

# Subsidized Housing with Slum Externalities: Evidence from South Africa

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- ▶ Rapid Urbanization in the developing world during past decades.
- ▶ Significant portion of low-income city-dwellers live in slums, i.e. unserviced and temporary/informal housing structures.
- ▶ Disagreement on whether slum-dwellers are in a transitory phase (Glaeser, 2011) or stuck in poverty traps (Marx, 2013).
- ▶ Regardless, slum living conditions are poor:
  - ▶ inadequate living space
  - ▶ poor sanitation and water access
  - ▶ high crime levels
  - ▶ low public goods provision

Why should Governments intervene?

- ① Redistributive goals.
- ② Slum Externalities:
  - ▶ increased fire hazards, health risks, crime.
  - ▶ overburdening of public infrastructure, e.g. water and sewage.

Standard policy portfolio:

- ▶ Altering property rights and land regulations.
- ▶ On-site slum upgrading/servicing.
- ▶ Subsidized formal housing.

## This Paper:

- ▶ Focus on subsidized formal housing.
- ▶ Learn from the South African experience with post-apartheid Reconstruction and Development Programme (RDP).
- ▶ Treat subsidized housing as a place-based policy that affects surrounding neighborhoods and households' location decision.
- ▶ Think about "optimal" housing subsidy if slums generate externalities.
- ▶ Think about interactions between subsidized formal housing and informal housing:
  - ▶ Subsidized units may attract informal structures because of service access and available land.
  - ▶ "Back-yarding" a prevalent phenomena in South Africa.

# Research Questions

- ➊ What is the extent, if any, of slum externalities ?
- ➋ Do formal housing subsidies spillover to informal housing?
- ➌ Given ➊ and ➋ , what are the GE welfare impacts of subsidized formal housing?

Today:

- ▶ Brief description of SA housing subsidies.
- ▶ Description of available data.
- ▶ Some empirical evidence towards answering ➊ and ➋ .
- ▶ Outline of a model towards ➌ .

## RDP housing in a nutshell

- ▶ The RDP is a policy framework implemented in 1994 to address several socioeconomic issues under apartheid rule.
- ▶ Includes a large housing subsidy scheme, which provides eligible households the opportunity of owning their first house.
- ▶ Eligibility is based on citizenship, marital status and income.
- ▶ Program recipients receive a one-off capital subsidy (the house) at very low or no cost.
- ▶ Large excess demand; allocation process loosely regulated by various priority systems and wait lists, with many noted cases of corruption.
- ▶ Supply is planned by municipal and provincial housing agencies, construction is outsourced to private developers, with constraints on costs per unit, services access, and rooms/lot sizes.

## Three main data sources:

- ① Census data on households and individuals, 2 cross-sections.
- ② Data on buildings, 2-cross sections.
- ③ Data on real-estate transactions.

## 1. Census data:

- ▶ National coverage of the 2001 and 2011 census, at the respondent level.
- ▶ Individuals and household geographically identified at the small area level (  $\sim 170$  households per small area)
- ▶ Basic information on demographics, employment, income, education and dwelling characteristics.



## 2. Building-Based Land use data:

- ▶ Exhaustive building census based on aerial imagery.
- ▶ Building stock differentiable by various categories: residential, commercial, industrial, etc.
- ▶ Within residential, ability to differentiate formal from informal housing, including backyard shacks.
- ▶ 2 waves:
  - ▶ 2001 covering Gauteng Province and Cape-town metro area.
  - ▶ 2012 National coverage.

## 3. Deeds data:

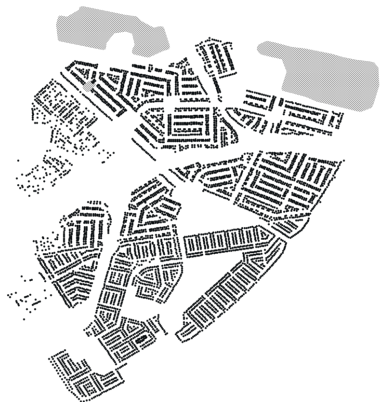
- ▶ Universe of housing transactions recorded during 2002-2011 in all affordable areas<sup>1</sup> in the country. ( $\sim 1.2$ M transactions)
- ▶ Exact geographic location of traded property, but limited information on characteristics other than price and lot size.
- ▶ RDP transactions noisily identifiable by filtering on Seller Name, price and lot size. ( $\sim 300$ K transactions)

