

Subsidized Housing and Urban Development in South Africa

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Introduction

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 - ▶ Poor infrastructure, High crime, Health externalities
 - ▶ Weak incentives to invest in housing/public goods
- ▶ Government response → **Public Housing Provision**

What do we know?

① Direct Recipient Impacts

- ▶ Health, Well-Being:
Cattaneo et al. [2009], Galiani et al. [2017]
- ▶ Employment, Income:
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- ▶ Amenity value to neighboring areas:
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② Indirect Recipient Impacts

- ▶ Amenity value to neighboring areas:
Diamond & McQuade [2015], Baum-Snow & Marion [2008]
- ▶ Informal housing possibilities within project areas.

Indirect Recipients

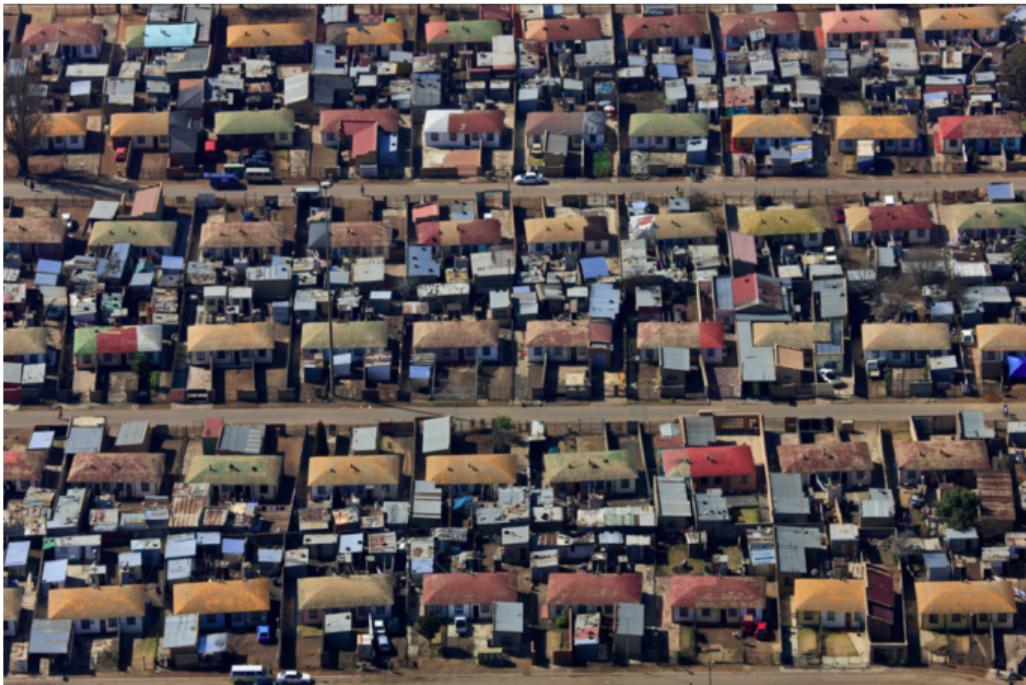


Figure: Apartheid-Era Housing with Backyard Shacks in Soweto

This Paper

► **Question:**

What are the urban development impacts from subsidized housing in developing contexts?

- ▶ Evaluate household's access to services within projects and nearby.
- ▶ Examine composition of building growth (formal and informal structures) in subsidized vs non-subsidized areas.
- ▶ Assess spillover effects on nearby home values in the private housing market.

This Paper

► Approach:

- ① Leverage granular spatial data with precise geography of housing projects.
- ② Use planned/delayed/cancelled but unconstructed projects as additional counter-factual.

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- ② Use planned/delayed/cancelled but unconstructed projects as additional counter-factual.

- ▶ **Data and Setting:**

~ 65 public housing projects in Gauteng province combined with GPS property transactions, building-based land information, and census data.

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- ① Significant improvement in households' access to water, sanitation, and electricity within project areas.
- ② Public housing is direct substitute for informal housing:
Total structure growth no different than control areas, but significant composition effects.
- ③ No evidence of amenity spillovers to neighboring areas.

Background

Public Housing in South Africa

- ▶ Large national subsidy scheme providing housing opportunities to eligible households.
- ▶ 3 million houses delivered since program inception in 1994.
 - ▶ free-standing, single-story, two-bedrooms dwellings
- ▶ Annual expenditure of 6bn Rands (US\$500M).
- ▶ Supply planned by national → provincial → municipal housing agencies, project construction outsourced to private developers.
- ▶ Constraints on costs per unit, services access, and rooms/lot sizes.

Where are the houses built?

- ▶ Vacant private or government-owned land-plots with varying levels of (mostly informal) residential structures.



Who gets a house?

► **Official Policy:**

- ▶ Must be eligible: South African Citizen, Married or with dependents, Monthly income < R3,500.
- ▶ National/provincial waiting lists.
- ▶ No resale within 7 years.

Who gets a house?

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► In Practice:

- ▶ Wait-lists and eligibility weakly enforced, with many noted cases of corruption.
- ▶ Developers often fail to meet quality requirements.
- ▶ 20% of houses not occupied by initial owners after 5 years.
- ▶ More than a third have backyard shacks after 2 or less years.

Canceled/Delayed Projects

"R95m down the tubes as housing project picked apart brick by brick"
– Timeslive, 2017

"MEC Mashatile delays Munsieville Ext 5 multimillion housing project"
– DA-GPL, 2017

"Objections put R242m housing project on hold"
– IOL News, 2016

Why?

- ▶ Disputes over beneficiaries; disagreement with security contractor.
- ▶ Lack of approval/coordination from all agencies.
- ▶ Failed environmental impact assessments.

Data and Set-up

Data Sources

- ▶ Focus on Gauteng Province (includes Johannesburg and Pretoria)

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- ▶ Four main data sources:
 - ① **Administrative Data on project location and costs**
 - ② **Deeds-Based Housing Transactions**
 - ③ **Household Census**
 - ④ **Building-Based Land Use**

Administrative Data on Subsidized Housing.

- ① Map of all Gauteng housing programs, as of 2008.
 - ▶ obtained from government-affiliated research unit.
 - ▶ exclude <0.5km² smaller-footprint policies (land titling, high-rises, sites-and-services).
 - ▶ includes name and (often missing) description.
 - ▶ various stages of completion: proposed, planning, under implementation, completed.
- ② Annual Budget Statements from Gauteng Provincial Housing Department.

Housing Transactions

- ▶ Sourced from South African deeds registry.
- ▶ "Universe" of formal housing transactions recorded during 2000-2012 in **affordable areas**. (~550K transactions)
- ▶ Exact geographic location of traded property, but limited information on characteristics other than price and lot size.
- ▶ Includes buyer and seller name.

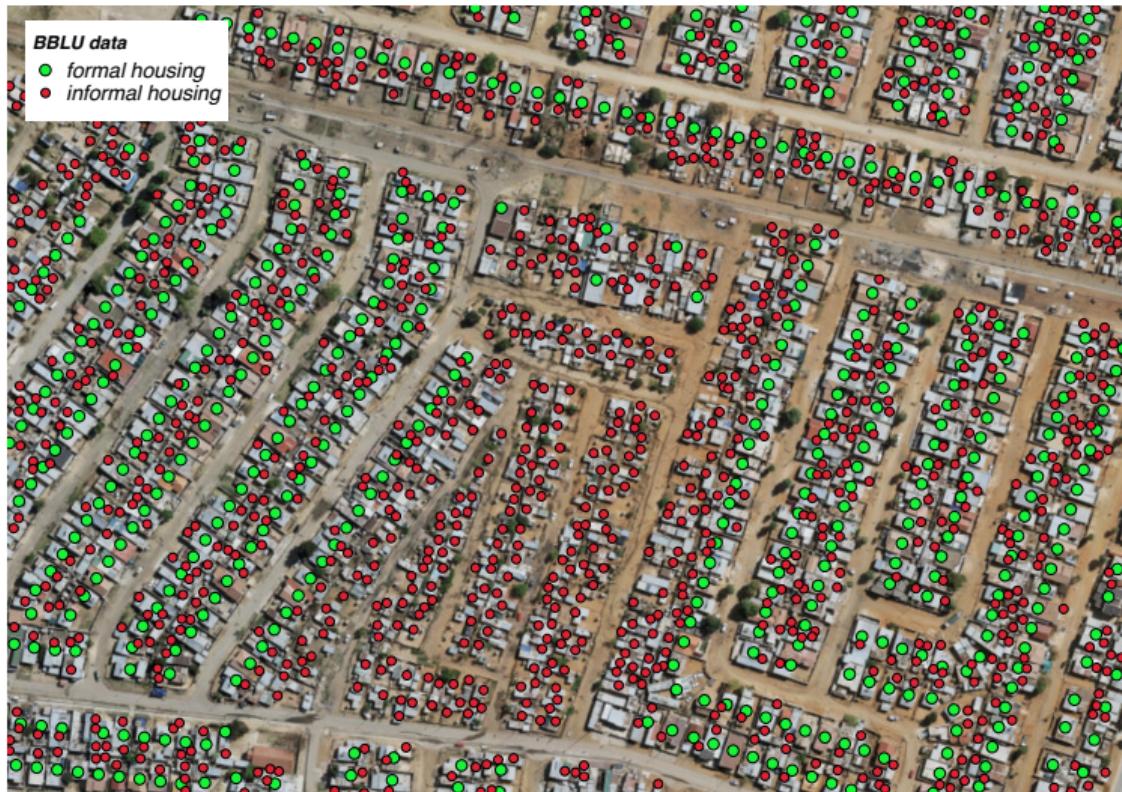
Census Data

- ▶ Full coverage from 2001 and 2011 censuses at the household level.
- ▶ Summary information on dwelling characteristics and access to services.
- ▶ Smallest identifiable geography is **small area**.
 - ▶ 170 household per small area, on average.
 - ▶ Gauteng: 11,000 small areas in 2001, 17,000 in 2011.

