Subsidized Housing with Slum Externalities: Evidence from South Africa

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Context

- Rapid Urbanization in the developping 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 proverty traps (Marx, 2013).
- Regardless, slum living conditions are poor:
  - inadequate living space
  - poor sanitation and water access
  - high crime levels
  - low public goods provision

Motivation

Why should Governments intervene?

1. Redistributive goals.
2. Slum Externalities.

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).
- Existing literature in development economics treats subsidized housing as relocation programs, focusing mainly on outcomes of relocated households.
- Subsidized housing is also a place-based policy that affects the surrounding neighborhoods and households' location decision.
- Think about "optimal" housing subsidy if slums generate externalities.

Research Questions

1. What is the extent, if any, of slum externalities ?
2. Do formal housing subsidies spillover to informal housing?
3. Given 1 and 2 , 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 1 and 2 .
- Outline of a model towards 3 .

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.

Data Sources

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.

Data Sources

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.

Data Sources

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.

Data Sources

3. Deeds data:

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

[1] defined as census enumeration areas with mean house price value less than R500,000 in 2010.

Local RDP impact on housing prices

A first-pass DD aproach:

- 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.

Local RDP impact on housing prices

Local RDP impact on housing prices

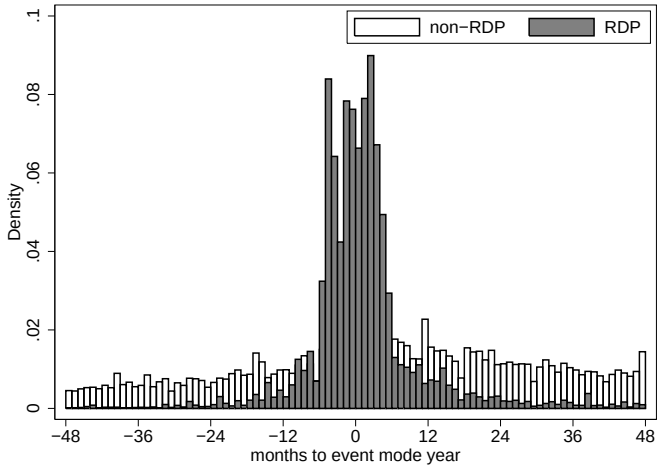
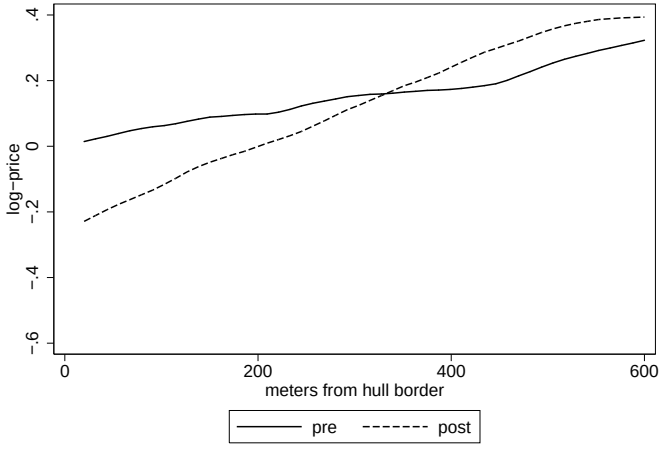


Figure: density of RDP vs Non-Rdp transactions centered around "event month"

Local 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.

A Model of Housing with Slum Externalities

Basic Setup:

- A city is comprised of N residential neighborhoods indexed $n \in \{1, ..., N\}$.
- 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 $\boldsymbol{\epsilon}_i \in \mathbb{R}^{2L}$ of neighborhood-sector specific valuations.
- The distribution of preferences in the population is given density $f(\boldsymbol{\epsilon})$ such that $\int f(\boldsymbol{\epsilon}) d\boldsymbol{\epsilon} = 1$.

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.
- ϵ_{ins} is individual i's taste for neighborhood-sector pair (n, s).

Individual i takes exogenous quantities $\{\boldsymbol{A}, \boldsymbol{B}, \boldsymbol{\epsilon}_i\}$ and endogenous rents $\boldsymbol{R}$ 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:

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

Housing Supply

- Neighborhoods are endowed with L_n units of land.
- A share θ_{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 δ_{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 $f(\boldsymbol{\epsilon})$ and exogenous quantities $\{\boldsymbol{A}, \boldsymbol{B}, \boldsymbol{L}, \boldsymbol{\theta}\}$, an equilibrium consists of rents $\boldsymbol{R}^*$ and housing quantities $\boldsymbol{H}^*$ such that all housing markets clear, that is, $\forall(n, h)$:

$$\begin{aligned} H^*_{ns} &= D_{ns}(\boldsymbol{A}, \boldsymbol{B}, \boldsymbol{R}^*) \\ \text{and} \quad R^*_{ns} &= S(H^*_{ns}, \theta_{ns} L_n) - \delta_{ns}, \end{aligned}$$

and all agents live somewhere:

$$\sum_n \sum_s H^*_{ns} = 1$$

Welfare

The sum of individuals' utility is given by:

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

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 $\mathcal{N} \subset \{1, ..., N\}$ 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 δ 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 δ. 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:

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

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

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

The subsidy δ 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:

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

$\delta = 0$ implies $MDWL < 0$. Some level of subsidy δ 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 response of 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:

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

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 α.[2] When α 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.

[2] 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 $a(\,)$ – this is research question 1 .
- The extent of spillovers α – 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, $\frac{\partial H^*_{nI}}{\partial \delta}\ \forall n$.