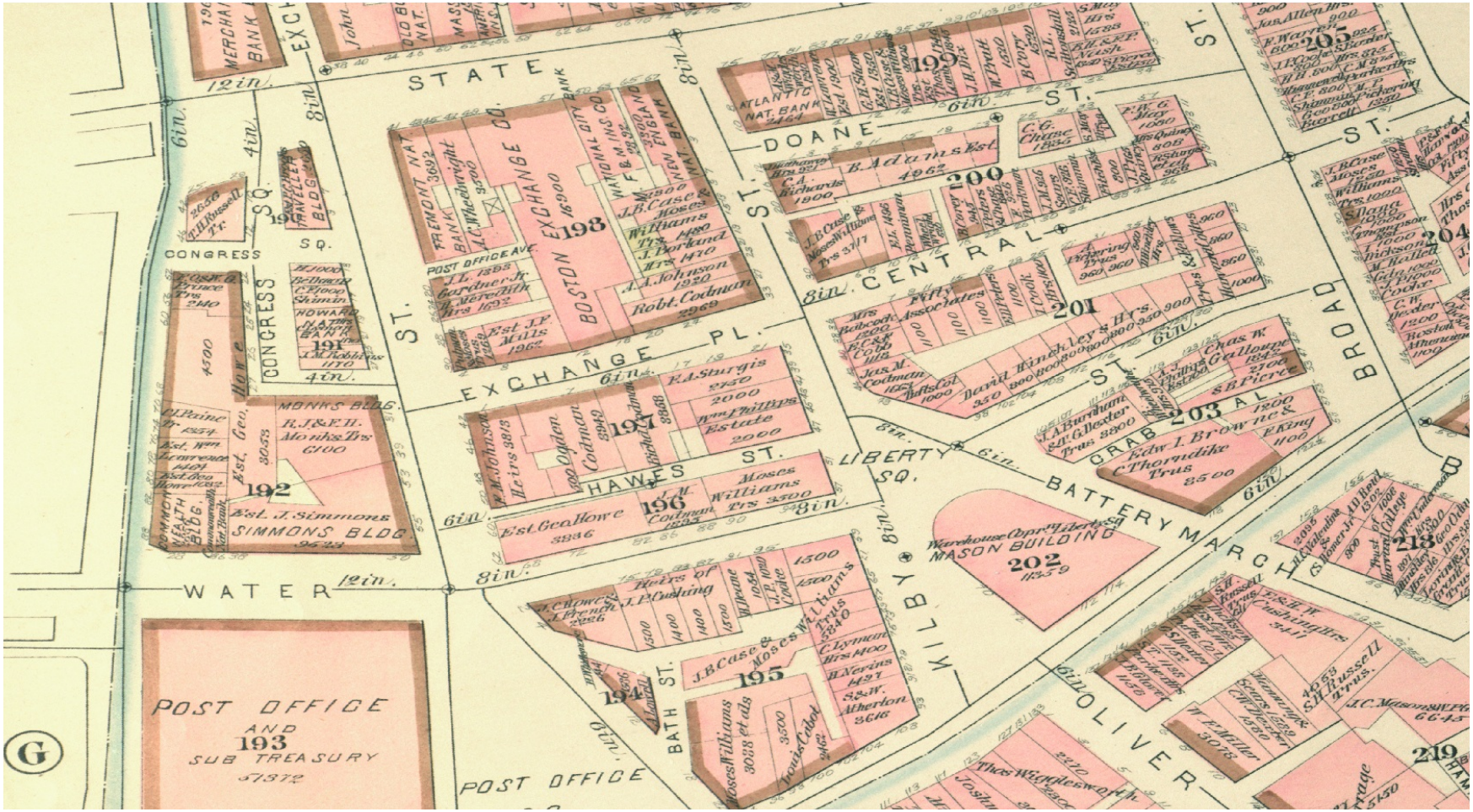
- Building variables:
  - Value of building, value of land, plot size
  - Owner name
- Occupant variables
  - Residential: capital (occupation, resident name)
  - Commercial: detailed industry, capital (proprietor name)

Locate buildings on historical plot-level maps

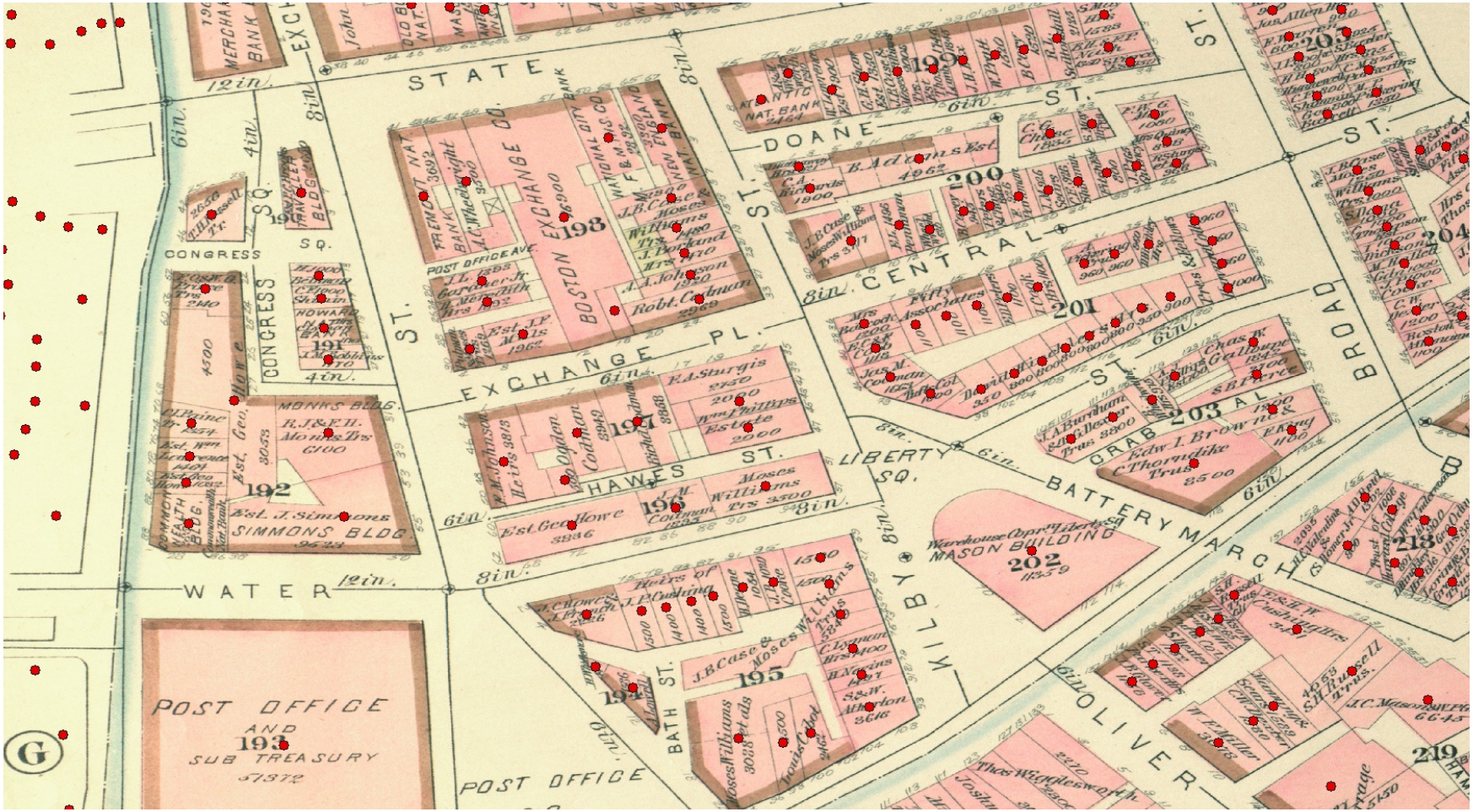
- Merge using address, owner name, plot size
- Plot boundaries can change over time



