Building the city:
Urban transition and institutional frictions

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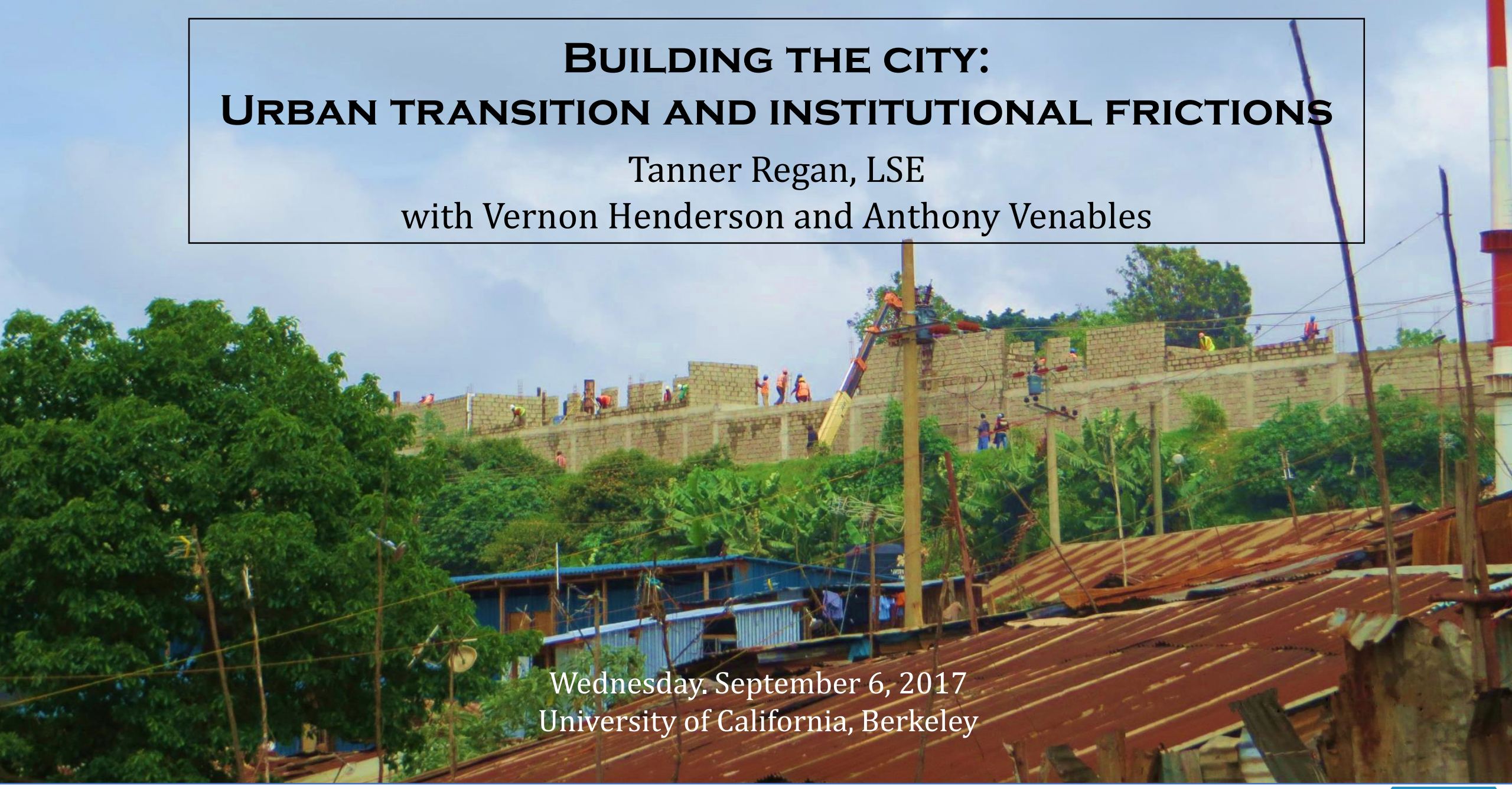
with Vernon Henderson and Anthony Venables



