Sewers and Urban Development

Brown University
Economics Department Lunch Lecture

Matthew A. Turner
Brown University
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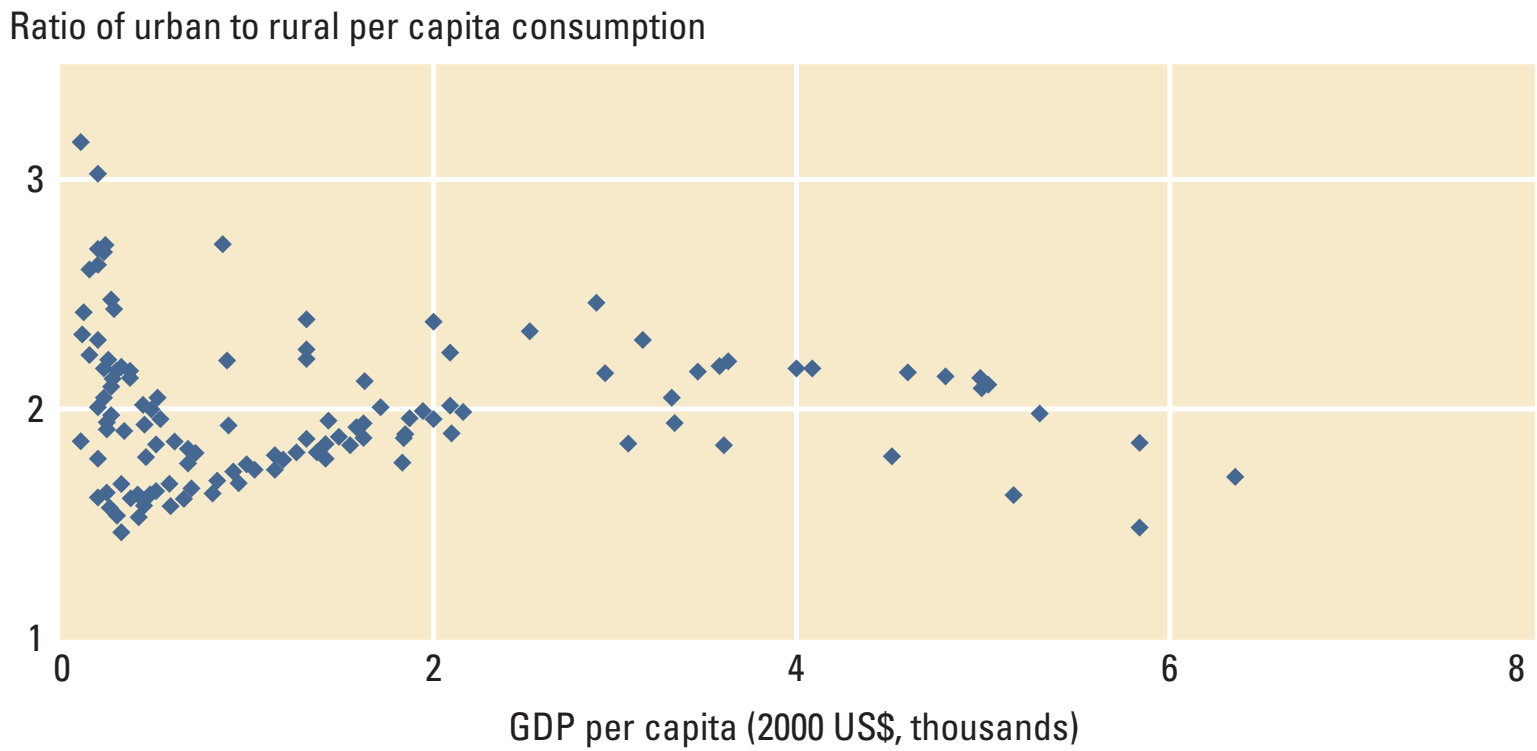
Why aren't people moving to cities faster? I

- In rural Bangladesh, the second rice harvest matures in November. The month before is a seasonal famine, known locally as 'monga'.
- Households can avoid deprivation by sending a household member to work for wages in a nearby city for the season.
- Only about one third of households do so.
- What is so terrible about cities that starving is better?