Tax Assessment Ledgers



Plot-Level Maps of Boston



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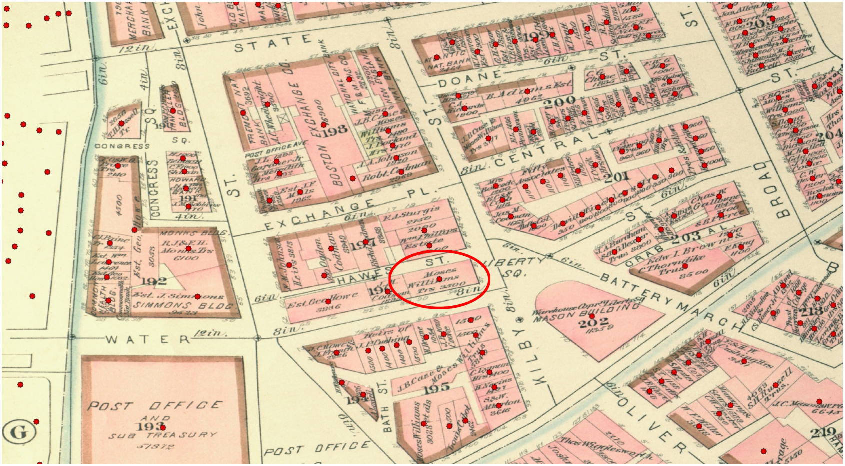
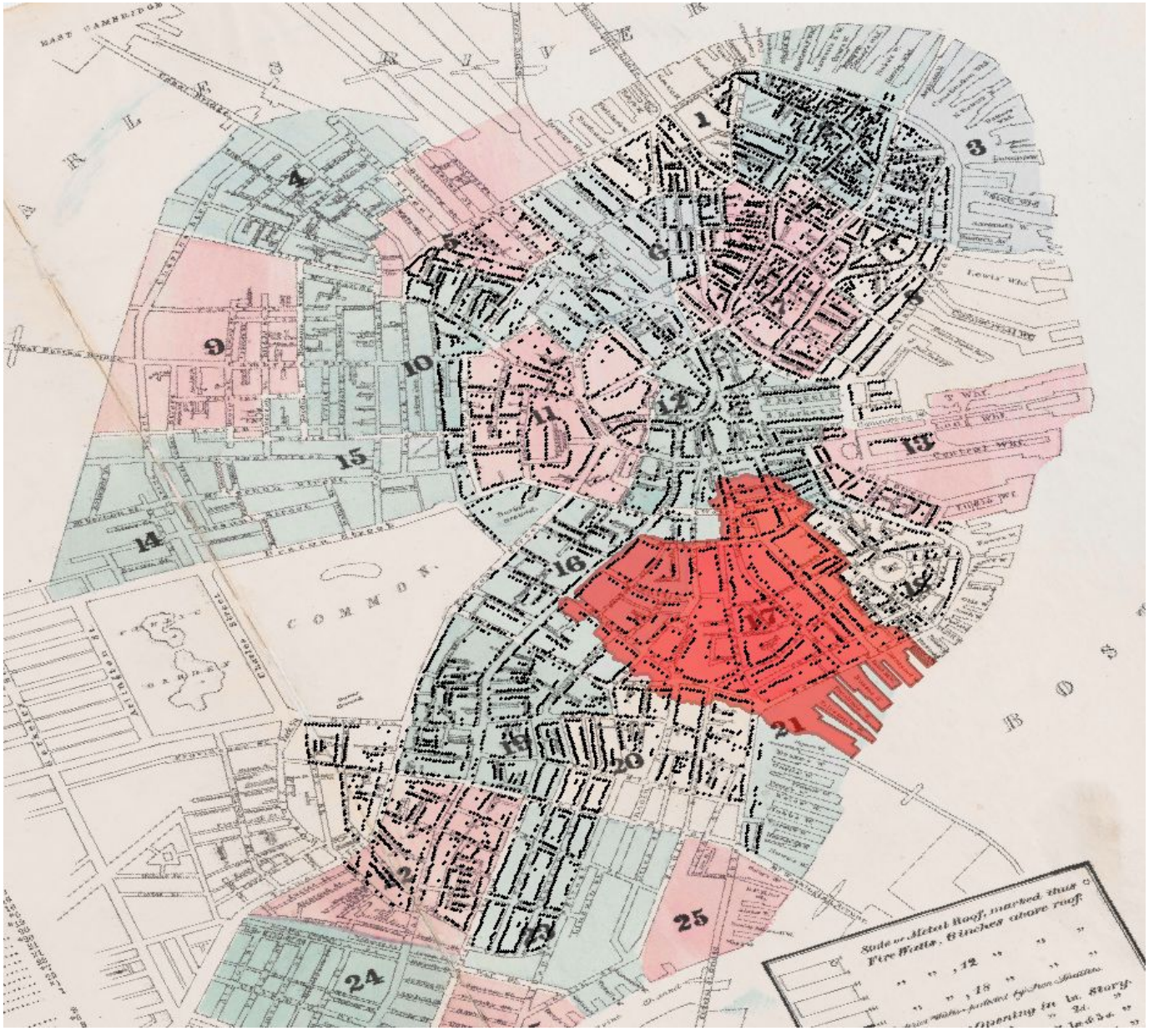


Plot-Level Maps of Boston

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
6392	1882	6	2	405	9	70192	Congress	48	Francis M Johnson Heirs		309	Louis							
6393	1882	6	2	405	10	70193	Congress	48	Francis M Johnson Heirs		309	Louis							
6394	1882	6	2	405	11	70194	Congress	48	Francis M Johnson Heirs		309	Louis							
6395	1882	6	2	405	12	70195	Congress	42	Francis M Johnson Heirs		309	Louis							
6396	1882	6	2	405	13	70196	Exchange Pl	7	Ogden Codman	3949	310	Louis							
6397	1882	6	2	405	14	70197	Exchange Pl	7	Ogden Codman		310	Louis							
6398	1882	6	2	405	15	70198	Exchange Pl	7	Ogden Codman		310	Louis							
6399	1882	6	2	406	1	70200	Exchange Pl	11	Richard Codman	3858	311	Louis							
6400	1882	6	2	406	2	70201	Exchange Pl	11	Richard Codman		311	Louis							
6401	1882	6	2	406	3	70202	Exchange Pl	11	Richard Codman		311	Louis							
6402	1882	6	2	406	4	70203	Kilby St	55	Moses Williams	3500	312	Louis							
6403	1882	6	2	406	5	70204	Kilby St	55	Moses Williams		312	Louis							
6404	1882	6	2	406	6	70205	Kilby St	55	Moses Williams		312	Louis							
6405	1882	6	2	406	7	70206	Water	88	Moses Williams		312	Louis							
6406	1882	6	2	406	8	70207	Water	90	Moses Williams		312	Louis							
6407	1882	6	2	406	9	70208	Water	82	James M Codman	1895	313	Louis							
6408	1882	6	2	406	10	70209	Water	72	George D Howe and Samuel Johnson	3836	314	Louis							
6409	1882	6	2	406	11	70210	Congress	60	George D Howe and Samuel Johnson		314	Louis							
6410	1882	6	2	406	12	70211	Congress	60	George D Howe and Samuel Johnson		314	Louis							
6411	1882	6	2	406	13	70212	Congress	60	George D Howe and Samuel Johnson		314	Louis							
6412	1882	6	2	407	1	70214	Kilby St	59	Moses Williams	1500	316	Louis							
6413	1882	6	2	407	2	70215	Kilby St	63	Moses Williams	1500	317	Louis							
6414	1882	6	2	407	3	70216	Kilby St	63	Moses Williams		317	Louis							
6415	1882	6	2	407	4	70217	Kilby St	69	Moses Williams	5840	318	Louis							
6416	1882	6	2	407	5	70218	Kilby St	73	Moses Williams		318	Louis							
6417	1882	6	2	407	6	70219	Kilby St	75	Charles Lyman Heirs	1400	319	Louis							
6418	1882	6	2	407	7	70220	Kilby St	75	Charles Lyman Heirs		319	Louis							
6419	1882	6	2	407	8	70221	Kilby St	75	Charles Lyman Heirs		319	Louis							
6420	1882	6	2	407	9	70222	Kilby St	75	Charles Lyman Heirs		319	Louis							
6421	1882	6	2	407	10	70223	Kilby St	75	Charles Lyman Heirs		319	Louis							
6422	1882	6	2	407	11	70224	Kilby St	75	Charles Lyman Heirs		319	Louis							
6423	1882	6	2	407	12	70225	Kilby St	75	Charles Lyman Heirs		319	Louis							
6424	1882	6	2	407	13	70226	Kilby St	75	Charles Lyman Heirs		319	Louis							
6425	1882	6	2	407	14	70227	Kilby St	75	Charles Lyman Heirs		319	Louis							
6426	1882	6	2	407	15	70228	Kilby St	75	Charles Lyman Heirs		319	Louis							
6427	1882	6	2	407	16	70229	Kilby St	75	Charles Lyman Heirs		319	Louis							
6428	1882	6	2	408	1	70231	Kilby St	77	Charles Lyman Heirs		319	Louis							

Data Entry Spreadsheet



Plot Locations in 1872

Data Construction

Geographic information on the Great Fire

- Burned area
- Distance to the Fire boundary

Individual building fire records (all fire department calls)

- Address
- Damages, amount insured
- Cause of fire

Empirical Specifications

Create a balanced panel of locations, rather than plots

- Locations in burned area vs. unburned area
- Locations by distance to fire boundary

Control for plot characteristics, assigned by location

- Block-level averages from 1867 and 1872
- Nearest neighbor characteristics from 1867 and 1872

Table 1. Plot Values in 1872, and Differences in the Burned Area

			Differences in Logs: Burned vs. Unburned			Differences in Logs: Burned vs. Restricted	
	Burned Area (1)	Unburned Area (2)	Difference in 1872: (1) - (2) (3)	Difference in Changes: 1867 to (4)	Restricted Unburned Area (5)	Difference in 1872: (1) - (3) (6)	Difference in Changes: 1867 to (7)
Land Value per Square Foot	$13.95 (6.77)	$8.44 (8.83)	0.774*** (0.084)	-0.174*** (0.041)	$14.69 (11.32)	0.087 (0.093)	-0.165*** (0.045)
Building Value per Square Foot	$7.48 (4.35)	$4.14 (3.77)	0.733*** (0.097)	0.182 (0.120)	$5.94 (4.75)	0.246** (0.106)	0.136 (0.127)
Number of Plots	580	6013			1837		
Total Plot Area	1,724,877	10,642,991			3,753,481		

Empirical Specifications

Baseline specification:

$$\begin{aligned} Y_{it} &= \alpha_t + \rho \mathbb{I}_i^{fire} + \beta_{1867} \mathbb{I}_i^{fire} \times \mathbb{I}_t^{1867} \\ &+ \beta_{1873} \mathbb{I}_i^{fire} \times \mathbb{I}_t^{1873} + \beta_{1882} \mathbb{I}_i^{fire} \times \mathbb{I}_t^{1882} + \beta_{1894} \mathbb{I}_i^{fire} \times \mathbb{I}_t^{1894} + \varepsilon \end{aligned}$$