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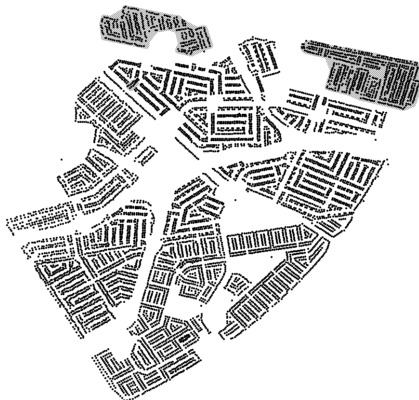
<sup>1</sup>defined as census enumeration areas with mean house price value less than R500,000 in 2010.

# Using BBLU data to examine Formal/Informal housing response

Formal Housing<sup>2</sup>:



2001



2012

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<sup>2</sup>grey polygons denote location of RDP projects

# Using BBLU data to examine Formal and Informal housing

Informal Housing<sup>3</sup>:



2001



2012

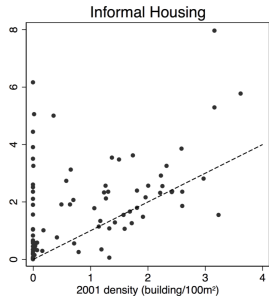
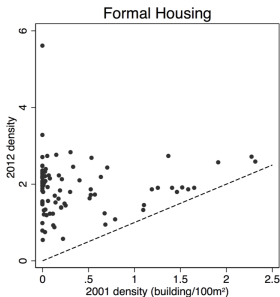
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<sup>3</sup>grey polygons denote location of RDP projects

# Using BBLU data to examine Formal and Informal housing

Residential housing density (buildings per 1000m<sup>2</sup>) using data from 94 RDP projects in Gauteng Province:

	Mean	S.D.
2001		
Formal:	0.34	0.54
Informal:	0.84	1.02
2012		
Formal:	1.91	0.67
Informal:	1.70	1.61



# Using deeds data to estimate RDP impact on housing prices

A first-pass DD approach:

- ▶ Identify areas where many clustered RDP houses were sold at similar dates.
- ▶ Examine house prices in adjacent areas, before and after construction, near and far from RDP project.
- ▶ Rely on spatial proximity for identification.

## Using deeds data to estimate RDP impact on housing prices



## Using deeds data to estimate RDP impact on housing prices

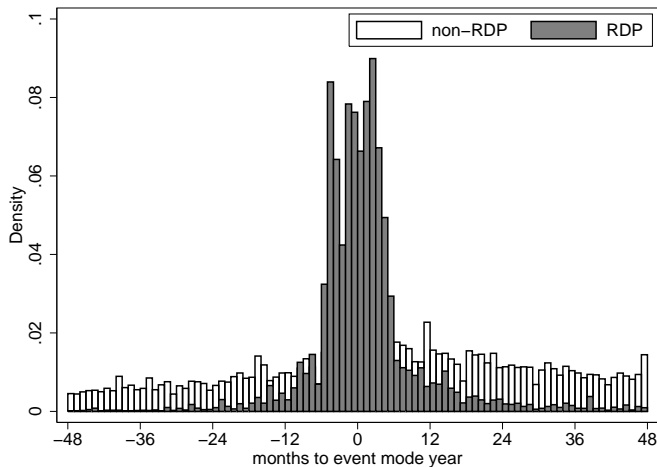
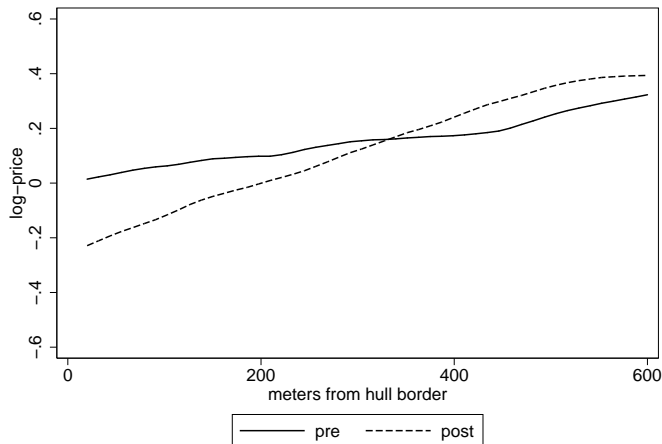


