

# Spillovers of Subsidized Housing Programs: Evidence from South Africa

Ben Bradlow, Stefano Polloni, Will Violette

May 2018

# Introduction

- ▶ In developing countries, 30% of urban pop lives in informal housing (UN, 2015)

# Introduction

- ▶ In developing countries, 30% of urban pop lives in informal housing (UN, 2015)
- ▶ Slums can be lasting poverty traps (Marx, 2013):
  - ▶ Poor infrastructure, High crime, Health externalities
  - ▶ Weak incentives to invest in housing/public goods

# Introduction

- ▶ In developing countries, 30% of urban pop lives in informal housing (UN, 2015)
- ▶ Slums can be lasting poverty traps (Marx, 2013):
  - ▶ Poor infrastructure, High crime, Health externalities
  - ▶ Weak incentives to invest in housing/public goods
- ▶ **Public Housing Provision** → primary government response

# What do we know?

## ① Direct Recipient Impacts

- ▶ Health, Well-Being:  
Cattaneo et al. [2009], Galiani et al. [2017]
- ▶ Employment, Income:  
Barnhardt et al. [2015], Picarelli [2017], Franklin [2018]

# What do we know?

## ① Direct Recipient Impacts

- ▶ Health, Well-Being:  
Cattaneo et al. [2009], Galiani et al. [2017]
- ▶ Employment, Income:  
Barnhardt et al. [2015], Picarelli [2017], Franklin [2018]

## ② Indirect Recipient Impacts

- ▶ Amenity value to neighboring residents:  
Diamond & McQuade [2016], Baum-Snow & Marion [2008]
- ▶ Informal housing possibilities / indirect access to provided services.

# Introduction

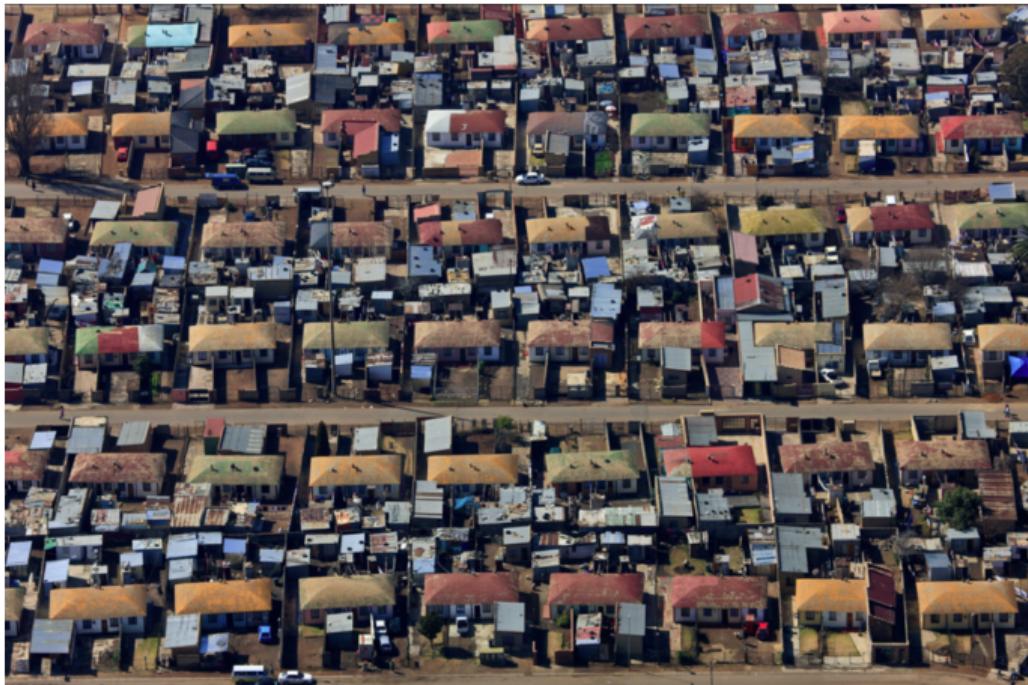


Figure: Public Housing with Backyard Shacks in Soweto

# This Paper

- ▶ **Question:**

What are the spillovers from public housing in developing contexts?

# This Paper

- ▶ **Question:**

What are the spillovers from public housing in developing contexts?

- ▶ Examine effect on nearby home values in the private housing market.

# This Paper

- ▶ **Question:**

What are the spillovers from public housing in developing contexts?

- ▶ Examine effect on nearby home values in the private housing market.
- ▶ Assess extent of slum crowd-in response (backyard shacks and nearby slum density).

# This Paper

- ▶ **Question:**

What are the spillovers from public housing in developing contexts?

- ▶ Examine effect on nearby home values in the private housing market.
- ▶ Assess extent of slum crowd-in response (backyard shacks and nearby slum density).
- ▶ Evaluate household's access to services within projects and nearby.

# This Paper

## ▶ **Question:**

What are the spillovers from public housing in developing contexts?

- ▶ Examine effect on nearby home values in the private housing market.
- ▶ Assess extent of slum crowd-in response (backyard shacks and nearby slum density).
- ▶ Evaluate household's access to services within projects and nearby.

## ▶ **Approach:**

- ▶ Leverage precise timing/geography of large housing projects.
- ▶ Use planned but unconstructed projects for falsification and as controls.

# This Paper

## ▶ **Question:**

What are the spillovers from public housing in developing contexts?

- ▶ Examine effect on nearby home values in the private housing market.
- ▶ Assess extent of slum crowd-in response (backyard shacks and nearby slum density).
- ▶ Evaluate household's access to services within projects and nearby.

## ▶ **Approach:**

- ▶ Leverage precise timing/geography of large housing projects.
- ▶ Use planned but unconstructed projects for falsification and as controls.

## ▶ **Data and Setting:**

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

## Preview of Findings

- ① Housing projects depress home prices within 400 meters by 14% for 3 years after construction.

## Preview of Findings

- ① Housing projects depress home prices within 400 meters by 14% for 3 years after construction.
- ② Slum growth twice as large inside and in vicinity of projects, compared with more distant locations.

## Preview of Findings

- ① Housing projects depress home prices within 400 meters by 14% for 3 years after construction.
- ② Slum growth twice as large inside and in vicinity of projects, compared with more distant locations.
- ③ Share of households with direct access to water and sanitation improves within project areas, but decreases in vicinity.

## 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, 30-40m<sup>2</sup> dwellings
- ▶ Annual expenditure of 6bn Rands (US\$500M).
- ▶ Supply planned by municipal and provincial housing agencies, project construction outsourced to private developers.
- ▶ Constraints on costs per unit, services access, and rooms/lot sizes.

# 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?

- ▶ **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

- ▶ **In Practice:**

- ▶ Wait-lists and eligibility weakly enforced (corruption).
- ▶ 20% of houses occupied not occupied by initial owners after 5 years.
- ▶ More than a third have backyard shacks after 2 or less years.

# Where are these houses built?

- ① **Greenfield projects** on undeveloped land near slums.
- ② **In-Situ upgrading** replacing existing slums.



- ▶ Projects are fully serviced (roads, water, sanitation, electricity)

# Data

## Data Sources

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

# Data Sources

- ▶ Focus on Gauteng Province (includes Johannesburg and Pretoria)
- ▶ Four main data sources:
  - ① **Property Transactions**
  - ② **Building-Based Land Use**
  - ③ **Population Census**
  - ④ **Additional Administrative Data**

