In da house!*

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Abstract

We estimate economic spillovers from subsidized housing projects on local neighborhoods using housing transaction records and high-resolution census data in South Africa. With a differences-in-differences design, we find that projects lead to a X% decline in nearby housing prices. We attribute this decline to externalities from informal settlements constructed within housing projects.

Keywords: traffic externalities; street livability; urban policy; housing market.

JEL Codes: O18; H4; R2; R4.

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1. Introduction

In developing countries, 30% of urban populations live in slums where households often suffer high rates of crime, low access to infrastructure, insecure property rights, and unsanitary conditions (United Nations [2015]). These negative externalities often combine to create poverty traps, preventing long-term economic development (Marx et al. [2013]). Governments have responded by replacing slums with new homes and moving slum dwellers to public housing projects. While these policies are often motivated by immediate health and economic benefits for recipients, economic theory emphasizes how high-quality public housing provides an incentive for neighbors to invest more in their own homes and communities, reducing negative externalities and steering communities away from poverty traps.

In this paper, we analyze the impacts of public housing on the development of surrounding neighborhoods. We study a large-scale housing program in South Africa, which has allocated over 4.3 million dwellings and houses over 13% of the total population (Department of Human Settlements [2012,2015]; GHS 2009-2013). Already one of the largest housing programs in the developing world, this program continues to respond to large backlogs in housing demand with an even mix of upgrading slum areas with new houses as well as constructing large public housing developments. This program is intended to not only serve as "a key strategy for poverty alleviation" for direct beneficiaries, but also generate community-wide benefits, "leveraging growth in the economy," "combating crime, promoting social cohesion and improving quality of life for the poor," and "utilizing housing as an instrument for the development of sustainable human settlements, in support of spatial restructuring" (Department of Human Settlements [2004]).

We combine administrative data on [XX] housing projects with data on property transactions, demographics, and building construction to measure the local impacts of these projects. We estimate a persistent [XX]% decline in home prices within [XX] meters of a project. We then use heterogeneity in the extent to which projects eradicate existing slums as a natural experiment to quantify negative externalities from slum areas. Our estimates imply that increasing slum density

by [XX]% leads to a [XX]% decline in local housing prices. We find some evidence that this effect scales non-linearly with the size of the housing projects, which has theoretical implications for the extent to which slum areas represent poverty traps.

To identify these effects, we use a differences-in-differences strategy leveraging both the exact timing of housing project construction as well as precise geographic proximity of surrounding areas. Like Diamond and McQuade [2016]'s similar analysis of public housing in the US, we leverage the substantial uncertainty in project timing due to difficulties coordinating many stakeholders and sources of funding (Tissington [2011]). Similar to the context in the US, we find little evidence that local housing markets anticipate these projects. We also build on Diamond and McQuade [2016] by using planned but unconstructed project areas as counterfactual areas, which help to control for demographic or housing market trends that might be correlated with the choice of project locations.

Our negative spillover estimates stand in contrast to a large literature in development that has focused on measuring housing impacts on direct recipients. Relying on small-scale experimental designs, previous studies have linked public housing to improvements in employment outcomes (Franklin [2016]), self-reported wellbeing (Galiani et al. [2017]; Devoto et al. [2012]), and child health outcomes (Cattaneo et al. [2009]). Data limitations both in finding a large enough sample of housing projects and in identifying outcomes at a precise spatial scale have prevented previous studies identifying spillover effects. Taken alongside these previous studies, our findings suggest that policymakers may benefit from weighing direct benefits to recipients against potential negative effects to the local housing neighborhoods in designing future housing policy.

To understand the welfare implications of this policy, we also develop a model similar to...