Why aren't people moving to cities faster? II



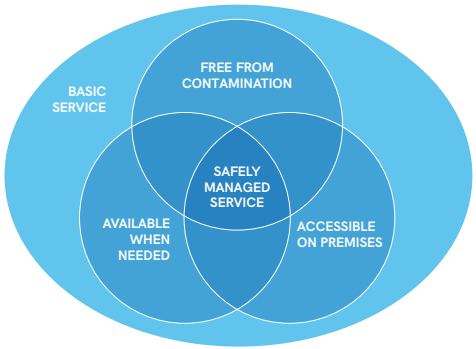
(World Bank, 2009) Urban consumption is usually about double rural consumption in poor countries. It is not just rural Bangladesh.

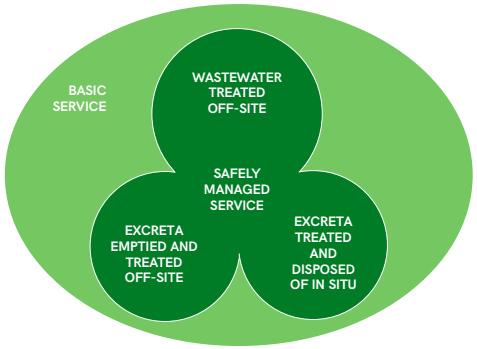
Why aren't people moving to cities faster? III

	% Urban 2018	Urbanization rate %/year, 2010-15
S. Asia	35.8	1.2
S.S. Africa	41.5	1.4
S.E. Asia	48.9	1.3
LAC	80.7	0.3
Europe	74.5	0.25
North America	82.2	0.21

LAC, Europe and North America are all highly urbanized and the urban share is stable. S. Asia, S.E. Asia, and S.S. Africa are less than half urbanized and the urban share is growing rapidly (Henderson and Turner, 2020). Lots of people still live in the countryside.

World availability of water and sewer I





SERVICE LEVEL	DEFINITION
SAFELY MANAGED	Drinking water from an improved water source that is located on premises, available when needed and free from faecal and priority chemical contamination
BASIC	Drinking water from an improved source, provided collection time is not more than 30 minutes for a round trip, including queuing
LIMITED	Drinking water from an improved source for which collection time exceeds 30 minutes for a round trip, including queuing
UNIMPROVED	Drinking water from an unprotected dug well or unprotected spring
SURFACE WATER	Drinking water directly from a river, dam, lake, pond, stream, canal or irrigation canal

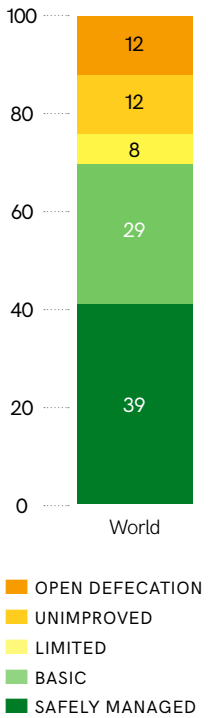
Note: *Improved sources include: piped water, boreholes or tubewells, protected dug wells, protected springs, rainwater, and packaged or delivered water.*

SERVICE LEVEL	DEFINITION
SAFELY MANAGED	Use of improved facilities that are not shared with other households and where excreta are safely disposed of in situ or transported and treated offsite
BASIC	Use of improved facilities that are not shared with other households
LIMITED	Use of improved facilities shared between two or more households
UNIMPROVED	Use of pit latrines without a slab or platform, hanging latrines or bucket latrines
OPEN DEFECATION	Disposal of human faeces in fields, forests, bushes, open bodies of water, beaches or other open spaces, or with solid waste