Wednesday. September 6, 2017
University of California, Berkeley

What this paper is all about

Urban theory for the developing world

- Dynamic monocentric city model with informality

Very high resolution satellite data

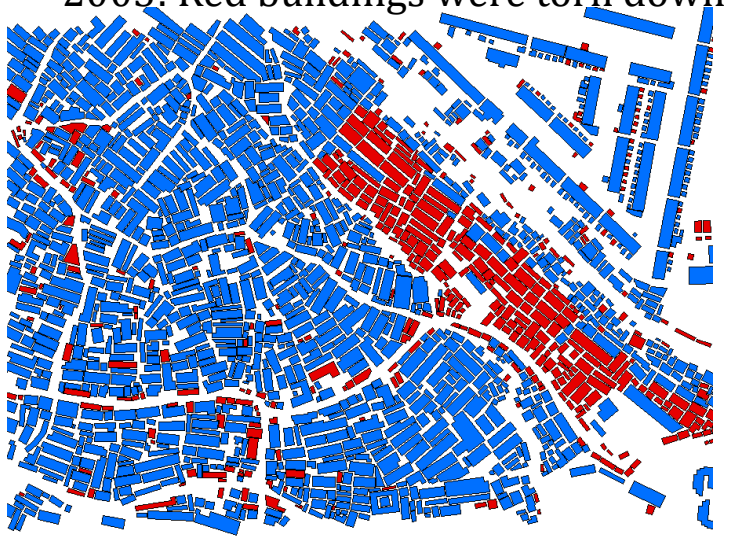
- Nairobi 2003 and 2015 manually traced buildings

Estimate the cost of delays

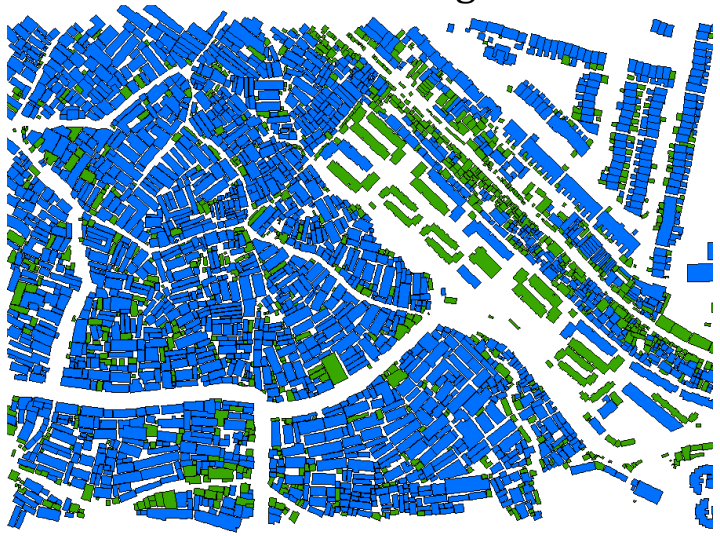
- Guiding policy makers towards efficient urban development