1.1. Where are houses built?

Between 2000 and 2010, subsidized housing efforts in South Africa have primarily focused on constructing and allocating single-story, two-room (30 to 40 square meter) dwellings to households in groups of 50 to 500 per project. These housing projects are evenly divided between two categories

(Department of Human Settlements [2012,2015]):

1. **Greenfield developments** involve the construction of housing projects primarily on undeveloped state-owned land although in some cases, municipalities will work with private developers to purchase inexpensive, undeveloped private land for these projects. Finding undeveloped land often requires policymakers to locate these projects far from city centers and economic opportunities.

2. **In-situ upgradings** replace existing informal settlements with housing developments.[1] Since informal settlements are often located closer to city centers, the resulting housing projects may provide better employment opportunities (Tissington [2011]).

Facing substantial housing demand, the Department of Human Settlements has continued to issue grants to provincial governments to keep the rate of yearly housing allocations roughly constant (Department of Human Settlements [2012,2015]). While the location and types of projects are determined by provincial and municipal governments, construction is subcontracted to private developers who also act as project managers assisting in the allocation of houses to beneficiaries (Durojaye et al. [2013]).

Since housing projects require coordination between many stakeholders, these projects often face unanticipated delays and cancellations due to labor and land procurement issues, difficulties gaining support from local government agencies, environmental impact assessments, and inadequate bulk infrastructure provision (Department of Human Settlements [2012,2015]). In one example, political disagreements with local stakeholders led to the abandonment of a large project in Gauteng (Dlmini [2017]).

1.2. Who are the beneficiaries?

The National Department of Human Settlements issues guidelines for eligibility and maintains an official waiting list for eligible households for greenfield developments. Eligibility requires

[1]While in some cases these programs refer simply to the provision of land titles and municipal services (water, electricity, etc.), this paper focuses on cases where informal settlements are replaced by fully-serviced, single-story houses.

citizenship, no previous property ownership, being married or having financial dependents, and having a monthly household income below R3,500 (Durojaye et al. [2013]).[2] The share of households reporting at least one member on the waiting list has remained stable at over 13% from 2009 to 2013.[3] Before construction, each project is assigned beneficiaries in a first-come, first-served basis according to the waiting list in their province or municipality. For in-situ upgrading projects, previous inhabitants of informal settlements receive renovated houses while any remaining houses are allocated according to the housing waiting list.

In practice, these guidelines are only loosely followed. Recent reports point to cases of corruption in the allocation of houses while in some instances, housing projects are organized with the assistance of local community groups who ultimately select the beneficiaries (Durojaye et al. [2013]; Mathoho [2010]). Research suggests that Beneficiaries are often selected over the course of project construction and sometimes even after construction has finished (Durojaye et al. [2013]).

Beneficiaries are expected to pay a small one-time payment in order to receive title for their houses. Guidelines also prevent beneficiaries from reselling their houses (and discourage renting) within their first 7 years of ownership. Despite these guidelines, only 82% of project houses are reported being still occupied by their original beneficiaries within five years of construction.[4] Anecdotal evidence suggests that project managers are aware of this active secondary market but have difficulty policing these transactions (Matsena [2018]).

2. Data

Understanding the spillover impacts of public housing requires (1) outcome measures at high spatial and geographic resolutions as well as (2) a precise measure of the location, timing, and size of housing projects.

[2]The Gauteng Province has implemented their own waiting list since 2008 in order to exert greater control over the allocation process.

[3]This figure is calculated from the General Household Surveys from 2009 to 2013

[4]This figure is calculated from the General Household Surveys from 2009 to 2013

2.1. Measuring Spillover Outcomes

To measure formal housing market impacts, we use over 500,000 housing transactions from the South African National Deeds Office covering the universe of transactions for suburbs in the bottom 20% of the housing market between 2003 and 2011 in the Gauteng Province (including the Johannesburg metro area).[5] These data include the price, exact location, plot size, buyer name, and seller name for each transaction. To isolate spillover effects, we focus on transactions occurring within 1.2 kilometers of a housing project bringing the final sample to around 100,000 transactions. We exclude the top 1% of prices as well as prices below 1,000 Rand, which are likely composed of measurement error or the exchange of property title between family members.