Figure: density of RDP vs Non-Rdp transactions centered around "event month"



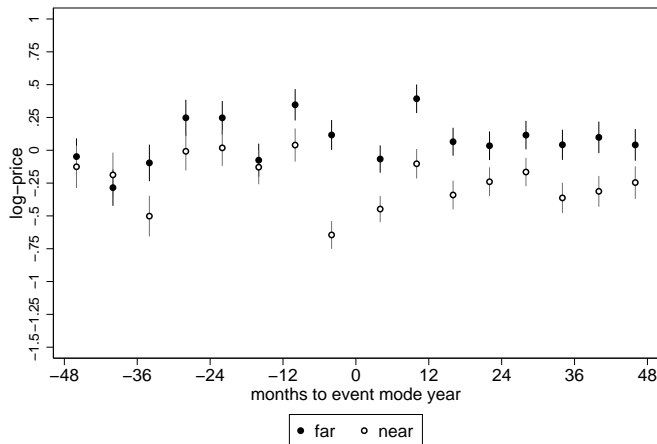
# Using deeds data to estimate RDP impact on housing prices



Note: controls for quadratic in erf size, mun-by-year and month FE.

**Figure:** Smoothed distance dummy coefficients of log-price of Non-RDP transactions, before and after mode year of construction.

# Using deeds data to estimate RDP impact on housing prices



Note: controls for quadratic in erf size, mun-by-year and month FE.

**Figure:** 6-month dummy coefficients of log-price of Non-RDP transactions, <300m (near) and >300m (far) from border of RDP project.

# A Model of Housing with Slum Externalities

## Basic Setup:

- ▶ A city is comprised of  $N$  residential neighborhoods indexed  $n \in \{1, \dots, N\}$ .
- ▶ Each neighborhood has a formal and informal housing sector, indexed  $s \in \{F, I\}$ .
- ▶ All jobs are in the CBD and pay a fixed wage rate; commuting to the CBD is costly.

# Housing Demand

## Housing Demand:

- ▶ Measure one of freely-mobile agents inelastically demand one unit of housing.
- ▶ An agent  $i$  has idiosyncratic tastes for neighborhoods, represented by the vector  $\epsilon_i \in \mathbb{R}^{2N}$  of neighborhood-sector specific valuations.
- ▶ The distribution of preferences in the population is given by density  $f(\epsilon)$  such that  $\int f(\epsilon) d\epsilon = 1$ .

# Housing Demand

Indirect Utility:

$$\begin{aligned}u_{ins} &= A_n + B_s - R_{ns} + \epsilon_{ins} \\ &= v_{ns} + \epsilon_{ins}\end{aligned}$$

With:

- ▶  $A_n$  is net-of-commuting and amenity-adjusted wage received in  $n$ .
- ▶  $B_s$  is a utility component specific to living in sector  $s$
- ▶  $R_{ns}$  is the rental rate of housing.
- ▶  $\epsilon_{ins}$  is individual  $i$ 's taste for neighborhood-sector pair  $(n, s)$ .

Individual  $i$  takes exogenous quantities  $\{\mathbf{A}, \mathbf{B}, \epsilon_i\}$  and endogenous rents  $\mathbf{R}$  as given, and locates in pair  $(n, s)$  yielding the highest indirect utility.

