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Evidence on the
range of policy
needs and scope of
mobility



Emily Rains
Anirudh Krishna
Erik Wibbels

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Urbanization and India's Slum Continuum: Evidence on the Range of Policy Needs and Scope of Mobility

Emily Rains, Anirudh Krishna, and Erik Wibbels

In contrast with historical precedent, urbanization across the Global South is associated with increasing levels of urban poverty. These trends engender unique challenges for practitioners and scholars of sustainable development. However, data deficits contribute obstacles to formulating effective poverty alleviation policy. Official statistics in developing countries omit the most vulnerable groups, leading to underestimates of the depth, breadth, and permanence of poverty. To address these gaps, we create our own dataset of over 8,000 households across three Indian cities with diverse economic and political histories: Bangalore, Jaipur, and Patna. We leverage satellite data and ground knowledge from local organizations in order to identify slum neighborhoods not contained in official government lists. We provide systematic evidence that living conditions increase along a wide-ranging continuum of wellbeing, corresponding to diverse circumstances and different policy needs. Most of the variation in living conditions is due to differences across rather than within slums. Furthermore, there is evidence of very limited social mobility in slums. These findings suggest a need for policy interventions targeted at the neighborhood level if urbanization is to provide a pathway to upward mobility.

INTRODUCTION

What do we really know about the human condition amongst the urban poor? To what extent do conditions and lived experiences vary? Is there social mobility within poorer urban spaces, or does the initial position in the urban strata determine where one ends up? The answers have important academic and policy implications that transcend the state of data availability. In an effort to provide initial answers, this paper leverages a large-scale data collection effort, including surveys of over 8,000 households in 279 slums across three cities in India. Contrary to a naïve, generic notion of slums and slum dwellers, our findings show that the urban poor vary considerably in their economic wellbeing and access to services. We also show that household outcomes strongly cluster within neighborhoods and that much of the variation in lived experience is *between* neighborhoods. The most important policy implication is that policy must be nuanced and responsive to the highly varied challenges facing the urban poor and the neighborhoods in which they live.

Scholars and practitioners appreciate that official statistics underestimate and oversimplify the complex and wide-ranging realities of urban poverty (Mitlin 2005; Mitlin and Satterthwaite 2013). Case studies, ethnographies, and field knowledge support claims that socioeconomic status and ability to access services vary substantially across urban residents in developing countries (Auyero 2000; Breman 2013; Marx, Stoker, and Suri 2013b; Menon-Sen 2006; Perlman 2006). However, systematic evidence is lacking on the vast range of conditions within and across slums.

To build evidence on diverse living conditions and the potential policy implications, we began an extensive data collection effort in India in 2010. In an earlier paper, one of the authors documents the distinct policy challenges for the least and most well off slums within one city (Krishna, Sriram, and Prakash 2014). This paper expands on the earlier work. We build a multi-city database of 8,257 households across 279 slums spanning conditions between the two polar types previously identified. We provide rigorous evidence to show that settlements omitted from official data span a wide range of wellbeing with different policy needs. We show that most of the variation in conditions occurs across neighborhoods. We provide preliminary evidence that households sort into slum

neighborhoods along socioeconomic lines, and experience limited economic mobility. This evidence has important policy implications for cities in the Global South.

1. FLUID BOUNDARIES AND A FLEXIBLE DEFINITION

Collecting data on slums is a messy exercise. It can be difficult to locate slums and define their boundaries and nearly impossible to locate the same household over time. In India, on any given day, between 40 and 70 percent of rural households have at least one family member who lives and works in an urban area – and the situation is similar in other developing countries (Deshingkar and Akter 2009; Deshingkar and Start 2003; Mosse et al. 2002; Rogaly et al. 2002; Sah and Shah 2005; Shah 2014). Many of these migrants are transient and undocumented in the city. Some are short-term itinerant migrants. Single men of working ages are predominantly represented within this stream of migration. Several short-term single migrants get together to rent a small accommodation, sleeping ten to a room, often in shifts (Breman 2003; Picherit 2014; Thachil 2014; Vijay 2005). The existing methodologies of population estimation have been unable to keep track of their numbers. Other migrants are more rooted, living with some immediate family members, but are still split between a city and a village. They spend up to one-quarter of the meager amounts they make on journeys to the village home and debt repayments. Among both types of migrants, the most vulnerable populations settle in precarious locations that those with better opportunities would not brave – along riverbanks or railroad tracks, among refuse, or under highway overpasses. These populations relocate as and when governments or landowners evict them or when displaced by the natural environment.