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Specification with additional pre-Fire controls:

$$\begin{aligned} Y_{it} &= \alpha_t + \eta_t \bar{Y}_{i1867}^{block} + \gamma_t \bar{Y}_{i1872}^{block} + \mu_t \bar{Y}_{i1867}^{near} + \gamma_t \bar{Y}_{i1872}^{near} \\ &+ \beta_{1873} \mathbb{I}_i^{fire} \times \mathbb{I}_t^{1873} + \beta_{1882} \mathbb{I}_i^{fire} \times \mathbb{I}_t^{1882} + \beta_{1894} \mathbb{I}_i^{fire} \times \mathbb{I}_t^{1894} + \varepsilon \end{aligned}$$

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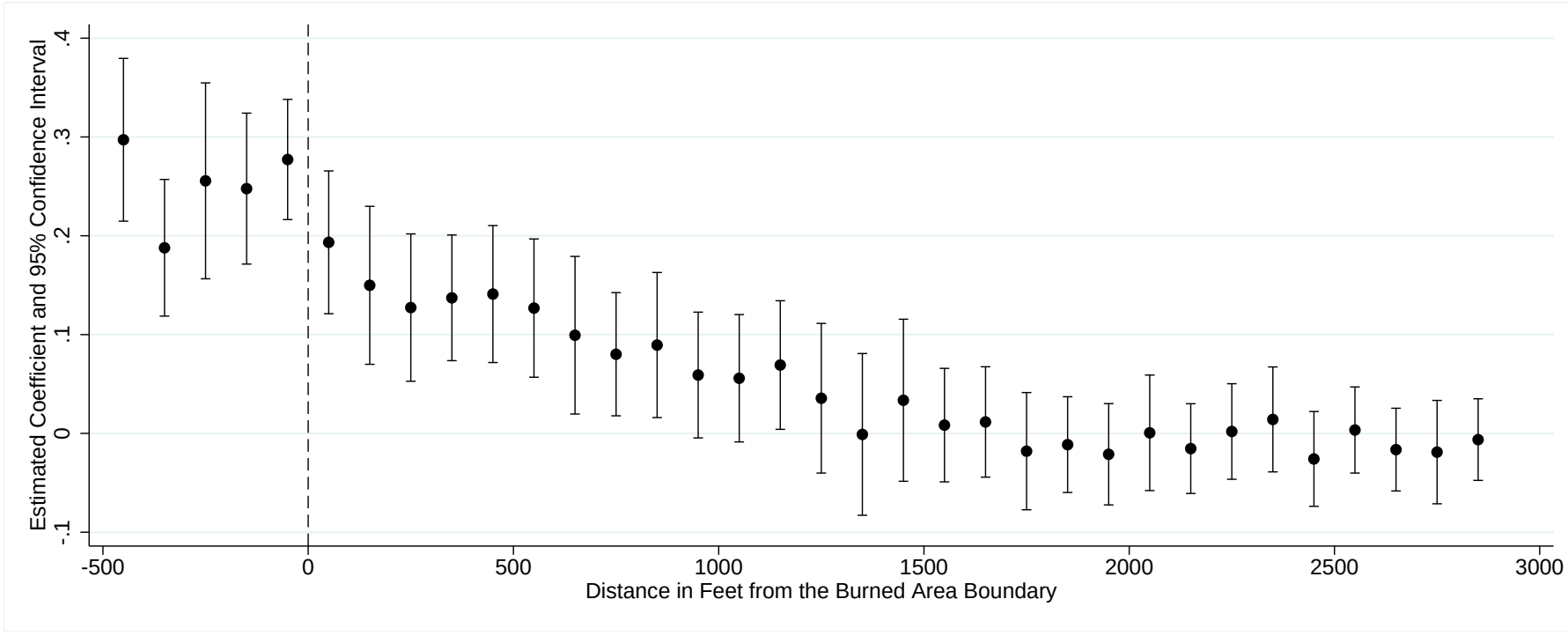
Estimation notes:

- Clustering within blocks
- Potential cross-building spatial correlation
- Weight analysis by plot size

Table 2. Estimated Impact on Land Values in Burned Area, Relative to 1872

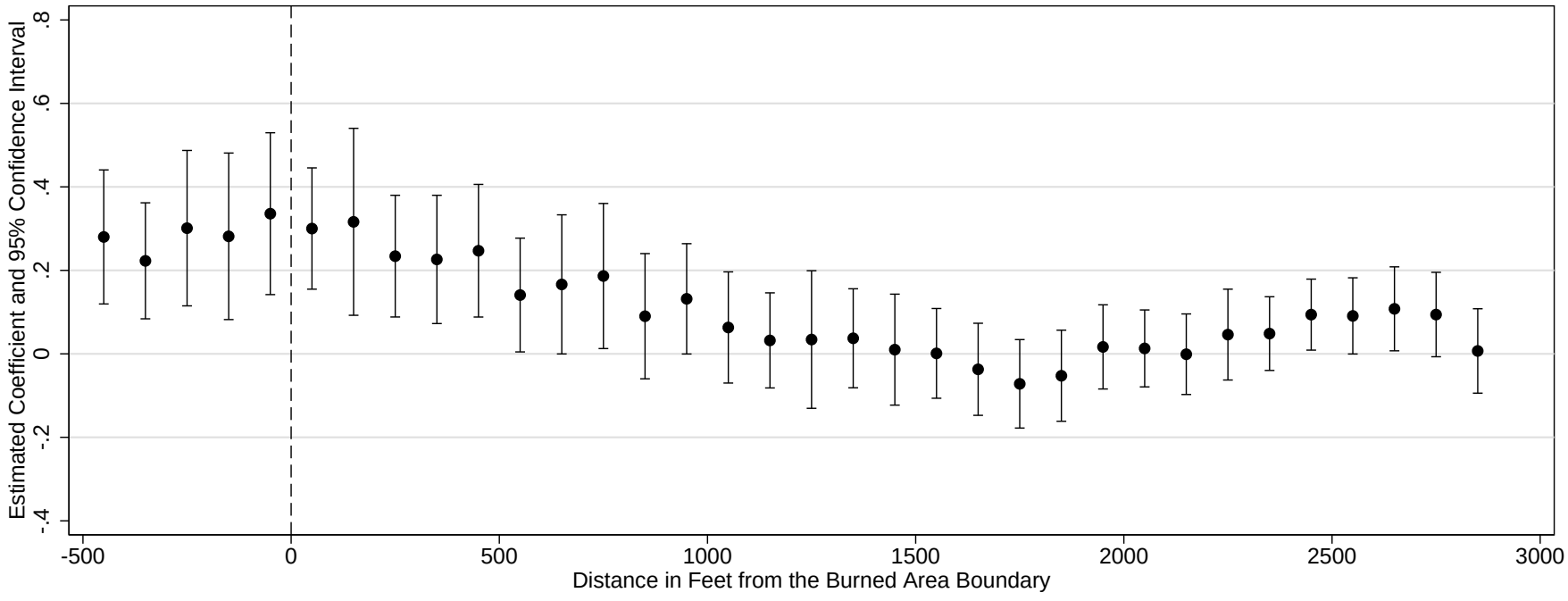
	Log Value of Land per Square Foot							
	Full Sample				Restricted Sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1867 x Burned	0.174***	0.019	-	-	0.165***	0.016	-	-
	(0.041)	(0.013)	( )	( )	(0.045)	(0.014)	( )	( )
1872 x Burned	0	0	0	0	0	0	0	0
	( )	( )	( )	( )	( )	( )	( )	( )
1873 x Burned	0.149***	0.169***	0.168***	0.172***	0.125***	0.124***	0.131***	0.133***
	(0.020)	(0.020)	(0.017)	(0.018)	(0.023)	(0.022)	(0.020)	(0.021)
1882 x Burned	0.157***	0.137***	0.139***	0.144***	0.059	0.073	0.052	0.083*
	(0.043)	(0.044)	(0.040)	(0.042)	(0.049)	(0.049)	(0.044)	(0.046)
1894 x Burned	-0.102*	-0.147**	-0.172***	-0.145**	-0.250***	-0.196***	-0.234***	-0.188**
	(0.056)	(0.061)	(0.056)	(0.060)	(0.069)	(0.073)	(0.067)	(0.073)
Controls:								
Year Fixed Effects	X	X	X	X	X	X	X	X
Year FE x Pre-Fire Block Average		X		X		X		X
Year FE x Pre-Fire Neighbor Value			X	X			X	X
R-squared	0.153	0.797	0.934	0.938	0.116	0.689	0.885	0.888
Number of Plots	31302	31302	31302	31302	11367	11367	11367	11367



