Sewers and Urbanization

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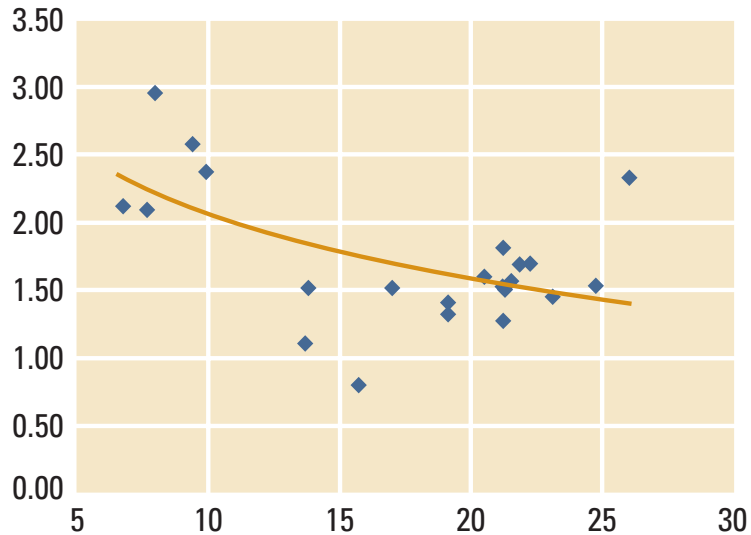
Introduction I



Ratio of urban to rural income by country income per capita (Scott, 2009). The rural-urban wage gap in the US is about 30% from 1850-1970.

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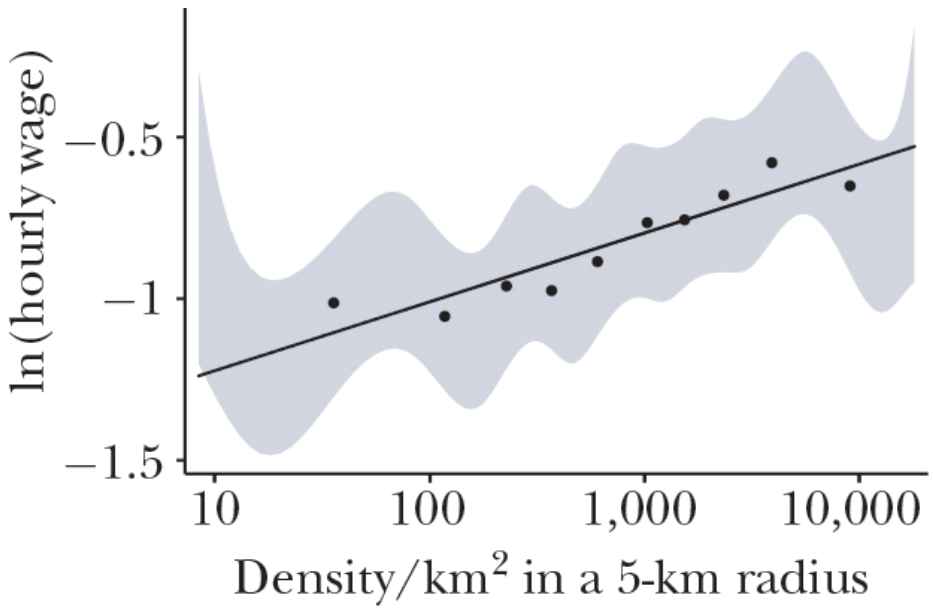
Introduction II



Conditional log wage by the log of population density in a 5km disk around DHS respondent's location in Ethiopia, Ghana, Malawi, Nigeria, Tanzania and Uganda. Slope is 0.05 (Henderson and Turner, 2020).

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Introduction III

- We are more productive working at higher densities (and with different people) than the densities at which we want to live. Cities are how we solve this problem.
- This leads to three questions,
  1. How much more productive, and why?
  2. How does the cost of commuting affect the way cities are organized?
  3. What determines our willingness to tolerate density?
- The first two questions are well studied. Not the third.
- This lecture attempts two things
  - To describe what we know about how sewage and sanitation affects urban residents and their willingness to tolerate density.
  - To sketch a process for valuing sewage infrastructure.