Furthermore, statistics vary based on how slums are defined. UN-HABITAT, a United Nations agency that has become an international authority on slums, presented the following understanding in their first global audit of slum conditions (UN Habitat, 2003, p.11):

- Slums are too complex to define according to one single parameter.
- Slums are a relative concept and what is considered as a slum in one city will be regarded as adequate in another city – even in the same country.
- Local variations among slums are too wide to define universally applicable criteria.
- Slums change too fast to render any criterion valid for a reasonably long period of time.
- The spatial nature of slums means that the size of particular slum areas is vulnerable to changes in jurisdiction or spatial aggregation.

UN-HABITAT has refined its definition of slums over time to improve measurability, but it is still generic. Without insisting upon any minimum number of households, it defines a variety of desirable *living conditions* that households in slums usually lack:

1. Durable housing of a permanent nature (that protects against extreme climate conditions).
2. Sufficient living space (which means not more than three people sharing the same room).
3. Easy access to safe water (in sufficient amounts at an affordable price).
4. Access to adequate sanitation (in the form of a private or public toilet shared by a reasonable number of people).

5. Security of tenure (that prevents forced evictions).¹

Identifying slum households as deficient in one or more of these living conditions, the UN agency found that, in 2014, India had as many as 104 million slum dwellers. This number seems closer to the facts on the ground than Indian government estimates, as depicted by independent grassroots investigations (see Amis & Kumar, 2000; Harriss, 2005; Khasnabis & Chatterjee, 2007; Mahadevia, 2010; Mitra, 2006; Unni & Rani, 2007). Indian government agencies have only recently started to count the number of people who live in slum settlements, and the methodologies that different official agencies employ disagree with one another. Adopting one definition of slums, the National Sample Survey Organization counted 44 million slum dwellers in 2008, but adopting another definition, the Census of India counted 65 million slum dwellers in 2011.² Regardless of definition, these official agencies commonly underestimate the slum population.³ These issues are hardly unique to India; across the Global South, there is an “astonishing lack of data about informal settlements” (Mitlin & Satterthwaite, 2013, p. 279).

Not only insofar as it concerns the numbers who inhabit them, knowledge is sparse as well about the range of living conditions in slums. Researchers and practitioners intuit that slum dwellers face a vast range of living conditions, but systematic evidence is lacking on the range of wellbeing across slums. As a result, not only is the true number of people in slums not clearly known in official circles, but there is also little information available that can help formulate answers to how policies of service provision and urban poverty reduction should be adjusted to account for the varying needs of people in slums with different living conditions.

Current policy does not appreciate these nuances. Federal policy dictates a minimum standard of living, but states also play a hand and are responsible for further developing and implementing urban policies (Kundu 2013). State and local governments draw rudimentary distinctions across slums: some slums are officially recognized and legally allowed to remain while others are deemed untenable (*ibid*); there is considerable variation across states in these policies.⁴ Untenable slums are further crudely classified into neighborhoods that must be upgraded to become tenable or neighborhoods that must be evicted. But thousands of families have stayed on many years after receiving a verdict of eviction, creating a third category.⁵

Service provision is also not systematic. Once officially recognized – after going through a protracted process consisting of many stages culminating with its name being officially “notified” – a slum is supposed to be provided with a series of public services. But in practice, service provision for legally recognized and unrecognized slums is nebulous. There is no discernible system in how service provision is prioritized. Some unrecognized slums are provided with public services, while many officially recognized ones go without. Service access can also vary greatly depending on the political networks of informal slum leadership (A. M. Auerbach 2016).

Furthermore, there is hardly any evidence on poverty dynamics. Analyzing trends over time is especially challenging in light of population transience and challenges with recall bias. However, it is imperative that researchers carefully study the potential for upward mobility in order to inform policies that promote inclusive development under current urbanization trends.

The upshot of these multiple data gaps is that very little is known about the range and hierarchy of needs across slums. How slum settlements differ at a point of time is poorly understood, and how their trajectories vary over time is almost completely unknown. More

data and analyses are required to determine how more carefully targeted investments in urban economies will translate into opportunities for those at the bottom of the urban pyramid. As we show below, needs and circumstances vary widely across slums, with limited movement across economic strata. Rectifying gaps in knowledge is essential for using resources more wisely. We make a beginning in this direction with our analysis.

2. STUDY CONTEXT

We interviewed a total of over 8,000 households living in 279 slums of varying conditions in three Indian cities – Bangalore, Jaipur, and Patna – each a state capital, located respectively in the south, west, and east of the country. A large number of the slums we sampled are not contained on official government lists, and are therefore omitted from official statistics. Conditions are wide ranging: there’s a community of beggars who traded up squatting along a road for living beside railroad tracks after someone was struck by a car; there are daily wage laborers and artisans who reside less precariously in brick homes but lack proper water and drainage systems; there are also residents in more stable occupations who live in concrete multistory buildings. Across these wide ranging conditions, evidence of upward mobility is slim.