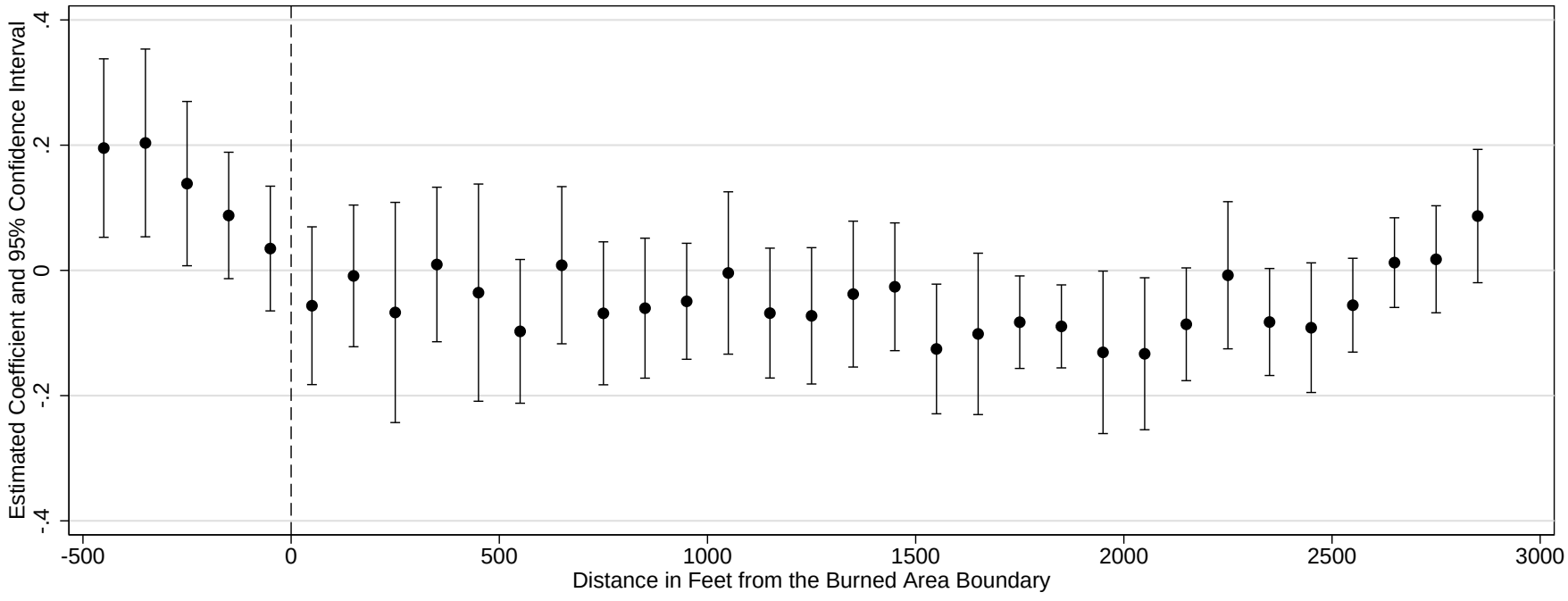
Estimated Changes in Land Value from 1872 to 1873, by Distance to the Fire Boundary (in Feet)

Table 3. Estimated Total Impact of Fire on Land Values in 1873 and 1882

	Distance Cutoff (1)	Impact in $1000's of 1872 Dollars: Burned Area (2)	Unburned Area (3)	Total Impact (4)	Ratio of (4) to Burned Building Value (5)
In 1873:					
Panel A. Estimated Cutoff	1,394	5,545	9,666	15,211	1.18
	(125)	(536)	(1,150)	(1,632)	(0.13)
Panel B. 1149 Foot Cutoff	1,149	5,305	8,039	13,343	1.03
	( )	(502)	(728)	(1,229)	(0.10)
Panel C. 1639 Foot Cutoff	1,639	5,735	11,133	16,869	1.31
	( )	(535)	(994)	(1,529)	(0.12)
In 1882:					
Panel D. Estimated Cutoff	1,412	7,236	12,561	19,797	1.53
	(189)	(1,313)	(2,562)	(3,781)	(0.29)
Panel E. 1040 Foot Cutoff	1,040	6,749	9,408	16,157	1.25
	( )	(1,287)	(1,714)	(3,001)	(0.23)
Panel F. 1784 Foot Cutoff	1,784	7,376	14,894	22,270	1.73
	( )	(1,328)	(2,572)	(3,899)	(0.30)



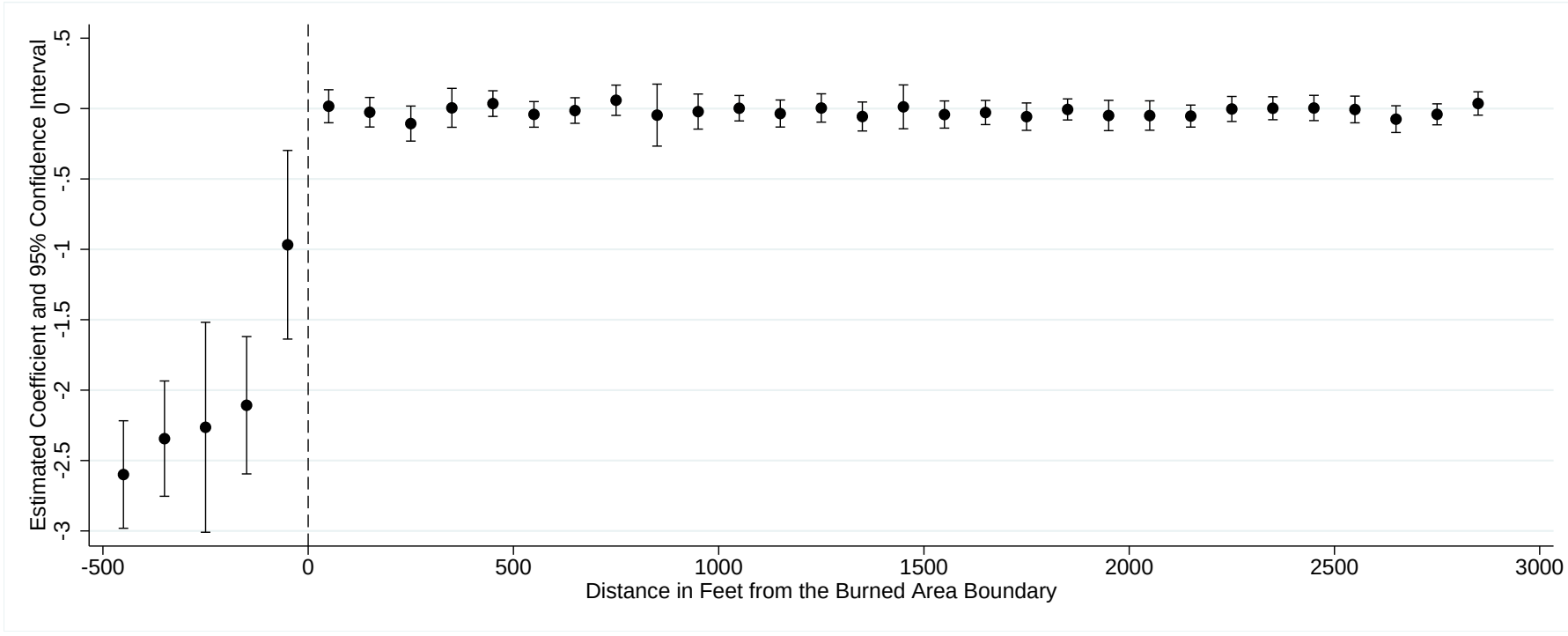
Estimated Changes in Land Value by Distance to the Fire Boundary (in Feet): Estimated Impact in 1882, Relative to 1872



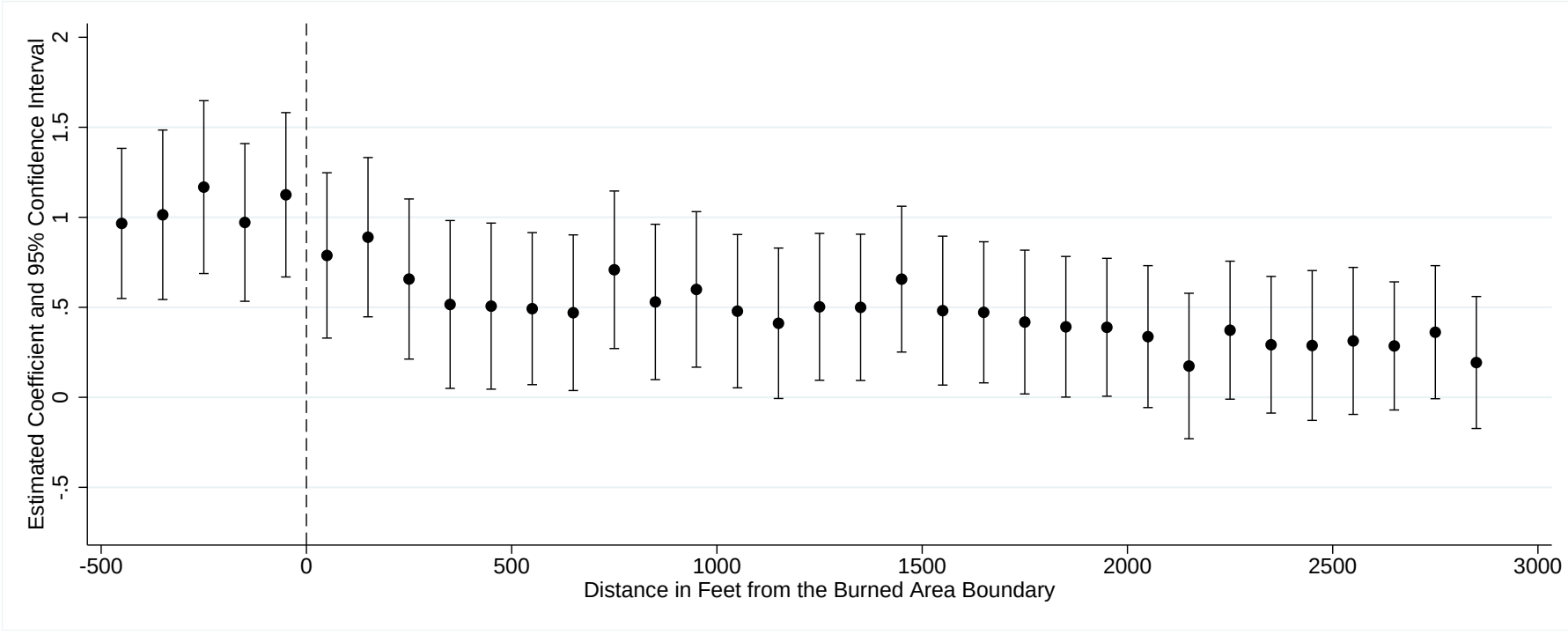
Estimated Changes in Land Value by Distance to the Fire Boundary (in Feet): Estimated Impact in 1867, Relative to 1872