Since government deeds records are unlikely to capture informal housing markets, we also include a building census of all structures in the Gauteng Province in 2001 and 2011. Using a combination of high-resolution satellite imagery and local field teams, these data record the precise location of each structure, identifying structures within over 30 categories including formal and informal residential dwellings. Out of 3,817,840 structures, this building census includes 1,628,073 formal structures and 1,560,345 informal structures. These data serve as both outcome measures of informal housing development as well as additional measures of public housing construction.

For demographic and economic outcomes, we turn to the census of population for 2001 and 2011 as well as the yearly General Household Survey for 2005 through 2014. Both surveys include information about dwelling type, employment, income, and demographics for each household. The General Household Survey includes additional details on participation in housing programs over time for a random sample of around 35,000 households in the Gauteng Province. To spatially link these households in both samples to their corresponding housing projects, we conduct the analysis at the census block level, which is the smallest geography available with 17,840 blocks in the Gauteng Province and 4,383 within 1.2 kilometers of a housing project.

[5]The bottom 20% suburbs were selected relative to prices in 2003 and followed every year from 2003 to 2011. These data were provided by the Affordable Land and Housing Data Centre, which tracks affordable housing markets.

Figure 1: Top-Five Sellers

Seller Name	Observations
Ekurhuleni Metropolitan Municipality	40,665
City Of Johannesburg Metropolitan Municipality	28,097
City Of Johannesburg	22,736
City Of Tshwane Metropolitan Municipality	22,367
Gauteng Provincial Housing Advisory Board	6,124
Total Observations	537,661

2.2. Defining Housing Projects

Our primary measure of housing projects matches a set of housing program characteristics using the transaction records in the deeds data. This procedure results in spatially distinct clusters that form the definition of housing projects for the empirical analysis (Tissington [2011]).

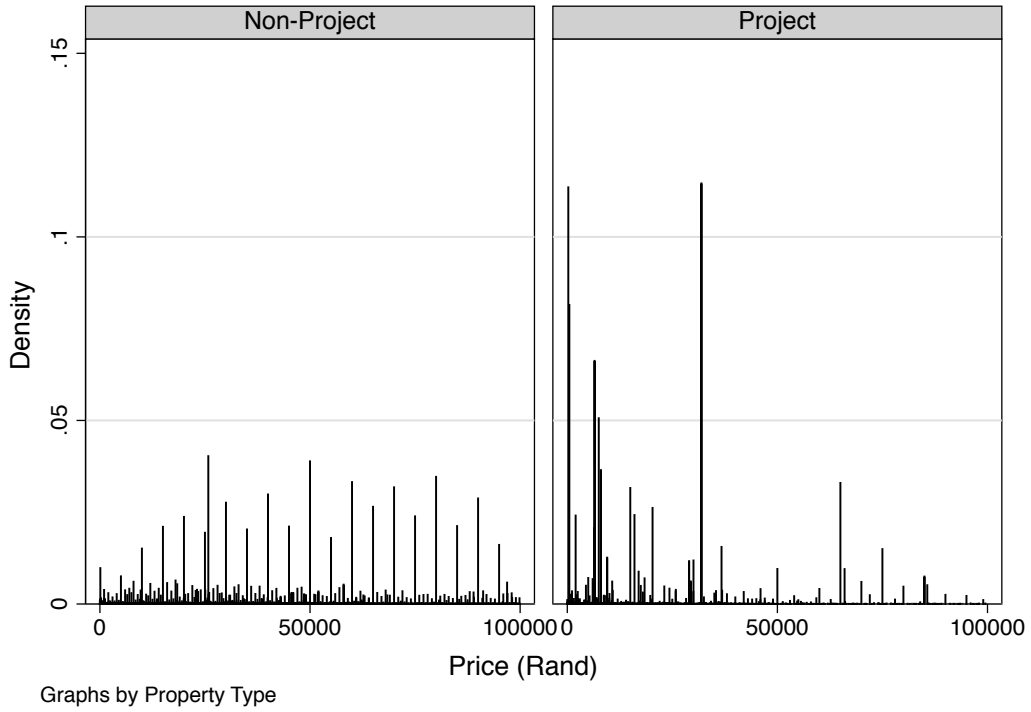
2.2.1. Seller Identity:

We focus on transactions from government entities or housing authorities from seller name records. To account for large developers or banks being listed as sellers for housing projects, we also include seller names that appear most frequently. We exclude transactions flagged as large buildings used for commercial purposes ($<$2% of records). Figure 1 shows the top five sellers, which account for a large share of the total transactions and all represent government housing programs in the region.

2.2.2. Subsidy Value:

We exclude transactions with purchase prices that are more than R50,000 above the yearly subsidy value ($<$4% of remaining transactions). Figure 2 provides a histogram of deed prices under R100,000 for transactions that meet our project definition and transactions that do not. Since project houses are distributed for free by government agencies, these agencies often record either zero price or the value of the subsidy in the deeds, which produces substantial bunching at these values compared to non-project transactions. We find some prices scattered away from subsidy values consistent with some measurement error in deeds reporting or miscategorization of non-project

Figure 2: Transaction Price Histogram



Note: Transactions are censored at R100,000.

properties as project properties.

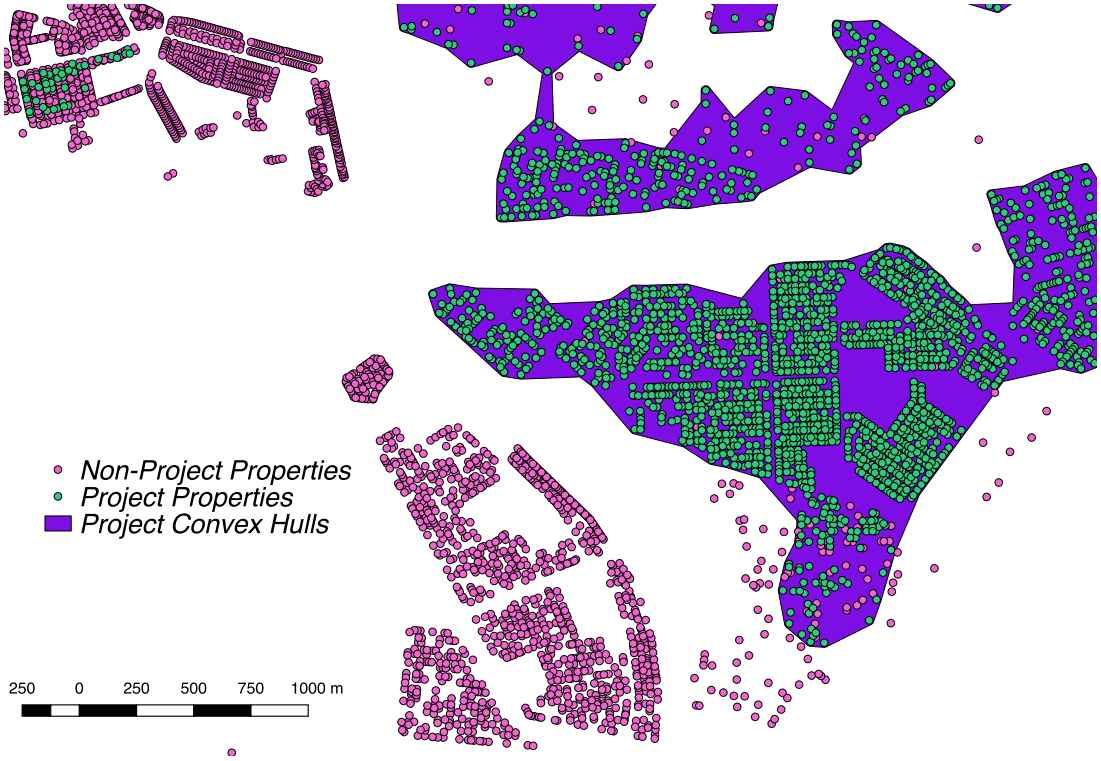
2.2.3. Pre-Existing Formal Dwellings:

We exclude transactions that occur on land plots with at least one preexisting formal residential structure in the 2001 building census (31% of remaining records). This method not only helps to reduce error in matching seller identities to housing programs, but also works to distinguish new housing projects from titling, home loan, or other programs that may have been implemented by local housing agencies over the same time period.