Bangalore: Planning for contemporary investment

Bangalore, the wealthiest and most rapidly growing of the three cities sampled, the capital city of the state of Karnataka, has received global attention for its booming information technology (IT) sector. Dubbed the “Silicon Valley” of India, Bangalore houses over 100 multinational IT firms (Jayatilaka and Chatterji 2007). Bangalore was particularly poised to attract these investments due to the highly competitive extant universities and public sector organizations that comport with the high skill demands of the tech industry (Heitzman 2004; Nair 2005). To further induce and retain corporate investments, public policies have diverted substantial resources to the IT sector (Benjamin 2000; Ghosh 2006). The wealth associated with these opportunities engenders the “Bangalore dream” of a sophisticated and internationally competitive hub of globalization (ibid). However, the benefits have only accrued to a minority in the city. The majority remains excluded from these opportunities, disconnected from the policies that privilege the corporate sector, and hurting from the effect of the tech boom on real estate prices (ibid). Studies document the salient divide in conditions: “The glass walled computer-ready office complexes, exclusive shopping malls and entertainment facilities that rival the best in the country contrast with the dense squatter settlements and their very poor services in central areas of the city” (Benjamin 2000, p. 38). Previous work describes the conditions of poverty and stasis that exist in parallel with growing affluence in Bangalore and suggest that there is little movement between these two worlds (Krishna 2013; Ramachandran and Sastry 2001). Further, the spillover effects of Bangalore’s rapid growth have not been widespread; the vast hinterland of rural Karnataka lags far behind Bangalore in terms of infrastructure, service provision, and socioeconomic achievements (Narayana 2011).

Jaipur: Historical planning

Jaipur is known as a heritage city due to its importance during the Rajput and Mughal periods. Founded in 1727 by *Maharaja* (King) Jai Singh II, Jaipur became India’s first planned city.⁶ The city was walled off, divided into grid sections, and then covered by an organized network of roads and infrastructure for water.⁷ Trade was an important part of the economy and the different grid areas within the walled city were comprised of different types

of craftspersons stratified by caste (Vibhuti and Tillotson 2002). The architecture and spatial arrangement of the walled part of the city has remained largely unchanged but Jaipur has expanded naturally beyond the walled areas over time (Kavilkar and Deshmukh 2014). Many sources document Jaipur's early meticulous urban planning, but less information exists on how well the city has planned in contemporary periods. Rajasthan, the state of which Jaipur is the capital city, was constituted at the time of national independence by bringing together a large number of princely states, indirectly ruled by the colonial power. Diverse socioeconomic indicators – literacy rates, infant mortality, etc. – remain lower than the national average.

Artisanal crafts and trading remain vital to Jaipur's economy, and tourism also plays an important role.⁸ More recently, Jaipur's economy has been growing due to investments in real estate as well as IT; investors attribute proximity to Delhi and policy reforms to these ventures.⁹ Economic growth has resulted in increased land prices in Jaipur, though likely not to the same extent as in Bangalore (Parmar 2009). In response to land price increases, the local government has attempted to relocate some slum areas to the less lucrative Northeast periphery of the city, but government-built housing remains largely unoccupied.¹⁰ Evidence is lacking on the relationship between urban policies and slum characteristics, but previous research on slums in Jaipur provide evidence on the importance of local political brokers in liaising with government agencies for services (A. Auerbach and Thachil 2016; Srivastava 2013).

Patna: Lack of planning

Patna is the poorest and slowest growing city in our sample (McKinsey Global Institute 2010). Patna is the capital of Bihar, a state characterized by many for its history of lawlessness and poor governance (Asadullah and Yalonetzky 2012; Mathew and Moore 2011; Rodgers and Satija 2012; Witsoe 2013). A substantial shift in leadership resulted in improved governance, inclusive growth policies, and impressive economic growth over the past decade, but Bihar remains one of the poorest states in India (Mathew & Moore, 2011). Furthermore, much of the development focus of the past ten years has been on rural areas, and the government estimates that over 90% of Patna remains unplanned, described in one study as a “pertinent case of endemic ‘state failure’” (Rodgers & Satija, 2012). Ground evidence suggests that more than half of the city's residents reside in slum-like conditions, in glaring contradiction to the official census estimate that three percent of Patna's residents live in slums.¹¹