Table 4. Estimated Impact on Building Values in Burned Area, Relative to 1872

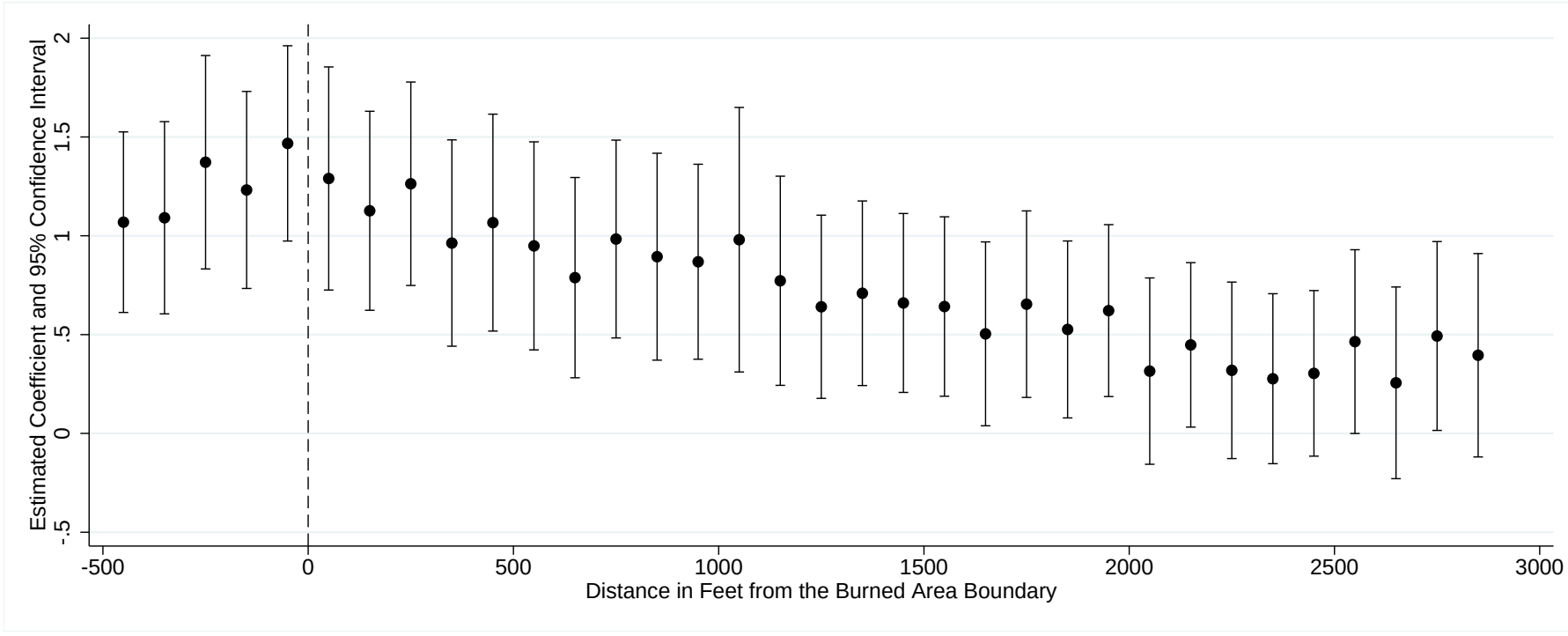
	Log Value of Building per Square Foot							
	Full Sample				Restricted Sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1867 x Burned	-0.182	-0.053	-	-	-0.136	-0.043	-	-
	(0.120)	(0.052)	( )	( )	(0.127)	(0.059)	( )	( )
1872 x Burned	0	0	0	0	0	0	0	0
	( )	( )	( )	( )	( )	( )	( )	( )
1873 x Burned	-1.803***	-1.881***	-1.961***	-2.016***	-1.800***	-1.890***	-1.965***	-2.011***
	(0.161)	(0.160)	(0.167)	(0.168)	(0.161)	(0.160)	(0.167)	(0.171)
1882 x Burned	0.401***	0.478***	0.637***	0.511***	0.357***	0.402***	0.493***	0.441***
	(0.067)	(0.069)	(0.056)	(0.055)	(0.070)	(0.066)	(0.050)	(0.049)
1894 x Burned	0.174**	0.371***	0.546***	0.410***	0.090	0.203**	0.274***	0.246***
	(0.078)	(0.087)	(0.068)	(0.080)	(0.089)	(0.081)	(0.066)	(0.069)
Controls:								
Year Fixed Effects	X	X	X	X	X	X	X	X
Year FE x Pre-Fire Block Average		X		X		X		X
Year FE x Pre-Fire Neighbor Value			X	X			X	X
R-squared	0.108	0.474	0.775	0.788	0.163	0.467	0.735	0.743
Number of Plots	30198	30198	30198	30198	10595	10595	10595	10595



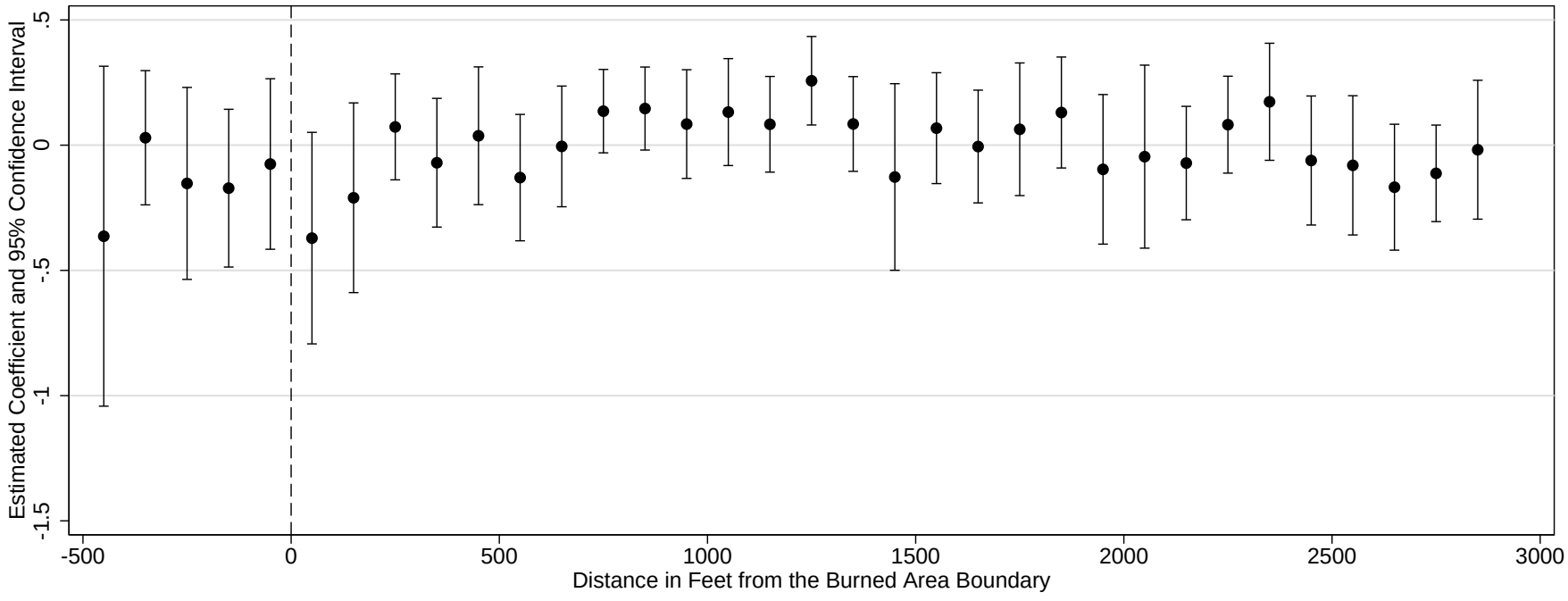
Estimated Changes in Building Value by Distance to the Fire Boundary (in Feet): Estimated Impact in 1873, Relative to 1872