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Introduction IV

- There are many related policies that may also affect our willingness to tolerate density. For example;
  - drinking water delivery and quality,
  - law and order,
  - sewer service
  - vaccination,
  - trash collection,
  - fire protection,
  - noise and pollution.

  The impact of these services on the organization of cities is also not well studied. My prior is that their importance corresponds approximately to their listed order.

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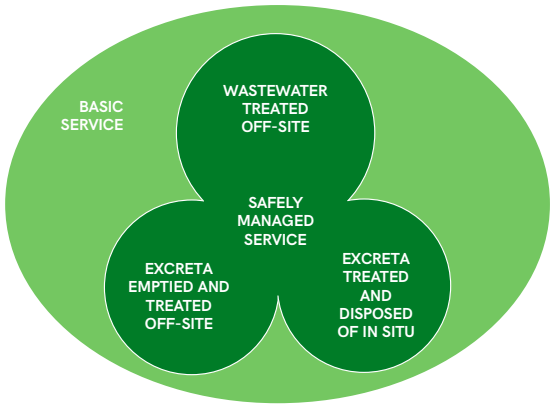
World availability of water and sewer I



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)

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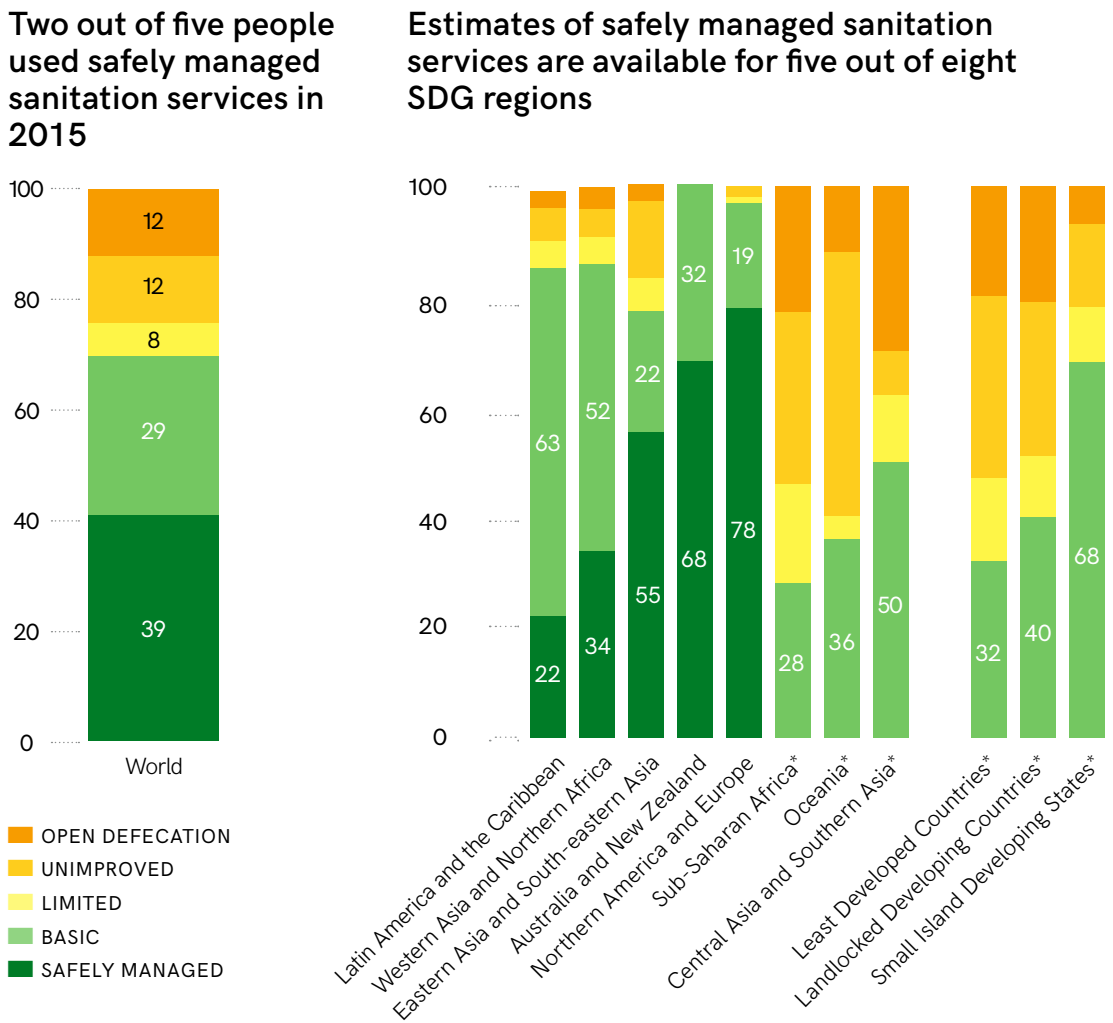
World availability of water and sewer II