# Housing Demand

Aggregate housing demand  $H_{ns}$  in  $(n, s)$  given by:

$$\begin{aligned} H_{ns} &= \int I\left(u_{ins} = \max_{n's'}\{u_{in's'} \mid \mathbf{A}, \mathbf{B}, \mathbf{R}\}\right) f(\epsilon) d\epsilon \\ &= D_{ns}(\mathbf{A}, \mathbf{B}, \mathbf{R}) \end{aligned}$$

# Housing Supply

- ▶ Neighborhoods are endowed with  $L_n$  units of land.
- ▶ A share  $\theta_{nF}$  of the total land stock is available for formal residential development, while the rest,  $\theta_{nI} = 1 - \theta_{nF}$ , is vacant or public land suited for informal housing.
- ▶ Price-taking landlords supply housing by combining land and materials  $M$  with CRS technology  $q(L, M)$ .
- ▶ Materials are supplied at fixed cost  $c$  on a large national market.
- ▶ Government can subsidize housing in market  $(n, s)$  at a rate of  $\delta_{ns}$  per unit.

Because land is fixed in every market, the marginal cost of housing is increasing. The inverse supply curve in  $(n, s)$  is:

$$R_{ns} = S(H_{ns}, \theta_{ns}L_n) - \delta_{ns}$$

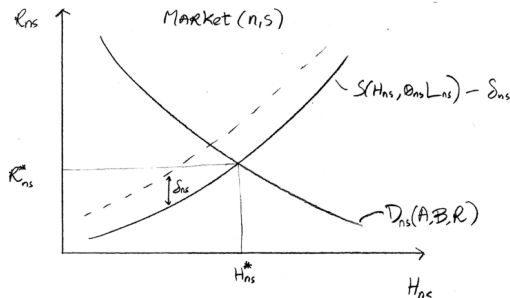
# Equilibrium

Given density  $f(\epsilon)$  and exogenous quantities  $\{A, B, L, \theta\}$ , an equilibrium consists of rents  $R^*$  and housing quantities  $H^*$  such that all housing markets clear, that is,  $\forall(n, h)$ :

$$H_{ns}^* = D_{ns}(A, B, R^*)$$

and  $R_{ns}^* = S(H_{ns}^*, \theta_{ns} L_n) - \delta_{ns},$

and all agents live somewhere:  $\sum_n \sum_s H_{ns}^* = 1$





The sum of individuals' utility is given by:

$$U = \int \max_{n's'} \{u_{in's'} \mid \mathbf{A}, \mathbf{B}, \mathbf{R}^*\} f(\epsilon) d\epsilon$$

and total landlords' profit is:

$$\Pi = \sum_n \sum_s \left( \int_0^{H_{ns}^*} [R_{ns}^* - (S(x, \theta_{ns} L_n) - \delta_{ns})] dx \right)$$

Total social welfare is:

$$W = U + \Pi$$

## Welfare Implications of Subsidies (No Market Failures)

We are interested in the welfare implications of the government subsidizing formal housing in a subset  $\mathcal{N} \subset \{1, \dots, N\}$  of neighborhoods:

$$\delta_{ns} = \begin{cases} \delta & \text{if } n \in \mathcal{N} \text{ and } s=F \\ 0 & \text{otherwise} \end{cases}$$

After some algebra, we can show that the marginal welfare effect of changing  $\delta$  simplifies to:

$$\frac{\partial W}{\partial \delta} = \frac{\partial U}{\partial \delta} + \frac{\partial \Pi}{\partial \delta} = \sum_{n \in \mathcal{N}} H_{nF}^*$$

## Welfare Implications of Subsidies (No Market Failures)

The total cost of the subsidy is given by  $TC = \sum_n \sum_s H_{ns}^* \delta_{ns}$  and its marginal cost is therefore:

$$\frac{\partial TC}{\partial \delta} = \sum_{n \in \mathcal{N}} \left( H_{nF}^* + \delta \frac{\partial H_{nF}^*}{\partial \delta} \right)$$

The extra term in this expression relative to (2) represents the marginal deadweight loss from an increase in  $\delta$ . The magnitude of the inefficiencies depends on the population responses in subsidized markets,  $\frac{\partial H_{nF}^*}{\partial \delta}$ .