Building Based Land-Use

- ▶ GeoTerralmage[©]: Exhaustive hand-coded building identification from aerial imagery.
- ▶ 2 cross-sections: 2001 and 2011.
- ▶ Building type differentiated by category: residential, commercial, industrial, etc.
- ▶ Within residential, ability to differentiate formal from informal housing, including backyard shacks.
- ▶ High Correlation ($>85\%$) with reported dwelling type from census data at coarser spatial resolution.

Building Based Land-Use



Identifying Housing Projects

From deeds data:

- ① **Filter on Seller Identity:** Find Governments, Housing authorities and Large Sellers from seller-names in transactions.

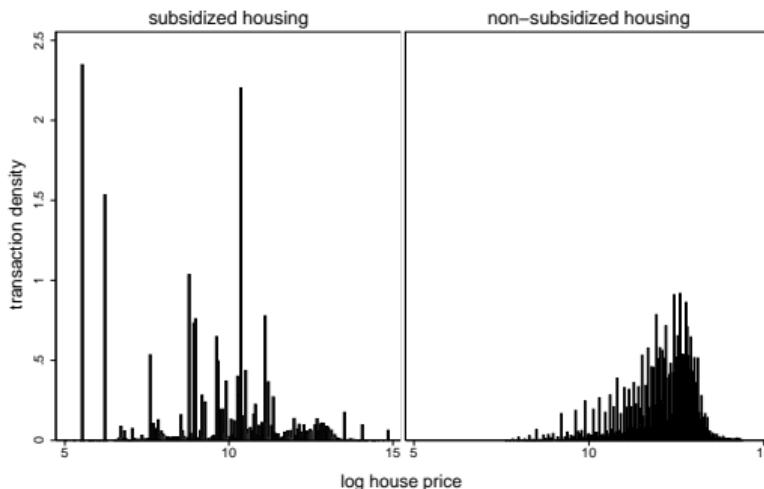
Figure: Top 5 Seller Names

Seller Name	Observations
City Of Johannesburg Metropolitan Municipality	29,087
City Of Johannesburg	27,672
City Of Tshwane Metropolitan Municipality	24,780
Ekurhuleni Metropolitan Municipality	21,758
Gauteng Provincial Housing Advisory Board	13,058
Total Observations	549,704

Identifying Housing Projects

From deeds data:

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→ Identifies 128K subsidized properties

Identifying Housing Projects

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With Project Map:

- ▶ Project footprints intersecting with subsidized transactions sample:
→ **68 Projects labeled as Constructed.**

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With Project Map:

- ▶ Project footprints intersecting with subsidized transactions sample:
→ **68 Projects labeled as Constructed.**
- ▶ Remaining project footprints
→ **65 Projects labeled as Unconstructed.**

Project Map keyword description: constructed vs unconstructed

	Constructed	Unconstructed
"proposed"	5	20
"planning"	8	12
"under implementation"	12	4
"complete"	6	1
<i>No Description</i>	37	28
Total	68	65

housing density: constructed vs. unconstructed

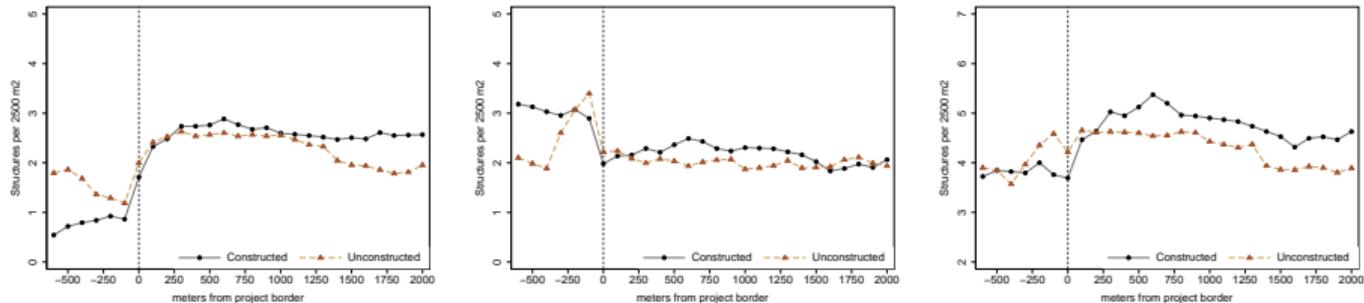
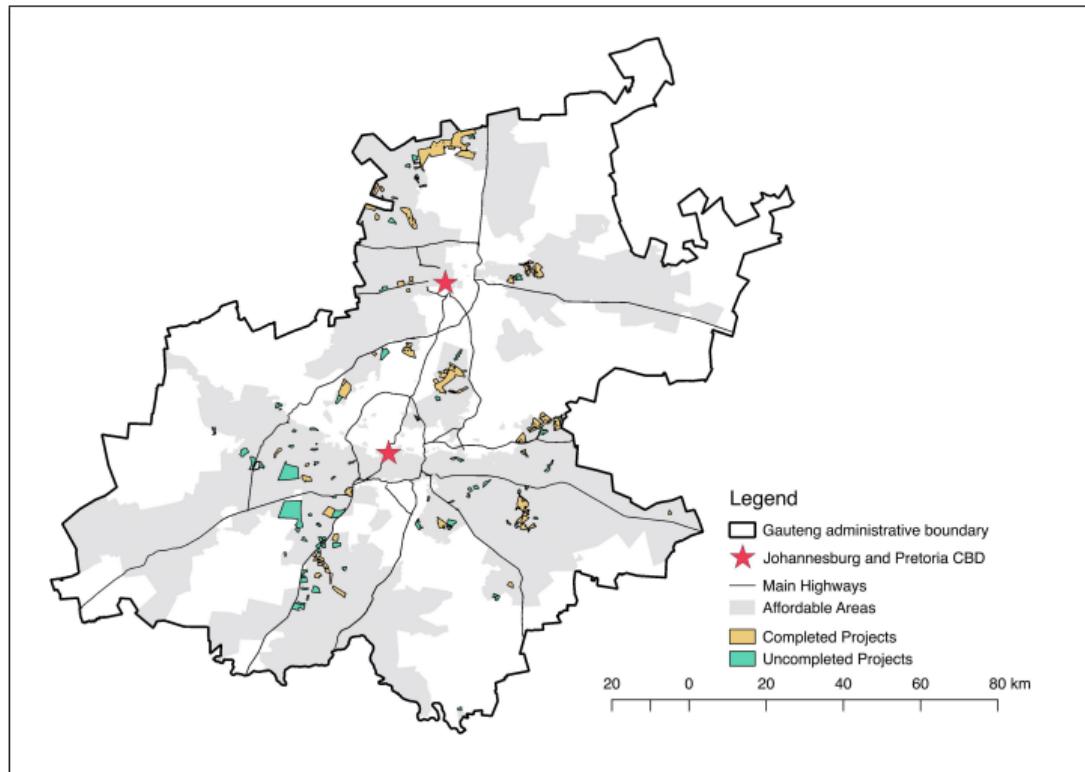