2.2.4. Spatial Clustering:

Since housing projects are characterized by large plots of adjacent dwellings, we use a density-based clustering algorithm to group transactions that satisfy the above criteria according to their geographic proximity. By eliminating loosely clustered or singleton transactions, this method

Figure 3: Convex Hull Example



additionally helps to distinguish large housing projects from other small-scale housing programs.

Figure 3 provides an example convex hulls formed around project housing transactions. The algorithm groups nearby transactions into two large projects on the right. Some non-project transactions (pink circles) are also included in the convex hulls, which are likely miscoded project houses or privately constructed houses within housing projects. The upper left collection of non-project houses contains a small group of houses coded as project houses (green circles). However, since there are very few of these houses and they are loosely clustered within a large group of non-project houses, they are not clustered into a convex hull. These more isolated cases are likely to be small-scale land-titling programs or home-financing programs launching by local NGOs in collaboration with the housing authorities.

2.2.5. Temporal Clustering:

Because the empirical design exploits the sudden timing of project construction, we assign a date for each cluster according to the modal year of transactions for houses within each project. We then include only clusters where over 50% of transactions occur during the modal year, which excludes half of total clusters. This approach rules out incremental projects as well as helps to exclude possible land titling programs, allowing us to leverage the sharp timing of large project construction in our identification.

Figure 4 indicates the distribution of transaction dates for properties within a 1.2 km buffer around clusters (above panel) and within the selected project areas (below panel). Project areas exhibit substantial bunching during a single month when projects were completed. There are also more transactions after the modal year than before the modal year, consistent with either a gradual roll-out for some project areas or immediate resale of projects houses after construction, which would be counter to housing regulations.

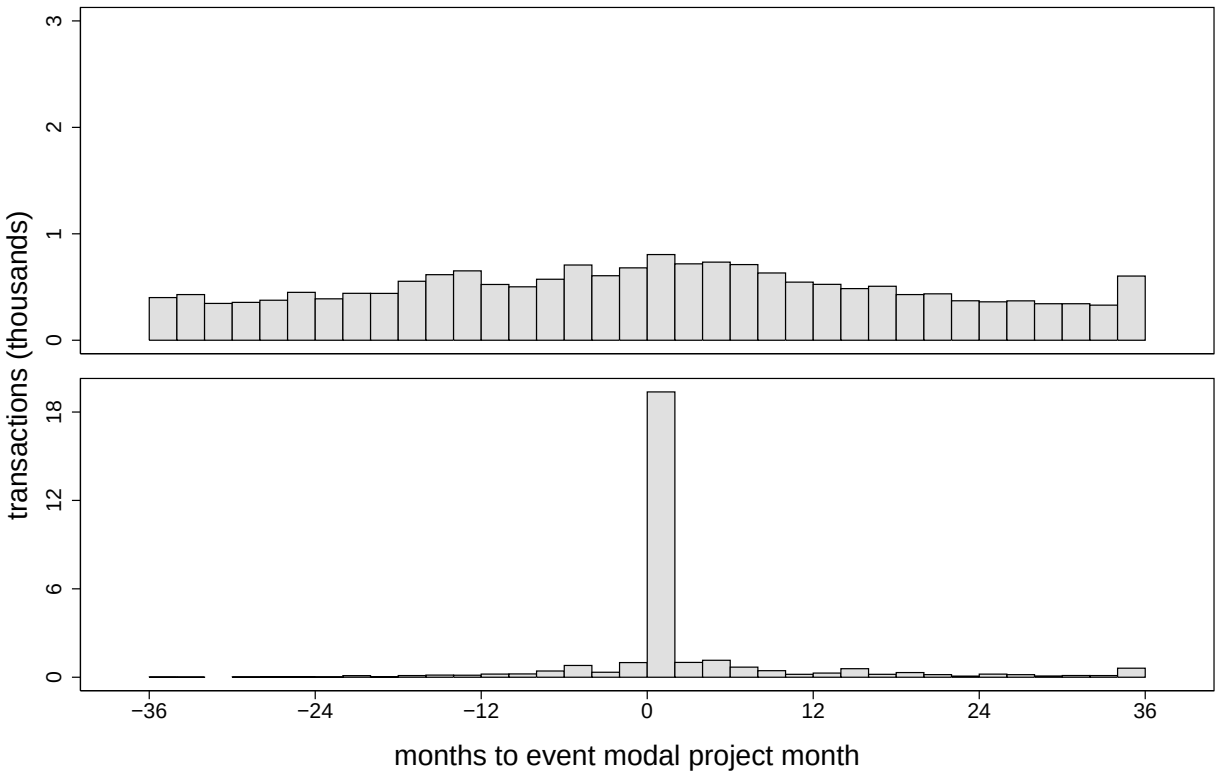
Evidence of similar bunching around the modal year for transactions coded as non-project transactions (above panel) would suggest that we may be miscoding project transactions as non-project transactions; instead, we find a smooth pattern relative to the modal year for these non-project transactions. The slight increase in density around and just following the mode year may also be consistent with housing projects having an immediate impact on local housing markets, which we will explore further below.