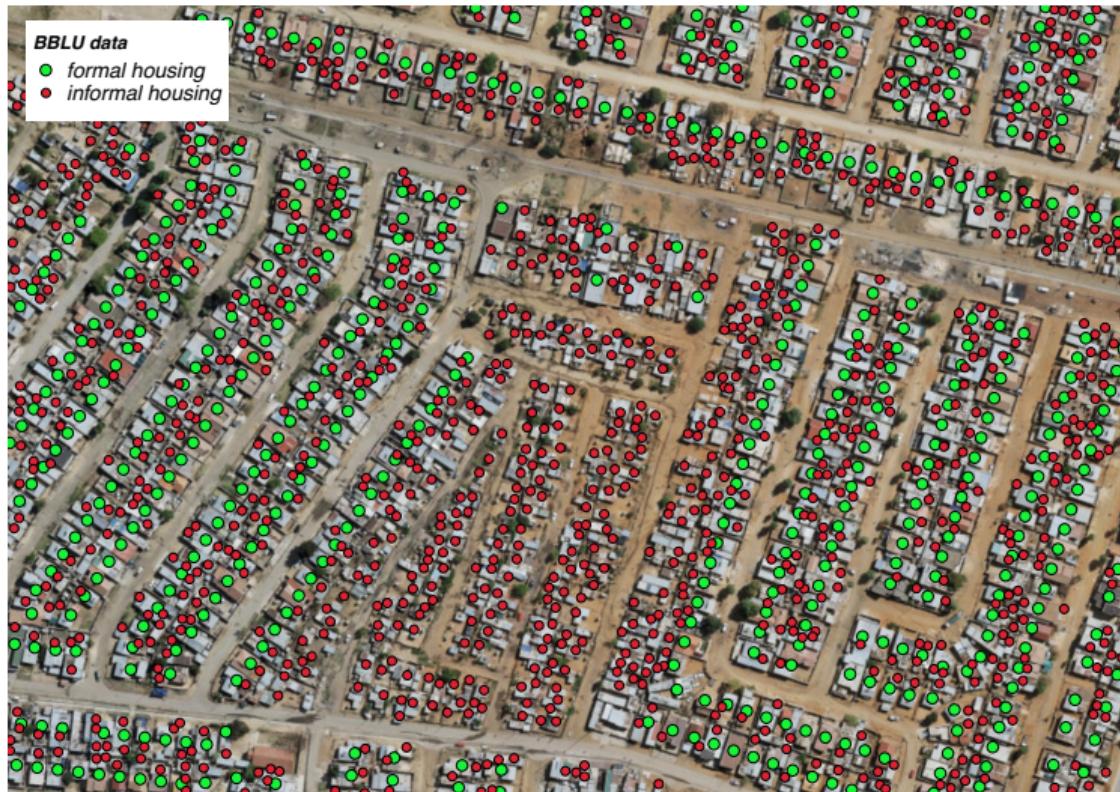
## Property Transactions

- ▶ Sourced from South African deeds registry.
- ▶ Universe of formal housing transactions recorded during 2001-2011 in affordable areas. (460K transactions)
- ▶ Exact geographic location of traded property, but limited information on characteristics other than price and lot size.
- ▶ Includes buyer and seller name.

## Building Based Land-Use

- ▶ Exhaustive hand-coded building identification from aerial imagery.
- ▶ 2 cross-sections: 2001 and 2012.
- ▶ Building type differentiated by category: residential, commercial, industrial, etc.
- ▶ Within residential, ability to differentiate formal from informal housing, including backyard shacks.
- ▶ High Correlation ( $>80\%$ ) with reported dwelling type from census data at coarser spatial resolution.

# Building Based Land-Use



# Other Data Sources

## Census Data

- ▶ Full coverage from 2001 and 2011 censuses at the individual and household level.
- ▶ Smallest identifiable geography is *census small area*.
  - ▶ 11,000 small areas in 2001, 17,000 in 2011.
  - ▶ average of 170 household per small area.

## Administrative Data Sources

- ▶ Data on location of government housing initiatives as of 2008.
  - ▶ Includes planned but unconstructed projects.
- ▶ Annual Budget Reports from National Treasury.

# Identifying Housing Projects

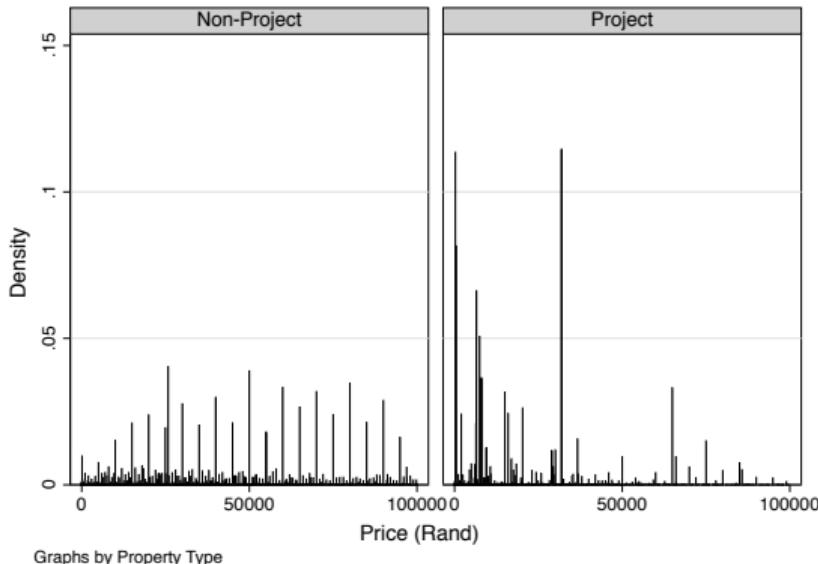
- ① **Filter on Seller Identity:** Match governments and housing authorities from seller-names in transactions.

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

- ① **Filter on Seller Identity:** Match governments and housing authorities from seller-names in transactions.
- ② **Filter on Price:** Exclude purchase prices R50,000 above yearly subsidy value for government houses.



# Identifying Housing Projects

- ① **Filter on Seller Identity:** Match governments and housing authorities from seller-names in transactions.
- ② **Filter on Price:** Exclude purchase prices R50,000 above yearly subsidy value for government houses.
- ③ **Pre-Existing Formal Dwellings:** Exclude land plots containing formal structures from 2001 building-based land-use data.

# Identifying Housing Projects

- ① **Filter on Seller Identity:** Match governments and housing authorities from seller-names in transactions.
- ② **Filter on Price:** Exclude purchase prices R50,000 above yearly subsidy value for government houses.
- ③ **Pre-Existing Formal Dwellings:** Exclude land plots containing formal structures from 2001 building-based land-use data.
- ④ **Spatial Clustering:** collect nearby houses into projects with density-based clustering algorithm. (DBSCAN)

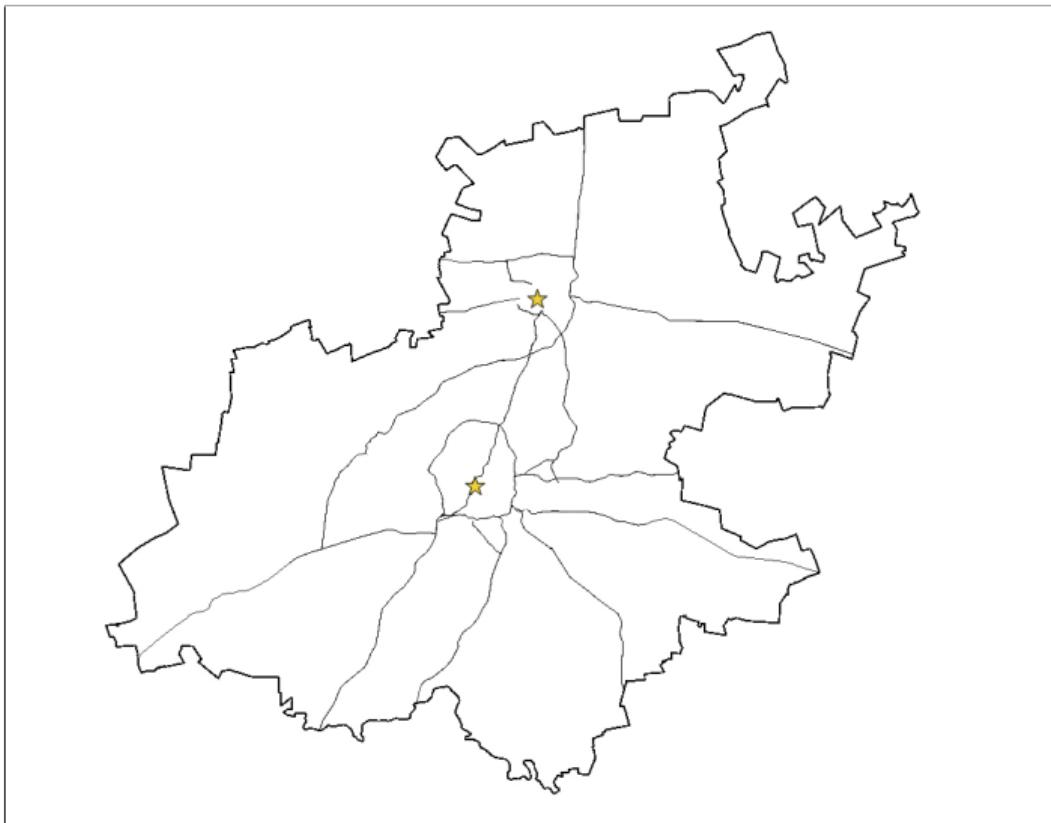
# Identifying Housing Projects

- ① **Filter on Seller Identity:** Match governments and housing authorities from seller-names in transactions.
- ② **Filter on Price:** Exclude purchase prices R50,000 above yearly subsidy value for government houses.
- ③ **Pre-Existing Formal Dwellings:** Exclude land plots containing formal structures from 2001 building-based land-use data.
- ④ **Spatial Clustering:** collect nearby houses into projects with density-based clustering algorithm. (DBSCAN)
- ⑤ **Attribute project completion date:** Examine within-cluster distribution of transactions date. Assign modal transaction month as completion date.