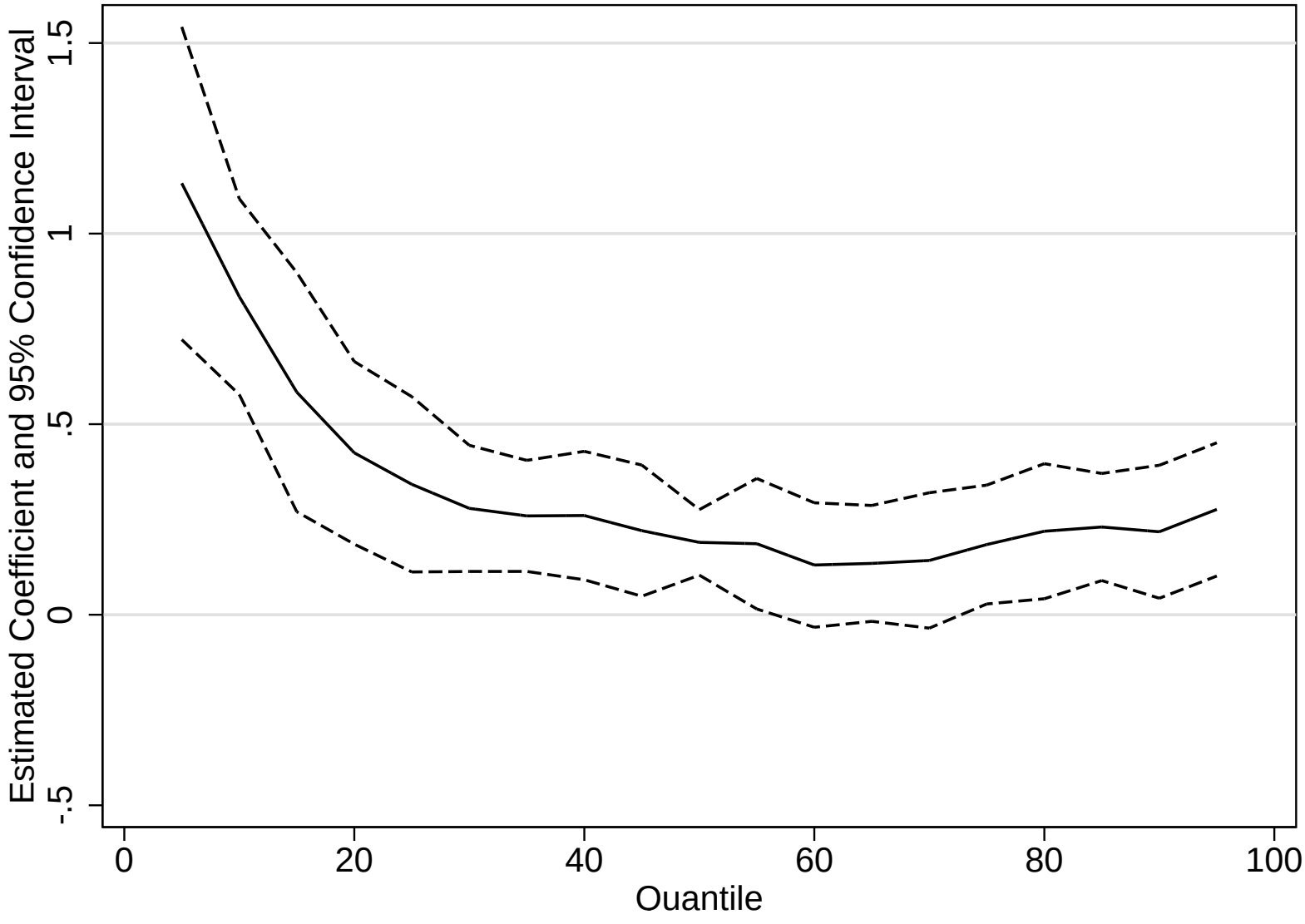
Estimated Changes in Building Value by Distance to the Fire Boundary (in Feet): Estimated Impact in 1882, Relative to 1872



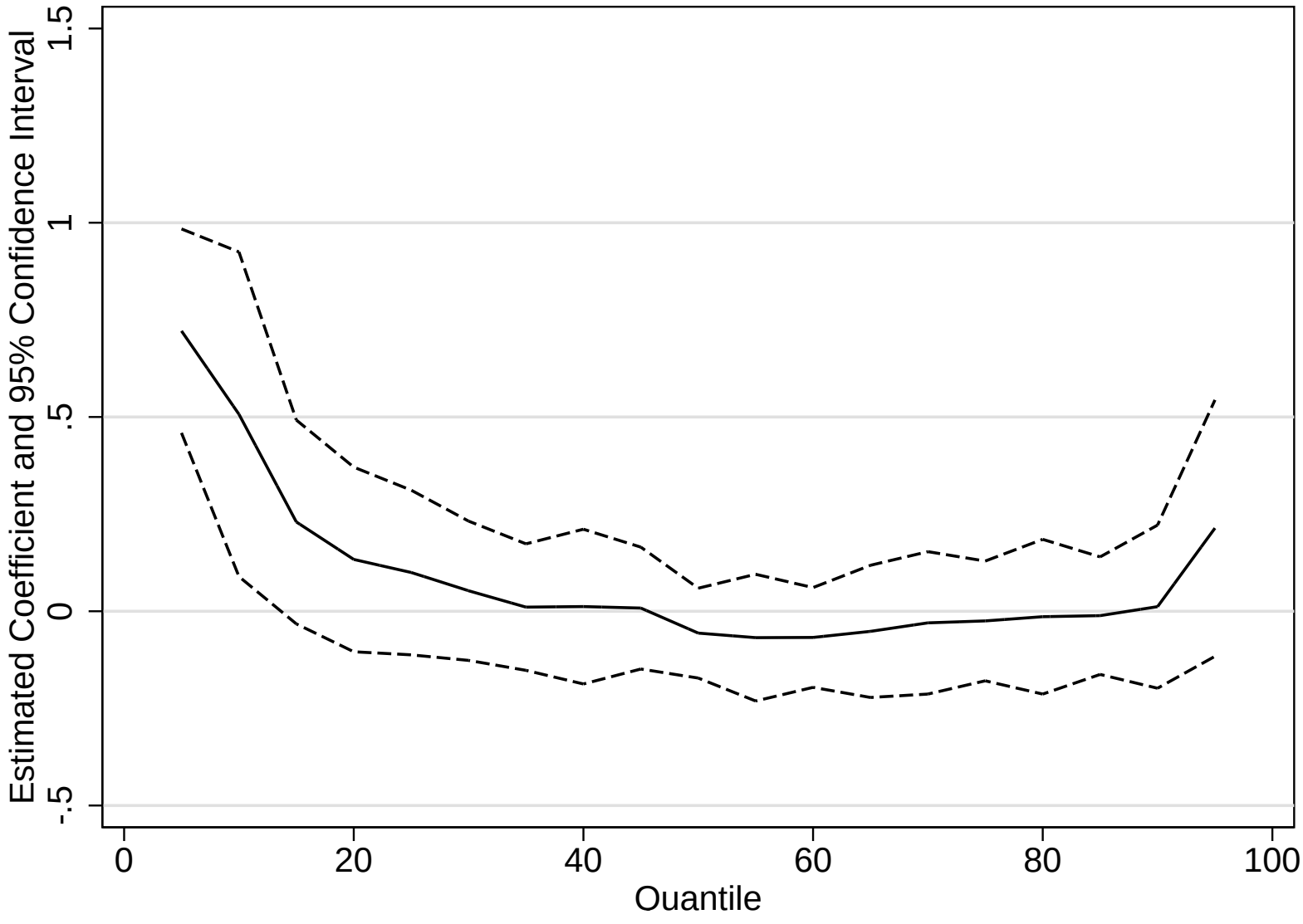
Estimated Changes in Building Value by Distance to the Fire Boundary (in Feet): Estimated Impact in 1894, Relative to 1872



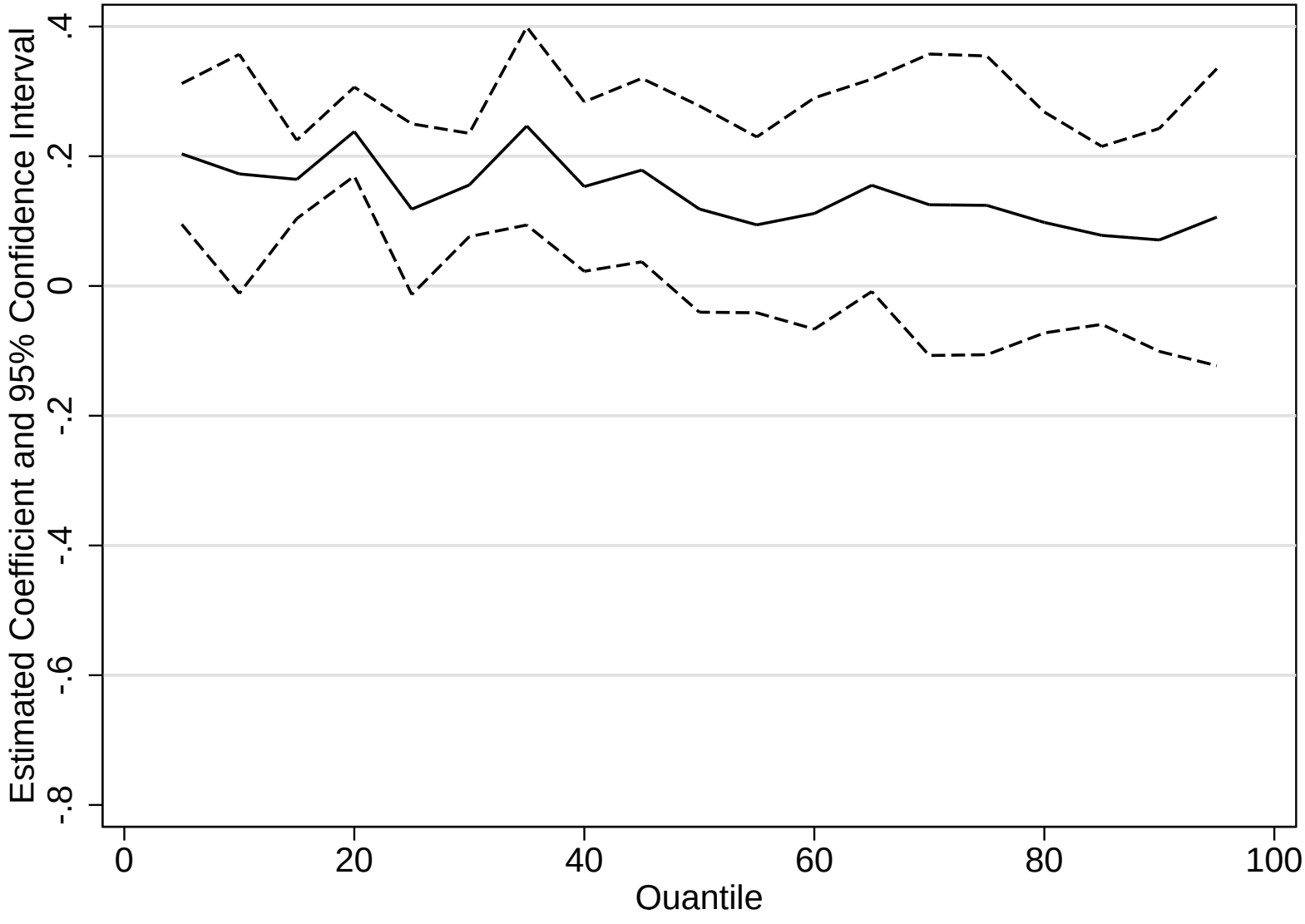
Estimated Changes in Building Value by Distance to the Fire Boundary (in Feet): Estimated Impact in 1867, Relative to 1872