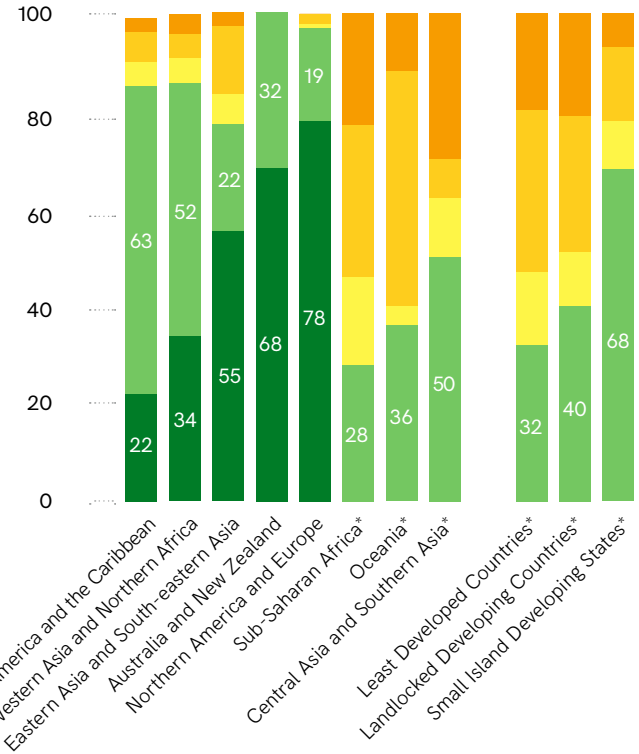
Note: *improved facilities include flush/pour flush to piped sewer systems, septic tanks or pit latrines; ventilated improved pit latrines, composting toilets or pit latrines with slabs.*

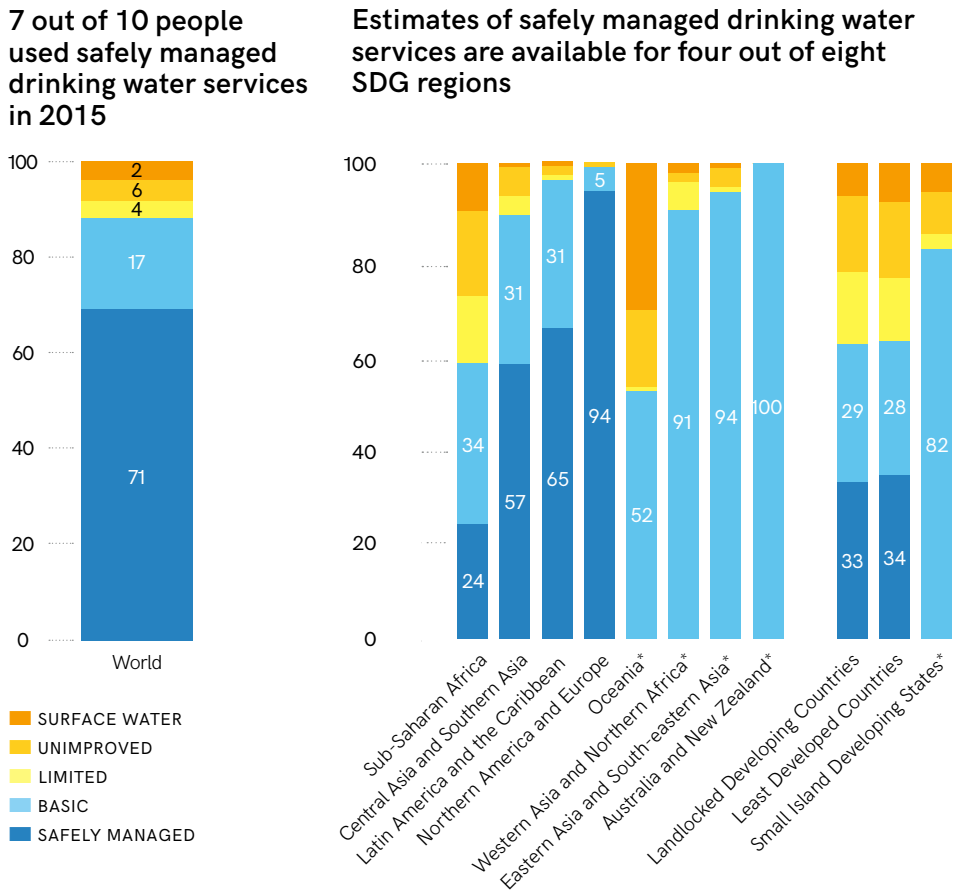
World Health Organization (2017)