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World availability of water and sewer III

- Water and sewer service is in short supply in much of the world, especially developing country slums. Sewers are scarcer than piped water.
- About 15% of the world's urban population does not have access to safely managed water.
- About 40% of the world's urban population does not have access to safely managed sanitation.(Piped water is more common than sewers, and necessary for them to operate.)
- 94% of households in central Capetown have sewer access. For Soshanguve, this share is 65%. Dar es Salaam is 2%.

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Public health and the organization of cities

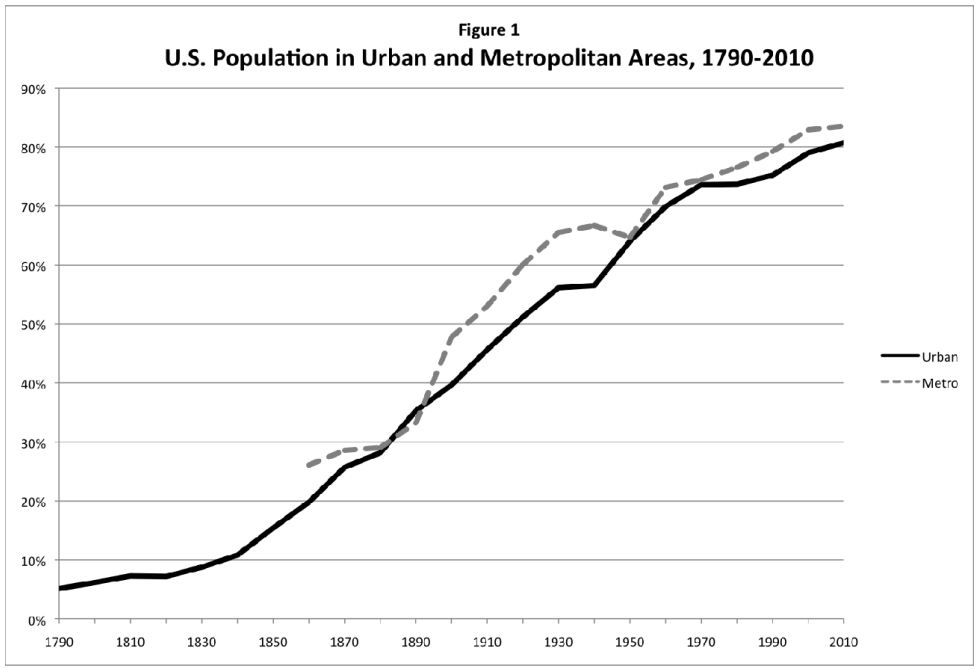

Figure 1: Before 1950, the urban share only includes residents living in incorporated places. From 1950 onward, the urban share includes residents living in both incorporated and unincorporated places. Data on urban population shares are from the U.S. Census Bureau. Metropolitan area population shares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

Growth of urban share of US population (Boustan et al., 2013).