Kibera, Nairobi

2003: Red buildings were torn down

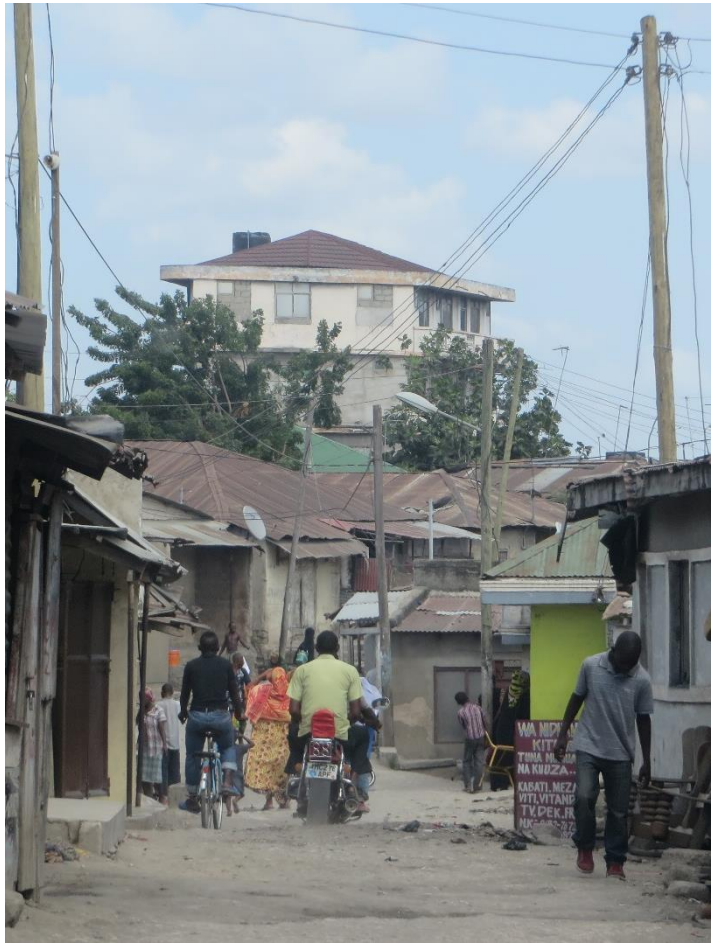


2015: Green buildings are new



Why is this new and important?

Tandale, Dar es Salaam
June 2016



Cities in sub-Saharan Africa are:

- Big, numerous, and fast growing
- High incidence of informal settlements

Economic relevance of volume

- The capital stock of a country is primarily in buildings

Contribution

- Urban theory has been focused on the developed world
  - Change is slow and land markets are formal
- No study in econ that details changes in buildings, with demolition, redevelopment, and infill
- Methodology to calculate welfare cost of old slums

A monocentric model for the developing world

Building technologies

Formal builds using 'putty-clay'

- Choose height
  - Assume a single cover to area ratio
- Height fixed until redeveloped
- Taller buildings are increasingly costly

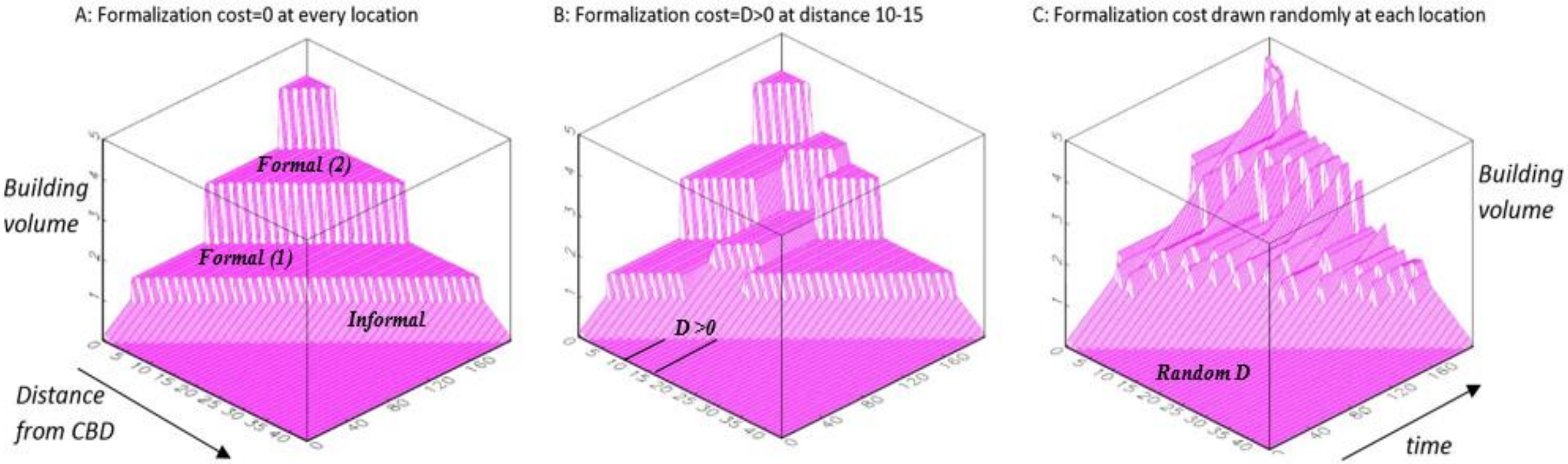
Slum rents flexible 'Meccano parts'