2.3. Defining Planned but Unconstructed Housing Projects

The administrative spatial data identifies many project areas that do not appear to have received housing projects, as measured by having fewer than 15 housing project transactions per square kilometer. We use these areas to create a sample of planned but unconstructed housing projects to serve as counterfactuals areas in our analysis.

To construct an estimated completion date for planned but unconstructed housing projects, we digitized National Treasury budget reports that detail the start date, expected completion date,

Figure 4: Transaction Densities Relative to Modal Project Month



The above panel includes transactions within a 1.2 kilometer buffer around a project cluster relative to the modal year of that cluster. The below panel includes all transactions within the final sample of clusters.

and cost of each housing project. We use a fuzzy-string matching algorithm with bigrams to successfully link project names from the budget reports for over 300 project names in our administrative spatial data (including both completed and uncompleted projects). Appendix 2 compares unmatched and matched projects finding that matched projects have a higher density of formal and informal houses although they are smaller in total area. We find that for completed projects, the mode transaction year observed in the deeds data falls an average of three years after the start date indicated in the budget reports. In other words, beneficiaries receive title to their new houses about three years after the housing program is announced in the budget. Therefore, we assign a expected completion date for unconstructed projects that is three years after the announced start-date in the project.

2.4. Assessing Project Measures

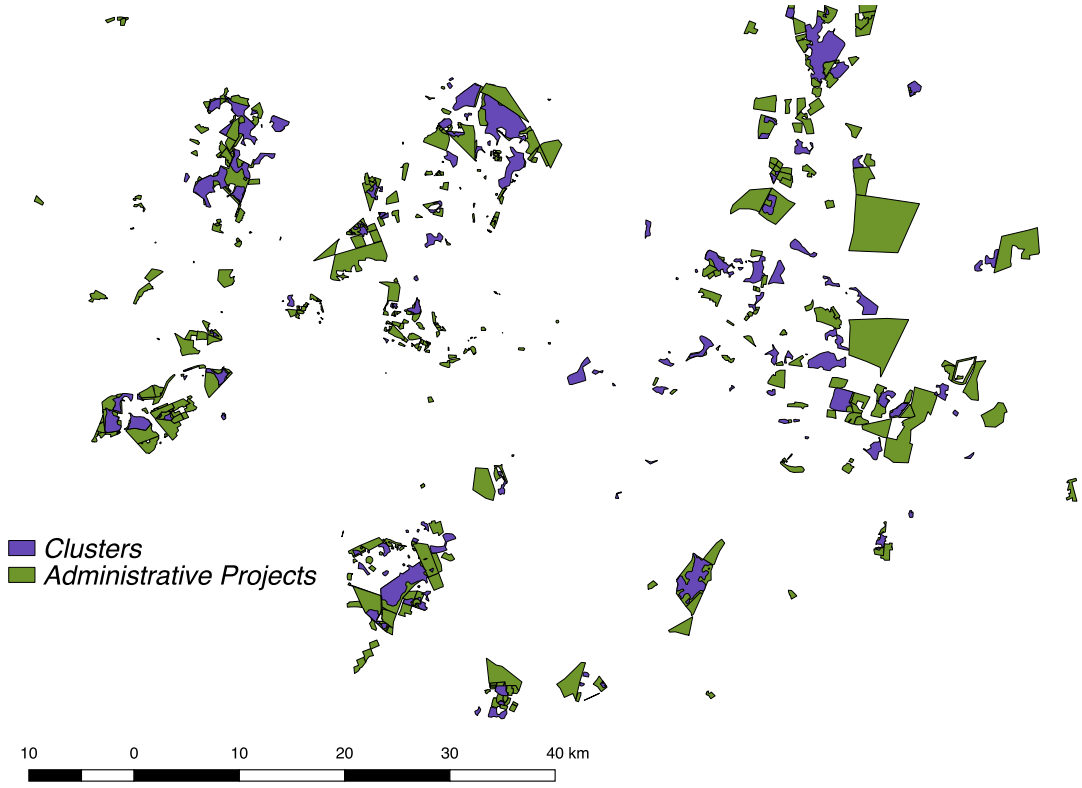