Figure: density of formal (left), informal (middle) and total (right) housing

Map of Studied Projects



Impact on Dwelling Characteristics

Census Areas Exposure Measures

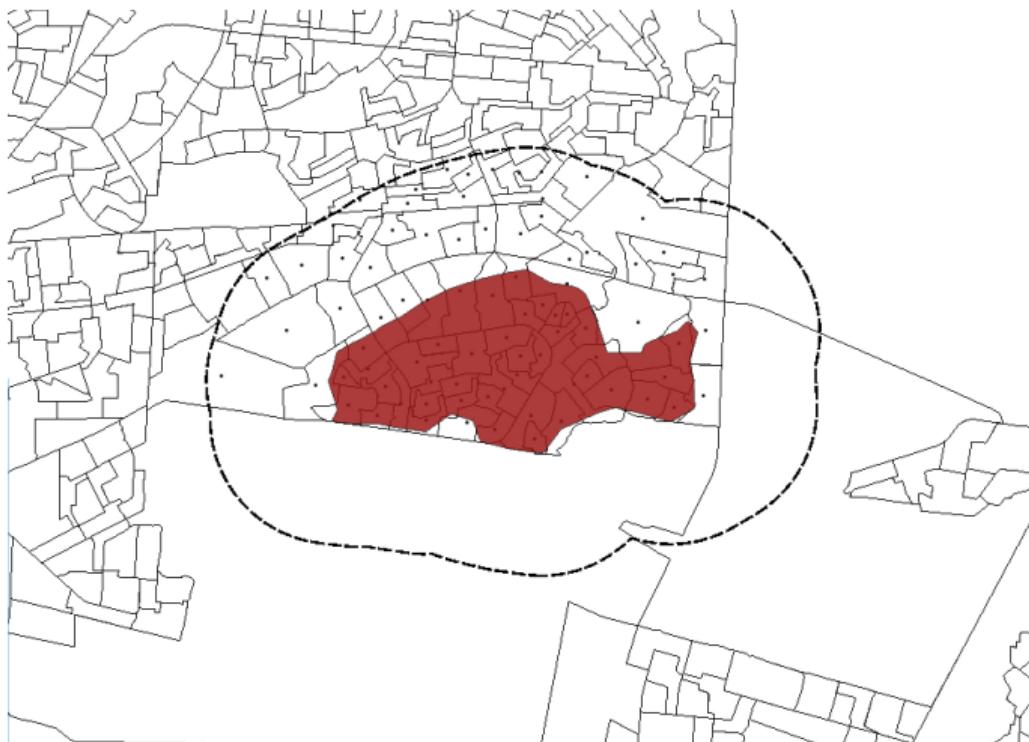


Figure: Census "Small Areas" with centroid within 1500m of project border

Census Areas Exposure Measures

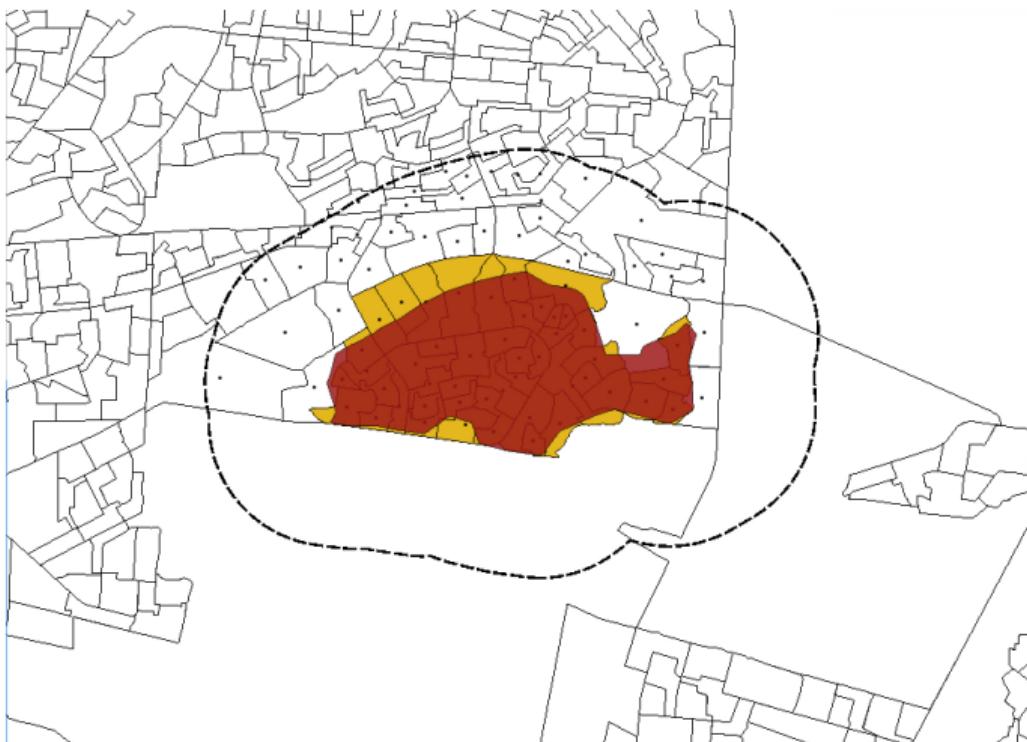


Figure: "project" exposure: small areas with $> 30\%$ area overlap

Census Areas Exposure Measures



Figure: "spillover" exposure: small areas with < 30% area overlap

Empirical Specification

$$y_{hpt} = \lambda_p + \sum_e I_{hpt}^e (\alpha^e D_t C_p + \beta^e D_t + \gamma^e C_p + \theta^e) + \varepsilon_{hpt}$$

with:

- ▶ e : exposure area, **{project, spillover}**.
- ▶ y_{hpt} : Outcome for household h living in vicinity of project p , observed in census year $t \in \{2001, 2011\}$.
- ▶ $I_{hpt}^e = 1$ if household h is in exposure area e of project p .
- ▶ $D_t = 1$ if year t is census year 2011 (post period).
- ▶ $C_p = 1$ if project p has been constructed.
- ▶ λ_p : project fixed-effect.
- ▶ ε_{hpt} : error term.

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$$y_{hpt} = \lambda_p + \sum_e I_{hpt}^e (\alpha^e D_t C_p + \beta^e D_t + \gamma^e C_p + \theta^e) + \varepsilon_{hpt}$$

- ▶ α^e is the DD effect of housing projects on outcome y at exposure e , comparing constructed vs. non-constructed projects, before and after construction.
- ▶ Assumes no differential trends between treatment and control areas, absent of project construction.
- ▶ concerns:
 - ▶ unobserved factors correlated with delays/cancellation/planning.
 - ▶ endogenous census geography.
 - ▶ "dosage".
 - ▶ anticipation and expectations.

Empirical Specification

$$y_{hpt} = \lambda_p + \sum_e I_{hpt}^e \left(\alpha^e D_t C_p + \beta^e D_t + \gamma^e C_p + \theta^e \right) + \varepsilon_{hpt}$$

Outcomes:

- ▶ water and sewers: whether households have a flush toilets, access to an indoors water tap, water from utility company.
- ▶ main energy sources for cooking, heating and lighting.
- ▶ whether household live in a formal house and whether they own it.
- ▶ population and household density.

Effect On Dwelling Characteristics I. (Inside Projects)

	flush toilet	water tap	utility water	owner	house
project_post_cnstr	0.137** (0.065)	0.143*** (0.052)	0.036 (0.038)	-0.085 (0.073)	0.158*** (0.055)
project_post	0.068 (0.048)	0.087** (0.040)	-0.028 (0.036)	0.036 (0.039)	0.065* (0.036)
project_cnstr	0.100 (0.120)	0.030 (0.082)	0.036 (0.033)	0.124 (0.081)	0.105 (0.092)
project	-0.343*** (0.089)	-0.251*** (0.059)	-0.038 (0.028)	-0.187*** (0.056)	-0.263*** (0.076)
	...				
\bar{y} 2001	0.747	0.345	0.948	0.511	0.550
\bar{y} 2011	0.822	0.518	0.936	0.457	0.623
N	3,214,472	3,214,472	3,214,472	3,112,425	3,067,560
R ²	0.231	0.147	0.062	0.064	0.110

All specifications include project Fixed Effects. Standard errors clustered at the project level.

Effect On Dwelling Characteristics I. (Nearby Projects)

	flush toilet	water tap	utility water	owner	house
...					
spillover_post_cnstr	0.017 (0.037)	-0.011 (0.033)	-0.005 (0.013)	-0.019 (0.029)	-0.012 (0.030)
spillover_post	0.069** (0.027)	0.177*** (0.024)	0.006 (0.010)	-0.030* (0.017)	0.077*** (0.023)
spillover_cnstr	-0.016 (0.052)	0.004 (0.049)	0.013 (0.017)	0.029 (0.032)	0.067 (0.043)
spillover	-0.023 (0.039)	-0.041 (0.038)	-0.003 (0.014)	-0.008 (0.023)	-0.029 (0.033)
\bar{y} 2001	0.747	0.345	0.948	0.511	0.550
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Effect On Dwelling Characteristics II. (Inside Projects)

	elec cooking	elec heat	elec light	hh density	pop density
project_post_cnstr	0.294*** (0.070)	0.209*** (0.067)	0.116 (0.081)	-127.3 (864.7)	-328.5 (1,631.7)
project_post	0.168*** (0.060)	0.142** (0.056)	0.143** (0.066)	1,265.5* (714.9)	2,635.3* (1,376.0)
project_cnstr	-0.038 (0.099)	-0.022 (0.088)	0.111 (0.110)	-928.7* (495.1)	-1,384.9 (1,254.1)
project	-0.359*** (0.071)	-0.329*** (0.068)	-0.369*** (0.081)	835.1** (383.7)	1,649.6 (1,005.9)
			...		
\bar{y} 2001	0.644	0.617	0.751	2,167.9	7,192.7
\bar{y} 2011	0.821	0.716	0.842	2,869.2	8,354.4
N	3,214,472	3,214,472	3,214,472	15,454	15,454
R ²	0.193	0.152	0.168	0.301	0.303

All specifications include project Fixed Effects. Standard errors clustered at the project level.