# Identifying Housing Projects

- ① **Filter on Seller Identity:** Match governments and housing authorities from seller-names in transactions.
- ② **Filter on Price:** Exclude purchase prices R50,000 above yearly subsidy value for government houses.
- ③ **Pre-Existing Formal Dwellings:** Exclude land plots containing formal structures from 2001 building-based land-use data.
- ④ **Spatial Clustering:** collect nearby houses into projects with density-based clustering algorithm. (DBSCAN)
- ⑤ **Attribute project completion date:** Examine within-cluster distribution of transactions date. Assign modal transaction month as completion date.
  - ▶ Overlaps well with completed projects from admin. data

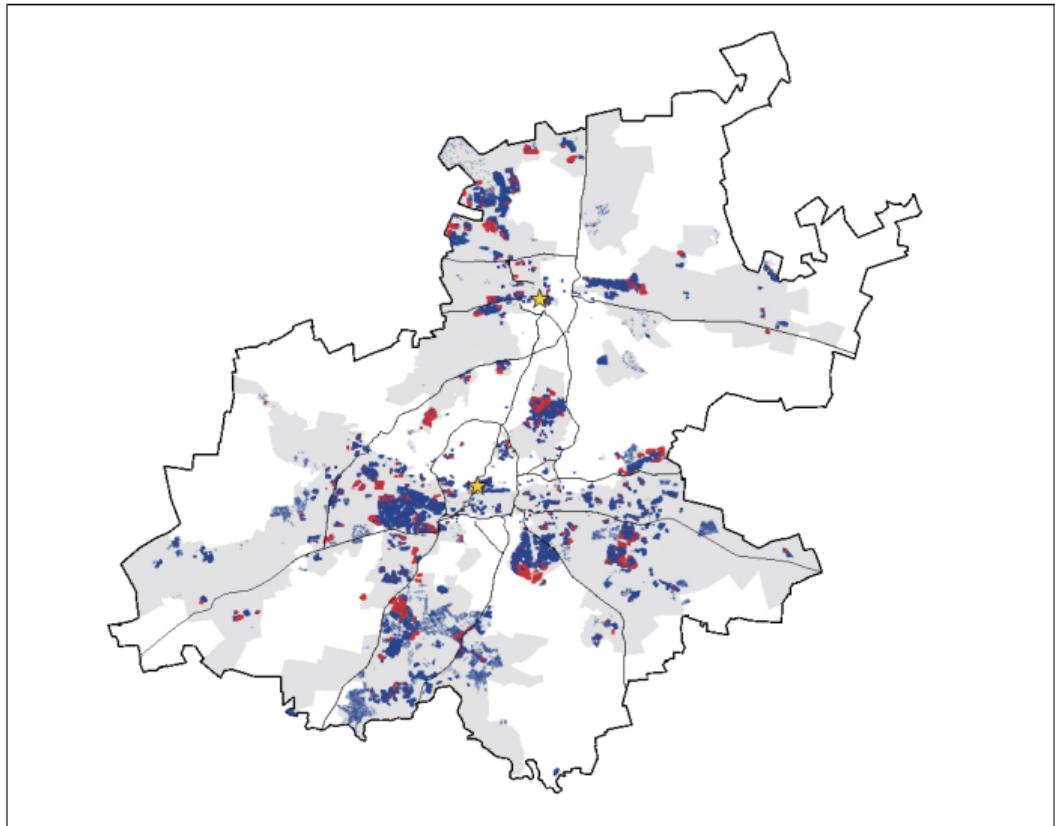
## Census Areas Exposure Measures



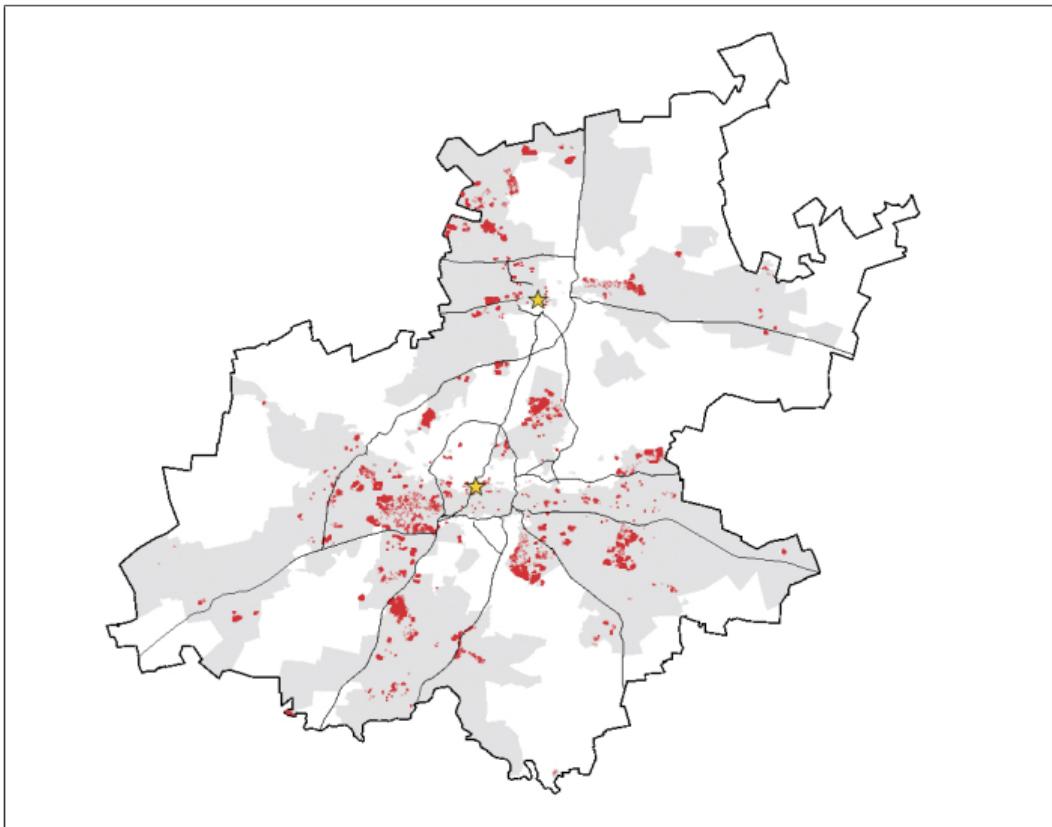
## Census Areas Exposure Measures



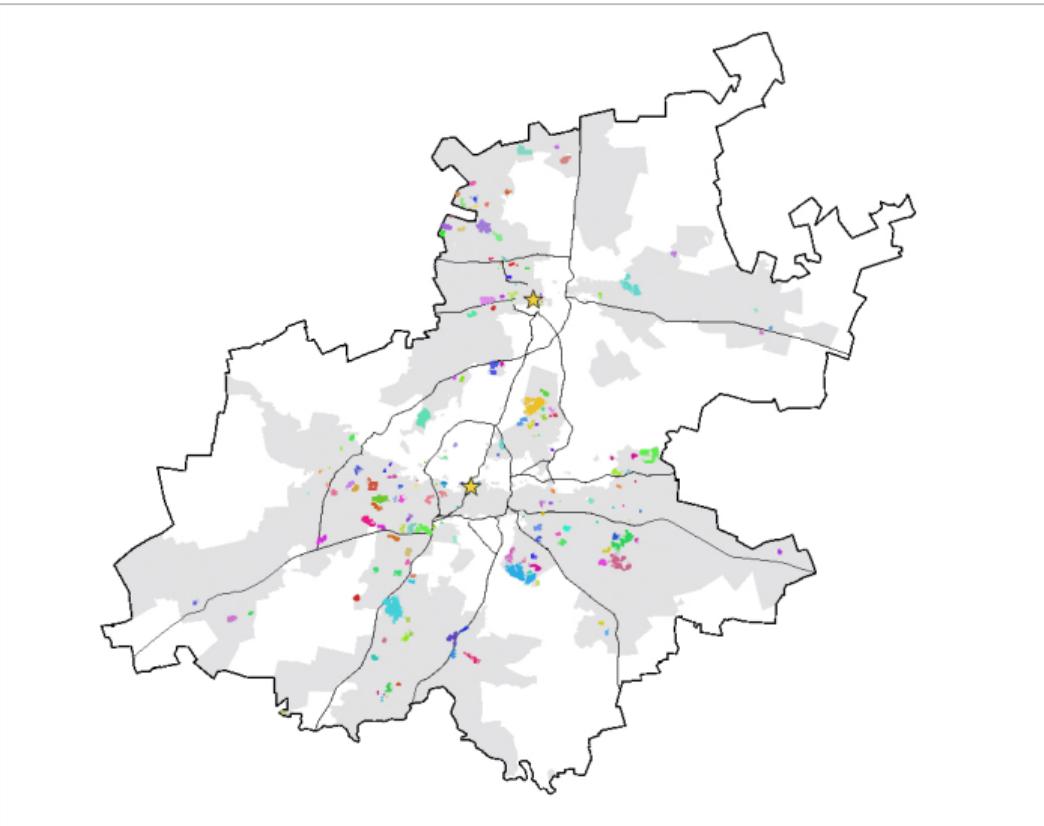
## Census Areas Exposure Measures



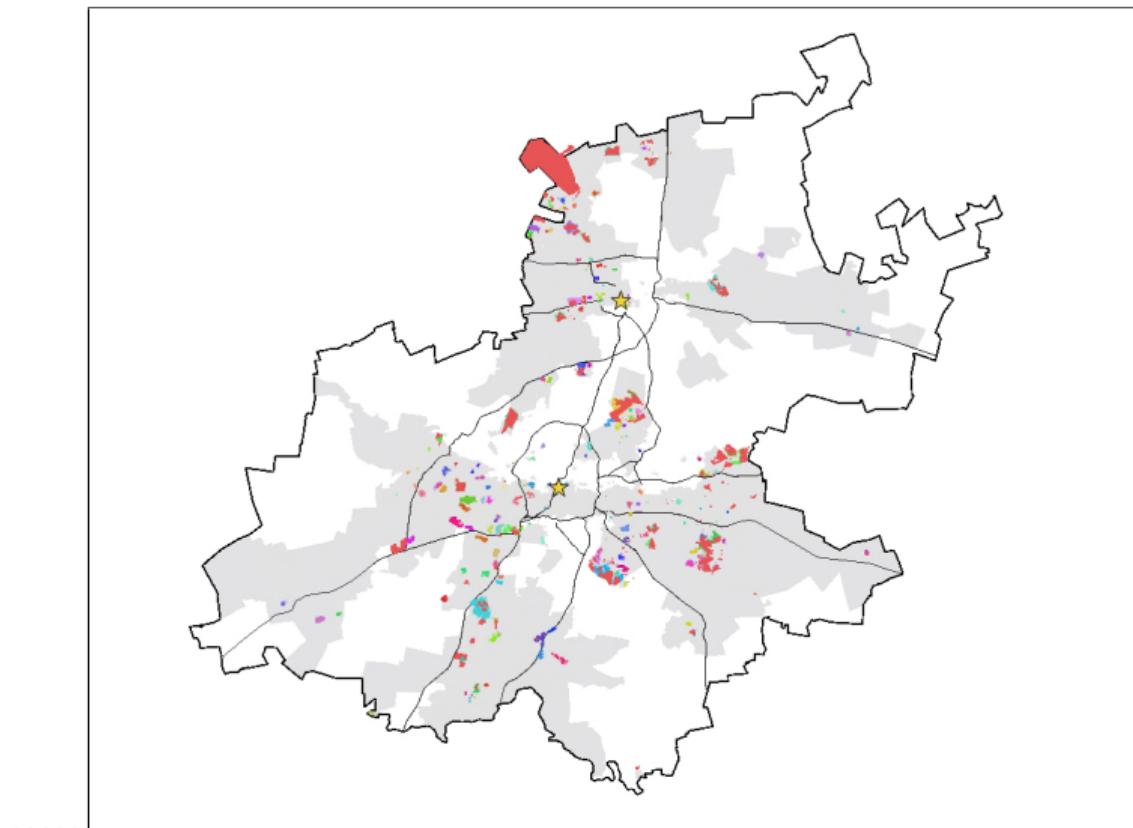
## Census Areas Exposure Measures



## Census Areas Exposure Measures



## Census Areas Exposure Measures



# Identifying Planned but Unconstructed Projects

- ① Admin. data have “planned,” “proposed,” “implementing” projects
  - ▶ Exclude projects with identified project transactions
- ② Assign projects an expected completion date
  - ▶ Fuzzy-string match budget data (with start-dates) on project names
  - ▶ Add avg. diff. between transaction-date and start-date for completed projects
- ▶ Why are projects canceled/delayed?
  - ▶ Legal disputes, service delivery backlogs, funding complications
  - ▶ Delays often exceed 12 years

# Housing Projects

Table: Housing Projects and Building Growth

|                        | Completed | Uncompleted |
|------------------------|-----------|-------------|
| Formal Density: 2001   | 338.3     | 238.9       |
| Formal Density: 2011   | 1,718.4   | 691.6       |
| Informal Density: 2001 | 435.2     | 2,125.8     |
| Informal Density: 2011 | 1,022.9   | 2,950.4     |
| Median Year (est.)     | 2005      | 2007        |
| Distance to CBD (km)   | 29.7      | 29.8        |
| Total Projects         | 57        | 64          |

Density is building number per square kilometer.

# Housing Price Descriptives

Table: Price Descriptives

|                       | Completed                | Uncompleted              | Other                    |
|-----------------------|--------------------------|--------------------------|--------------------------|