Two out of five people used safely managed sanitation services in 2015



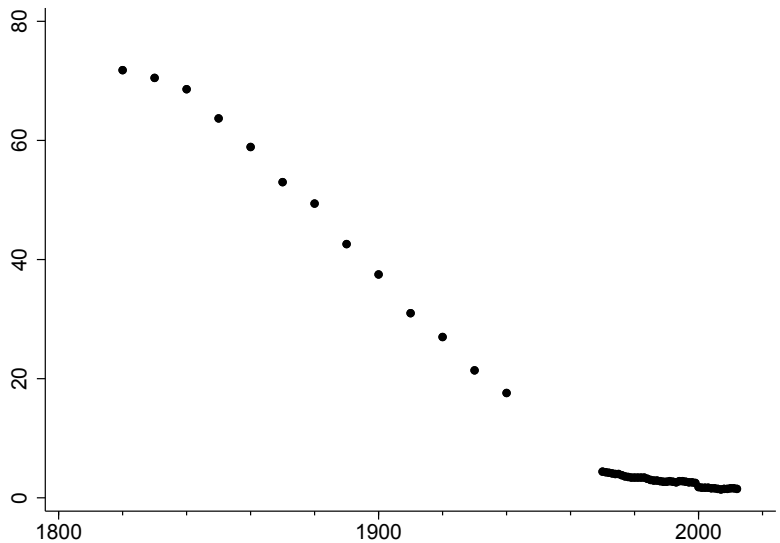
Estimates of safely managed sanitation services are available for five out of eight SDG regions





Water and sewer service is in short supply in much of the world, especially developing country slums. Sewers are scarcer than piped water.

Public health and the growth of US cities



% US Employment in Ag. (FRED)

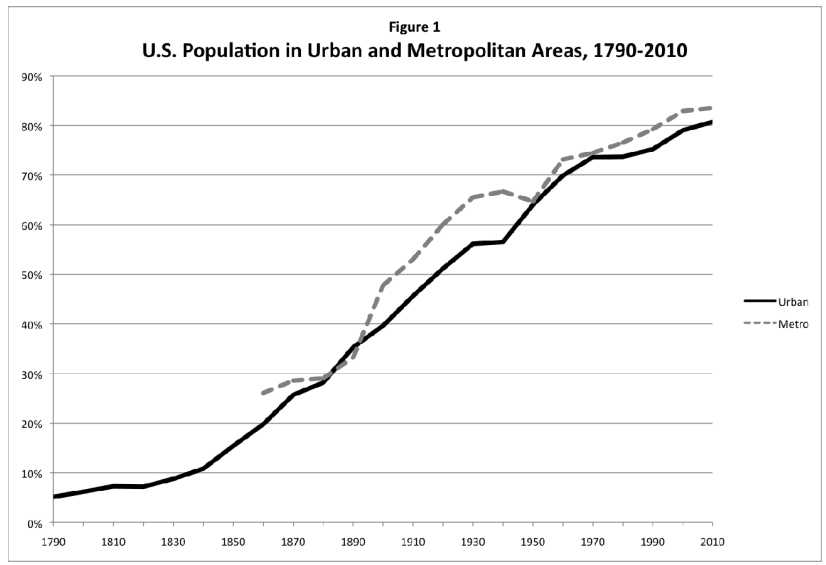
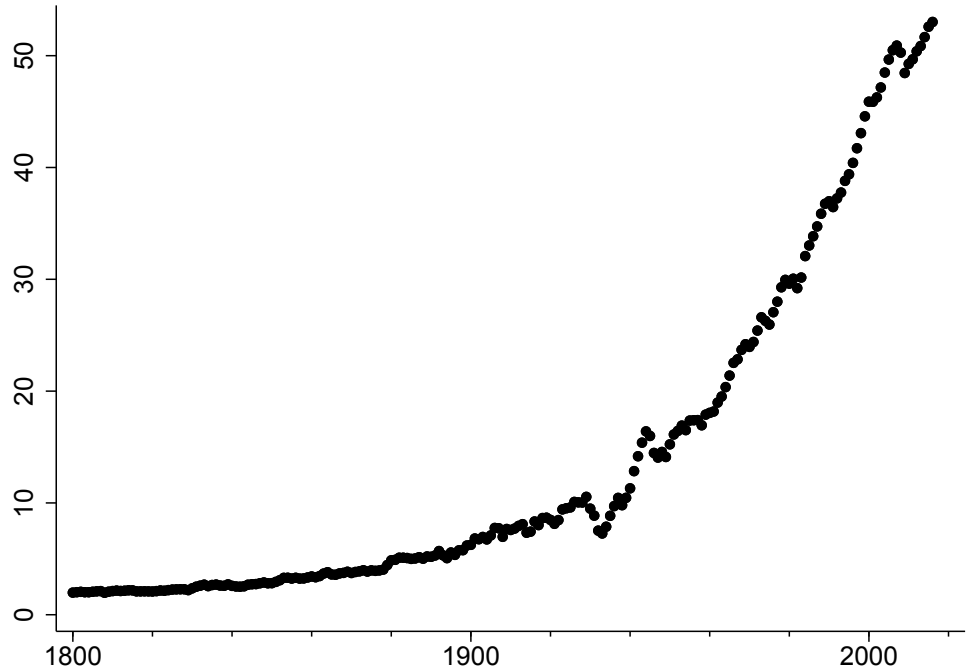


