Segregation and the Initial Provision of Water in the United States

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Clean Water and the Growth of American Cities

Table 1. Percentage of Deaths, by Cause, in Major Cities

Cause of Death	1900	1936
Major Infectious Diseases	39.3	17.9
Tuberculosis	11.1	5.3
Pneumonia	9.6	9.3
Diarrhea and enteritis	7.0	N/A
Typhoid fever	2.4	0.1
Meningitis	2.4	0.3
Malaria	1.2	0.1
Smallpox	0.7	0.0
Influenza	0.7	1.3
Childhood Infectious Diseases	4.2	0.5
Measles	0.7	0.0
Scarlet fever	0.5	0.1
Whooping cough	0.6	0.2
Diphtheria and croup	2.3	0.1

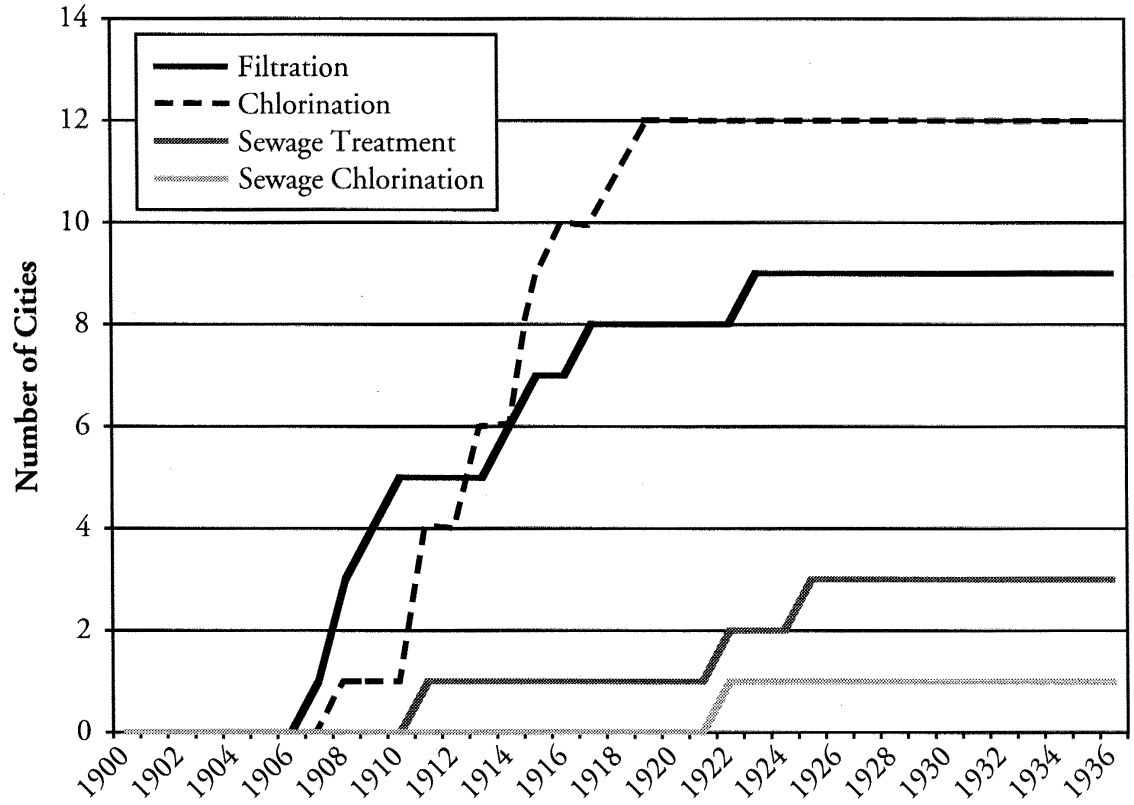
Note: All percentages are shares of total mortality.

Source: U.S. Census Bureau's Mortality Statistics, 1900 and 1936.

From Cutler and Miller (2005)

Clean Water and the Growth of American Cities

Figure 1. Cumulative Number of Sample Cities That Adopted Technologies, 1900 to 1936

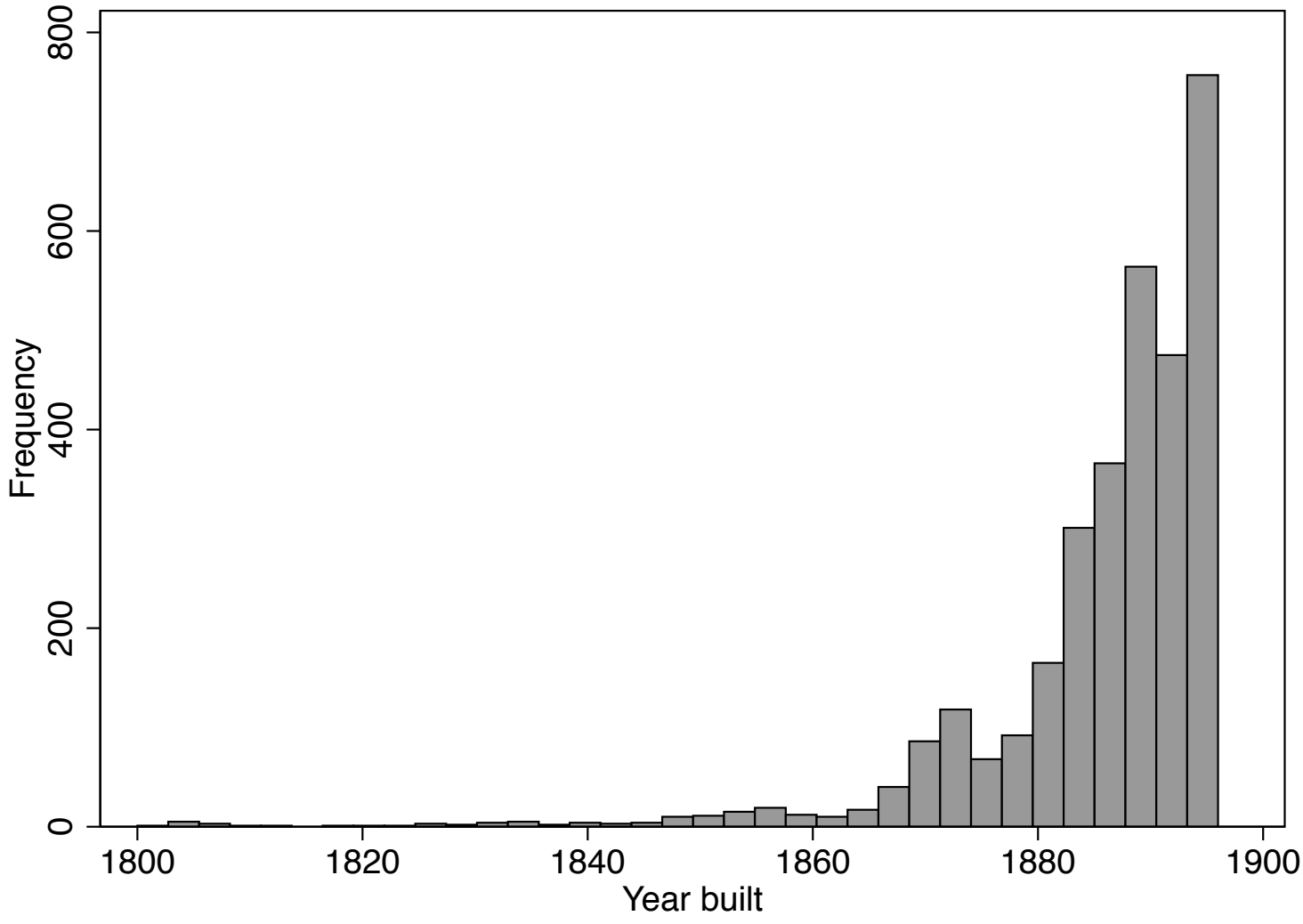


From Cutler and Miller (2005)

Building American Water Infrastructure

- The introduction of clean water technologies and sewer systems had a tremendous impact on urban economies
- The chlorination and filtration introduced in the early 1900s dramatically reduced infectious diseases
- However, the benefits of these improvements were not evenly distributed, they depended on the geography of the water and sewer systems relative to the spatial distribution of different groups
- We are interested in going back to the initial construction of water and sewer systems in the 1800s, thinking about how the location of minority residents influenced the size and layout of those systems

Building American Water Infrastructure



Building American Water Infrastructure

- Most American cities built waterworks in the mid to late 1800s
- These waterworks were costly and the decision to build them depended on having a sufficient number of interested voters (or customers)
- The timing of waterworks construction and the coverage of the system will be functions of total population and, importantly, the demographics and spatial distribution of that population