| Purchase Price (Rand) | 249,739.8<br>[1436396.3] | 195,237.4<br>[605,346.6] | 249,334.9<br>[304,547.1] |
| Plot Size (m3)        | 863.3<br>[34,095.1]      | 743.1<br>[5,112.2]       | 1,972.1<br>[57,208.8]    |
| Sold At Least Once    | 0.327                    | 0.328                    | 0.336                    |
| Median Purchase Year  | 2006                     | 2006                     | 2006                     |
| Observations          | 29,104                   | 30,552                   | 157,692                  |

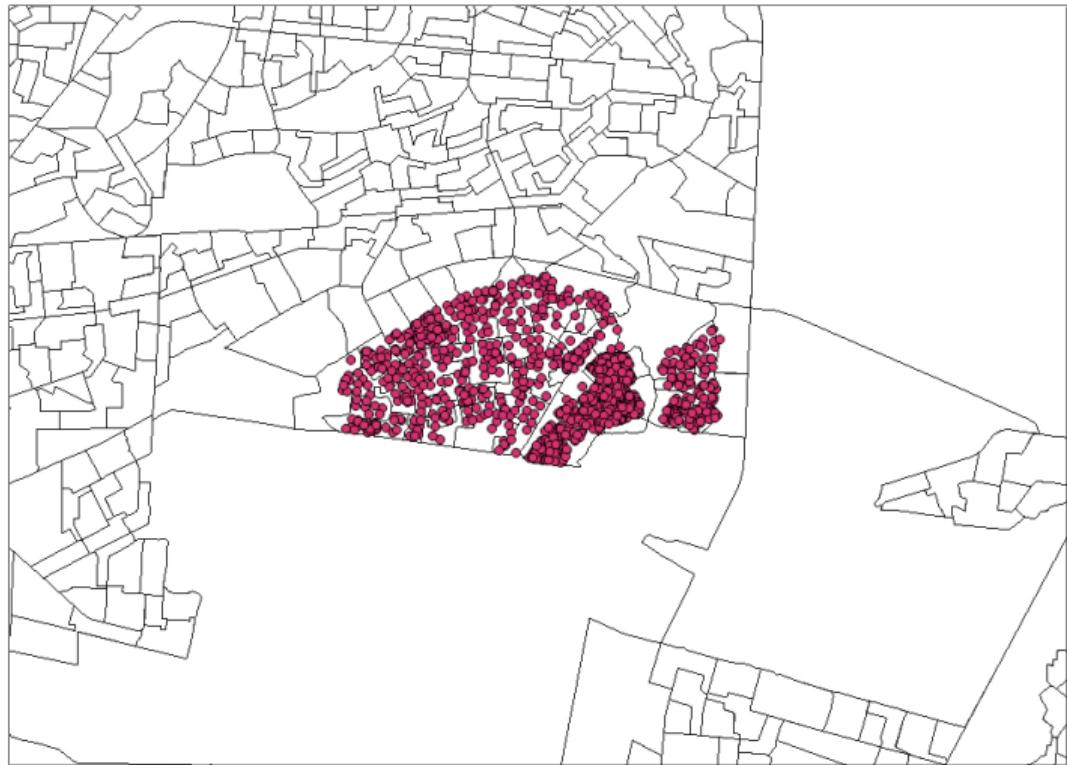
# Census Descriptives

|                    | In Buffer but No Overlap |             | 0% < Overlap ≤ 50% |             | 50% < Overlap |             |
|--------------------|--------------------------|-------------|--------------------|-------------|---------------|-------------|
|                    | Completed                | Uncompleted | Completed          | Uncompleted | Completed     | Uncompleted |
| Flush Toilet: 2001 | 0.78                     | 0.84        | 0.74               | 0.66        | 0.69          | 0.16        |
| Flush Toilet: 2011 | 0.79                     | 0.90        | 0.86               | 0.74        | 0.93          | 0.23        |
| Piped Water: 2001  | 0.39                     | 0.36        | 0.38               | 0.31        | 0.23          | 0.09        |
| Piped Water: 2011  | 0.52                     | 0.54        | 0.57               | 0.47        | 0.52          | 0.17        |
| Owner: 2001        | 0.48                     | 0.52        | 0.51               | 0.41        | 0.44          | 0.39        |
| Owner: 2011        | 0.73                     | 0.78        | 0.76               | 0.63        | 0.73          | 0.56        |
| House: 2001        | 0.50                     | 0.56        | 0.52               | 0.41        | 0.35          | 0.32        |
| House: 2011        | 0.52                     | 0.63        | 0.61               | 0.54        | 0.64          | 0.32        |
| Rooms: 2001        | 3.30                     | 3.39        | 3.16               | 3.14        | 2.85          | 3.01        |
| Rooms: 2011        | 3.44                     | 3.57        | 3.49               | 3.49        | 3.32          | 3.12        |
| Observations       | 1,196,080                | 996,443     | 356,975            | 131,708     | 567,633       | 225,675     |