Estimated Impacts on Building Value in the Burned Area, by Quantile, 1882



Estimated Impacts on Building Value in the Burned Area, by Quantile, 1894



Estimated Impacts on Land Value in the Burned Area, by Quantile, 1873

Table 5. Estimated Impact of Fire: Great Fire vs. "Individual Fires"

	Log Value of Building per Sqr. Ft.		Log Value of Land per Sqr. Ft.	
	Full Sample	Restricted Sample	Full Sample	Restricted Sample
	(1)	(2)	(3)	(4)
1873 x Burned	-1.950***	-1.944***	0.170***	0.129***
	(0.173)	(0.178)	(0.018)	(0.022)
1882 x Burned	0.514***	0.445***	0.142***	0.080*
	(0.059)	(0.053)	(0.042)	(0.046)
1894 x Burned	0.413***	0.247***	-0.156***	-0.200***
	(0.083)	(0.072)	(0.060)	(0.072)
~7 Months After Individual Fire	-0.127	-0.005	-0.054	-0.019
	(0.131)	(0.028)	(0.062)	(0.042)
~10 Years After Individual Fire	0.346**	0.128*	0.084	-0.008
	(0.152)	(0.068)	(0.102)	(0.156)
~22 Years After Individual Fire	0.012	-0.013	-0.210	-0.205
	(0.085)	(0.083)	(0.269)	(0.298)
Test of Equality of Individual Fire and Great Fire Effects (p-value):				
~7 Month Interval	0.000	0.000	0.001	0.002
~ 10 Year Interval	0.299	0.000	0.606	0.600
~ 22 Year Interval	0.000	0.003	0.848	0.988
Controls:				
Year Fixed Effects	X	X	X	X
Year FE x Pre-Fire Block Average	X	X	X	X
Year FE x Pre-Fire Neighbor Value	X	X	X	X
R-squared	0.788	0.744	0.938	0.889
Number of Plots	30128	10525	31219	11284

Appendix Table 2. Main Results with Conley Standard Errors at Varying Cutoffs

	Log Value per Square Foot			
	Land Value		Building Value	
	Full Sample (1)	Restricted Sample (2)	Full Sample (3)	Restricted Sample (4)
1873 x Burned	0.172	0.133	-2.016	-2.011
Clustered by Block	(0.018)	(0.021)	(0.168)	(0.171)
250 foot cutoff	(0.019)	(0.020)	(0.164)	(0.167)
750 foot cutoff	(0.021)	(0.025)	(0.257)	(0.259)
1,250 foot cutoff	(0.022)	(0.027)	(0.247)	(0.247)
1,750 foot cutoff	(0.018)	(0.022)	(0.208)	(0.209)
1882 x Burned	0.144	0.083	0.511	0.441
Clustered by Block	(0.042)	(0.046)	(0.055)	(0.049)
250 foot cutoff	(0.039)	(0.041)	(0.059)	(0.058)
750 foot cutoff	(0.058)	(0.061)	(0.065)	(0.062)
1,250 foot cutoff	(0.064)	(0.068)	(0.051)	(0.048)
1,750 foot cutoff	(0.058)	(0.064)	(0.045)	(0.039)
1894 x Burned	-0.145	-0.188	0.410	0.246
Clustered by Block	(0.060)	(0.073)	(0.080)	(0.069)
250 foot cutoff	(0.054)	(0.062)	(0.076)	(0.071)
750 foot cutoff	(0.094)	(0.115)	(0.096)	(0.095)
1,250 foot cutoff	(0.112)	(0.133)	(0.081)	(0.079)
1,750 foot cutoff	(0.109)	(0.133)	(0.081)	(0.066)
Controls:				
Year Fixed Effects	X	X	X	X
Year FE x Pre-Fire Block Average	X	X	X	X
Year FE x Pre-Fire Neighbor Value	X	X	X	X
R-squared	0.987	0.991	0.902	0.934
Number of Plots	31302	11367	30198	10595

Appendix Table 3. Main Results, Unweighted Specifications

	Log Value per Square Foot			
	Land Value		Building Value	
	Full Sample	Restricted Sample	Full Sample	Restricted Sample
	(1)	(2)	(3)	(4)
1873 x Burned	0.192***	0.152***	-1.693***	-1.695***
	(0.020)	(0.021)	(0.158)	(0.166)
1882 x Burned	0.147***	0.091*	0.543***	0.494***
	(0.048)	(0.052)	(0.058)	(0.051)
1894 x Burned	-0.116*	-0.102	0.480***	0.377***
	(0.064)	(0.074)	(0.064)	(0.060)
Controls:				
Year Fixed Effects	X	X	X	X
Year FE x Pre-Fire Block Average	X	X	X	X
Year FE x Pre-Fire Neighbor Value	X	X	X	X
R-squared	0.944	0.904	0.806	0.771
Number of Plots	31302	11367	30198	10595

PLAN OF

BURNT DISTRICT,

[by Fire of Nov. 9th and 10th 1872.]

Showing STREET IMPROVEMENTS as adopted by
BOARD OF STREET COMMISSIONERS AND CITY COUNCIL.

1873.

Appendix Table 4. Main Results Excluding Plots With Road Widening

	Log Value per Square Foot			
	Land Value		Building Value	
	Full Sample	Restricted Sample	Full Sample	Restricted Sample
	(1)	(2)	(3)	(4)
1873 x Burned	0.148***	0.108***	-1.852***	-1.841***
	(0.019)	(0.023)	(0.202)	(0.211)
1882 x Burned	0.100**	0.040	0.439***	0.374***
	(0.046)	(0.048)	(0.051)	(0.047)
1894 x Burned	-0.192***	-0.239***	0.353***	0.178**
	(0.067)	(0.078)	(0.097)	(0.081)
Controls:				
Year Fixed Effects	X	X	X	X
Year FE x Pre-Fire Block Average	X	X	X	X
Year FE x Pre-Fire Neighbor Value	X	X	X	X
R-squared	0.937	0.890	0.784	0.739
Number of Plots	30289	10354	29320	9717

Table 6. Estimated Impact on Plot Sizes in Burned Area, Relative to 1872

	Log Plot Size							
					Plots Unaffected by Road Widening			
	All Plots		Restricted Sample		All Plots		Restricted Sample	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1867 x Burned	-0.069	-	-0.063	-	-0.094	-	-0.089	-
	(0.043)	( )	(0.043)	( )	(0.064)	( )	(0.064)	( )
1872 x Burned	0	0	0	0	0	0	0	0
	( )	( )	( )	( )	( )	( )	( )	( )
1873 x Burned	0.006	-0.014	-0.001	-0.021	0.061***	0.050**	0.055**	0.040
	(0.023)	(0.025)	(0.024)	(0.026)	(0.021)	(0.023)	(0.023)	(0.025)
1882 x Burned	0.090*	0.067**	0.094*	0.057	0.156***	0.137***	0.160***	0.126***
	(0.046)	(0.033)	(0.047)	(0.038)	(0.055)	(0.036)	(0.056)	(0.040)
1894 x Burned	0.088*	0.029	0.023	0.011	0.165***	0.091**	0.100	0.067
	(0.051)	(0.036)	(0.057)	(0.041)	(0.061)	(0.044)	(0.066)	(0.045)
Controls:								
Year Fixed Effects	X	X	X	X	X	X	X	X
Year FE x Pre-Fire Block Average		X		X		X		X
Year FE x Pre-Fire Neighbor Value		X		X		X		X
R-squared	0.058	0.818	0.074	0.805	0.039	0.819	0.056	0.811
Number of Plots	31353	31353	11381	11381	30340	30340	10368	10368

Appendix Table 5. Number of Unique Owners and Number of Plots, by Burned and Unburned Areas

	Number of Owners		Annual Percent Change		Number of Plots		Annual Percent Change	
	Burned	Unburned	Burned	Unburned	Burned	Unburned	Burned	Unburned
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Full Sample								
1867	402	3,534			620	6,120		
1872	367	3,390	-1.74	-0.81	580	6,013	-1.29	-0.35
1873	346	3,401	-5.72	0.32	519	5,970	-10.52	-0.72
1882	322	3,287	-0.77	-0.37	486	5,504	-0.71	-0.87
1894	309	3,097	-0.34	-0.48	465	5,076	-0.36	-0.65
2012					112	1,964	-0.64	-0.52
Panel B. Restricted Sample								
1867	402	1261			620	1911		
1872	367	1160	-1.74	-1.60	580	1837	-1.29	-0.77
1873	346	1177	-5.72	1.47	519	1808	-10.52	-1.58
1882	322	1108	-0.77	-0.65	486	1693	-0.71	-0.71
1894	309	971	-0.34	-1.03	465	1462	-0.36	-1.14
2012					112	439	-0.64	-0.59