Bihar has a complex history of caste-based conflict. This conflict has manifested in extreme violence at times and continues to permeate politics (EPW 2013; Kumar 2015; Witsoe 2013). During the colonial period, the British privileged high caste landowners, *zamindars*, with power to oversee and exploit lower caste laborers (Rodgers & Satija, 2012). This system augmented caste-based disparities linked to land ownership that continued after Independence (Banerjee and Iyer 2005). Lower caste individuals have traditionally been blocked from owning land and some of Bihar's most intense violence has erupted from disputes between the landholding and landless classes (Chaudhry 1988; EPW 2013). Issues of land reform remain unresolved, and some argue that land reform remains an “impossible task” (Kumar 2013; Thakur 2013). Not only is Patna largely unplanned, but planning may be particularly challenging in light of the complexities surrounding land reform and the inflow of land-poor rural residents.

3. SIX WAVES OF SURVEYS

We conducted six waves of original surveys in Bangalore, Jaipur, and Patna between 2010 and 2016. The first four waves were undertaken in Bangalore – in 2010, 2012, 2013 and 2015. The next two waves were undertaken in Jaipur and Patna in 2016. Incremental improvements were made to a pretested set of survey instruments across successive waves.

The first survey was undertaken in 2010. The method of sample selection reflects the extent of our knowledge at that time. Following a track taken by much prior research on slums, we obtained a list from the municipal authority (Karnataka Slum Development Board or KSDB), and randomly selected 14 slums from this official list for investigations.¹²

Interviews with a random sample of 1,481 households show that the slums which appear on the official list represent the pinnacle of a vast iceberg, home not so much to the poorest people as to a settled lower-middle class, most of whom have lived in Bangalore for multiple generations: multi-story permanent constructions prevail; electricity connections and clean drinking water are commonly available; TVs, pressure cookers, and electric fans are commonly owned; poverty is low compared to the average for the city. 41 percent own the homes in which they live, and of them, 70 percent possess official papers (Krishna, 2013).

Since the official data sources are of little help, we began to develop new, more reliable methods of slum identification. Following a path taken by other analysts (Livengood and Kunte 2012; Oleksandr, Lüdeke, and Reckien 2013; Sudhira, Ramachandra, and Jagadish 2004), we looked to leverage satellite images. We started by examining images that are publicly available on Google Earth. We divided the spatial borders of the area administered by Bangalore’s municipal authority into quadrants. Considering each quadrant separately helped analyze a more manageable number of identified settlements (polygons), enabling ground verifications to be made quadrant-by-quadrant. After several iterations between satellite-image identification and detailed verification on the ground, we shortlisted criteria for identifying low-income settlements in Bangalore and identified 279 potential low-income polygons.¹³

It was immediately clear that one group of slums appeared distinct from the others. We dubbed this group the “blue polygons,” as the blue tarp roofs of these tent neighborhoods are distinctive in the satellite images. We used the time slider feature on Google Earth and noticed that blue-polygon settlements had mostly developed in the past few years, although some have been around for much longer, expanding over time.¹⁴ We identified 61 such settlements in all, and our ground-verification exercises revealed that these initial identifications were accurate in nearly all cases. Figure 1 illustrates the stark contrast between the satellite image of a slum surveyed in the initial 2010 wave and a blue polygon settlement.

Figure 1. Satellite image of government-listed slum (left) and blue polygon slum (right): 2016



In our second round of household surveys, undertaken in 2012, we conducted interviews with 631 households in 18 randomly selected blue polygon settlements. This wave of surveys took the surveyors into some of the roughest parts of the city. Most homes do not have electricity and there are no street lights, so working after dark is virtually impossible, but the residents, men and women, are at work during the daylight hours, which makes things difficult for the interviewers. The typical abode is a 7'x7' tent erected on land hired from a private owner. Families of between 3 and 5 individuals share these meager spaces. Prior to coming to the city the principal occupation of a little more than one-half, 52 percent, of residents was agricultural labor. Their reasons for coming to the city have to do with agrarian distress and a consequent need to pay off accumulated debts. Our data show that households from this wave own only a quarter of the number of assets owned by households in officially listed slums. The contrast between the blue polygon wave and the initial wave revealed the substantial range between these two slum types in Bangalore.

In order to learn more about conditions between these two poles, we turned to a third round of surveys. In 2013, we conducted neighborhood surveys in the 157 slums that were neither included in our original government sample nor appeared to be blue polygons.¹⁵ These neighborhood surveys helped cover some important data gaps. Most importantly, we

generated a more complete map of Bangalore's slum population, identifying a range of places that are not on the official list of slums and where people are living in slum-like conditions – either because they had not applied for official notification, or because their applications were in process or had been rejected. These first three waves helped us pinpoint a range of slums in Bangalore with varied living conditions. In our fourth wave of data collection, undertaken in Bangalore in 2015, we selected slums representing the full range of living conditions.