Figure 1: Before 1950, the urban share only includes residents living in incorporated places. From 1950 onward, the urban share includes residents living in both incorporated and unincorporated places. Data on urban population shares are from the U.S. Census Bureau. Metropolitan area population shares were calculated using data and the contemporaneous definitions provided by IPUMS in each year.

Boustan et al. (2013).



Real per capita GDP in constant 2011 dollars from Bolt and Van Zanden (2014). From 1800 to 2016, US incomes increased from 1980$ to 53015$, a factor of about 27.

Fig. 2 *Crude Death Rate*
Boston, MA, 1811-1920

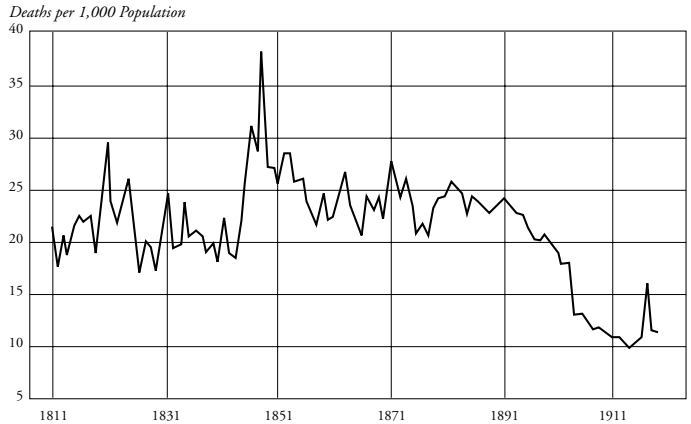


Fig. 3 *Crude Death Rate*
Philadelphia, 1802-1920

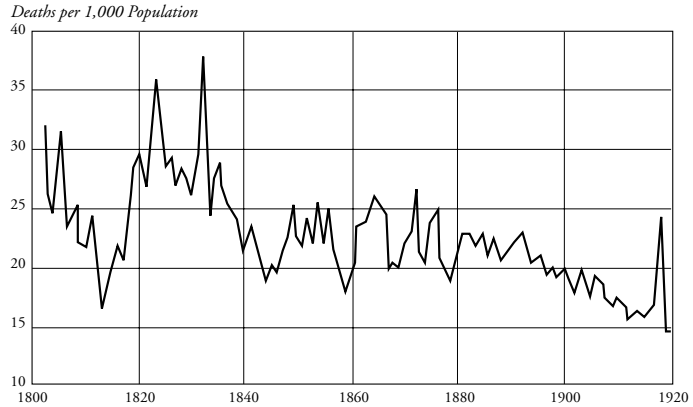


Fig. 1 *Crude Death Rate*
New York City, 1804-1900

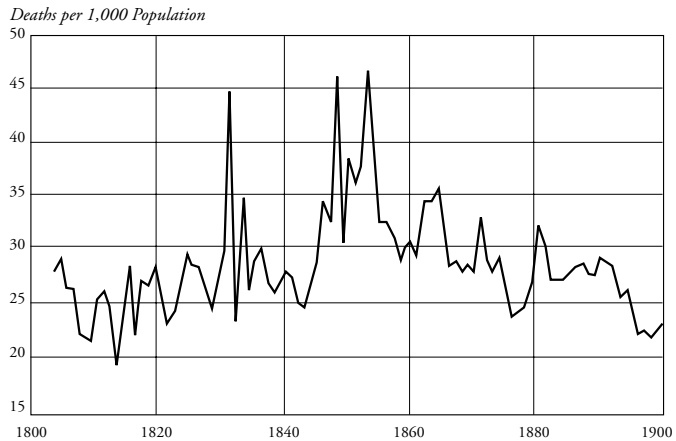
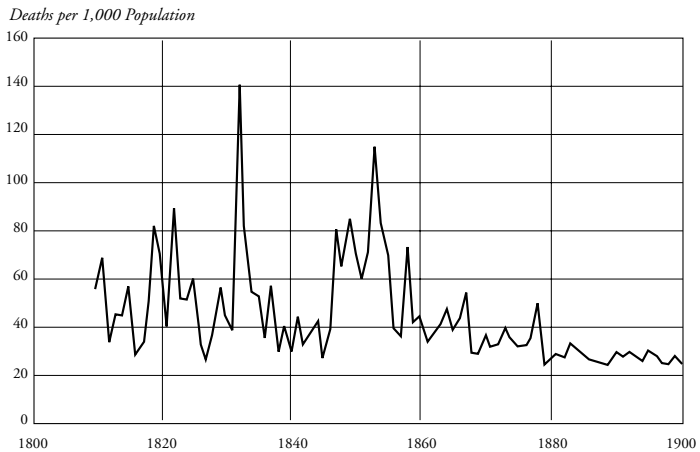


Fig. 5 *Crude Death Rate*
New Orleans, 1810-1900



Crude death rates were 20-80 in 19th century US cities, and fell in the 20th century (Haines, 2001).