Appendix Table 6. Industry-by-Industry Changes in Agglomeration (Ripley's L Function, 100 foot radius)

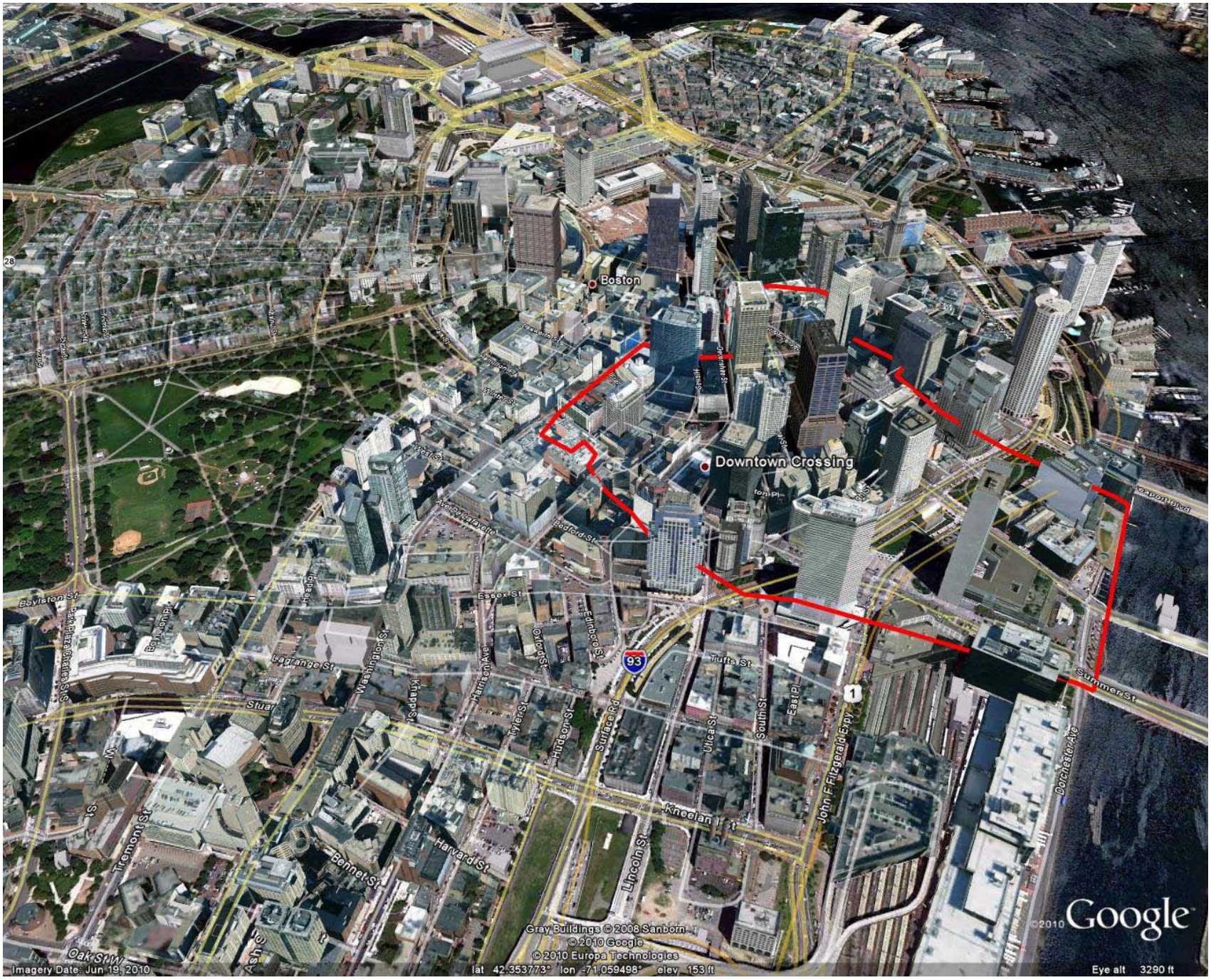
		Clustering Index						D-in-D	
		Burned Area			Unburned Area			Burned vs. Unburned	
	Obs.	1872	1882	1894	1872	1882	1894	72 to 82	72 to 94
Industry	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Shoes	297	215	143	189	229	555	376	-398	-173
Leather	159	171	178	185	222	1167	1100	-937	-864
Clothes	112	93	154	166	153	134	238	80	-13
Liquors	110	224	287	-100	199	202	185	60	-310
Dry Goods	107	108	101	-100	276	380	283	-111	-214
Hats	107	169	412	204	200	233	231	210	3
Tailor	88	311	457	142	211	350	295	7	-254
Machinery	50	248	130	28	498	331	223	49	54
Hardware	48	62	118	221	422	276	254	203	327
Jewelry	48	571	648	703	373	553	638	-103	-133
Printer	48	78	99	105	283	197	221	107	89
Fancy Goods	46	140	-100	318	161	-100	414	21	-75
Teams	45	26	-11	24	210	329	-100	-156	308
Kitchen Goods	37	87	216	-100	181	500	289	-190	-295
Cigars	35	318	318	-100	98	235	188	-137	-509
Paper	34	145	169	111	351	115	219	260	98
Clothing Acc.	18	152	412	142	627	264	289	624	328
Cotton	13	165	71	-100	-100	659	-100	-853	-265

Appendix Table 7. Estimated Impacts on Industrial Agglomeration, Relative to 1872

	Ripley's L Function					
	Radius = 50 ft.		Radius = 100 ft.		Radius = 200 ft.	
	(1)	(2)	(3)	(4)	(5)	(6)
1867 x Burned	-4.9	-	-35.3	-	-69.0	-
	(65.7)	( )	(62.1)	( )	(87.0)	( )
1872 x Burned	0	0	0	0	0	0
	( )	( )	( )	( )	( )	( )
1882 x Burned	-23.9	-62.5	-160.8	-148.6*	-236.6	-156.1*
	(69.4)	(38.3)	(115.3)	(82.1)	(177.8)	(87.4)
1894 x Burned	-33.6	-106.4***	-161.5*	-187.5**	-209.6	-194.2*
	(41.7)	(31.4)	(84.1)	(87.7)	(155.6)	(96.5)
Controls:						
Year Fixed Effects	X	X	X	X	X	X
Year FE x Industry L Value in 1867		X		X		X
Year FE x Industry L Value in 1872		X		X		X
R-squared	0.199	0.68	0.136	0.433	0.114	0.431
Industry-by-Year Observations	144	144	144	144	144	144

Appendix Table 8. Changes in Occupant Density and Value of Capital

	Number of Assessed Occupants				Log Value of Capital per Square Foot			
	Commercial		Residential		Commercial		Residential	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1867 x Burned	0.146**	-	0.362***	-	-0.616***	-	-0.029	-
	(0.067)	( )	(0.067)	( )	(0.218)	( )	(0.054)	( )
1872 x Burned	0	0	0	0	0	0	0	0
	( )	( )	( )	( )	( )	( )	( )	( )
1873 x Burned	-0.294***	-0.368***	-0.327***	-0.202***	-4.438***	-3.752***	-0.073	-0.174***
	(0.043)	(0.052)	(0.064)	(0.069)	(0.225)	(0.218)	(0.051)	(0.053)
1882 x Burned	0.268***	0.251***	-0.404***	-0.328***	0.047	1.253***	0.258***	-0.070
	(0.066)	(0.075)	(0.072)	(0.088)	(0.199)	(0.185)	(0.078)	(0.094)
1894 x Burned	0.340***	0.289***	-0.283***	-0.158	-0.331	0.997***	0.209**	-0.246**
	(0.066)	(0.077)	(0.080)	(0.097)	(0.225)	(0.203)	(0.090)	(0.113)
Controls:								
Year Fixed Effects	X	X	X	X	X	X	X	X
Year FE x Pre-Fire Block Average		X		X		X		X
Year FE x Pre-Fire Neighbor Value		X		X		X		X
R-squared	0.02	0.534	0.053	0.559	0.121	0.65	0.044	0.681
Number of Plots	31353	31353	31353	31353	31353	31353	31353	31353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Downtown Crossing
Boylston St
Essex St
Bedford St
Lagrange St
Stuart St
Washington St
Harrison Ave
Knapp St
Tyler St
Hudson St
Surface Rd
Utica St
South St
East Pl
Tufts St
Kneeland St
John F Fitzgerald Expy
Summer St
Dorchester Ave
Lincoln St
Harvard St
Bennet St
Tremont St
Oak St W
93
1
Gray Buildings © 2008 Sanborn
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©2010 Google
Imagery Date: Jun 19, 2010
lat 42.353773° lon -71.059498° elev 153 ft
Eye alt 3290 ft

Appendix Table 9. Estimated Impact on Land and Building Value in 2012

	Log Total Value per Square Foot			
	Full Sample		Restricted Sample	
	(1)	(2)	(3)	(4)
1867 x Burned	0.081	-	0.069	-
	(0.050)	( )	(0.054)	( )
1872 x Burned	0	0	0	0
	( )	( )	( )	( )
2012 x Burned	0.123	0.569***	0.108	0.266
	(0.217)	(0.207)	(0.233)	(0.209)
Controls:				
Year Fixed Effects	X	X	X	X
Year FE x Pre-Fire Block Average		X		X
Year FE x Pre-Fire Neighbor Value		X		X
R-squared	0.842	0.928	0.863	0.932
Number of Plots	15382	15382	5491	5491

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Further analysis of mechanisms

- Indications of building quality mechanism
- Mixed evidence for plot size, density, agglomeration, and infrastructure channels