- Choose cover
  - Assume single height
- Cover continuously adjustable
- More cover (crowding) lowers quality

Kibera, Nairobi 2014

flexible but not load bearing slum 'technology'
tall but durable formal 'technology' in the background

Simulated city (results)



Measuring the evolution of the built environment in Nairobi 2003-2015

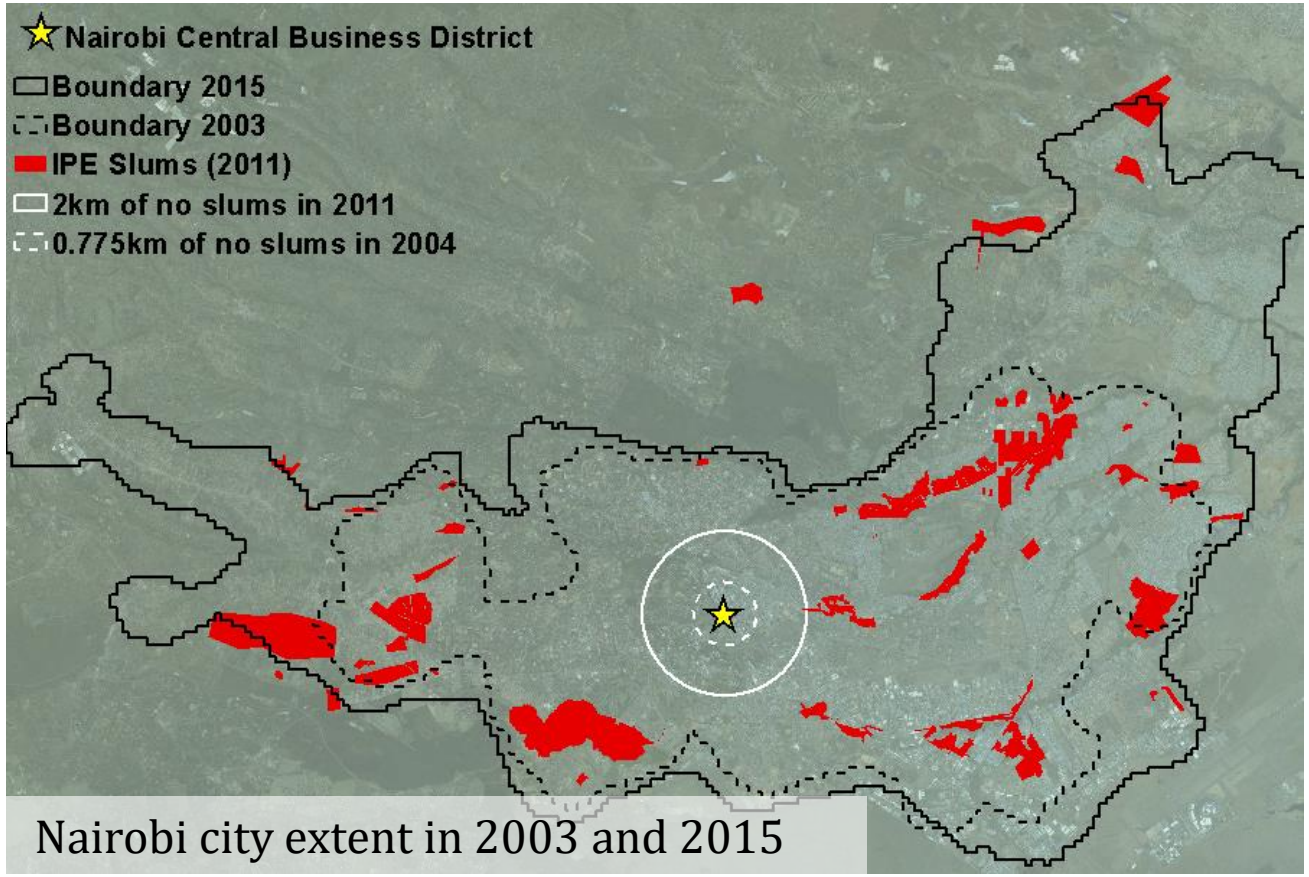
Empirical work

Building footprints

- Our algorithm identifies unchanged buildings, redevelopment, infill, and demolition
- Height data for 2015 from LiDAR
  - For 2004 interpolate using nearby unchanged buildings