Memphis Sewer System

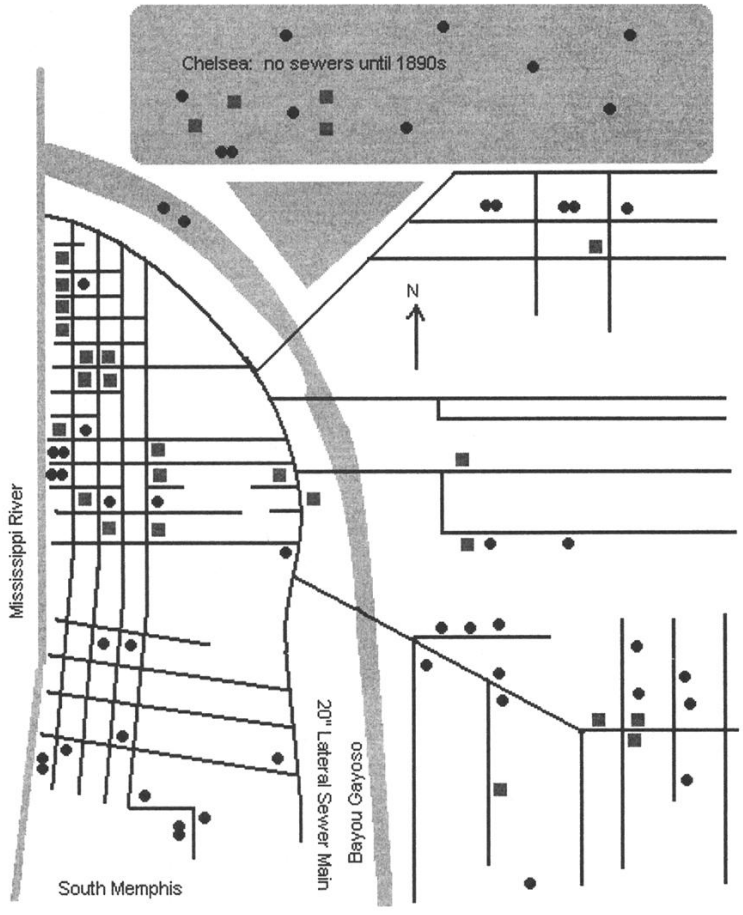


FIGURE 1
THE MEMPHIS SEWER SYSTEM, 1884

Key:
▬ - no sewerage services until the 1890s, including Chelsea and the area surrounding the Bayou Gayoso; ■ - white dwelling; ● - black dwelling; ●● - multi-race dwelling

From Troesken (2002)

Savannah Sewer System

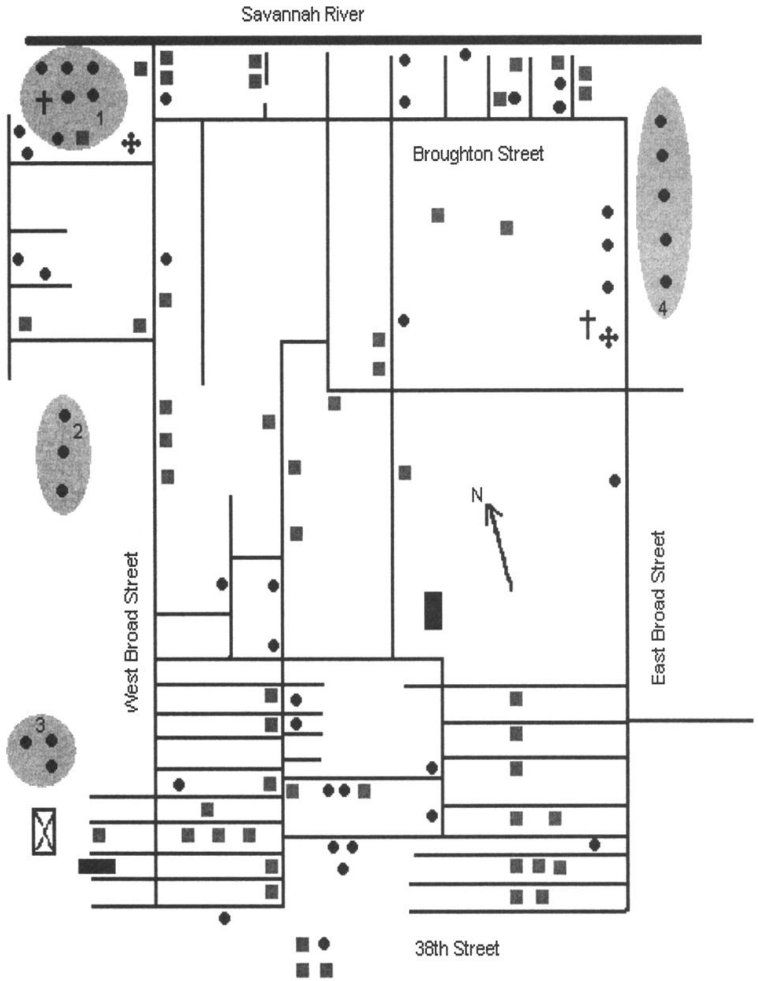


FIGURE 4
SAVANNAH SEWER SYSTEM, 1900

Key:
▬ - indicates predominantly black neighborhoods without sewerage services circa 1900
■ - white dwelling
● - black dwelling.
other symbols: African-American churches (†), schools (✣), cemetery (⊠), and hospitals (▬)

From Troesken (2002)

Segregation and the Water System

- We seek to extend the work of Troesken (2002), taking advantage of newly available data, thinking about the roles of minority population share and segregation in the initial construction of waterworks
- There is a wealth of new data that can really expand our understanding of the rollout of water and sewer systems
- Complete count census data, digitized maps of water and sewer systems, and digitized reports on water and sewer systems offer a tremendous opportunity to apply big(gish) data to the evolution of urban infrastructure
- To think of how to use these new data, we first develop a theoretical model of water (and sewage) provision

Modeling Segregation and the Water System

- We consider both public and private systems (1/3 of the waterworks we have data on are private)
- For public systems, we assume the local government places greater weight on white access to water compared to black access (either through discrimination or reelection considerations)
- For private systems, we assume a greater average ability to pay on the part of white residents compared to black residents
- Given the high costs of building a waterworks and the costs of extending mains, the model predicts a water system that serves only a fraction of the neighborhoods in a city

Modeling Segregation and the Water System

- What determines how many neighborhoods get access?
- Both the size of the minority population and its distribution matter
- Larger minority population shares will delay water works construction and lead to smaller systems
- Segregation's impact is more nuanced, it has two opposing effects:
  - With more segregation, an additional mile of mains while still in a predominately white neighborhood has a higher return
  - However, there will be fewer neighborhoods you are willing to serve

Data on Segregation and the Water System

- To provide empirical tests of the relationship between residential segregation and water systems, we need data on both
- Details on water systems come from Baker's *Manual of American Water Works* (1897) and the Department of the Interior's *Social Statistics of Cities* based on the 1890 census
- These sources provide basic information on over 4,000 waterworks and a fairly comprehensive view of the water systems for nearly 200 cities
- We have data on year of construction, miles of mains, number of taps, type of waterworks, various costs, and a variety of other variables (but all at one point in time)

Water System Data

TABLE 66.—WATERWORKS.

OWNERSHIP, CAPACITY, CONSUMPTION, DISTRIBUTION, AVERAGE ANNUAL COST

	CITIES.	Ownership.	Daily capacity of supply. (In 1,000 gallons.)	RESERVOIRS.		CONSUMPTION.	
				Number.	Capacity. (In 1,000 gallons.)	Average daily. (In 1,000 gallons.)	Gallons daily per capita.
1	Akron, Ohio	Private	(a)	1	5,000	1,800	65
2	Alameda, Cal	Private	(a)	3	750	720	64
3	Albany, N. Y	City	(c)	7	212,670	14,500	153
4	Alexandria, Va. (a)						
5	Allegheny, Pa. (a)						
6	Allentown, Pa	City	4,500	2	410	3,000	119
7	Alpena, Mich	Private	(c)			1,500	133
8	Alton, Ill	Private	(c)			700	68
9	Altoona, Pa	City	3,000	2	68,000	1,750	58
10	Amsterdam, N. Y	City	(a)	1	90,000	2,000	115
11	Anderson, Ind	City	(c)			200	19
12	Appleton, Wis	Private	1,000	1	2,500	600	51
13	Asheville, N. C	City	725	1	1,000	200	20
14	Atchison, Kan	Private	(c)	1	5,000	500	36
15	Atlanta, Ga	City	(a)	1	250,000	2,100	32
16	Atlantic city, N. J	Private	26,000	4	20,400	1,550	119
17	Auburn, Me	Private	2,000	1	600	500	44
18	Auburn, N. Y	Private	15,000			2,000	77
19	Augusta, Ga	City	(c)	1	100,000	3,400	102
20	Augusta, Me. (a)						
21	Aurora, Ill	City	(c)			800	41
22	Austin, Tex	Private	4,000			2,000	137
23	Baltimore, Md	City	218,000	8	2,274,000	40,000	92
24	Bangor, Me	City	(c)			3,000	157
25	Baton Rouge, La. (a)						
26	Battle Creek, Mich	City	2,000			324	25
27	Bay city, Mich	City	(c)			2,588	93

Report on the Social Statistics of Cities (1895)

Water System Data

TABLE 66.—WATERWORKS.

RECEIPTS, AND NUMBER OF MILES OF MAINS TO EACH MILE OF SEWER—Continued.