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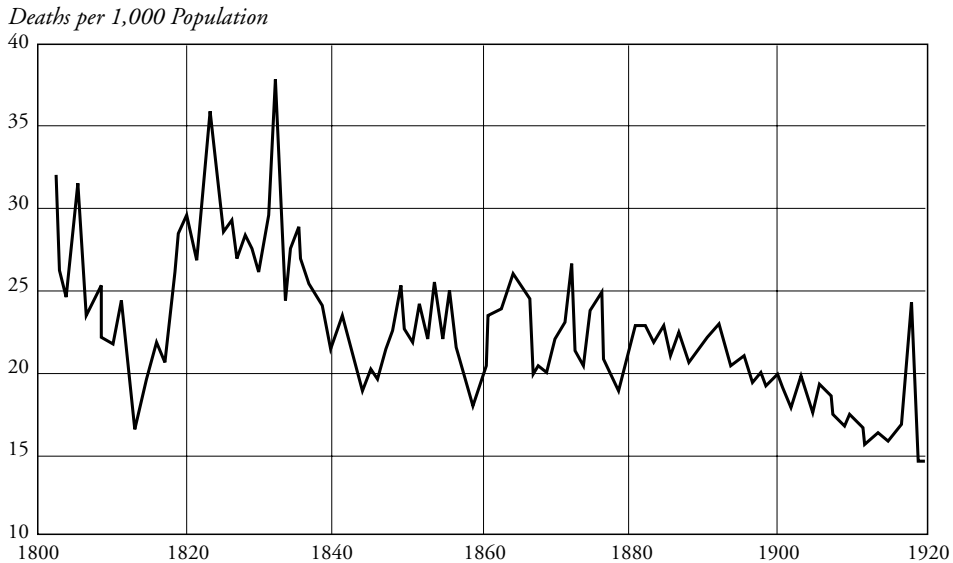
Fig. 3 *Crude Death Rate*
Philadelphia, 1802-1920



- Crude death rates were 20-80 in 19th century US cities, and fell in the 20th century (Haines, 2001).
- The urban mortality premium in the US fell from 1.4 in 1870 to 1.2 in 1910 to about 0.7 today (Haines, 2001).

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- Three events approximately coincided in the late 19th and early 20th century US;
  - Urban population increased
  - Productivity increased
  - Urban mortality rates fell
- The conventional wisdom is that the decline in the absolute and relative level of urban mortality was an important contributor to the process of urbanization and growth in the US. (It would be nice to have better evidence for this).
- Recall, cities grew rapidly in spite of the mortality premium.
- Modern experience with Covid confirms the importance of public health for process of urbanization in the US (Gupta et al., 2021).

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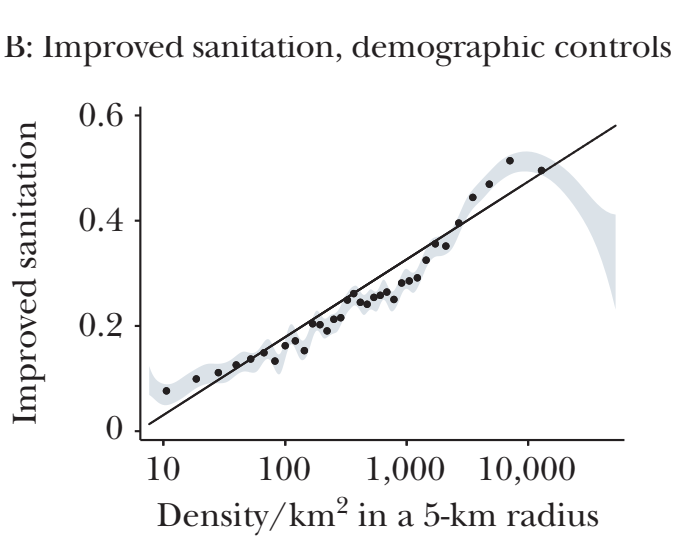
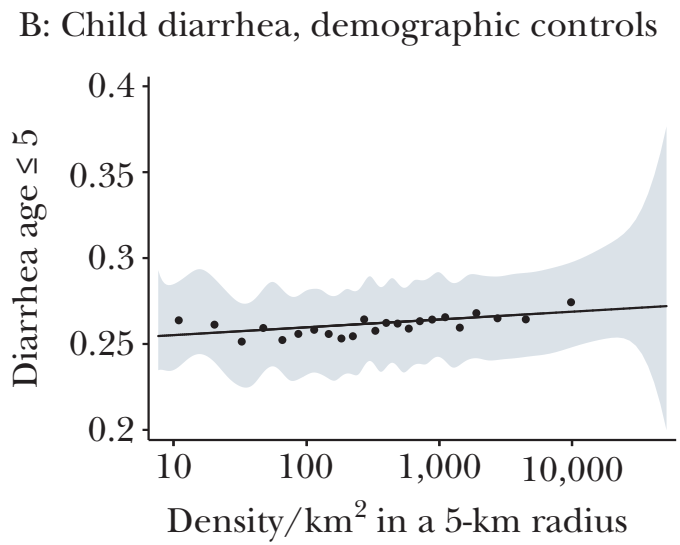
- The pattern in modern day Africa is not obviously the same. African cities are not obviously more dangerous than rural regions (Henderson and Turner, 2020).