Figure 1: Infant Mortality in the United States and Massachusetts: 1850 to 1998

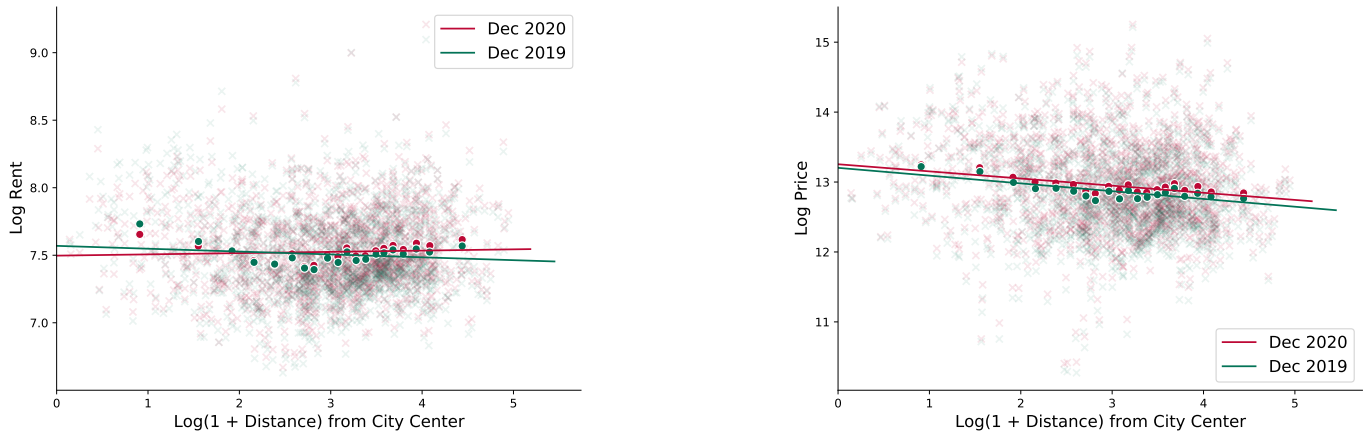
Infant mortality in the US and Massachusetts in the 19th century was terrifyingly high (Alsan and Goldin, 2019). Current US rates are about 5 per 1000.

Decade	Ratio
1870-1880	1.38
1880-1890	1.50
1890-1900	1.35
1900-1910	1.33
1910-1920	1.21

Ratio of urban to rural crude death rates in the US, by decade. The urban mortality premium was about 40% in 1780 and declined to 20% by 1920 (Haines, 2001).

- Three events approximately coincided in the late 19th and early 20th century.
  - Urban population increased
  - Productivity increased
  - Urban mortality rates fell
- This suggests that improvements to urban public health were an important contributor to the growth of US cities.

Covid and US cities



Left: relationship between log distance from the city center and log rent before (green) and after (red) the pandemic. Right: sale price gradients (Gupta et al., 2021).

Public health is still important for US cities.