DISTRIBUTION.						COST AND RECEIPTS.							
Mains. (Miles.)	Hydrants. (Number.)	Taps. (Number.)	Meters. (Number.)	Fountains. (Number.)	Watering troughs. (Number.)	Cost of works.	Average annual cost of maintenance. (For 10 years.)	Average annual receipts from water rents. (For 10 years.)	Annual charge for water for an average dwelling.	Cost of works per capita.	Number of meters to each 100 taps.	Miles of mains to each mile of sewer.	
31	200	2,000	2	5	25	$448,790	$2,430	$15,250	$9.75	$10.01	0.10	6.20	1
95	519	4,700	25	.....	25	(b)	(b)	(b)	(b)	.....	0.53	47.50	2
97	290	2,371	1,438	3	50	1,565,000	(b)	(b)	21.00	96.85	60.65	2.43	3
31	215	1,950	80	2	13	470,000	11,925	16,000	12.50	25.45	4.10	1.41	4
342	1,661	37,244	11,786	.....	.....	15,000,000	.....	.....	20.00	50.17	31.65	1.77	5
66	152	4,000	12	3	103	650,000	.....	.....	21.60	35.99	0.30	1.74	6
30	215	2,500	3	.....	2	325,000	10,000	30,000	9.00	27.14	0.12	1.58	7
36	359	4,000	3	5	4	500,000	20,000	36,000	9.00	11.58	0.08	2.25	8
17	174	1,800	1	6	5	150,000	25,000	30,000	7.00	7.54	0.06	1.06	9
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10
32	53	1,700	50	.....	.....	(b)	.....	.....	27.00	.....	2.94	2.46	11
30	156	1,500	145	4	6	400,000	(b)	(b)	17.00	28.43	9.67	.....	12
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13
22	295	467	20	.....	.....	250,000	(b)	(b)	c7.00	15.28	4.28	.....	14
8	30	2,500	1	.....	.....	150,000	(b)	(b)	11.00	9.41	0.04	.....	15
14	114	500	20	.....	.....	253,869	.....	.....	17.00	21.19	4.00	.....	16
25	129	2,500	50	2	5	195,000	15,000	25,000	12.00	5.16	2.00	0.68	17
11	67	390	.....	.....	.....	65,000	.....	.....	13.50	6.39	.....	.....	18
37	401	5,885	25	.....	29	443,065	16,566	27,417	12.00	11.03	0.42	0.77	19
27	105	1,300	90	3	5	(b)	4,000	8,000	(b)	.....	6.92	4.50	20
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	21
11	101	1,200	65	.....	4	258,220	(b)	(b)	18.00	12.96	5.42	3.67	22
34	150	1,750	85	.....	.....	655,000	13,606	36,349	(b)	26.24	4.86	1.06	23
91	672	5,497	703	10	40	1,406,969	18,060	90,193	16.00	31.85	12.79	1.78	24
40	206	1,600	40	.....	3	(b)	(b)	(b)	13.00	.....	2.50	.....	25
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	27
21	131	3,000	.....	.....	3	150,000	8,250	17,122	13.00	11.20	.....	.....	28

Report on the Social Statistics of Cities (1895)

Water System Data

TABLE 71.—AMUSEMENTS, SALOONS, LICENSES, ETC.

SALOONS, AND LICENSED DOGS; THE LICENSE PAID FOR EACH, AND AVERAGE ANNUAL AMOUNT RECEIVED BY LICENSES—Continued.

PUBLIC VEHICLES.			SALOONS.				LICENSED DOGS.			Average annual amount received by city from foregoing class of licenses. (For 10 years.)	
Number.	Yearly license for each.		Number.	Total yearly license for each.		Number to each 1,000 population.	Yearly number.	License.			
	Hacks.	Cabs, coupes, etc.		First grade.	Second grade.	Third grade.		Male.	Female.		
35	$20.00	$20.00	51	$1,200	.....	.....	1.14	400	$3.00	$3.00	$63,400	1
110	5.00	.....	221	150	$25	.....	5.87	1,200	0.50	0.50	16,060	2
.....	.....	.....	80	(a)	.....	.....	4.95	.....	.....	.....	(a)	3
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
442	5.00	3.00	2,900	84	.....	.....	9.70	2,800	2.00	2.00	225,000	5
58	5.00	5.00	110	100	.....	.....	6.09	300	2.00	2.00	c15,000	6
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
100	18.00	.....	260	200	.....	.....	6.02	1,200	1.00	1.00	57,000	8
.....	.....	.....	(a)	75	60	.....	.....	.....	.....	.....	(a)	9
.....	.....	.....	182	500	.....	.....	2.42	.....	.....	.....	32,582	10
65	20.00	20.00	156	600	.....	.....	3.64	520	1.00	1.00	96,420	11
5	10.00	10.00	25	350	.....	.....	1.78	500	1.00	1.00	9,550	12
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13
.....	.....	.....	72	200	.....	.....	4.40	(a)	.....	.....	14,400	14
.....	.....	.....	116	175	.....	.....	7.28	.....	.....	.....	20,300	15
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16
20	20.00	.....	(d)	.....	.....	.....	.....	600	1.00	2.00	1,000	17
45	15.00	10.00	20	1,000	.....	.....	1.97	50	2.00	4.00	20,675	18
.....	.....	.....	.....	.....	.....	.....	.....	835	2.00	5.00	1,871	19
.....	.....	.....	68	100	.....	.....	3.12	238	1.00	2.00	7,075	20

Report on the Social Statistics of Cities (1895)

Water System Data

6. **BRISTOL**, Hartford Co. (7,382.) Built in '85 by Bristol Water Co. FRANCHISE.—Perpetual; does not provide for purchase of works by city. Rates are not fixed in franchise nor subject to regulation by city. Co. is not exempt from local taxes. No legal difficulties. SUPPLY.—Green Meadow and Poland Brooks, by gravity from impounding reservoirs. RESERVOIRS.—Cap., 157,000,000 galls.; Green Meadow, 55,000,000; Poland, 100,000,000, another of 2,000,000. FISCAL YEAR CLOSED Mar. 31. DISTRIBUTION.—Mains (in '91), 16 miles. Taps, 700. Services, galv. i.; paid for by consumer. Meters: 27; owned, controlled and repaired by Co. Use of meters optional with Co.; compulsory for manufacturers, livery stables, etc. Hydrants, public, 68; private, 9. PRESSURE.—Ordinary, 60-130 lbs. FINANCIAL.—Cost (in '90), $126,275. Cap. Stock: Authorized, $100,000; all paid-up. MANAGEMENT.—Prest., J. H. Sessions; Secy. and Treas., C. S. Treadway. Supt., T. H. Keirns. Rept. by Secy., June 8. SEWERS.—Has sanitary and partial system of storm sewers.

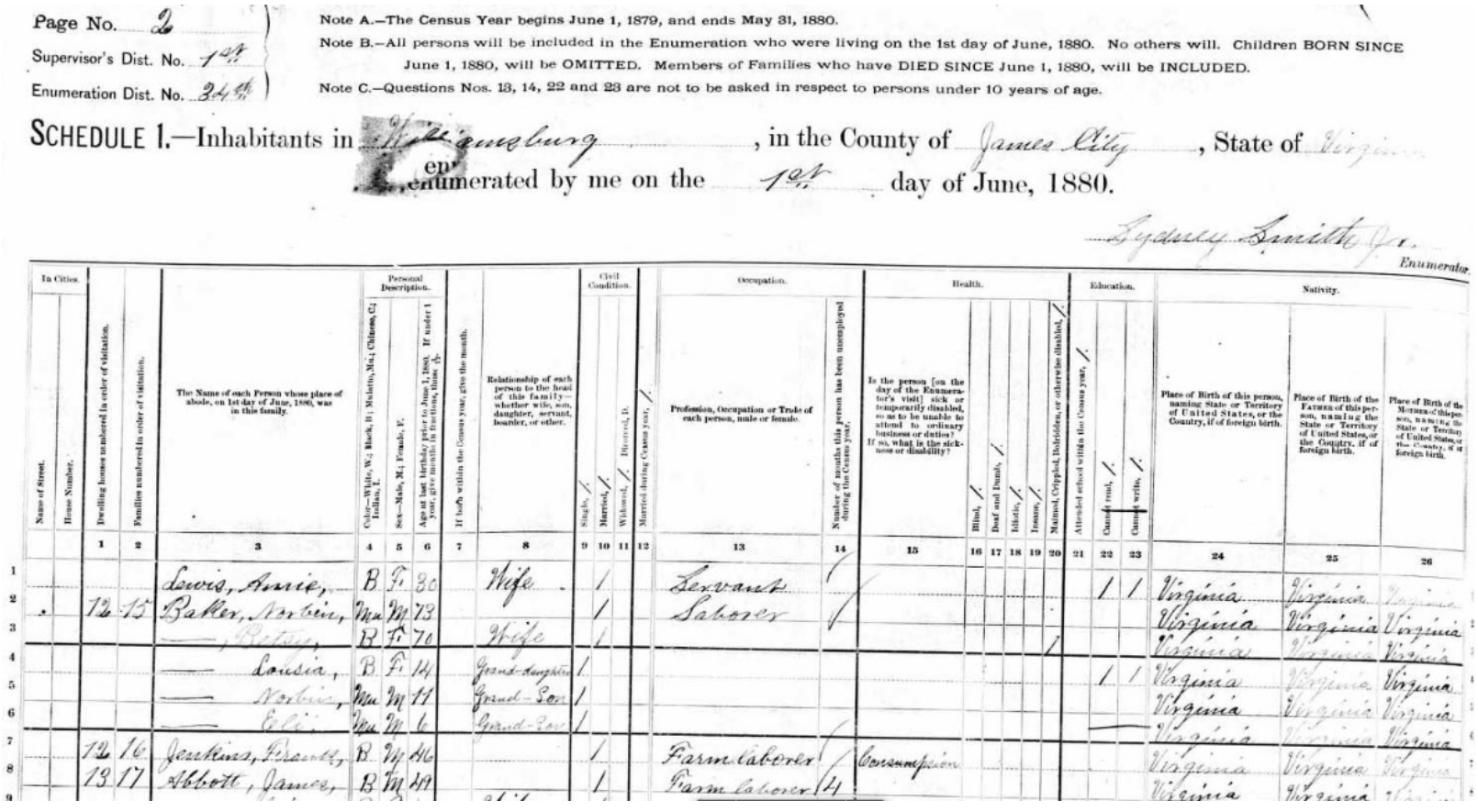
Baker's *Manual of American Waterworks* (1897)

