Upgrade slums or invest before they form? Evidence from Tanzania

(work in progress)

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Research questions

Do basic urban infrastructure investments affect housing quality in the long term?

Does timing matter? Should infrastructure investments pre-empt or upgrade slums?

African cities: a problem of housing quality

- Urban population is large and fast growing
  - Africa's total population of 1.2 billion expected to double by 2050 (UN 2015)
  - Urbanization rate: 40% in 2010, may reach 60% by 2050 (Freire et al. 2014)
- Housing quality is low
  - UN Habitat (2012): slums home to 62% of this region's urban dwellers; slum population growth suggests doubling within 15 years
  - Concerns about "type" of density and about slum persistence and creation
- Despite the challenge little is known about the long term impact of infrastructure investments on housing quality in Africa
  - Public provision of only basic infrastructure: mostly roads, drainage, water pipes
  - With high building replacement rates, it's unclear how investments persist and matter for residential quality

Empirical approach

"Sites and Services"

- Projects in seven Tanzanian cities circa 1980
- Provide public basic infrastructure and people built own homes.

Two types of adjacent areas

1) Squatter settlements (**upgrading**)
2) Greenfield or unoccupied land (**de-novo**)

Untreated greenfield as counterfactual for **de-novo** treatments

- Mitigate concerns about site selection by using "spatial discontinuity"
- Mitigate concerns owner sorting by controlling for current owner fixed effects

No obvious counterfactual for **upgrading**, but provide descriptives

Empirical approach

Main outcome data

- High resolution satellite daylight images on seven cities
- Survey data on buildings in three of the cities

Level of analysis (treated and outcome unit is land)

- We study physical outcomes (building & neighbourhood quality) rather than individual level outcomes
- What happens on a treated piece of land?
- No GE effects, no tracking project recipients

Model: why invest in infrastructure early on?

Private housing response to new infrastructure ($I \rightarrow I'$)

- Value quality and infrastructure as complements

Upgrade: have a house optimized at I, must knock down to rebuild at I'

De-novo: need to build a house anyway, optimize to I'

- If investment is very high then upgrade quality catches up right away
- At lower levels of investment upgrading areas adjust upwards slowly only as houses need replacing
- Extensions:
  - Credit constraints,
  - Expropriation risk
  - Feedback quality on public infrastructure
    - Large gaps in land values and housing quality if we model public investments deteriorating over time if private quality not upgraded.

Background on Sites and Services in Tanzania

We study building-level data from 24 neighborhoods in 7 cities

- 12 De-novo neighborhoods (greenfield investments)
- 12 Upgrading of squatter settlements

Investments made in two rounds

1. Mid 1970s
   - plots and roads, and in some cases also drainage, water pipes, street lights near community centres
2. Early 1980s
   - mostly plots and roads, though upgrading also got water pipes and drainage

Plots completed (1980s) and population (2002)

		Plots completed (by 1980s)	Population	Population per plots completed	Area in square km	Population density (people per square km)
Project 1	De Novo	8,527	89,150	10.5	8.5	10,488
	Upgrading	14,634	200,630	13.7	6.5	30,866
	Total	23,161	289,780	12.5	15.0	19,319
Project 2	De Novo	1,978	17,926	9.1	2.5	7,170
	Upgrading	20,128	195,378	9.7	10.2	19,155
	Total	22,106	213,304	9.6	12.7	16,796
Total	De Novo	10,505	107,076	10.2	11.0	9,734
	Upgrading	34,762	396,008	11.4	16.7	23,713
	Total	45,267	503,084	11.1	27.7	18,162

Benchmark population densities:

Dar ~3k
London ~5k
New York ~10k
Manhattan ~25k
Hong Kong ~7k
Macau ~20k

But a very different type of density

Satellite Measures for 7 cities

- Log Building Area Footprint
- Road within 10m
- Nearest Building More than 1m Away
- Similarity of Orientation Relative to Nearest Building
- [We are trying to get measures of roof material quality]