Water and sewer interventions and public health I

The effect of late 19th and early 20th century municipal water quality is well studied;

- (Alsan and Goldin, 2019) Interaction of water and sewer main in a municipality gives a 26% decrease in infant mortality, Boston Harbor watershed, 1880 to 1920.
- (Anderson et al., 2018) Sample of 25 US cities between 1900 and 1940. Manage sewage outflows 0% effect on infant mortality, water filtration 11% decline. Joint effect of all water quality related interventions is 4%. Note disagreement with (Alsan and Goldin, 2019).

Water and sewer interventions and public health II

- (Ferrie and Troesken, 2008) Event study of improved municipal water quality on mortality and future mortality in 19th century Chicago. Improved water quality reduces crude death rate by 18-30% from 1850-1925.
- (Kesztenbaum and Rosenthal, 2017). Completely sewering an unsewered Paris neighborhood between 1880 and 1915 gives 1-3 years of life expectancy at birth.

Water and sewer interventions and public health III

The effects of improvements to water and sewer infrastructure have also been studied in the context of the modern day developing world.

- Bhalotra et al. (2021) looks at the roll-out of municipal water treatment in late 20th century Mexico reduced childhood mortality from diarrheal disease by about half.
- Gamper-Rabindran et al. (2010) finds that roll-out of piped water, but not sewer access, has an important effect on infant mortality in Brazil around 2000.
- Devoto et al. (2012) finds that access to piped drinking water increases time spent at leisure but does not affect childhood incidence of waterborne disease in Morocco in 2007.

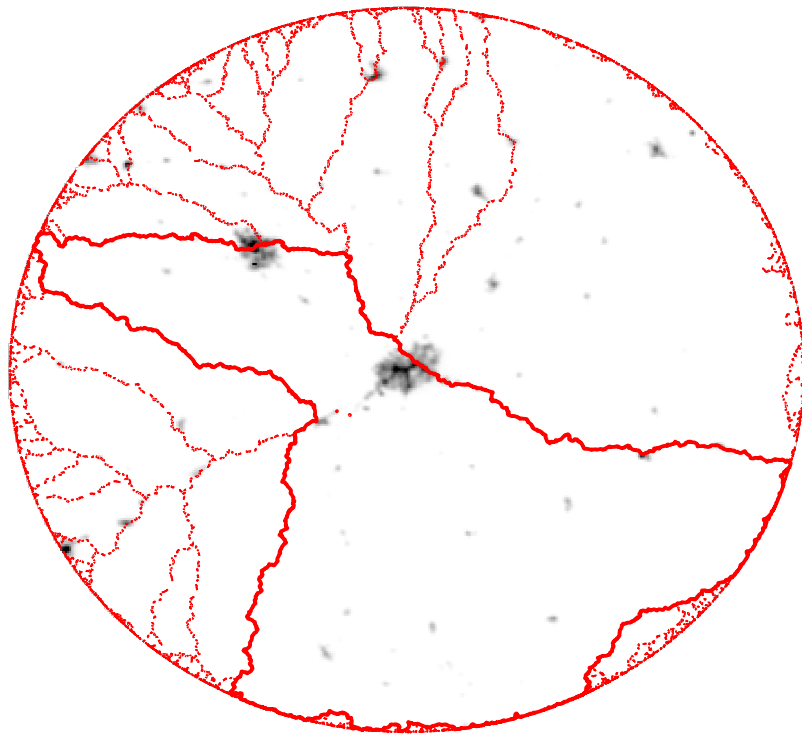
Water and sewer interventions and public health IV

- Ashraf et al. (2017) find that more reliable drinking water supplies decreases childhood diarrheal disease and increases the time girls spend at school in urban Lusaka in 2000.