Effect On Dwelling Characteristics II. (Nearby Projects)

	elec cooking	elec heat	elec light	hh density	pop density
...					
spillover_post_cnstr	-0.004 (0.039)	-0.065 (0.047)	-0.053 (0.037)	345.6* (205.3)	579.8 (445.8)
spillover_post	0.170*** (0.031)	0.131*** (0.027)	0.118*** (0.033)	270.2** (118.8)	625.1** (278.1)
spillover_cnstr	-0.017 (0.042)	0.005 (0.044)	0.019 (0.043)	-118.7 (302.5)	-69.4 (753.3)
spillover	-0.044 (0.035)	-0.036 (0.033)	-0.033 (0.036)	284.4 (204.1)	654.5 (505.2)
\bar{y} 2001	0.644	0.617	0.751	2,167.9	7,192.7
\bar{y} 2011	0.821	0.716	0.842	2,869.2	8,354.4
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Impact on Building Density

Gridded Building Density Measure

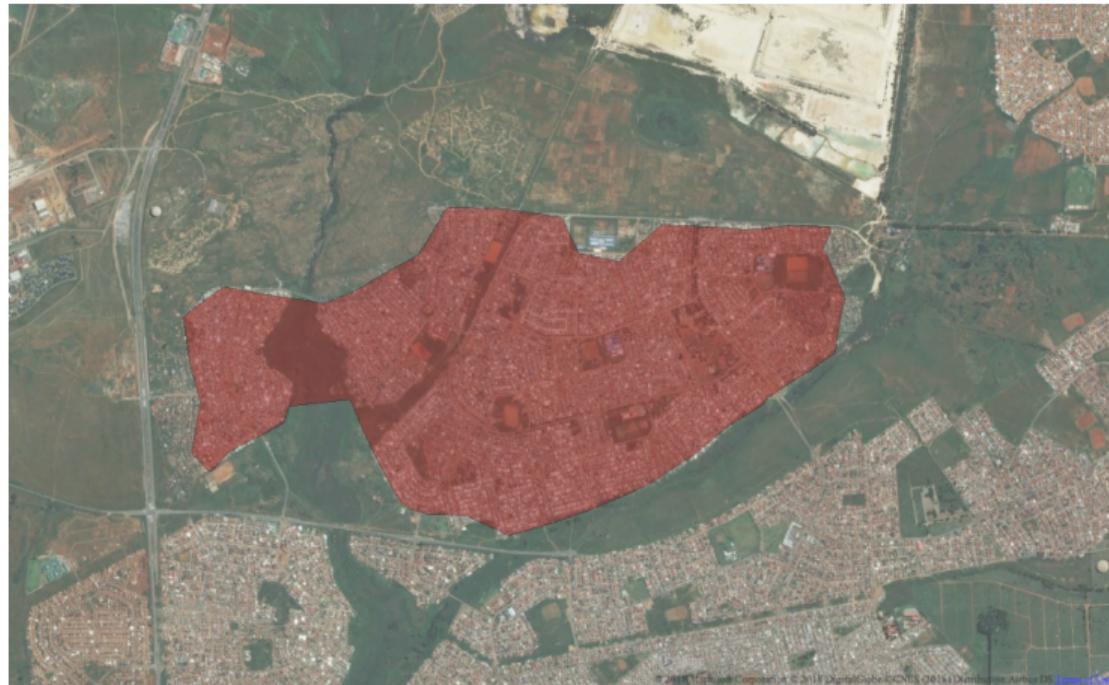


Figure: Empirical design for building density regressions

Gridded Building Density Measure



Figure: BBLU data showing formal (black) and informal (green) residential structures

Gridded Building Density Measure



Figure: 50m \times 50m grid overlay.

Gridded Building Density Measure



Figure: Aggregated data at the cell level.

Raw Density Means

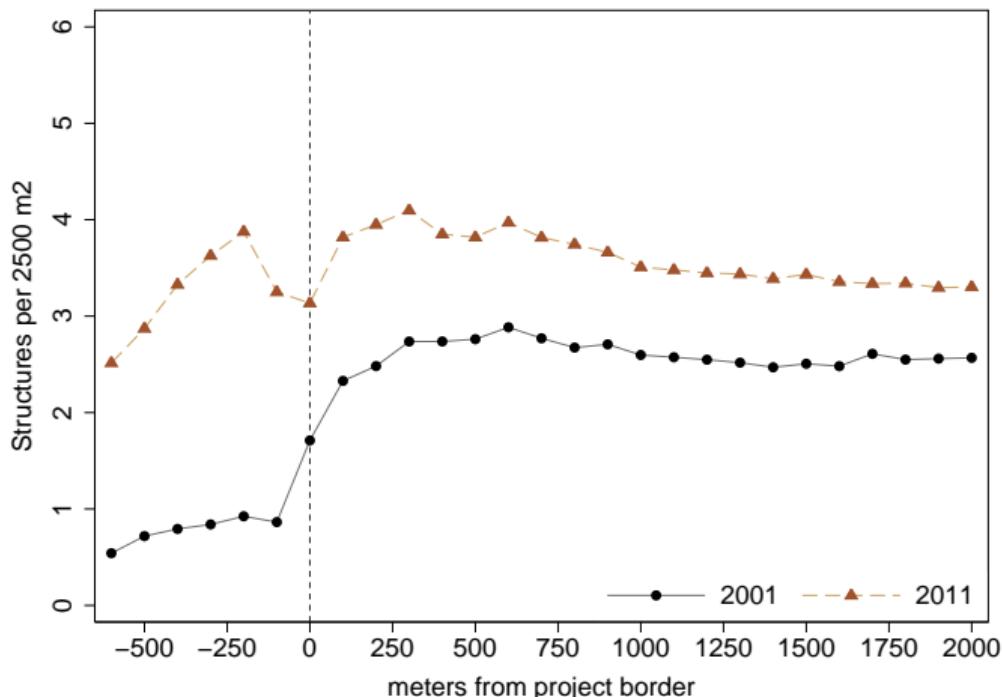


Figure: formal structures, constructed projects.

Raw Density Means

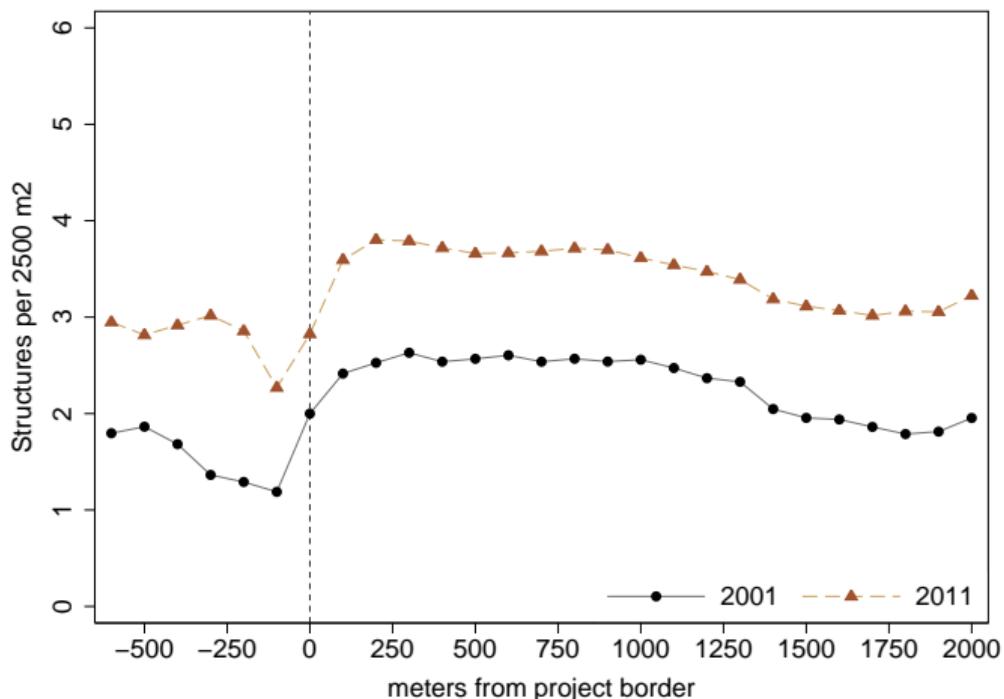


Figure: formal structures, non-constructed projects.