Water System Data

Summary statistics for city water systems included the Social Statistics of Cities (1895)

	Mean	Median	Standard deviation
Population in 1890	75,856	28,646	173,411
Year waterworks construction started	1867.92	1872.00	15.57
Cost of waterworks (in 1890 $)	1,817,285	530,000	4,304,320
Miles of mains	77.15	36.00	123.12
Taps	8152.00	2536.00	20440.73
Cost per capita	22.44	18.78	14.79
Cost per dwelling	138.03	107.46	98.13
Cost per tap	264.61	234.70	174.38
Taps per dwelling	0.60	0.59	0.33
Mains per acre	0.011	0.009	0.009
ln(population)	10.53	10.26	0.96
Population per acre	9.46	7.75	7.92
Number of cities	167		

Measuring Segregation



Page No. 2
Supervisor's Dist. No. 1st
Enumeration Dist. No. 24th

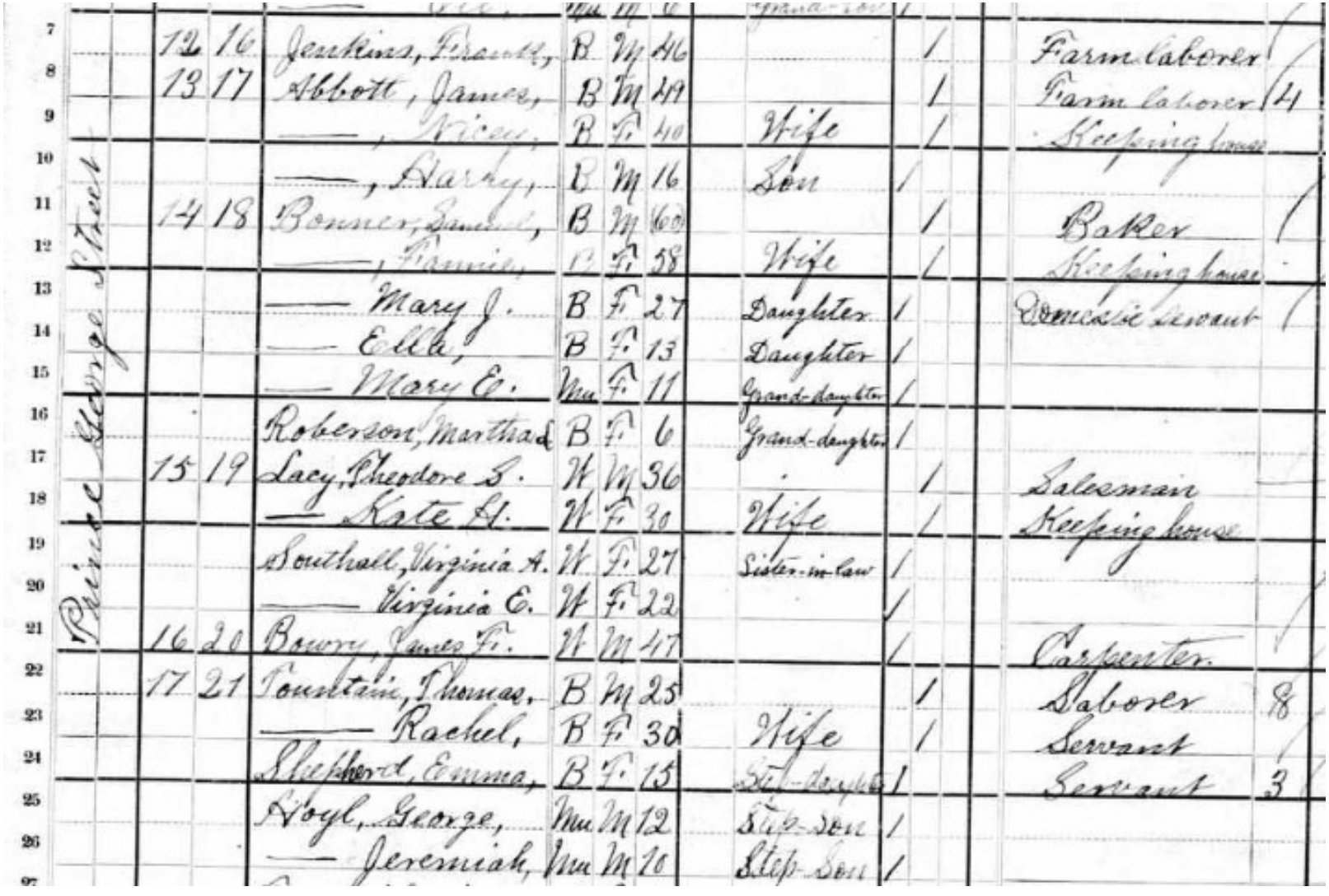
Note A.—The Census Year begins June 1, 1879, and ends May 31, 1880.
Note B.—All persons will be included in the Enumeration who were living on the 1st day of June, 1880. No others will. Children BORN SINCE June 1, 1880, will be OMITTED. Members of Families who have DIED SINCE June 1, 1880, will be INCLUDED.
Note C.—Questions Nos. 13, 14, 22 and 23 are not to be asked in respect to persons under 10 years of age.

SCHEDULE 1.—Inhabitants in Williamsburg, in the County of James City, State of Virginia, enumerated by me on the 1st day of June, 1880.

Sydney Smith Jr.
Enumerator.

In Cities: Name of Street.	In Cities: House Number.	Dwelling houses numbered in order of visitation.	Families numbered in order of visitation.	The Name of each Person whose place of abode, on 1st day of June, 1880, was in this family.	Personal Description: Color—White, W.; Black, B.; Mulatto, Mu.; Chinese, C.; Indian, I.	Personal Description: Sex—Male, M.; Female, F.	Personal Description: Age at last birthday prior to June 1, 1880. If under 1 year, give months in fractions, thus, 6/12.	If born within the Census year, give the month.	Relationship of each person to the head of this family—whether wife, son, daughter, servant, boarder, or other.	Civil Condition: Single, /.	Civil Condition: Married, /.	Civil Condition: Widowed, /.	Civil Condition: Divorced, /.	Married during Census year, /.	Occupation: Profession, Occupation or Trade of each person, male or female.	Occupation: Number of months this person has been unemployed during the Census year.	Health: Is the person [on the day of the Enumerator's visit] sick or temporarily disabled, so as to be unable to attend to ordinary business or duties? If so, what is the sickness or disability?	Health: Blind, /.	Health: Deaf and Dumb, /.	Health: Idiotic, /.	Health: Insane, /.	Health: Maimed, Crippled, Bedridden, or otherwise disabled, /.	Education: Attended school within the Census year, /.	Education: Cannot read, /.	Education: Cannot write, /.	Nativity: Place of Birth of this person, naming State or Territory of United States, or the Country, if of foreign birth.	Nativity: Place of Birth of the Father of this person, naming the State or Territory of United States, or the Country, if of foreign birth.	Nativity: Place of Birth of the Mother of this person, naming the State or Territory of United States, or the Country, if of foreign birth.
		1	2	3	4	5	6	7	8	9	10	11	12		13	14	15	16	17	18	19	20	21	22	23	24	25	26
1				Lewis, Annie,	B	F	30		Wife		1				Servant									1	1	Virginia	Virginia	Virginia
2		12	15	Baker, Norbin,	Mu	M	73				1				Laborer	1										Virginia	Virginia	Virginia
3				—, Betsy,	B	F	70		Wife		1															Virginia	Virginia	Virginia
4				— Louisa,	B	F	14		Grand-daughter	1														1	1	Virginia	Virginia	Virginia
5				— Norbin,	Mu	M	11		Grand-Son	1																Virginia	Virginia	Virginia
6				— Eli,	Mu	M	6		Grand-Son	1																Virginia	Virginia	Virginia
7		12	16	Jenkins, Peranth,	B	M	46				1				Farm Laborer											Virginia	Virginia	Virginia
8		13	17	Abbott, James,	B	M	49				1				Farm Laborer	4	Consumption									Virginia	Virginia	Virginia
9																										Virginia	Virginia	Virginia