Sewers and urbanization I

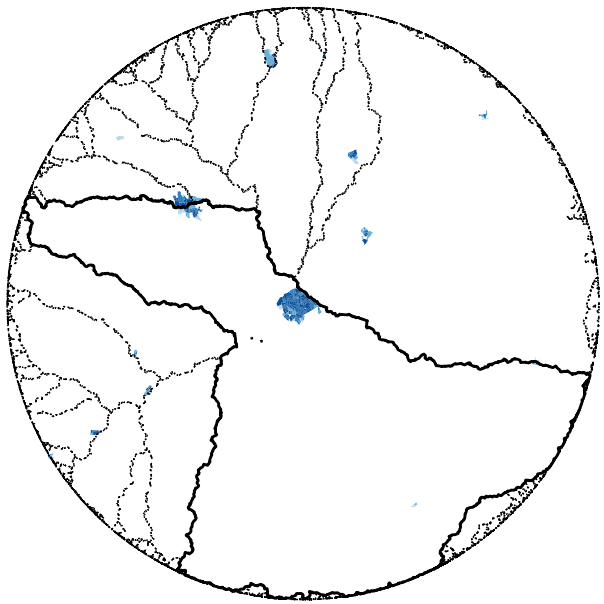
We would like to estimate how urban population density responds to sewer access by comparing census tracts on opposite sides of drainage basin divides.

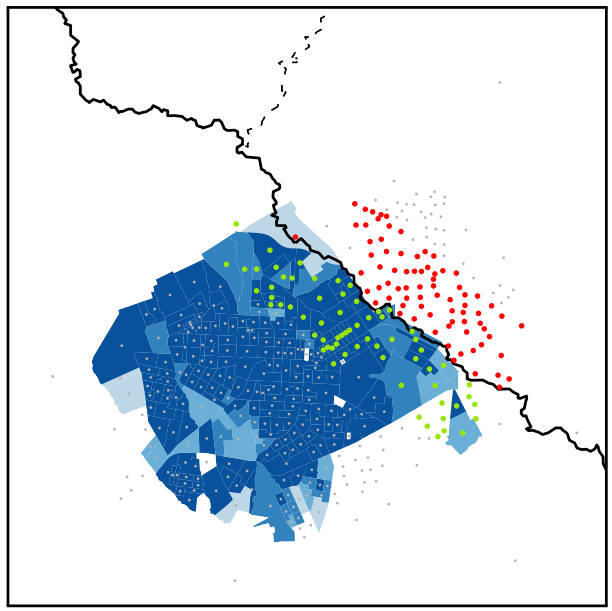
Drainage basins around Cascavel, Brazil



Dashed Red lines indicate drainage basins boundaries. The disk has a radius of 75KM.

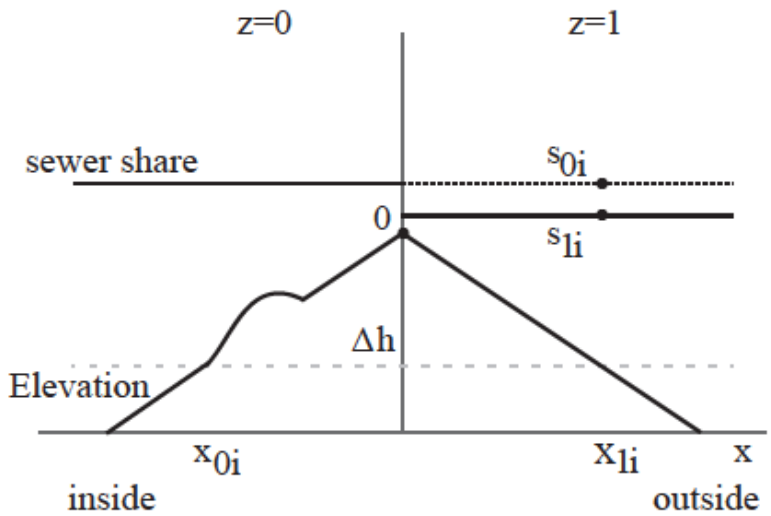
Sewer access around Cascavel, Brazil





Darker blue indicates a larger share of households reporting a toilet connected to a public sewer. Dots indicate census tract centroids.

Identifying treatment effects around a stylized basin boundary



Elevation and sewer share profile around a drainage basin divide.

Adding 1% of city households to the sewer network is about as important as a large transportation infrastructure project.

Conclusion

- There is a large persistent rural-urban income gap in developing countries. This is puzzling.
- Sanitation is primitive for many residents of developing world cities.
- Improvements in public health were probably important for the growth of US cities. COVID suggests this is still true.
- Interventions to improve municipal water almost certainly have important health benefits in the 19th century developed world and in the modern developing world.
- Sewer access has a large effect on urban population density in developing world cities.
- This suggests that we could reduce hunger in rural Bangladesh by improving urban sanitation, and these effects are likely large.

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