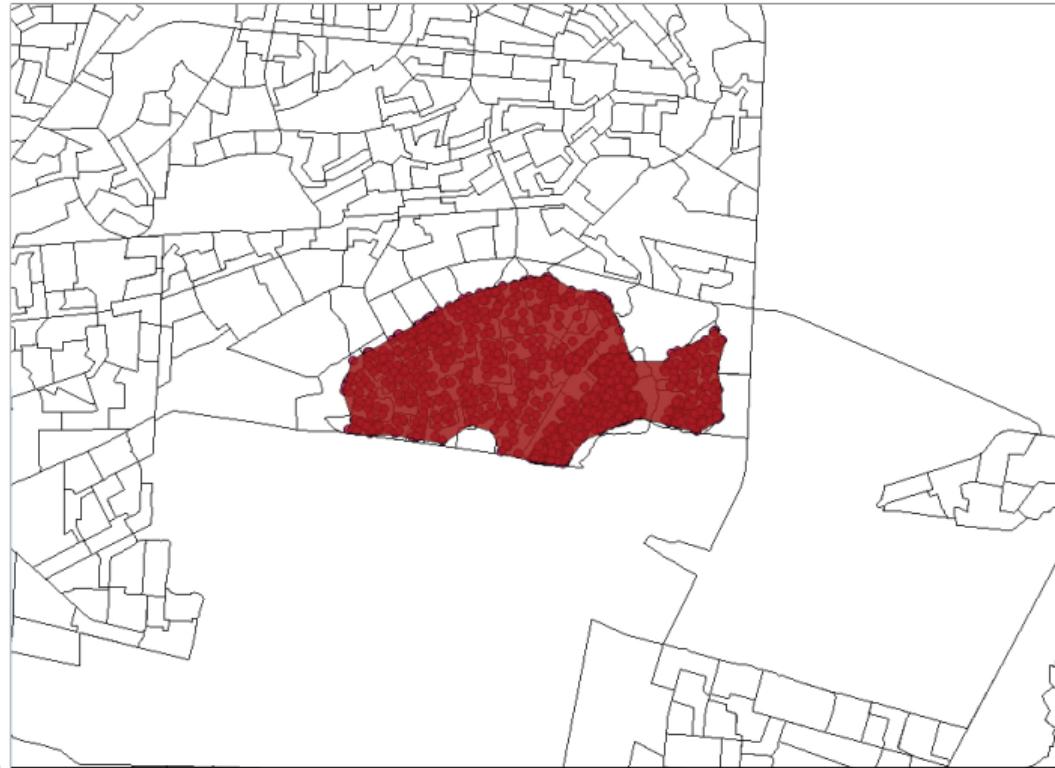
## Census Descriptives

|               | Within Project<br>(>30% Overlap) |             | Outside Project<br>(<30% Overlap) |             |
|---------------|----------------------------------|-------------|-----------------------------------|-------------|
|               | Completed                        | Uncompleted | Completed                         | Uncompleted |
| Flush Toilet  | 0.56                             | 0.14        | 0.77                              | 0.81        |
| Piped Water   | 0.21                             | 0.06        | 0.42                              | 0.36        |
| Elec. Cooking | 0.58                             | 0.19        | 0.68                              | 0.67        |
| Elec. Light   | 0.79                             | 0.33        | 0.74                              | 0.82        |
| Single House  | 0.51                             | 0.48        | 0.53                              | 0.59        |
| Observations  | 59,460                           | 48,065      | 213,809                           | 205,744     |