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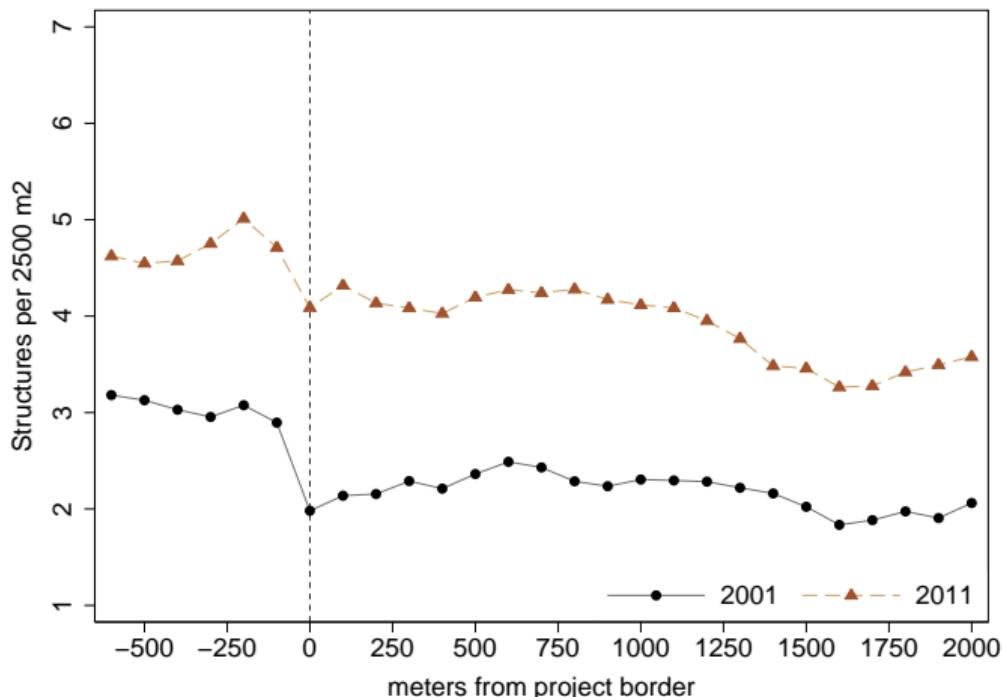


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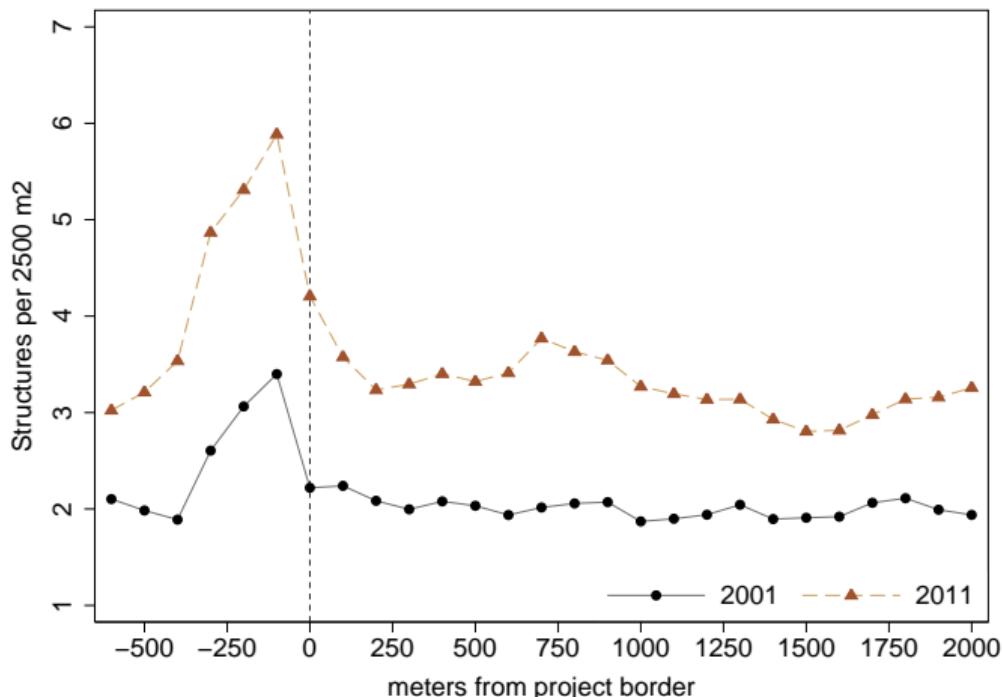


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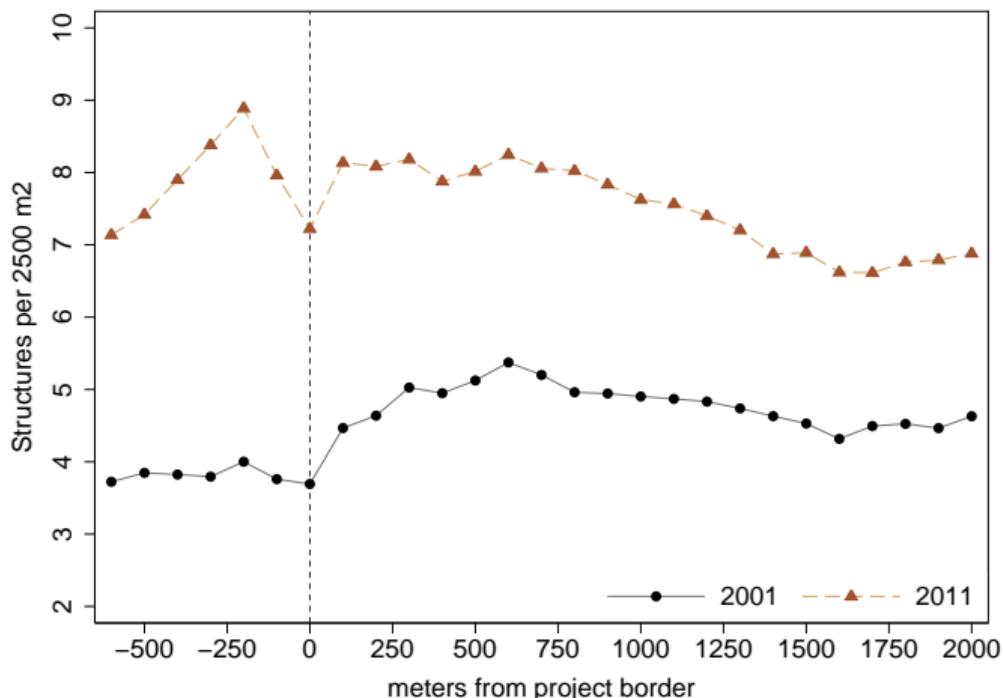


Figure: total structures, constructed projects.

Raw Density Means

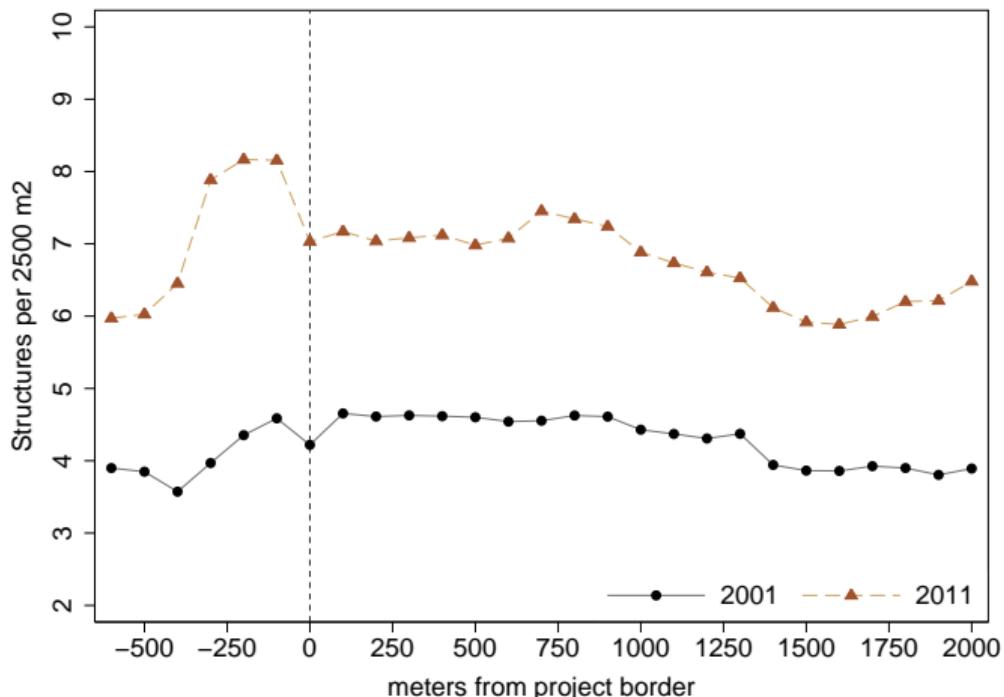


Figure: total structures, non-constructed projects.