Building regressions 7 cities (satellite data)

$$y_i = \beta Denovo_i + \gamma Upgrading_i + Dist\_CBD_i + City_i + \varepsilon_i$$

	Log Building Area Footprint	Road within 10m	Nearest Building More than 1m Away	Similarity of Orientation Relative to Nearest Building	Z index
De Novo	0.340	0.217	0.004	2.434	0.328
	(0.035)	(0.023)	(0.025)	(0.221)	(0.023)
Upgrade	0.030	0.034	-0.105	-0.137	-0.030
	(0.037)	(0.017)	(0.023)	(0.145)	(0.020)
Observations	143,430	143,434	143,434	143,434	143,434
Mean (control)	4.151	.194	.342	-5.119	0

Sharper focus on 3 cities

Building level survey data

- For Mbeya, Tanga, and Mwanza, we have detailed outcomes from the Tanzanian Strategic Cities Project (TSCP)
- This includes information on building and owner characteristics

Housing units: ownership and selection

- Residential buildings are split into “units” which have owners
- We then add fixed effects for owner full name
- To what extent owner selection accounts for the differential?

Unit-level regressions: baseline (TSCP data*)

	Log Building Area Footprint	Connection to Electricity	Connection to Water Mains	Sanitation: Sewerage or Septic Tank	Good Roof Materials	Multistory Building	Road Access	Z-Index
De Novo	0.613	0.355	0.286	0.219	-0.022	0.190	0.221	0.506
	(0.080)	(0.030)	(0.029)	(0.056)	(0.022)	(0.079)	(0.047)	(0.046)
Upgrade	-0.009	0.029	-0.022	-0.061	-0.044	-0.117	0.037	-0.093
	(0.086)	(0.050)	(0.041)	(0.038)	(0.020)	(0.038)	(0.047)	(0.061)
N	23,921	23,921	23,903	23,627	23,858	20,351	23,910	23,921
Mean (control)	4.626	.448	.51	.265	.975	.103	.647	0

*We exclude nonhabitable ‘outbuildings’ such as sheds, outdoor toilets, etc.

Unit-level regressions: full name FEs (TSCP data)

	Log Building Area Footprint	Connection to Electricity	Connection to Water Mains	Sanitation: Sewerage or Septic Tank	Good Roof Materials	Multistory Building	Road Access	Z-Index
De Novo	0.518	0.241	0.193	0.022	0.002	0.179	0.062	0.341
	(0.140)	(0.073)	(0.062)	(0.093)	(0.046)	(0.105)	(0.080)	(0.097)
Upgrade	0.021	0.263	0.045	0.034	-0.013	-0.046	-0.139	0.022
	(0.130)	(0.089)	(0.074)	(0.073)	(0.029)	(0.072)	(0.070)	(0.086)
N	6,534	6,534	6,532	6,349	6,498	4,675	6,534	6,534
Mean (control)	4.626	.448	.51	.265	.975	.103	.647	0

Comparing program costs & land values in Dar

- Preliminary calculations of land values in Dar (in 2016 US$)
  - De-novo
    - Land value about US$180 per square meter
    - Cost of de-novo plot about US$7.5 per sq-meter (from WB reports)
  - Upgrading
    - Land value about US$40 per square meter
    - Without knowing exact plot size, costs around US$3.5 per sq-meter (from WB reports)

Summary of our findings (1: de-novo)

De-Novo neighborhoods look ‘better’ than controls

- Lower population density
- Larger buildings
- More regular layout
- Better road access
- Better amenities (e.g. electricity, water, sanitation)
  - Partial data suggests de-novo has higher land values

Summary of our findings (2: upgrading)

Upgrading neighborhoods look ‘worse’ than controls*

- Similarly low quality
- Especially high population and building density

*NB: Counterfactual not exactly comparable for the upgrading neighbourhoods

Thank you!