In 2016, we began expanding our data collection efforts to Jaipur and Patna. We again turned to satellite images to build a database, and information provided by local partners helped to refine our query. In Jaipur, we began with a list of geolocations of 273 slums compiled by a colleague over several years of fieldwork.¹⁶ We plotted all 273 slums in Google Earth in order to examine the range of visible characteristics. We inductively identified four rudimentary types based on the density and arrangement of the buildings.¹⁷ Example images of each of the four types are shown in the Appendix. In total, we conducted 2,718 household surveys and 45 neighborhood focus group discussions.¹⁸ In this wave, we also conducted qualitative interviews with 91 local slum leaders and collected data on social networks for every household within four slums.

Sampling in Patna produced unique challenges. We began with a list of 113 slums provided by a local partner.¹⁹ When we plotted the boundaries in Google Earth, we found that slum boundaries were indistinguishable; most of the city displays slum-like characteristics in satellite images. An example is shown in the Appendix. For Patna, we could not design our sample based on satellite image classifications. Finer grain images than those publicly available on Google Earth are necessary to discern slum characteristics in Patna.²⁰ Instead we utilized survey data available from our partner organization to classify slums into rudimentary groups. The survey data include metrics on durability of housing, access to sanitation, and access to streetlights. We used these data to classify slums into two groups – those with higher and lower infrastructure quality.²¹ We randomly selected slums across these two groups. In total, we conducted 2,155 household surveys, 43 neighborhood focus group discussions, 78 qualitative interviews with local leaders, and four social network census surveys.²²

All data waves are summarized in Table 1. This section has described our sampling strategy in detail; refining and implementing a satellite methodology to identify and sample slums is a major contribution of this work. We are currently working to develop a remote sensing algorithm that will automate slum detection from satellite images, which could provide an important tool to summarily identify neighborhoods not contained on official lists. We contend that much of India's urban story has yet to be told, and other creative methods of investigation are required.

Table 1. Summary of data collected between 2010 and 2016

Year	City	Sample source	Neighborhood surveys	Household surveys	Social network census surveys	Leader interviews
2010	Bangalore	KSDB data	14	1,481	-	-
2012	Bangalore	Satellite images	18	631	-	-
2013	Bangalore	Satellite images	157	-	-	-
2015	Bangalore	2010, 2012, and 2013 samples	40	1,272	-	-
2016	Jaipur	PDCOR and satellite data	45	2,718	4	91
2016	Patna	SPUR data	43	2,155	4	78

4. A WIDE RANGE OF LIVING CONDITIONS

To shed more light on the differences between official data and our sample, we compare some key statistics. We find that respondents in our sample are considerably less well off than slum households described in the 2011 census. For example, while the 2011 Census of India estimates that 66 percent of slum households have toilets, only 55 percent of households in our sample do. The census reports that 94 percent of slum dwellers live in sturdy or semi-sturdy households, but only 72 percent of our sample live in houses made of bricks, wood, or cement, while nearly 30 percent reside under tarp or in mud or tin huts. The census also estimates that 53 percent of homes store money in banks, but our sample reveals approximately half of that.

To map the spectrum of conditions within and across Indian slums, we adapt the UN-HABITAT definition of slum living conditions.²³ We build upon the definition in several ways to create operationalizable definitions at the household and neighborhood levels. The UN-HABITAT definition simply indicates whether or not a household meets each living condition or not, whereas we develop a score based on the quality of each indicator. For instance, the UN defines “crowding” as having more than three people per room, but it does not account for the size of the room. We adjust by measuring square footage available to each person. The indicators used to score each household and slum are summarized in Table 2. Of the seven indicators we utilize, five are measured at the household level and two are measured at the neighborhood level.