Empirical Specification

$$y_{ipt} = \lambda_i + \sum_d I_{ipt}^d (\alpha^d D_t C_p + \beta^d D_t) + \varepsilon_{ipt}$$

with:

- ▶ y_{itdp} : building density for cell i in vicinity of project p observed in year t .
- ▶ $I_{ip}^d = 1$ if cell i is at distance d of project p 's border.
- ▶ $D_t = 1$ if year t is 2011 (post period).
- ▶ $C_p = 1$ if project p has been constructed.
- ▶ λ_i : cell fixed-effect.
- ▶ ε_{ipt} : error term

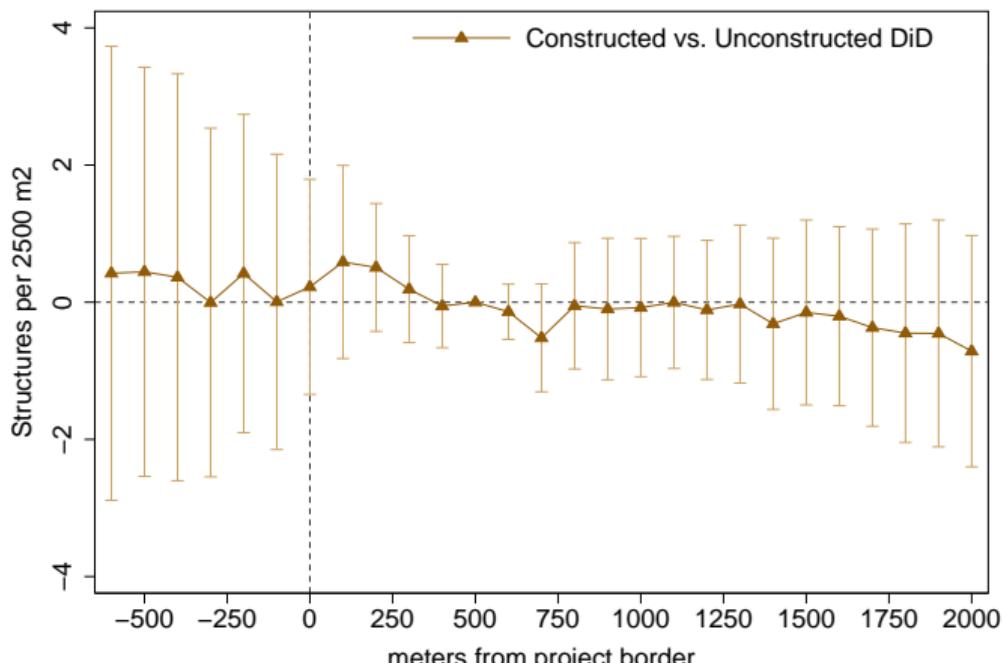
Empirical Specification

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Density Outcomes:

- ▶ total buildings.
- ▶ formal buildings.
- ▶ informal buildings.
- ▶ backyard/non-backyard informal.