To assess the extent to which our definitions accurately measure housing projects, Figure 5 maps our cluster definitions on top of administrative data on housing projects. We see strong overlap between clusters and administrative projects, providing additional support for our deeds-based cluster measure. A few smaller clusters do not overlap with administrative definitions, which is consistent with the administrative data recording larger, higher-cost projects. Similarly, administrative boundaries that do not contain clusters are likely to be projects that were planned but were not completed or are scheduled to be completed in the future.

Table 1 provides descriptive statistics for the final sample of both completed and uncompleted housing projects. At baseline, we find that completed and uncompleted projects have similar formal building density although uncompleted projects have much higher density of informal structures

For demographic and economic outcomes, we turn to the census of population for 2001 and 2011 includes information about dwelling type, employment, income, and demographics for each household.

The population census The smallest level of geography available is census block where

Figure 5: Clusters and Administrative Project Boundaries



This figure includes the northern half of housing projects.

Table 1: Housing Project Descriptives

	Completed	Uncompleted
Formal Density: 2001	340.6	276.4
Formal Density: 2011	1,783.1	681.7
Informal Density: 2001	443.0	2,030.4
Informal Density: 2011	1,064.6	2,782.2
Median Year (est.)	2005	2006
Distance to CBD (km)	28.9	31.0
Total Projects	56	51

Density measures number structures per km^2.

We are able to identify households within a census block,

We use the smallest level of geography available, which leaves us with 1,00

General Household Survey

We capture demographic responses to the

and where administrative data on housing projects.

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Table 2: Assessing Name Matching between Budget and Spatial Administrative Data

	Matched	Unmatched
Formal Density: 2001	230.5	171.5
Formal Density: 2011	814.1	444.0
Informal Density: 2001	1,055.6	1,401.0
Informal Density: 2011	1,613.2	2,147.0
Project House Density	125.0	66.0
Project Mode Year	2005	2005
Hectares	97.3	119.6
Observations	322	320

Density is measured in structures per km^2.

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Appendix