Table 2. Summary of indicators used to calculate slum score

Condition	Indicators	Data source	Calculation
Durability of housing	Roof type	Household surveys	Average score (tarp = 0, brick = 1, tin = 2, cement sheet = 3, concrete = 4)
Sufficient living space	Square footage per person	Household surveys	Median household area per capita. The median is taken across the neighborhood rather than the average to account for potential measurement error in area.
	Building height	Household surveys	Average height (single storey = 1, double storey = 2, triple storey = 3)
Access to safe water	Water source	Neighborhood surveys	Average score of all water sources present in neighborhood (tanker = 0, borewell = 1, handpump = 2, private connections = 3). Data are not available on proportion using each type of water.
Access to adequate sanitation	Toilet source	Household surveys	Average score (none = 0, shared public = 1, shared private = 2, private toilet = 3)
	Drainage type	Neighborhood surveys	Weighted average of proportion of neighborhood covered by each drain type (none = 0, open rough = 1, open sturdy = 2, closed = 3)
Availability of economic resources	Asset score	Household surveys	Average first component score from principal component analysis of twenty binary variables indicating whether or not the household owns that asset

We choose to exclude security of tenure in score so that we may explicitly examine the relationship between *perceived* tenure status and relative deprivation. Ascertaining the actual status of official notification proves to be well near impossible. Official data on slums and the tenure statuses of their inhabitants are messy and deficient. Slums are listed by name rather than by ID or location, which makes it nearly impossible to compare across lists. There are multiple slums with the same or very similar names and simple spelling differences compound these problems. Diverse official agencies work within Bangalore, for instance, and each agency provided a different list of slums with notified status.²⁴ Furthermore, the notification process takes years; depending on where the slum is in the process, they may experience varying levels of security. Notification status may exist on more of a spectrum than as a binary. Surprisingly, almost one third of slums in Patna said their slum is notified in a focus group discussion, but there is no process of notification in Patna, and no notified slums. This suggests that this response indicates a sense of perceived security but may or may not purport with official government documentation. Lacking the means to gain reliable knowledge about the actual tenure status, we selected to work, instead, with households' perceptions.²⁵

5. EXPLORING THE GENUS

We show that there is greater diversity in living conditions across than within slums, with slums in these three cities lying along a wide-ranging continuum of wellbeing. This continuum ranges from the least well off who reside in flimsy tarp-covered huts to the most well off, residing in three-story concrete structures that are visually indistinguishable from other lower-middle class neighborhoods. There are functional equivalents of Bangalore's blue polygons in the other two cities, and there are equivalents, too, of slums at intermediate points and the top end of the continuum.

To locate each household and neighborhood along this continuum, we calculate scores from the wellbeing indicators for data collected in 2015 in Bangalore and in 2016 in Jaipur and Patna.²⁶ We first create household-level scores from the five variables measured at the household-level in Table 2 – roof type, square footage per person, building height, toilet source, and asset score.²⁷ To evaluate the extent to which household conditions vary within

and across slums, we calculate the proportion of variation in household scores attributable to within neighborhood variation, across neighborhood variation, and across city variation.²⁸

Table 3 shows that the largest share of the variance in household conditions can be attributed to differences across slums. This has important policy implications, as it suggests that policies should be targeted at the slum-level rather than the individual-level. It also suggests there is a wide range of conditions across neighborhoods within the same city. As such, we next turn to slum-level analyses.