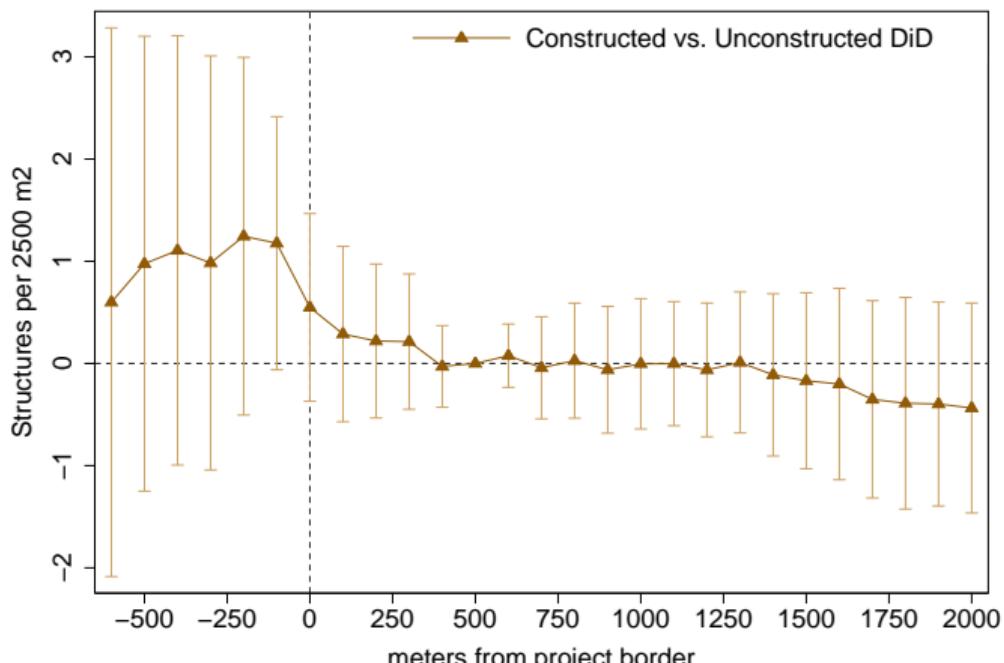
Building Density: Estimation Results



Mean Structures per 2500 m²: 5.77

Figure: total structures

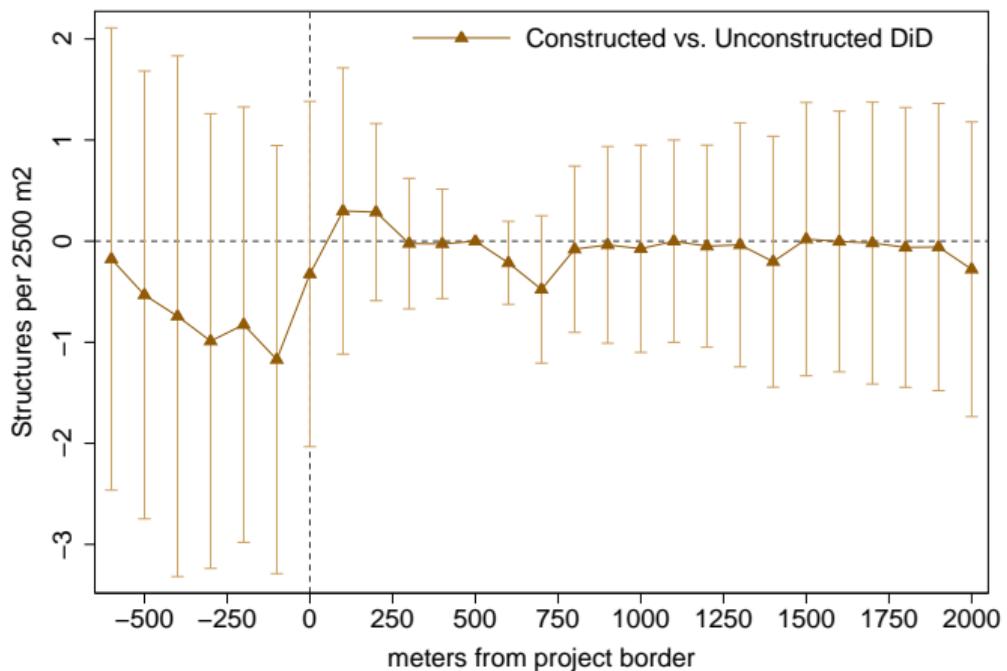
Building Density: Estimation Results



Mean Structures per 2500 m²: 2.75

Figure: formal structures

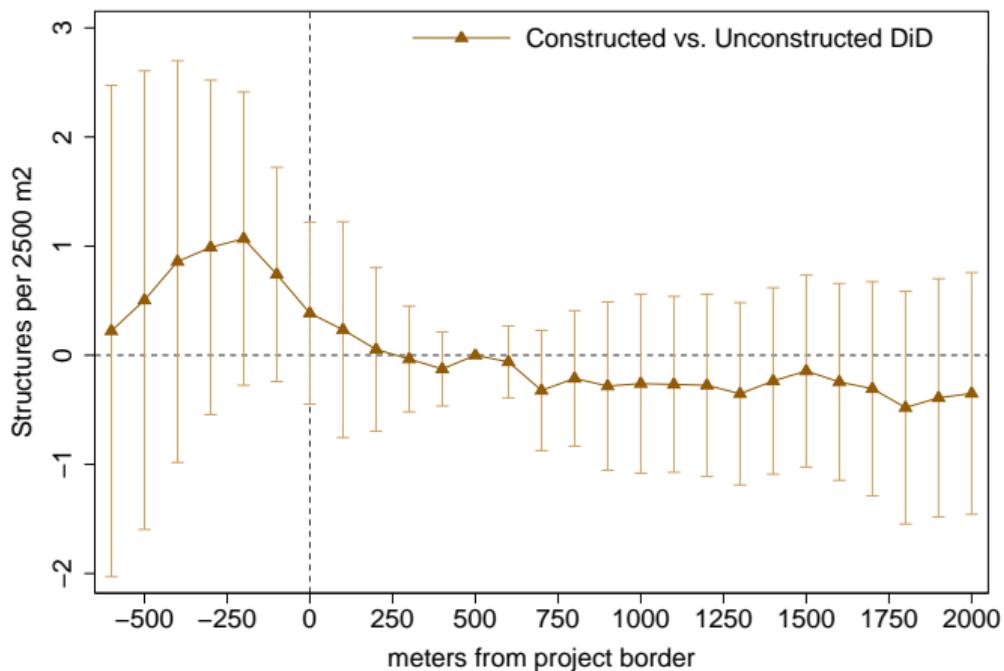
Building Density: Estimation Results



Mean Structures per 2500 m²: 3.02

Figure: informal structures

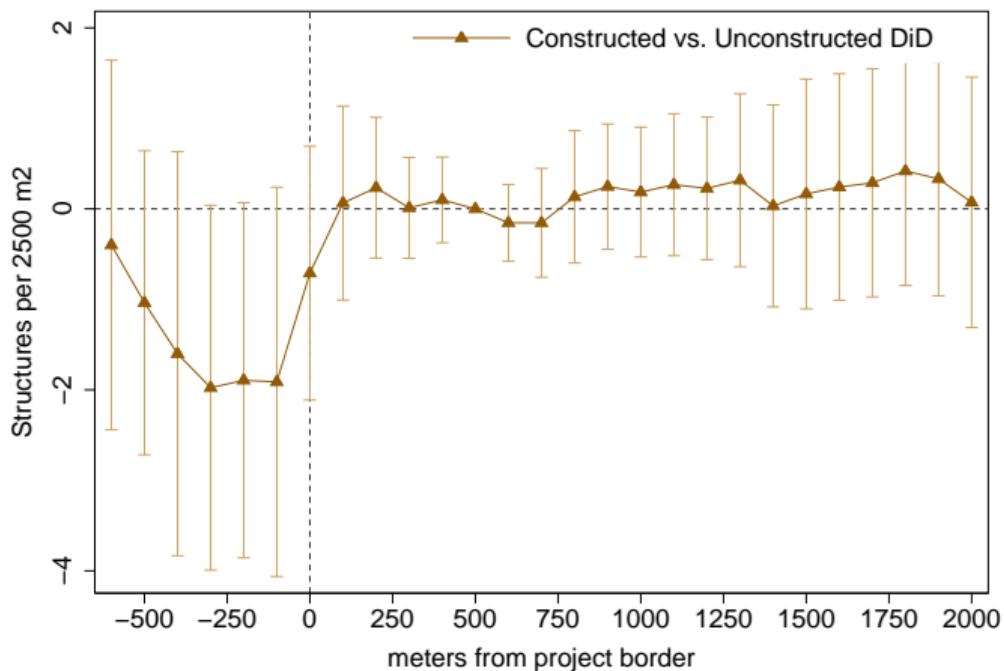
Building Density: Estimation Results



Mean Structures per 2500 m²: 1.46

Figure: informal backyard structures

Building Density: Estimation Results



Mean Structures per 2500 m²: 1.55

Figure: informal non-backyard structures

Triple Differences Tests

	total	formal	informal	backyrd	non-bckyrd
inside	0.185 (1.045)	1.125* (0.658)	-0.940 (1.022)	1.076 (0.726)	-2.016** (0.839)
within 500m	0.264 (0.423)	0.195 (0.358)	0.068 (0.475)	0.247 (0.389)	-0.179 (0.412)
<i>N</i>	399,406	399,406	399,406	399,406	399,406
<i>R</i> ²	0.818	0.828	0.785	0.741	0.774

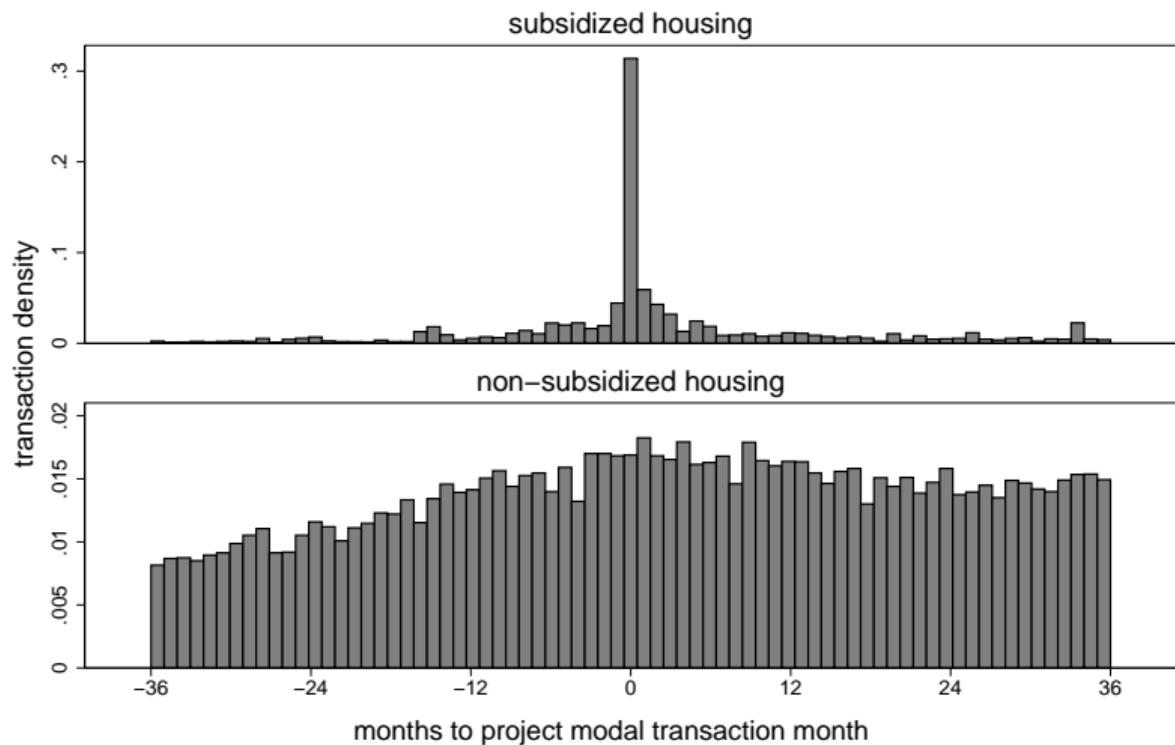
All specifications include project Fixed Effects. Standard errors clustered at the project level.

Spillovers on Housing Prices

Empirical Set-up

- ▶ Sample composed of non-subsidized formal housing transactions outside of project borders.
- ▶ Exact transaction date is observed.
- ▶ Assign event date to **constructed** projects.
 - ▶ modal transaction month for subsidized transactions.
- ▶ Assign "event date" to **unconstructed** projects.
 - ▶ apply average delay between project announcement and delivery.

Transaction Densities



Empirical Specifications

$$P_{ipt} = \sum_d I_{ipt}^d \left(\alpha^d D_t^1 C_p^1 + \beta^d D_t^1 C_p^0 + \gamma^d D_t^0 C_p^1 + \theta^d D_t^0 C_p^0 \right) + \lambda_p + \eta_t + X_i' \phi + \varepsilon_{ipt}$$

- ▶ P_{itp} : log-price of property i sold at time t , in vicinity of project p .
- ▶ $I_{ip}^d = 1$ if property i is at distance d of project p 's border.
- ▶ $D_t^j = 1$ if date t is before ($j = 0$) or after ($j = 1$) construction.
- ▶ $C_p^j = 1$ if project p unconstructed ($j = 1$) or constructed ($j = 0$).
- ▶ X_i : quadratic in lot size of property i .
- ▶ λ_p : project fixed-effect.
- ▶ η_t : time (year \times month) fixed-effect.
- ▶ ε_{itp} : error term