## Welfare Implications with Slum Externalities

We consider an external utility cost from informal housing of the form:

$$A_n = \bar{A}_n + a\left(\frac{H_{nI}}{L_n}\right)$$

where  $a'(\cdot) < 0$ . The private decision of locating in  $(n, I)$  negatively impacts all residents in  $n$  because of congestion effects. The welfare response to  $\delta$  is now:

$$\frac{\partial W}{\partial \delta} = \sum_{n \in \mathcal{N}} H_{nF}^* + \sum_n \underbrace{a'\left(\frac{H_{nI}^*}{L_n}\right)}_{(<0)} \underbrace{\frac{\partial H_{nI}^*}{\partial \delta}}_{(<0)} \frac{(H_{nF}^* + H_{nI}^*)}{L_n}$$

The subsidy  $\delta$  makes formal housing in  $\mathcal{N}$  more attractive relative to informal housing. Marginal residents moving to  $\mathcal{N}$  make remaining residents better-off because of reduced congestion.

## Welfare Implications with Slum Externalities

Since the cost of the subsidy is unaffected by the externality, the marginal deadweight loss is now:

$$\begin{aligned} MDWL &= \frac{\partial TC}{\partial \delta} - \frac{\partial W}{\partial \delta} \\ &= \sum_{n \in \mathcal{N}} \delta \frac{\partial H_{nF}^*}{\partial \delta} - \sum_n a' \left( \frac{H_{nI}^*}{L_n} \right) \frac{\partial H_{nI}^*}{\partial \delta} \frac{(H_{nF}^* + H_{nI}^*)}{L_n} \end{aligned}$$

$\delta = 0$  implies  $MDWL < 0$ . Some level of subsidy  $\delta$  is welfare improving when compared to no subsidy. This is expected since the social benefits exceed the private benefits of moving from informal to formal housing.

## Welfare with Slum Externalities and Subsidy Spillovers.

To capture the possibility of increased "backyarding", we now assume subsidies in the formal sector spillover to the informal sector at no additional cost for the government:

$$\delta_{ns} = \begin{cases} \delta & \text{if } n \in \mathcal{N} \text{ and } s=F \\ \alpha\delta & \text{if } n \in \mathcal{N} \text{ and } s=I \\ 0 & \text{otherwise} \end{cases}$$

This yields:

$$\frac{\partial W}{\partial \delta} = \sum_{n \in \mathcal{N}} (H_{nF}^* + \alpha H_{nI}^*) + \sum_n \underbrace{a' \left( \frac{H_{nI}^*}{L_n} \right)}_{(<0)} \underbrace{\frac{\partial H_{nI}^*}{\partial \delta}}_{(\leq 0)} \left( \frac{H_{nF}^* + H_{nI}^*}{L_n} \right)$$

# Welfare with Slum Externalities and Subsidy Spillovers.

The presence of such spillovers alter welfare implications in two ways:

- ▶ Suppliers of informal housing benefit from an increase in profit due to the indirect subsidies.
- ▶ For  $n \in \mathcal{N}$ , the sign of informal housing response  $\frac{\partial H_{nI}^*}{\partial \delta}$  is now ambiguous and depends on the magnitude of  $\alpha$ .<sup>4</sup> When  $\alpha$  is large, the indirect subsidies in  $(n, I)$  dominate and net-migration is positive, i.e.  $\frac{\partial H_{nI}^*}{\partial \delta} > 0$ , making incumbent residents in  $(n, I)$  and  $(n, F)$  worse-off.

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<sup>4</sup>This can also be shown formally by combining the equilibrium conditions in (1) and using the implicit function theorem. For  $n \in \mathcal{N}^C$ ,  $\frac{\partial H_{nI}^*}{\partial \delta}$  remains unambiguously negative.

# Takeaways from the model

With this set-up, welfare considerations depend critically on 3 quantities:

- ▶ The shape of externalities  $a(\cdot)$  – this is research question ① .
- ▶ The extent of spillovers  $\alpha$  – this is research question ② .
- ▶ The population (housing) responses in both subsidized formal markets,  $\frac{\partial H_{nF}^*}{\partial \delta} \forall n \in \mathcal{N}$ , and informal markets,  $\frac{\partial H_{nI}^*}{\partial \delta} \forall n$ .