Slum definition

- Slum areas are based off a single 2011 map



Nairobi city extent in 2003 and 2015

*Threshold built cover above 10% to define the city extent in 2003 and 2015

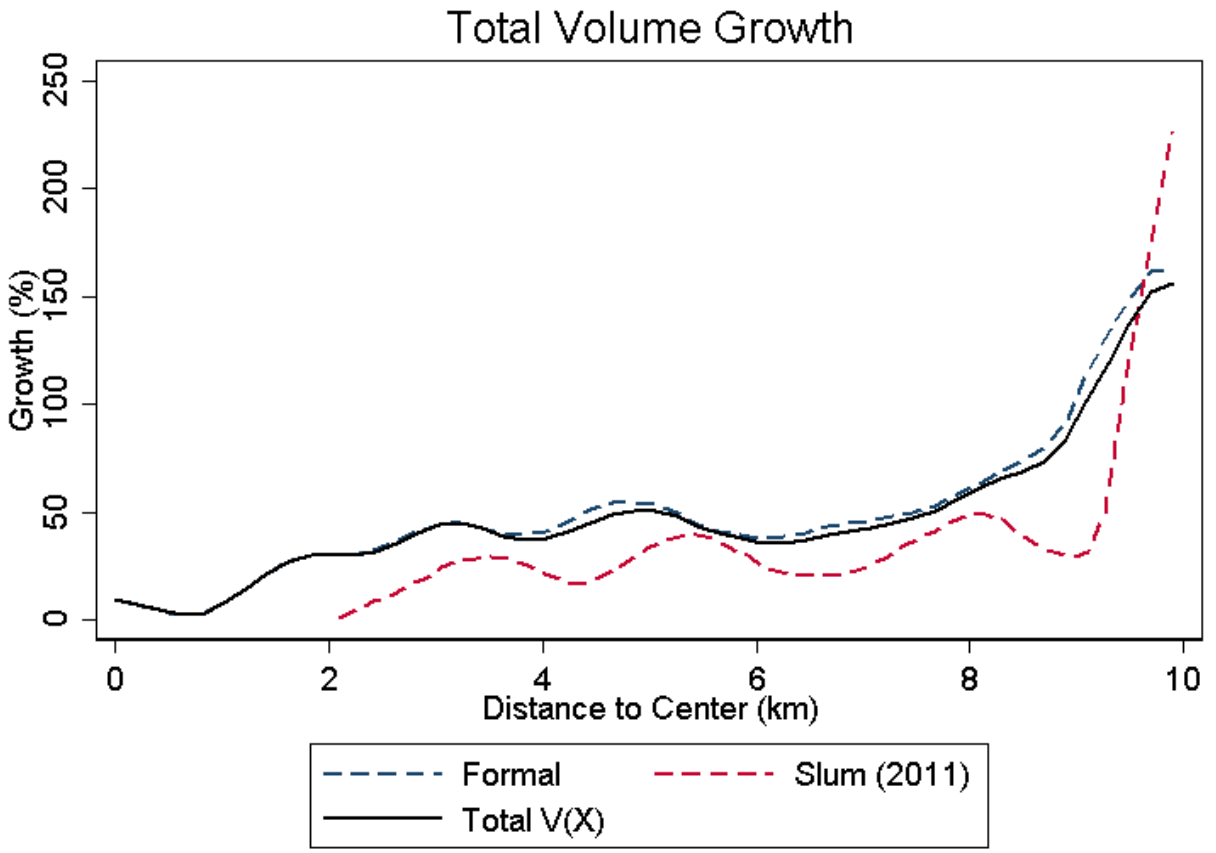
Volume growth

Evolution 2003-2015

- Total volume increases 59% inside the 2015 extent
- Overall growth is slightly higher in formal (60% vs 55%)
  - Formal sector grows more quickly until 9km, then slum takes over