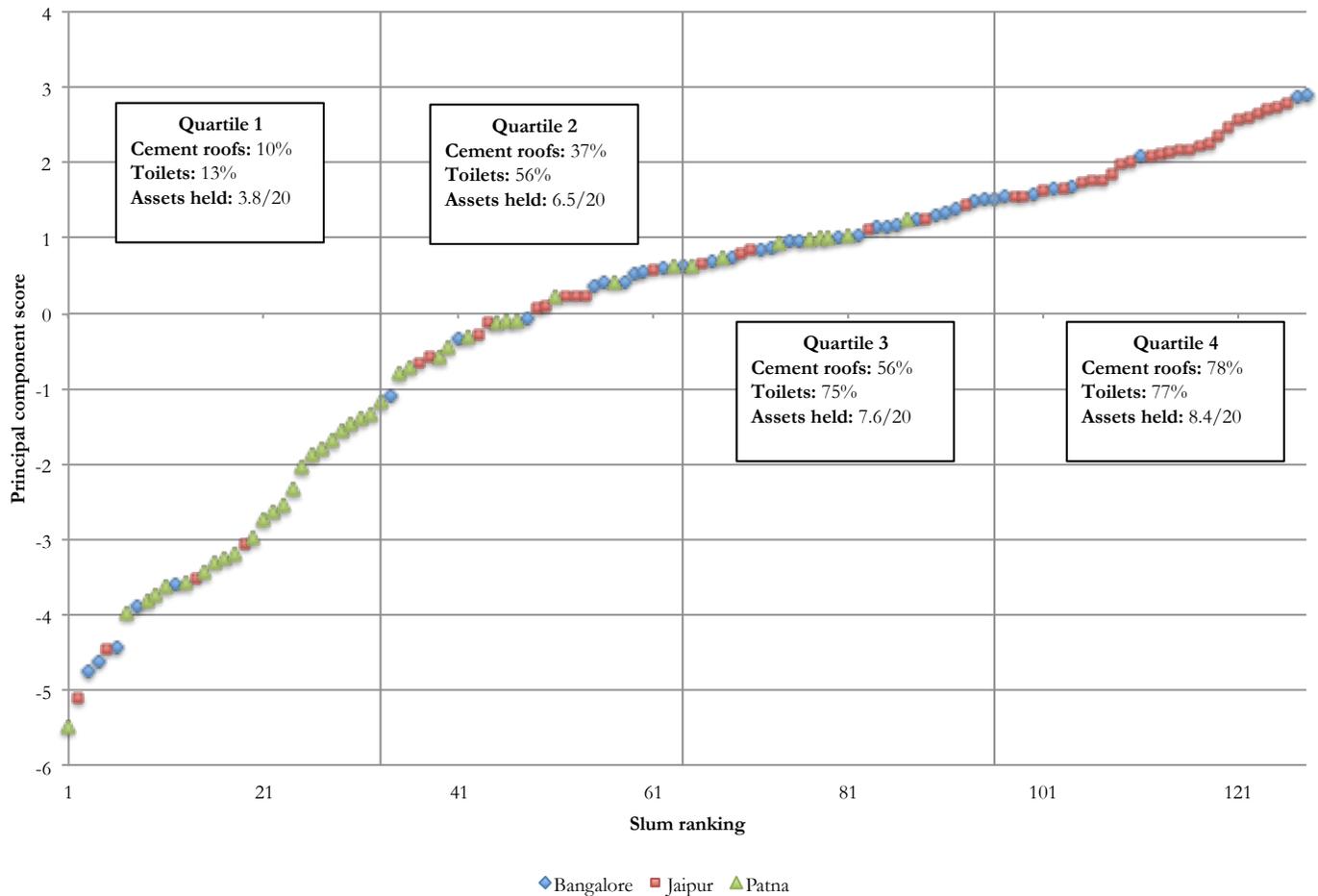
Table 3. Variation in household scores within and across slums

VARIABLES	Household score
Number of households	5,896
Number of cities	3
Number of neighborhoods	128
RANDOM-EFFECTS PARAMETERS	
Across city variance	0.383 (0.337)
Across neighborhood variance	1.277 (0.165)
Within neighborhood variance	0.952 (0.018)

We next create slum-level scores from the neighborhood-level indicators. For the five indicators measured at the household-level, we first compute the average by slum. The slum-level score is hereon referred to as “slum score.”²⁹ Households in slums located higher along the continuum (to the right in Figure 2) have sturdier roofs, better toilets, better water and drainage infrastructure, more spacious and taller homes, and they hold more assets, on average.³⁰

Figure 2 below plots the range of slum scores in ascending order. There is a distinct pattern: slums fall along a defined continuum, rather than constituting a small number of distinct groups, which we also checked with cluster and factor analysis.³¹ If the change in score were constant from one slum to the slum with the next highest score, then the scores would fall along a 45-degree line. Instead, in the bottom quartile of the spectrum, there is a greater difference in wellbeing from one slum to the next, and the incremental increase tapers off after that. Slums toward the top of the continuum are differentiated by much finer differences and slums toward the top are also blend in with planned lower-middle class neighborhoods in terms of livelihood patterns and physical character, which makes it hard to distinguish between them from satellite images alone.

Figure 2. Slum rankings and associated continuum score



We provide three ethnographic descriptions of slums at different positions on the continuum to illustrate the substantive differences across principal component scores. Harding Park, in Patna, is located at the very bottom of the continuum and is the worst-off slum in our sample. Life in Harding Park is precarious. Residents are forsaken by outside support and they survive by their own grit. The forty families are accustomed to the cycle of displacement and relocation within a one-kilometer radius. Their current location is between the railway tracks and a busy road. To enter the settlement, they either climb up a mound of trash or through a hole in the roadside wall. There are no modern conveniences here. Five people sleep to a “room”: a 9’x13’ hut constructed of mud floors and recycled political posters wrapped around posts. There are no toilets, no drains, no electricity, or water. To subsist, men, women, and children beg and pick trash, as their parents did before them. None of the respondents have spent a day in school and only two children have cumulatively spent three years in school. No households have ration cards or receive any government benefits. Several women tell us they have been scammed by people who promise ration cards in exchange for money but never return.³² There is no readily identifiable local leadership, and social capital is nearly nonexistent.³³