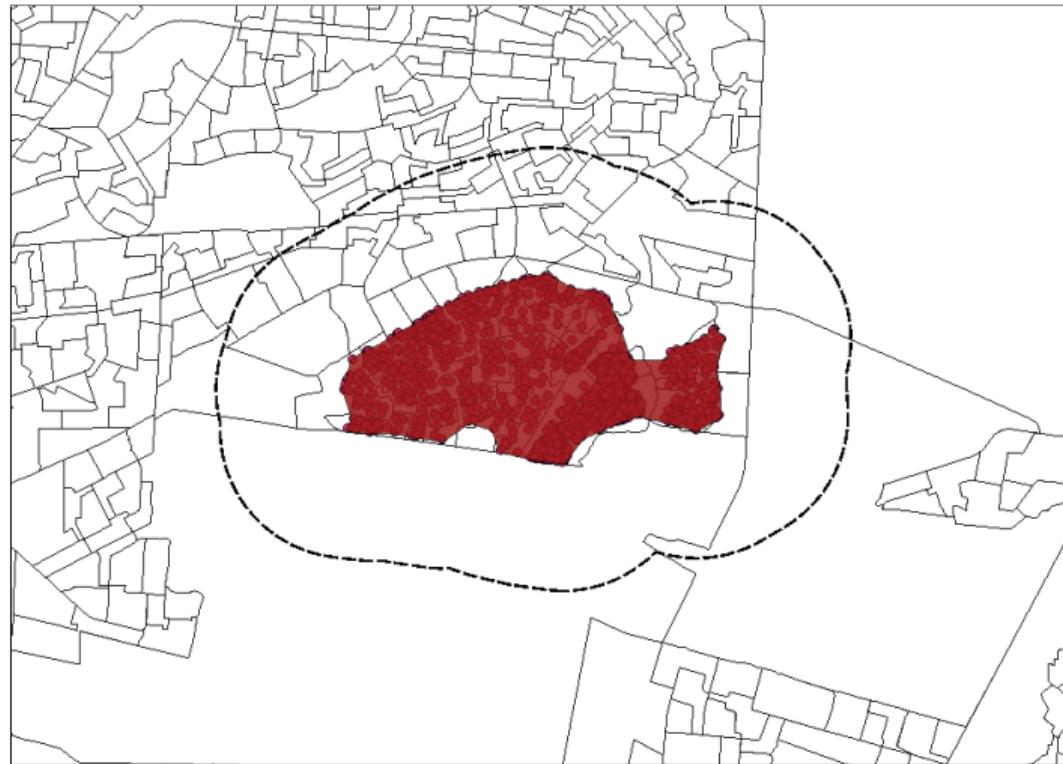
# Census Areas Exposure Measures



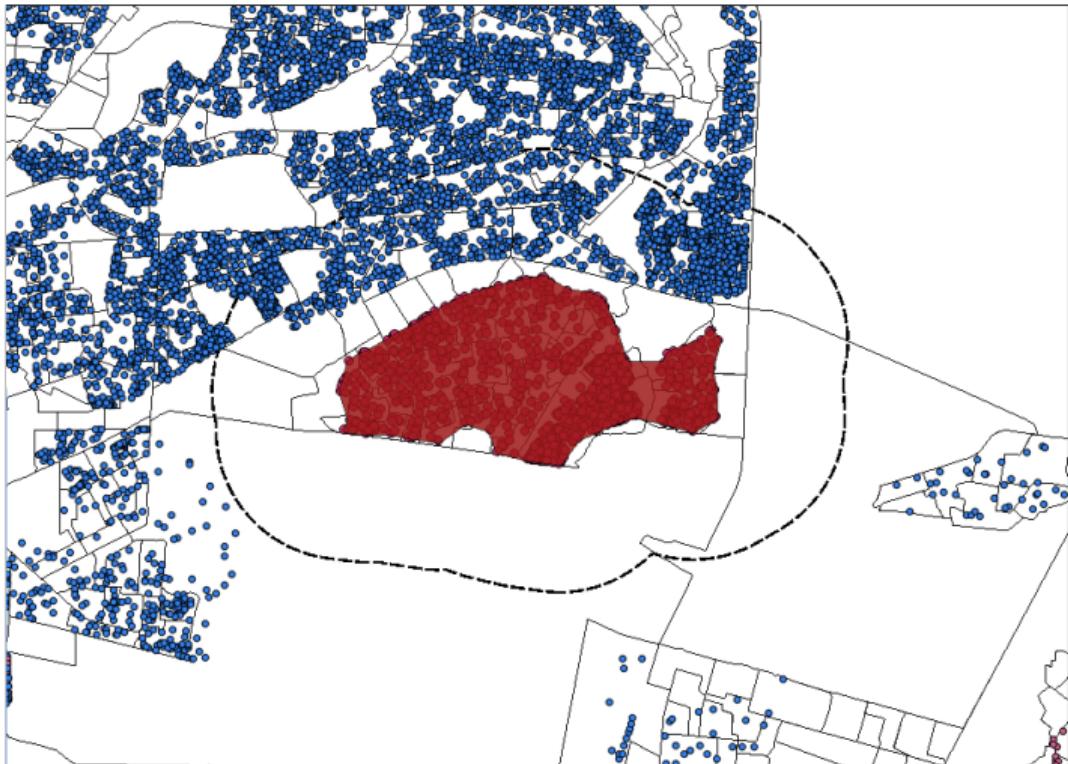
# Census Areas Exposure Measures



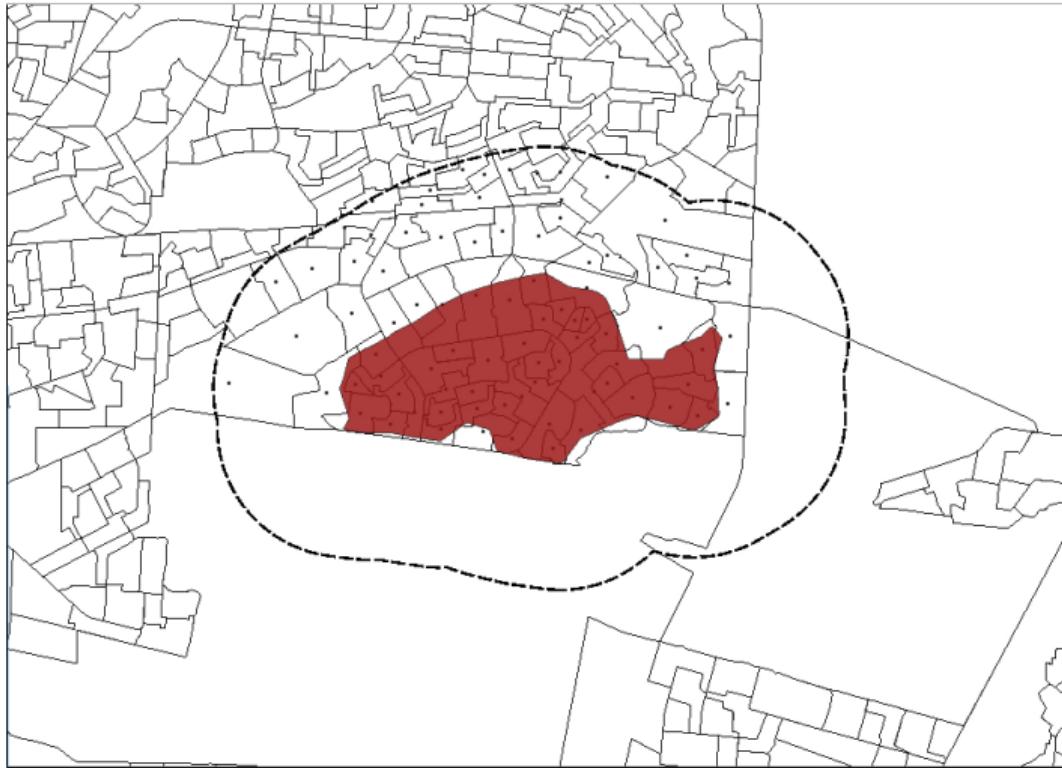
## Census Areas Exposure Measures



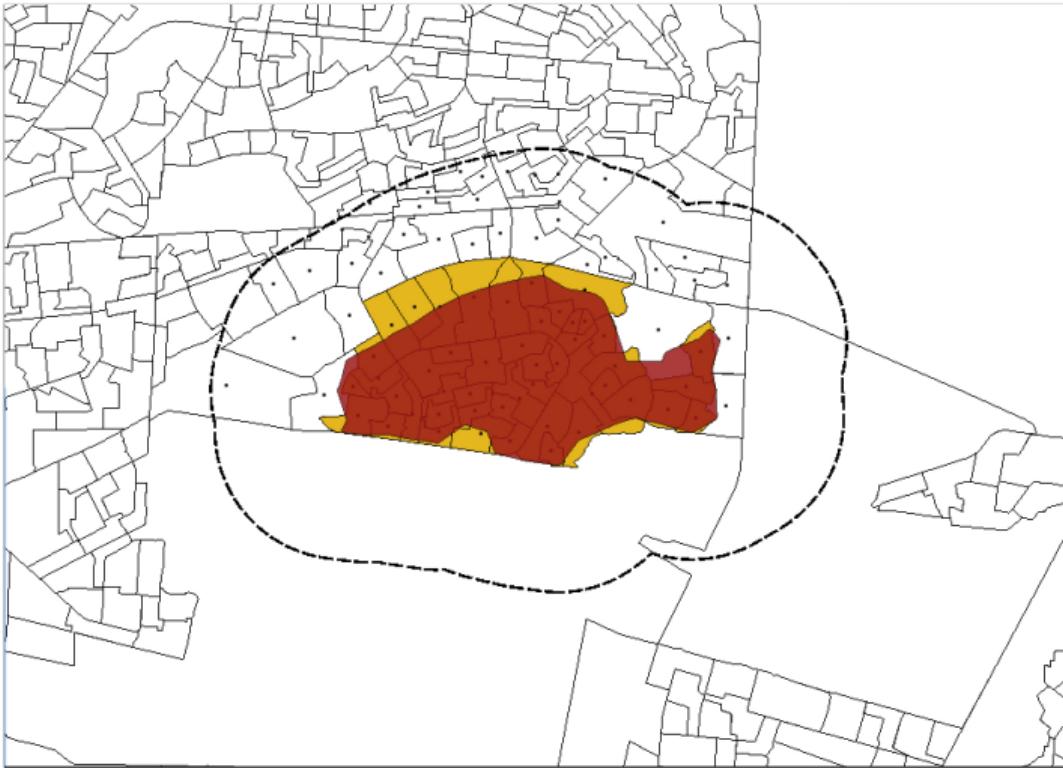
# Census Areas Exposure Measures



# Census Areas Exposure Measures



# Census Areas Exposure Measures



## Census Areas Exposure Measures



# Empirical Methodology

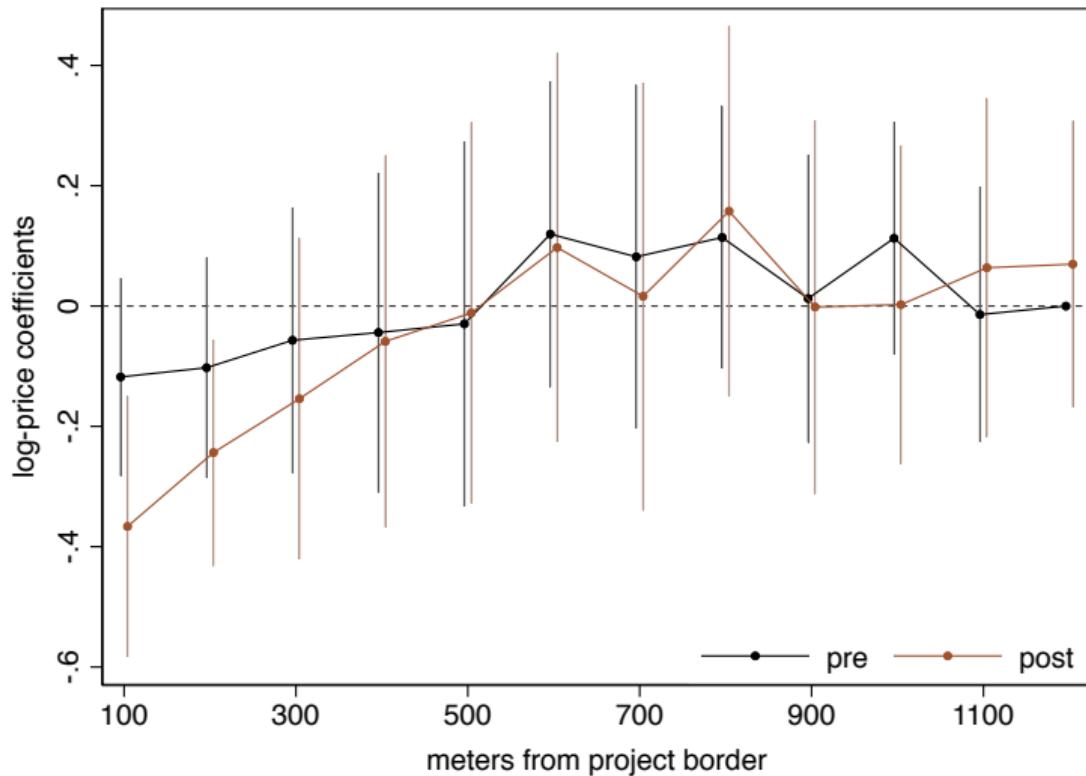
DID model:

$$P_{itp} = \alpha D_{tp} T_{ip} + \theta_1 D_{tp} + \theta_2 T_{ip} + X_i' \beta + \lambda_p + \eta_t + \varepsilon_{itp},$$