Housing Prices: Estimation Results

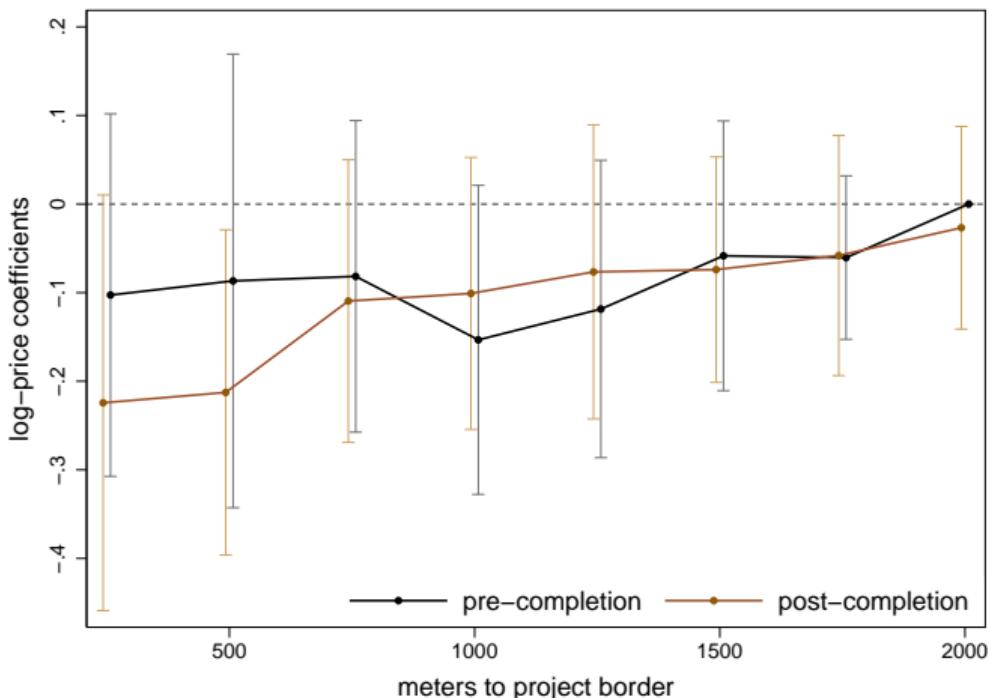


Figure: proximity effects: constructed projects

Housing Prices: Estimation Results

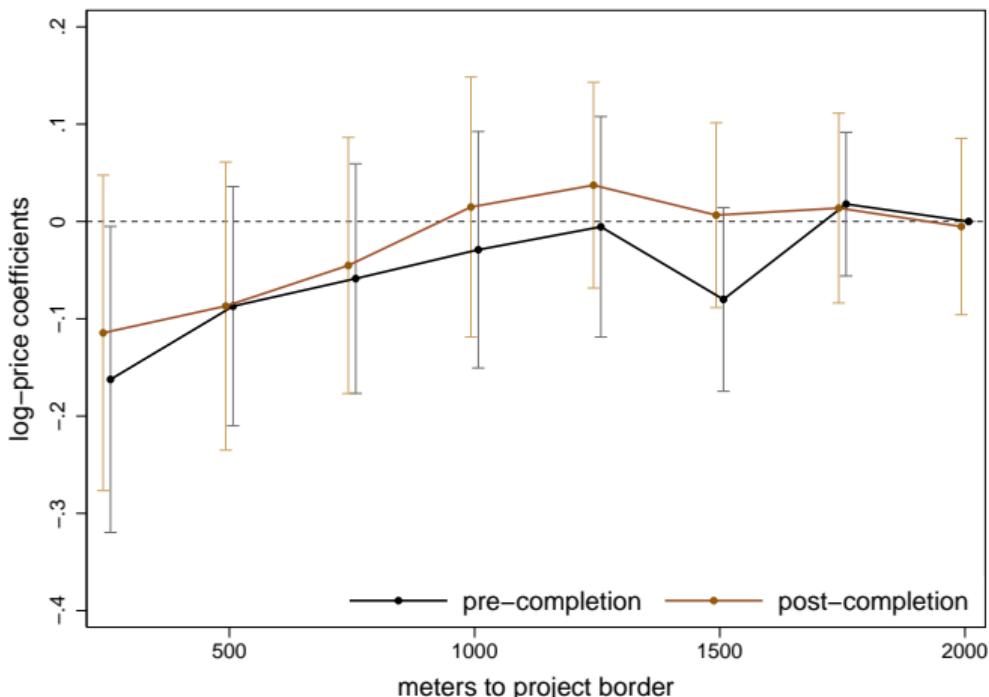


Figure: proximity effects: non-constructed projects

Housing Prices: Estimation Results

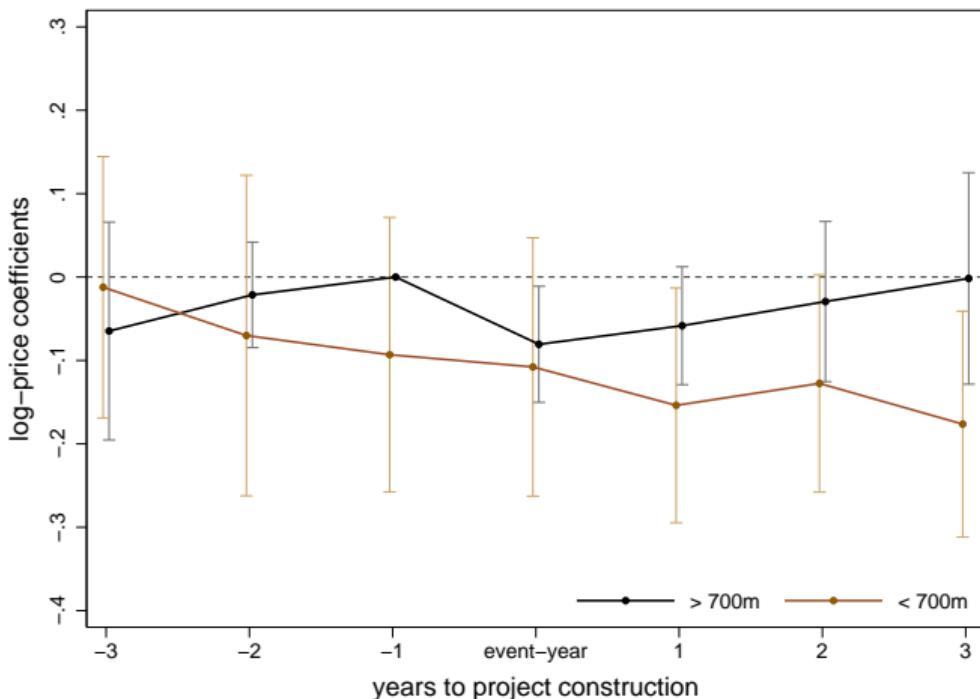


Figure: timing effects: constructed projects

Housing Prices: Estimation Results

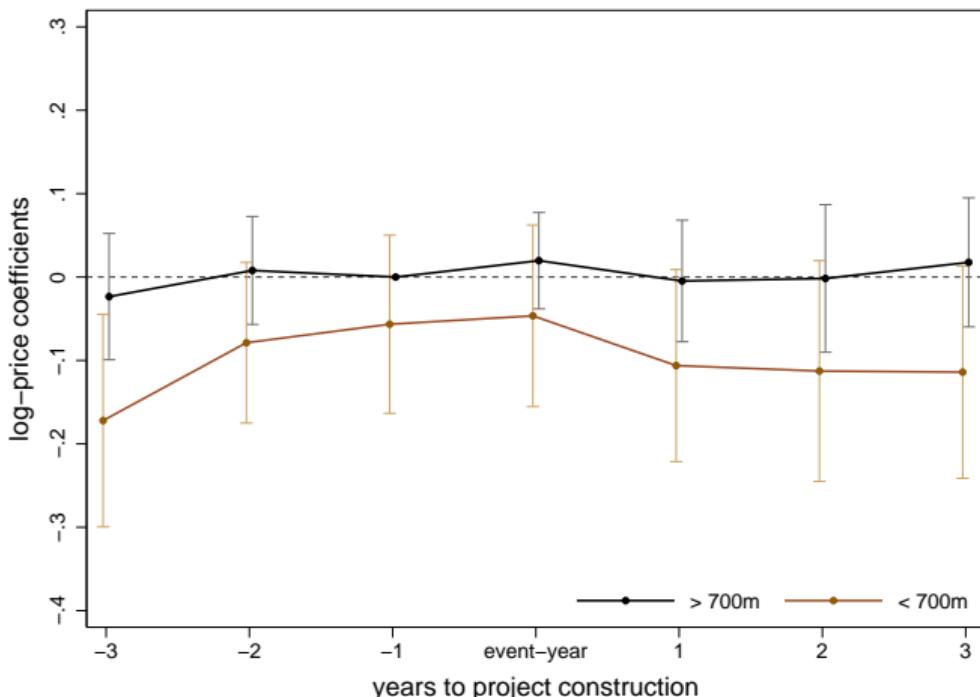


Figure: timing effects: non-constructed projects

Summary & Conclusion

Main Takeaway:

- ▶ Public housing effective tool to crowd-out slum development, but limited spillover benefits.

Next Steps:

- ▶ Cost/Benefit calculations
- ▶ Heterogeneity
- ▶ Mechanisms

Summary & Conclusion

Thank You!