Measuring Segregation



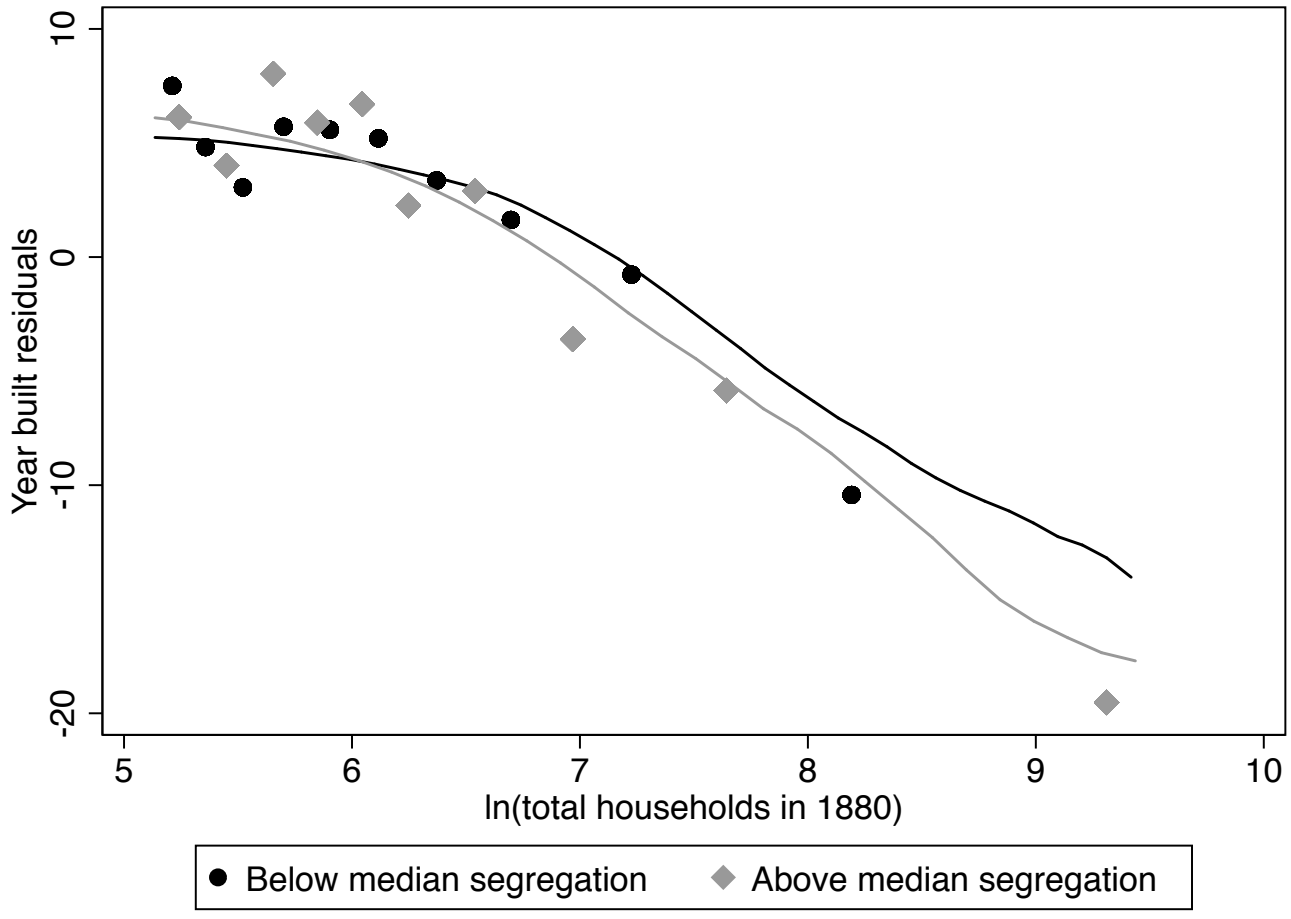
Measuring Segregation

- Full count census data and the methodology of Logan and Parman (2017) allow us to estimate segregation for any city on the basis of the characteristics of next-door neighbors
- This approach has two useful features in our context
- First, moving away from ward-based measures (or a reliance on geocoded data) greatly expands the number of cities we can look at
- Second, the geography of building out water systems is really at the level of street segments rather than wards
- At the moment, we focus on segregation on the basis of race, we have plans for ethnicity and income as well

Basic Empirical Approach

- Our empirical analysis is going to focus first on segregation and the timing of waterworks construction
- Focusing on an intensive margin of water system size would be interesting but has two drawbacks:
  - The sample of cities is substantially reduced
  - The relationship between miles of mains and actual access differs with the geography of cities
  - Similar issues with measures based on number of taps
- Our basic approach is to consider year built as a function of population size, black population share and the level of segregation

Segregation and Waterworks Construction



Residuals after regressing year built on a set of region dummies

Segregation and Waterworks Construction

Segregation and the timing of waterworks construction, Cox proportional hazard model

		City size restriction:			
	All cities	Bottom 50th percentile	50th to 80th percentile	80th to 95th percentile	95th percentile and up
ln(total households)	2.395	4.981	3.625	2.655	1.755
	(0.163)	(1.179)	(0.731)	(0.615)	(0.353)
Segregation	1.114	0.661	1.104	4.999	34.435
	(0.246)	(0.225)	(0.392)	(3.079)	(43.597)
Black pop. Share	0.274	0.113	0.104	0.082	0.118
	(0.107)	(0.059)	(0.083)	(0.061)	(0.273)
Observations	1,188	608	351	178	51
Failures	823	279	318	175	51

Coefficients reported in the table are hazard ratios. Each regressions includes census region fixed effects. Robust standard errors in parentheses. The median city in our sample has 253 households, while the 80th percentile had 995 households, and the 95th percentile had 4474 households.

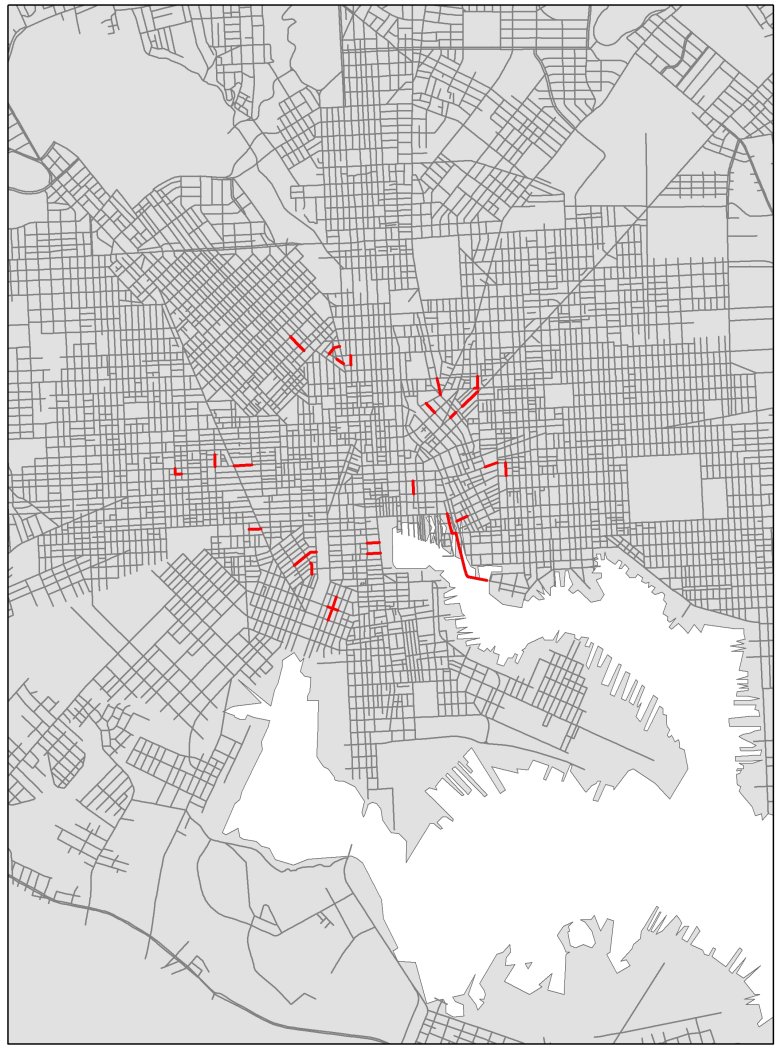
Segregation and Waterworks Construction

- Across all cities, larger black population shares are associated with delayed waterworks construction
- In larger cities, higher levels of segregation are associated with earlier construction
- This is consistent with our model predictions based on black households being excluded from access
- However, the Baker data and the Social Statistics of Cities do not provide any information by race
- One alternative: turn to geocoded population census and water system data

Access to Water Pipes

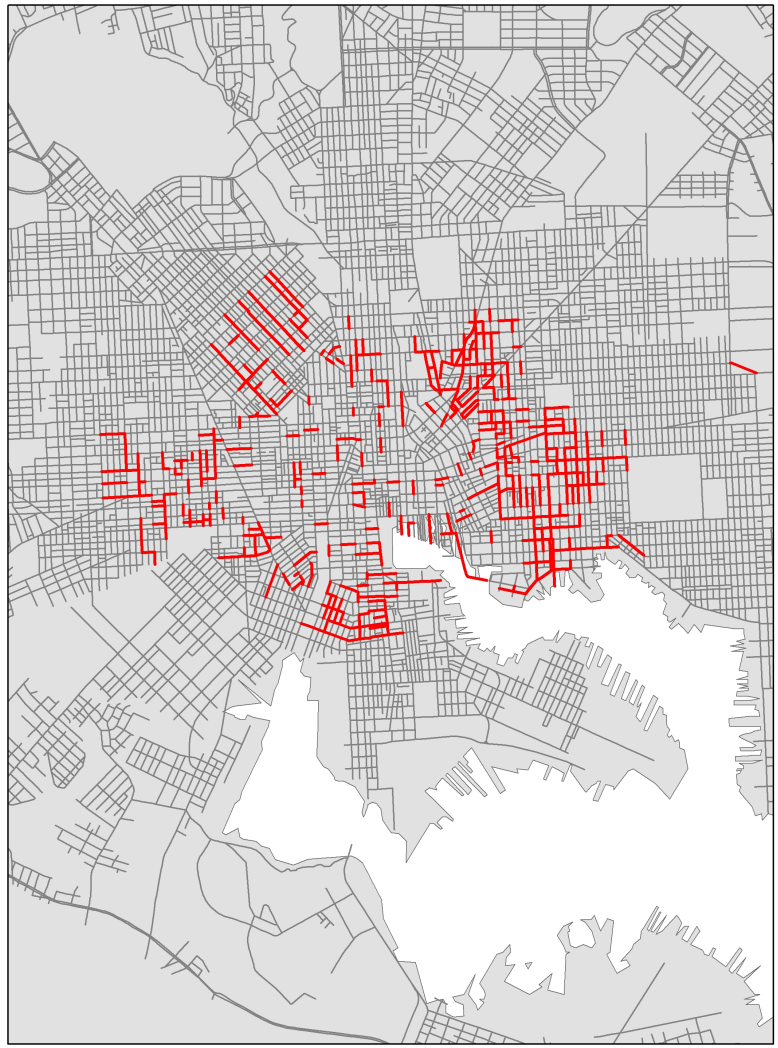
- The Union Army Project has geocoded the sanitation systems of Baltimore, Boston, Chicago, Philadelphia, Manhattan and Brooklyn up to the early 1900s
- John Logan has geocoded dwellings in the 1880 population census for 39 cities for the urban transition historical GIS project
- We've combined these, allowing us to identify the closest water pipe, water main and sewer pipe for every person in the city and see when that pipe was built
- This gives us a way to see how access in 1880 varied with demographic characteristics