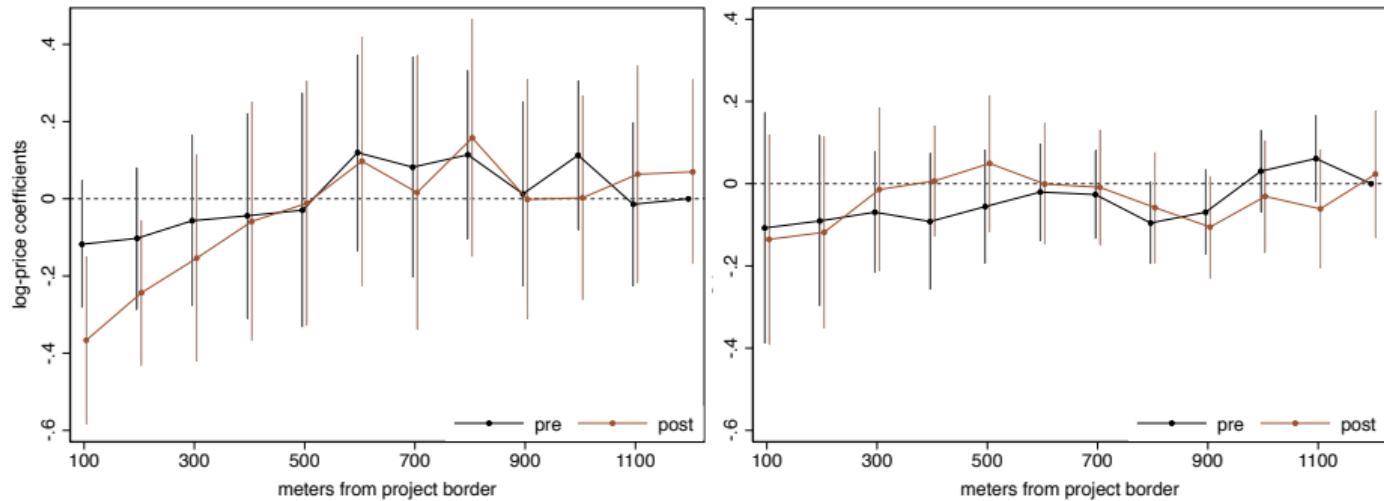
with:

- ▶  $P_{itp}$ : log-price of property  $i$  sold at time  $t$ , in vicinity of project  $p$ .
- ▶  $D_{tp} = 1$  if date  $t$  is after modal construction month.
- ▶  $T_{ip} = 1$  if property  $i$  within 400m of project border.
- ▶  $X_i$ : quadratic in lot size of property  $i$ .
- ▶  $\lambda_p$ : project fixed-effect.
- ▶  $\eta_t$ : time (year  $\times$  month) fixed-effect.
- ▶  $\varepsilon_{itp}$ : error term

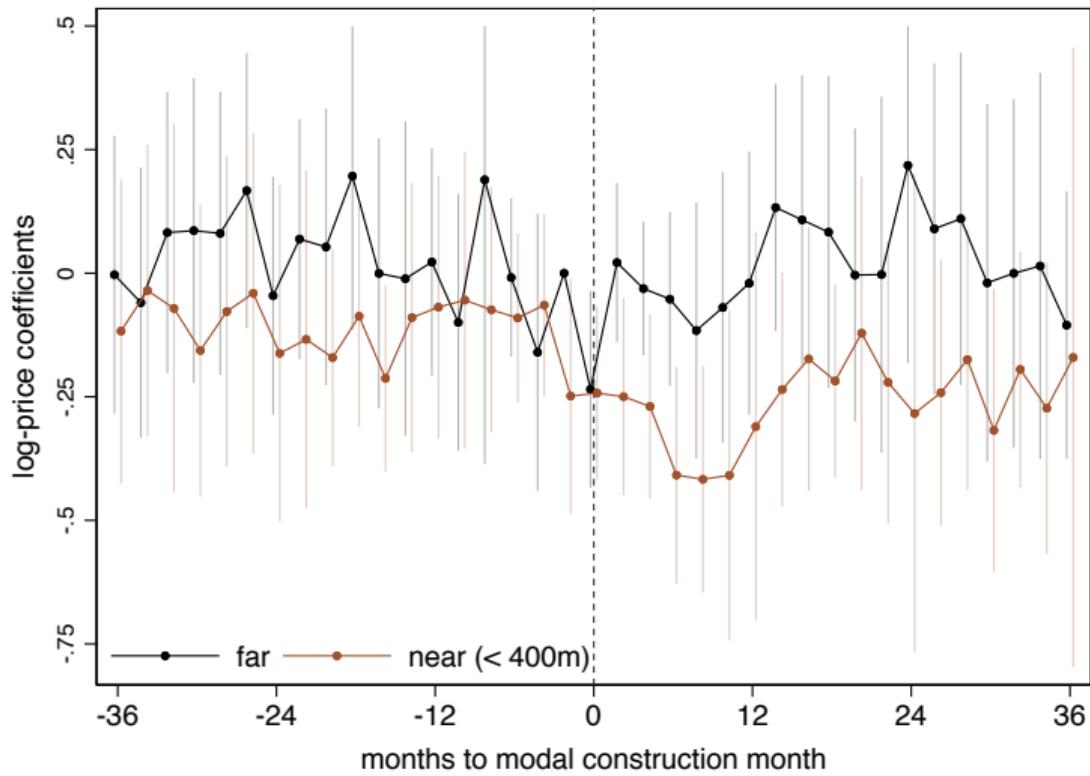
# Distance Plot



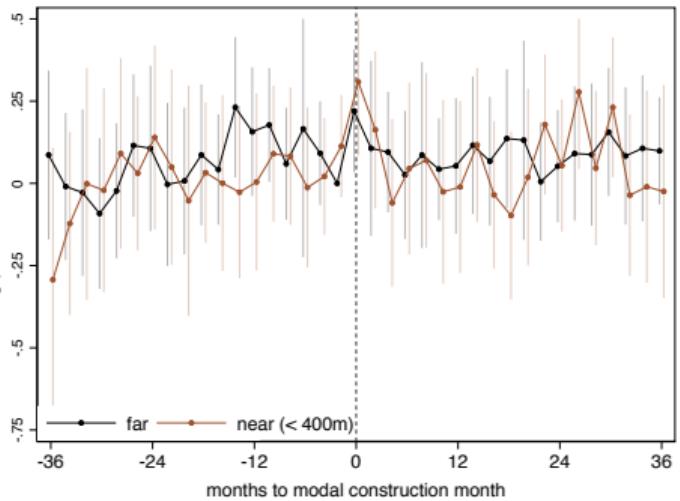
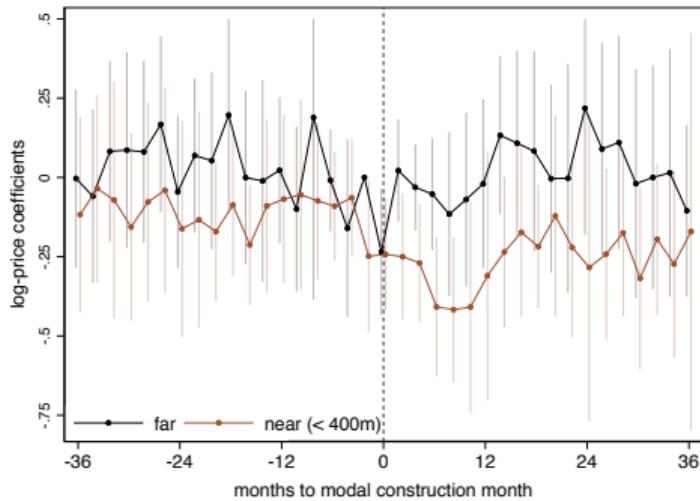
# Placebo Distance Plot