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Water and sewer interventions and public health I

- Water and sewer together gives a 26% decrease in infant mortality, Boston Harbor watershed, 1880 to 1920 (Alsan and Goldin, 2019).
- 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% (Anderson et al., 2018). Note disagreement with Alsan and Goldin.
- Universal sewers in Paris 1880-1915 gives 1-3 years of life expectancy at birth (Kesztenbaum and Rosenthal, 2017).
- Improved municipal water quality in Chicago reduces crude death rate by 18-30% from 1850-1925 (Ferrie and Troesken, 2008).

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Water and sewer interventions and public health II

- Privatizing Argentina's water supply services led to an 8% reduction in child mortality, all from a reduction in waterborne disease (Galiani et al., 2005).
- Water treatment in late 20th century Mexico reduced childhood mortality from diarrheal disease by about half (Bhalotra et al., 2021).
- Piped water, but *not* sewer access, has an important effect on infant mortality in Brazil around 2000 (Gamper-Rabindran et al., 2010).
- Access to piped drinking water increases time spent at leisure but does not affect childhood incidence of waterborne disease in Morocco in 2007 (Devoto et al., 2012).

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Water and sewer interventions and public health III

- More reliable drinking water supplies decrease childhood diarrheal disease and increases the time girls spend at school in urban Lusaka in 2000 (Ashraf et al., 2017).

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Water and sewer interventions and public health IV

Where does this leave us?

- Interventions to improve access to safe drinking water have important health benefits in the developing world and the 19th century US. There is disagreement about effect sizes, or treatment effects are heterogenous ways that is not understood.
- The evidence for the effects of sewer access on health is less clear.
- Conjecture: If sewers don't keep sewage out of drinking water then they don't have large effects on health. If a place is swampy, like Chicago or Lagos, or if typhoid and cholera are common, then sewers probably help.

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Water and sewer interventions and cities

- Alsan and Goldin (2019) fail to reject zero effect of water and sewer mains on; demographics or population density, but confidence intervals are large.
- Land values in 19th century Chicago more than double with access to sewer network (Coury et al., 2024). This suggests an increase in density.
- 1% increase in share with sewer access gives 6% increase in population density in 5 developing countries. No evidence of demographic sorting (McCulloch et al., 2025).

There is a lot more here to do.

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Conclusions I

Let's think about the value of making sewer access universal in central Soshanguve.

- 65% currently have sewer access. At 6% population increase per 1% sewer access, universal sewers increase central population by about 200% (calculation is tract-by-tract)
- Existing population should see wages go up by about $2 \times 0.05 = 0.10$. New arrivals should see their wages increase by the rural-urban gap. Guess at this increase in regional income from sewers.
- Cholera and typhoid appear rare in Soshanguve even though only 60% have piped water. Expect modest public health improvements from sewers.

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Conclusions II

- Piped water is necessary to operate sanitary sewers, so we need to build this out too/first.

We can use this number to compare to the cost of the project, or to the benefits of other projects.

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