Access to Water Pipes



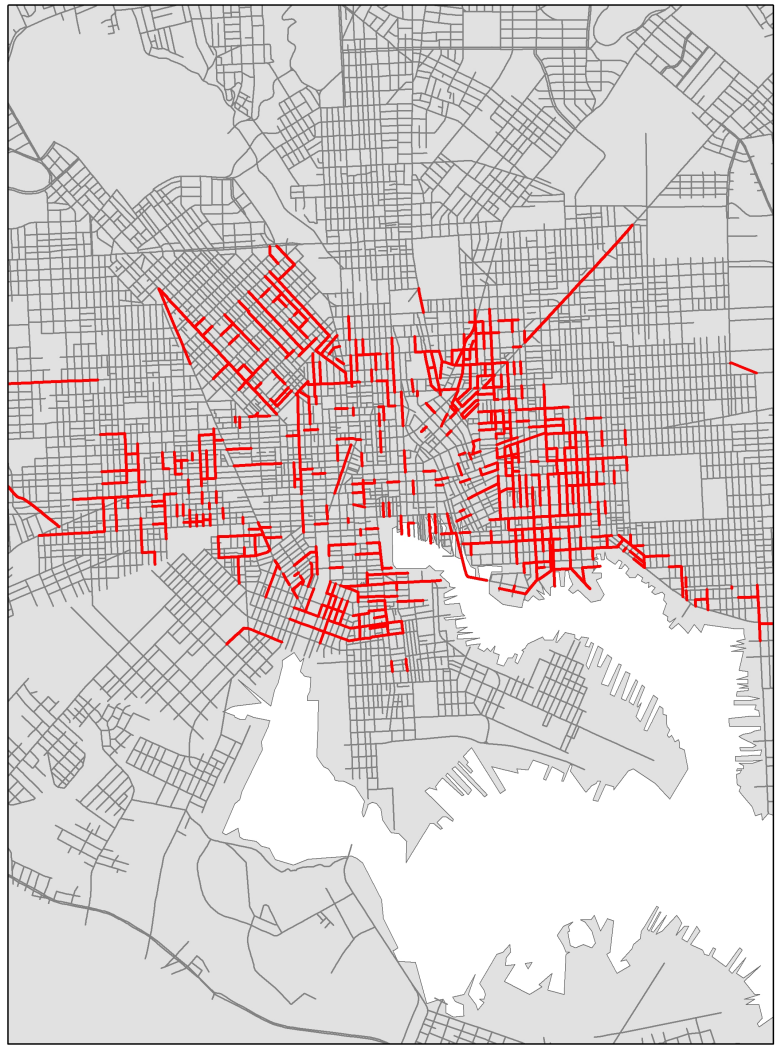
Baltimore's water system, 1855

Access to Water Pipes



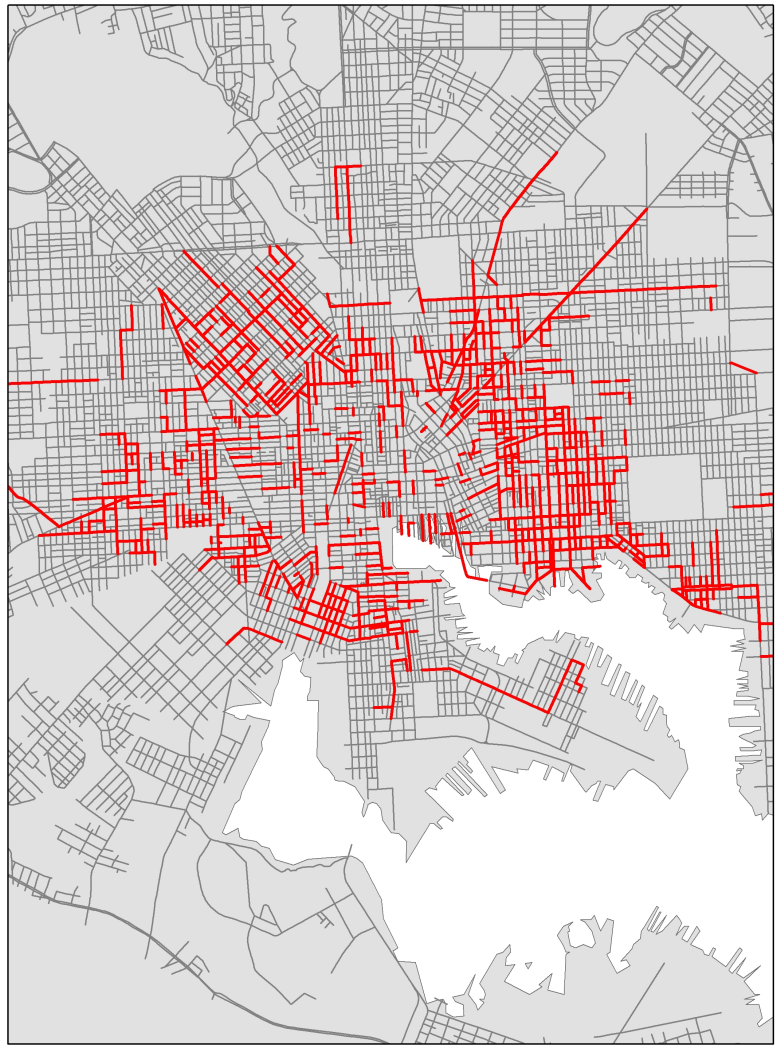
Baltimore's water system, 1860

Access to Water Pipes



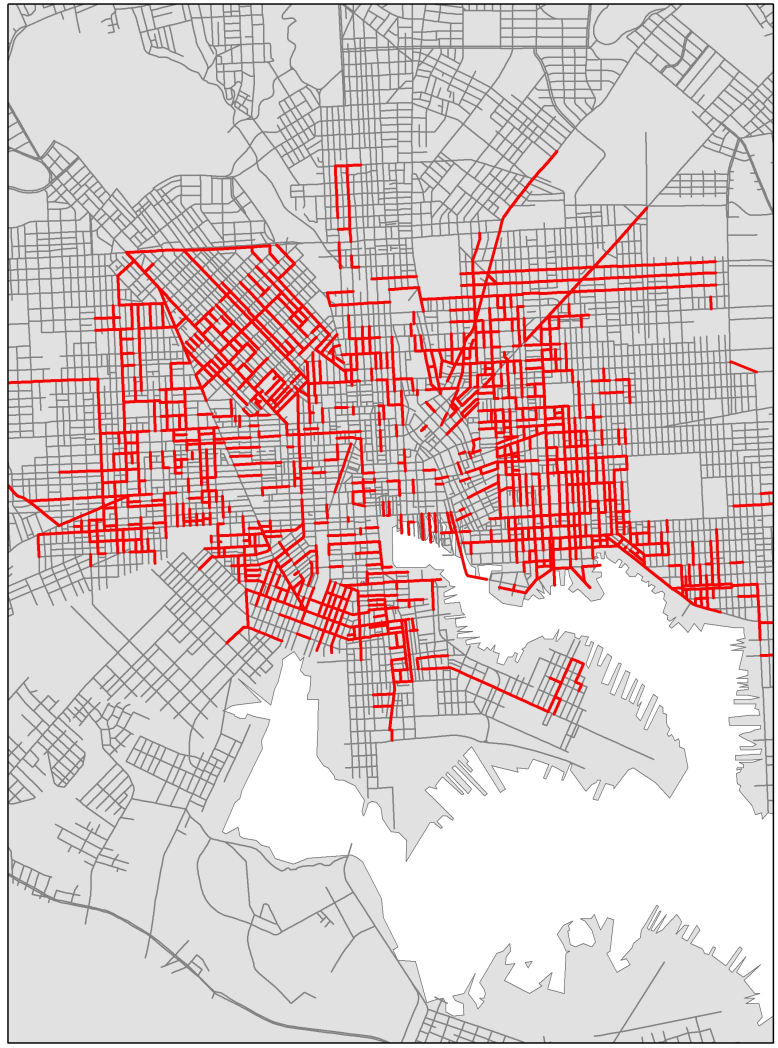
Baltimore's water system, 1865

Access to Water Pipes



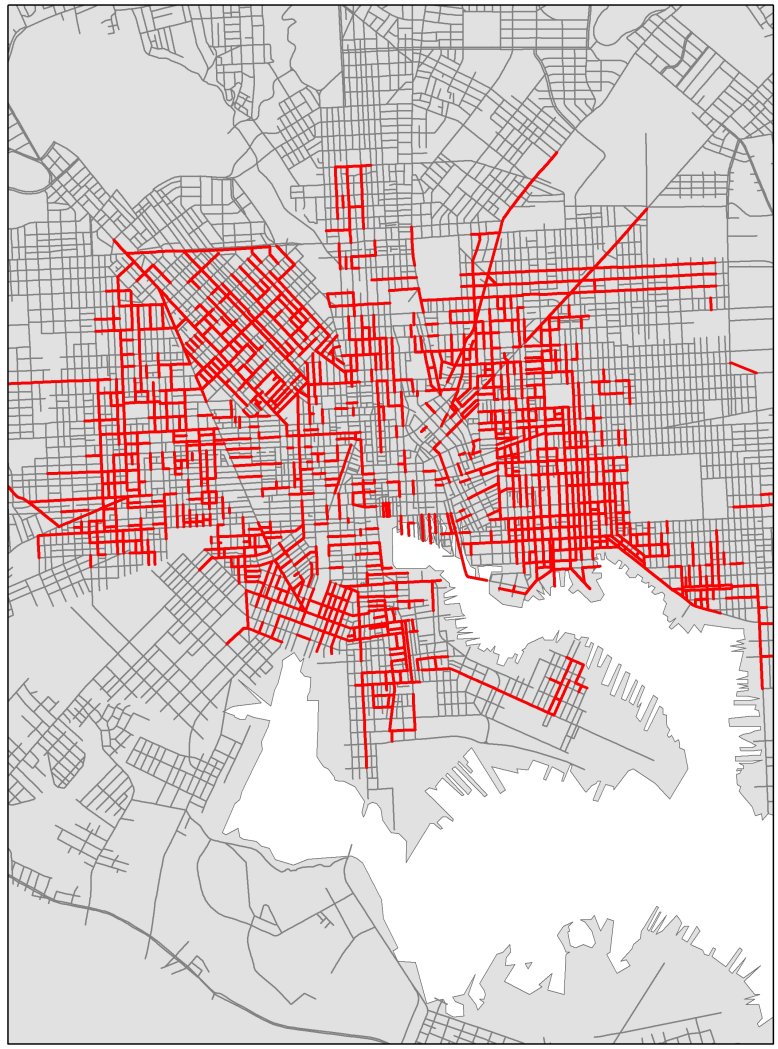
Baltimore's water system, 1870

Access to Water Pipes



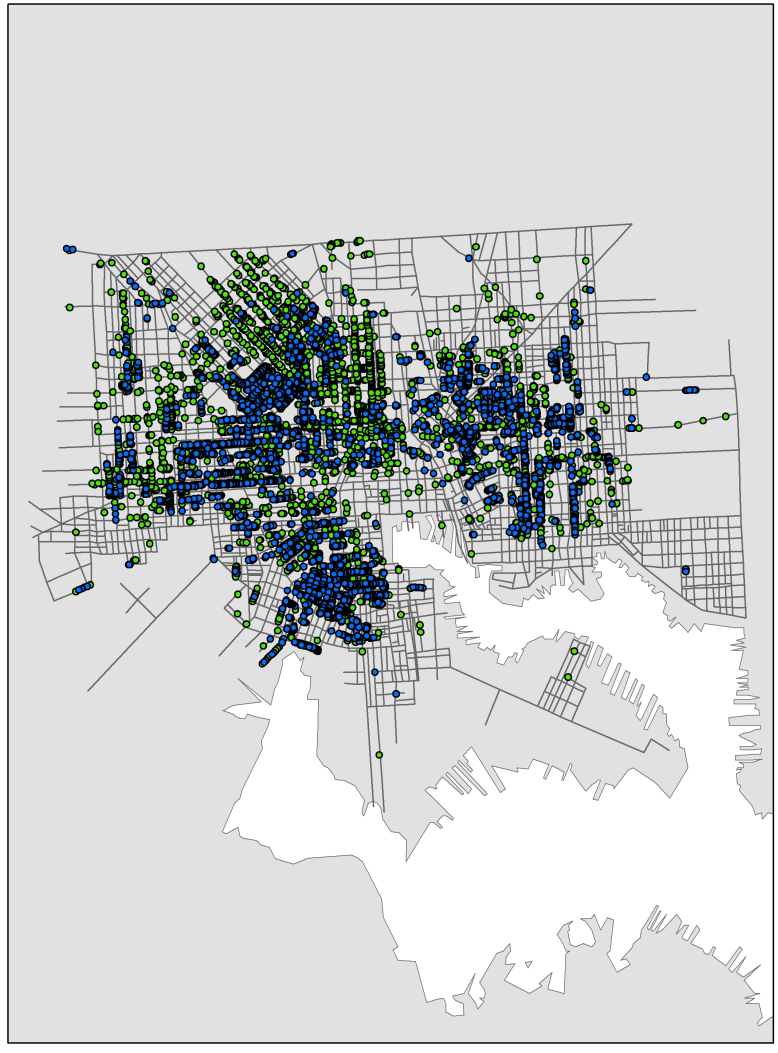
Baltimore's water system, 1875

Access to Water Pipes



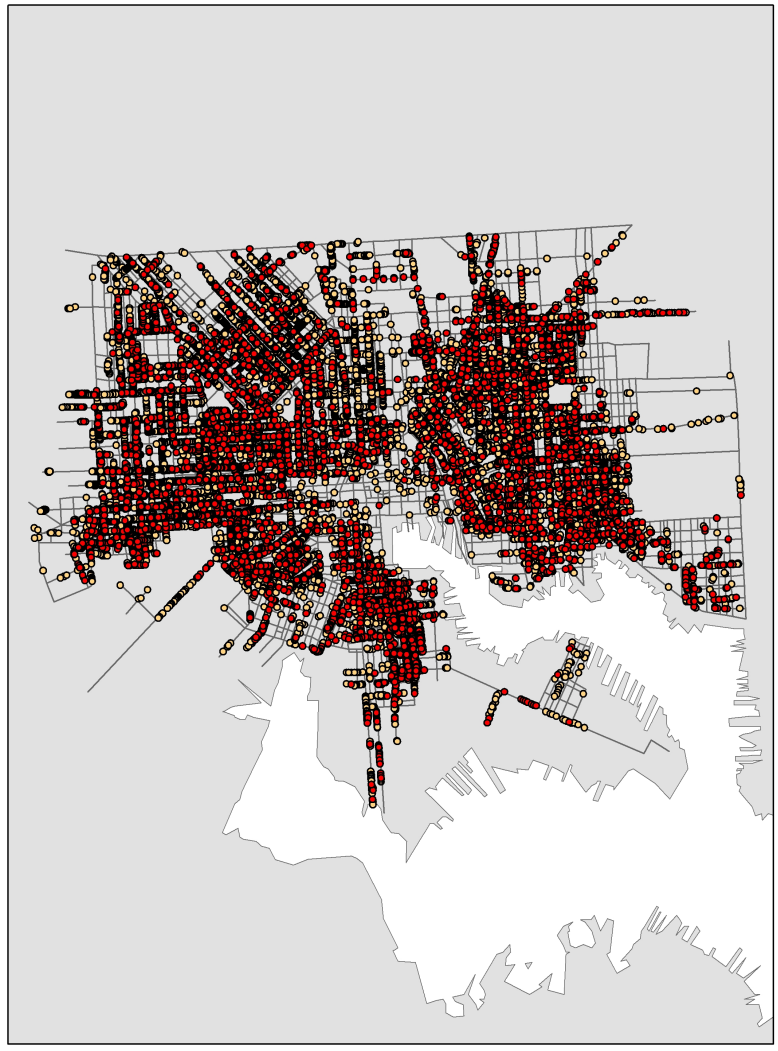
Baltimore's water system, 1880

Access to Water Pipes



Baltimore's black population, 1880

Access to Water Pipes



Baltimore's white population, 1880

Access to Water Pipes

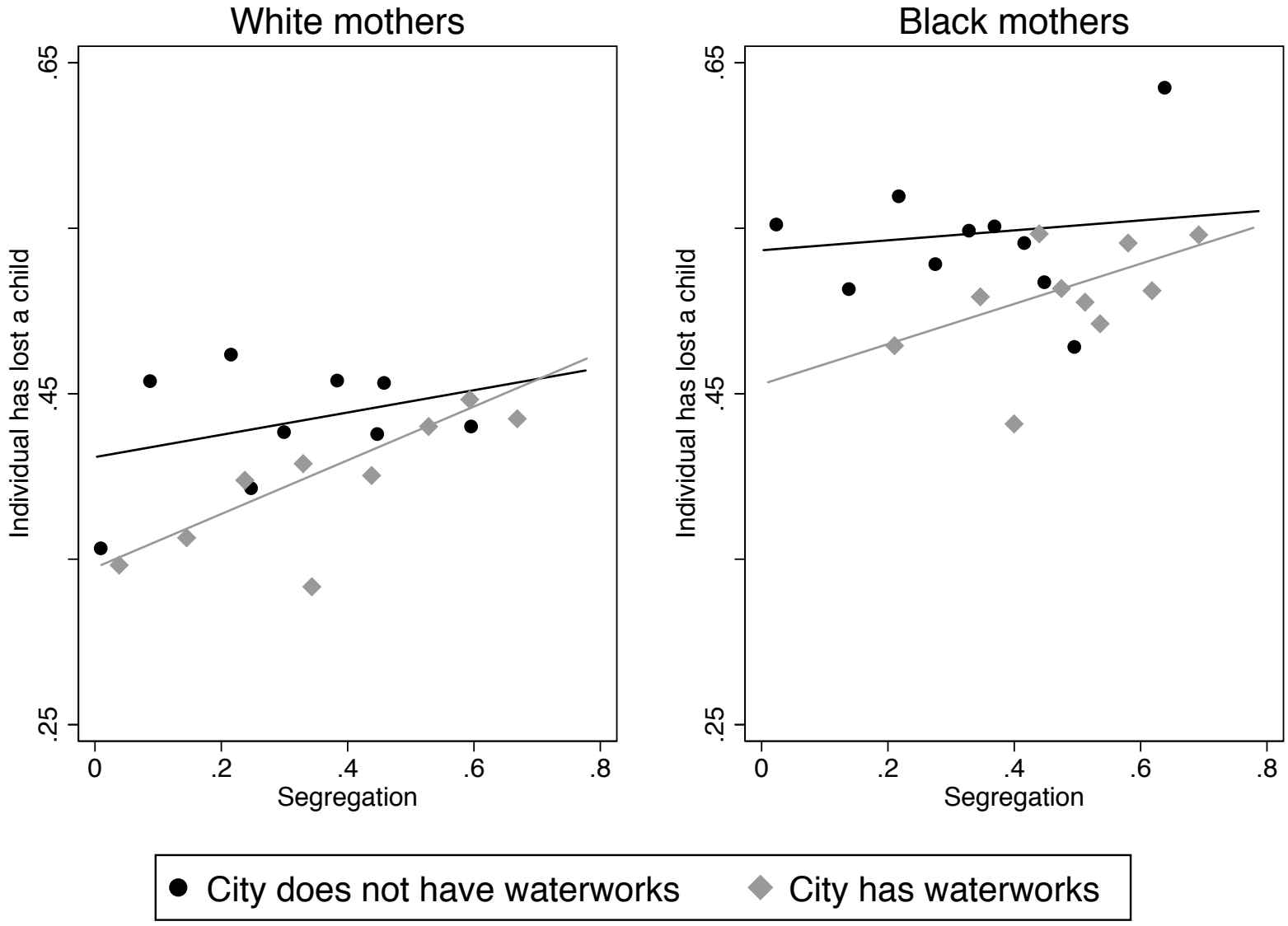
Access to water and sewer by race and city, 1880

	Share with access to water		Share with access to sewer	
	White	Black	White	Black
Baltimore	0.50	0.39	--	--
Boston	0.42	0.31	--	--
Brooklyn	0.77	0.82	0.20	0.27
Chicago	0.87	0.94	0.95	0.86
Manhattan	0.87	0.92	0.53	0.66
Philadelphia	0.78	0.80	0.04	0.04

Health and Access to Water

- Unfortunately, six cities is all we are going to get taking that approach
- An alternative is to focus on health outcomes that may be related to access to clean water
- To look at the largest possible number of cities, our first approach is going to be to impute a proxy for infant and child mortality from the 1900 federal census
- We identify women who have lost a child through the 'children ever born' and 'children surviving' questions
- The basic idea is to relate access to water to the probability of having lost a child