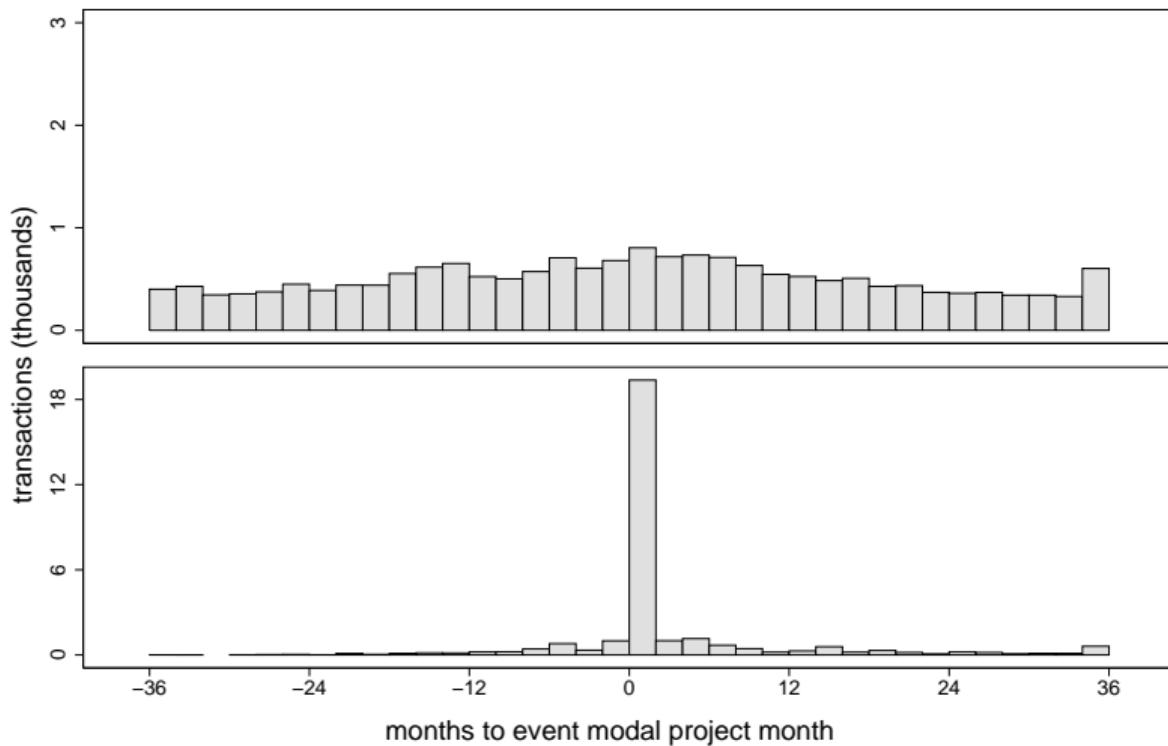
# Time Plot



# Placebo Time Plot



# Transaction Densities



# Housing Projects

| Effects:                  | (1)                 | (2)                | (3)                | (4)                 |
|---------------------------|---------------------|--------------------|--------------------|---------------------|
| 3 yrs 0-400m              | -0.235**<br>(0.106) | -0.157*<br>(0.083) |                    |                     |
| 1 <sup>st</sup> yr 0-400m |                     |                    | -0.138*<br>(0.075) |                     |
| 2 <sup>nd</sup> yr 0-400m |                     |                    | -0.170<br>(0.115)  |                     |
| 3 <sup>rd</sup> yr 0-400m |                     |                    | -0.109<br>(0.096)  |                     |
| 3 yrs 0-200m              |                     |                    |                    | -0.212**<br>(0.095) |
| 3 yrs 200-400m            |                     |                    |                    | -0.061<br>(0.067)   |
| Project FE                | no                  | yes                | yes                | yes                 |
| N                         | 28,856              | 28,856             | 28,856             | 28,856              |
| R <sup>2</sup>            | 0.228               | 0.489              | 0.490              | 0.491               |

Standard errors clustered at the project level.

All specifications control for year-month FE and cubic in plot size.

# Housing Projects

| Effects:                  | (1)              | (2)              | (3)               | (4)               |
|---------------------------|------------------|------------------|-------------------|-------------------|
| 3 yrs 0-400m              | 0.044<br>(0.082) | 0.010<br>(0.070) |                   |                   |
| 1 <sup>st</sup> yr 0-400m |                  |                  | 0.027<br>(0.081)  |                   |
| 2 <sup>nd</sup> yr 0-400m |                  |                  | -0.012<br>(0.080) |                   |
| 3 <sup>rd</sup> yr 0-400m |                  |                  | 0.004<br>(0.081)  |                   |
| 3 yrs 0-200m              |                  |                  |                   | -0.064<br>(0.093) |
| 3 yrs 200-400m            |                  |                  |                   | 0.067<br>(0.060)  |
| Project FE                | no               | yes              | yes               | yes               |
| N                         | 35,096           | 35,096           | 35,096            | 35,096            |
| R <sup>2</sup>            | 0.276            | 0.430            | 0.430             | 0.430             |

Standard errors clustered at the project level.

All specifications control for year-month FE and cubic in plot size.

# Housing Projects

|                       | (1)                | (2)                 | (3)                 | (4)               | (5)                 |
|-----------------------|--------------------|---------------------|---------------------|-------------------|---------------------|
|                       | flush toilet       | water tap           | elec. cooking       | elec. light       | house               |
| DD >30% overlap       | 0.265**<br>(0.101) | 0.241***<br>(0.060) | 0.034<br>(0.107)    | -0.029<br>(0.134) | 0.207***<br>(0.051) |
| DD $\leq$ 30% overlap | -0.027<br>(0.037)  | -0.070**<br>(0.033) | -0.106**<br>(0.042) | -0.016<br>(0.033) | -0.069**<br>(0.032) |
| N                     | 1,382,550          | 1,382,550           | 1,382,550           | 1,382,550         | 1,329,296           |
| R <sup>2</sup>        | 0.352              | 0.212               | 0.249               | 0.244             | 0.157               |

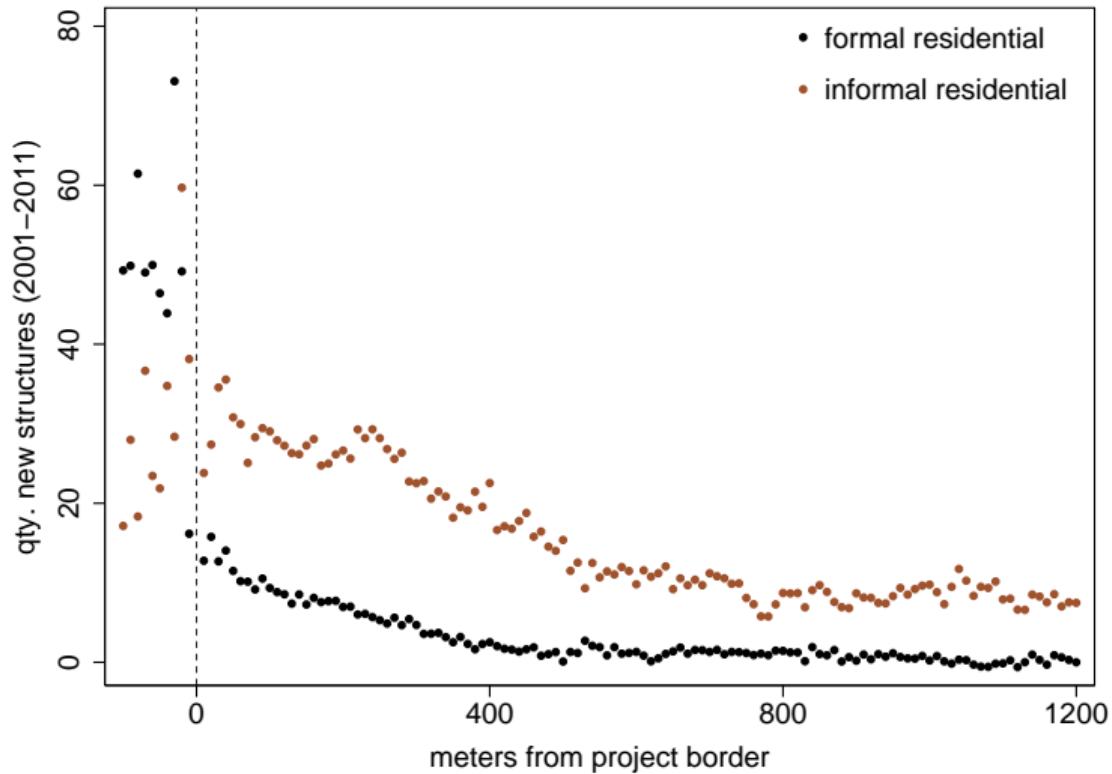
Standard errors clustered at the project level. All specifications control for project FE

# Housing Projects

|                       | (1)                  | (2)                  | (3)               |
|-----------------------|----------------------|----------------------|-------------------|
|                       | high-school          | monthly income       | unemployed        |
| DD >30% overlap       | -0.053***<br>(0.013) | 226.330<br>(372.469) | -0.008<br>(0.023) |
| DD $\leq$ 30% overlap | -0.008<br>(0.012)    | 77.967<br>(428.078)  | 0.024<br>(0.016)  |
| $N$                   | 2,055,289            | 909,466              | 1,069,857         |
| $R^2$                 | 0.024                | 0.050                | 0.049             |

Standard errors clustered at the project level. All specifications control for project FE

# BBLU plot



# BBLU plot placebo