Churning

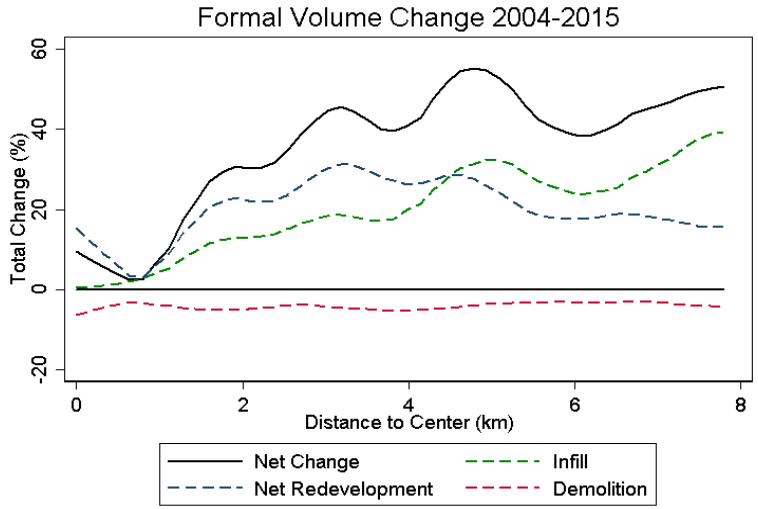
- 35% of buildings torn down inside 3km
  - Roughly three times what would be typical in a US city



BREAKING DOWN GROWTH

The process of change (formal)

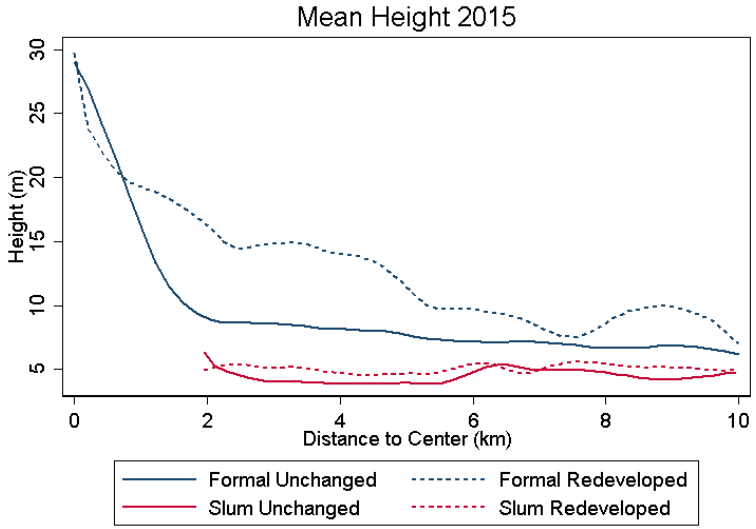
- Redevelopment near centre, infill near fringe



the role of redevelopment, infill, and demolition in volume growth

Redeveloped heights by sector

- Formal buildings are taller when redeveloped
- Slum buildings remain short even after redevelopment



redeveloped heights in and outside of slums

Estimating the welfare cost of delayed conversion of slum land

COSTLY DELAYS

Intuition for formalisation costs

- History of a particular location can create conflicting claims to ownership
- This leaves areas stuck in slum use near to the centre where land is highly valued

Welfare cost

- We calibrate parameters of the model using data on buildings, prices, and rents
- Plug in and use the structure of the model to estimate the present value of land
  - Will differ based on a choice parameter (z), the date the land is converted to formal
- Conversion of remaining slum land inside 4km results in a gain around $268 million or $9,200 per household living on this land

Present value of land rent ($/m^2)

Date of formalisation, z	3-4 km	4-5km	5-6km	6-7km	7-8km
Optimal z (year)	2000	2005	2011	2017	2023
z = 2015	767	645	542	456	384
z = ∞	409	369	332	299	270
z = optimal z	790	652	543	457	387

Conclusion

Model

- Slums locate at the fringe without formalisation costs
- Random costs can create a city 'hodgepodge'

Observed growth in Nairobi

- Large volume increases across the city
- Formal and slums add volume differently

Welfare Cost

- Slums inside of 6km are past their due date
- Large gains to conversion

Next steps…

- More cities: framework suitable for many cities given more affordable data
- Need to overcome issue of manual digitization (automatic building and height classification)