Health and Access to Water



Health and Access to Water

Waterworks construction and infant mortality, dependent variable is whether mother has lost a child by 1900

Sample:	All cities	All cities	Top 50% city size	Top 25% city size
		Panel A: White Mothers		
Water Exposure	-0.037	-0.033	-0.026	-0.030
	(0.012)	(0.012)	(0.014)	(0.018)
Water Exposure		-0.010	-0.020	-0.028
x Segregated City		(0.008)	(0.011)	(0.017)
Sample mean	0.375	0.375	0.374	0.375
Observations	1,704,294	1,704,294	1,543,628	1,336,236
R-squared	0.068	0.068	0.066	0.065

Robust standard errors (clustered at the city level) are reported in parentheses. Sample is restricted to black and white women between the ages of 18 and 55 who have had given birth to at least one child (at the time of 1900 census enumeration). Water exposure is the share of fertile years (ages 18 to 45) that the mother resided in a city with a constructed waterworks. Each regression includes city fixed effects and cohort fixed effects. Segregation is measured using the Logan-Parman segregation index.

Health and Access to Water

Waterworks construction and infant mortality, dependent variable is whether mother has lost a child by 1900

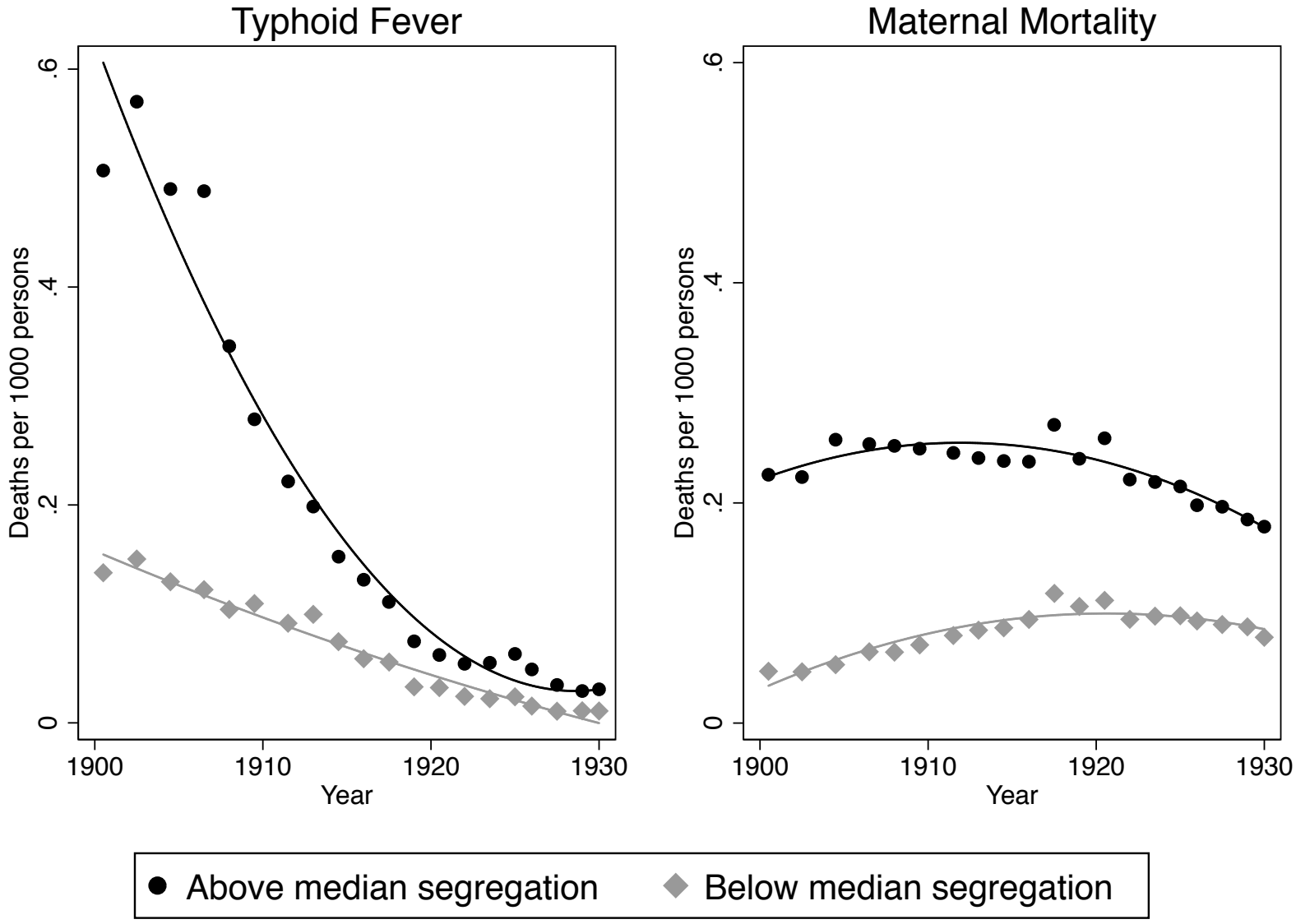
Sample:	All cities	All cities	Top 50% city size	Top 25% city size
		Panel B: Black Mothers		
Water Exposure	-0.041	-0.126	-0.149	-0.123
	(0.012)	(0.022)	(0.031)	(0.044)
Water Exposure		0.093	0.112	0.088
x Segregated City		(0.021)	(0.031)	(0.046)
Sample mean	0.541	0.541	0.541	0.540
Observations	278,839	278,839	238,671	201,970
R-squared	0.068	0.068	0.062	0.058

Robust standard errors (clustered at the city level) are reported in parentheses. Sample is restricted to black and white women between the ages of 18 and 55 who have had given birth to at least one child (at the time of 1900 census enumeration). Water exposure is the share of fertile years (ages 18 to 45) that the mother resided in a city with a constructed waterworks. Each regression includes city fixed effects and cohort fixed effects. Segregation is measured using the Logan-Parman segregation index.

Health and Access to Water

- These results allow us to see variation in health outcomes before and after the construction of waterworks
- But the big health differences may show up when filtration and chlorination technologies diffuse in the early 1900s
- This gives us another way to think about the longer term impacts of the initial water system design decisions
- To do this, we pull mortality rates by cause by city from the annual mortality reports published by the Census Bureau
- We focus on two key causes of death: typhoid fever and maternal mortality

Health and Access to Water



Concluding Remarks

- There are strong ties between the initial construction of American water systems and racial residential segregation
- We see cities with smaller black population shares and higher levels of segregation build sooner
- We also find evidence of black households being excluded from water access in segregated cities
- This exclusion likely had negative health consequences for both the black and white populations
- The next steps are to consider segregation along dimensions other than race