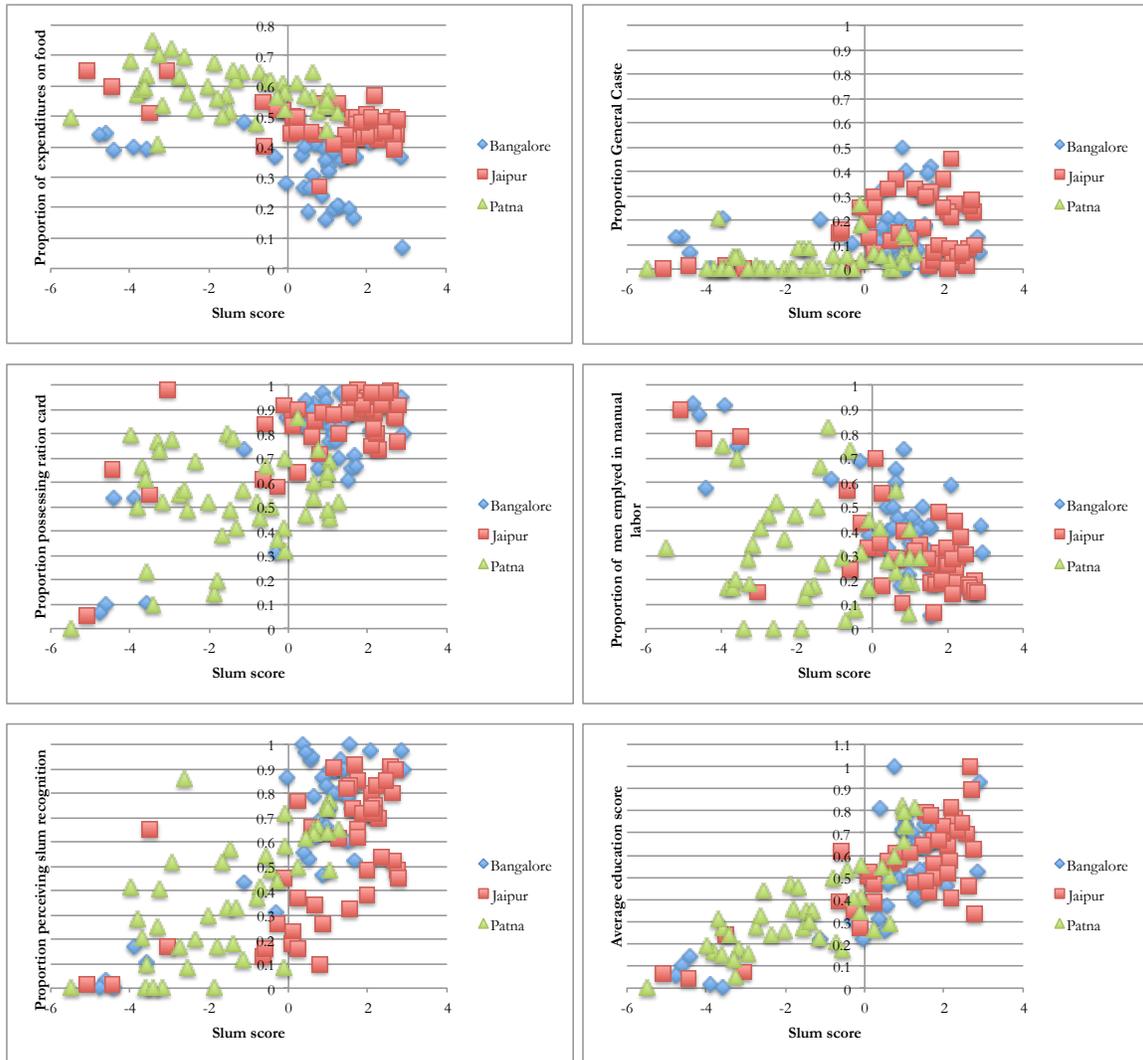
Govardhanpuri Dhalan, in Jaipur, near the top of the continuum, provides a sharp contrast.³⁴ Residents enjoy greater physical and subjective wellbeing. Set back from the main road at the base of a hilltop-temple, this settlement provides many more comforts. Multi-story concrete buildings are carefully planned around four main streets. Buildings are painted bright colors and adorned with decorations; several buildings have balconies. Cars, motorbikes, and trees line the streets. Looking up, one sees electricity wires and satellite dishes. Almost all households have piped water and metered electricity connections. Only eight percent of survey respondents work in manual labor, eighty-eight percent have ration cards, and eighty-five percent of respondents say they feel very safe from eviction.

Patna's Nehru Nagar Musahar Toli is an example of a slum with intermediate conditions.³⁵ Houses are multi-story and sturdy; forty-eight percent have private water connections and sixty-seven percent have toilets. Almost all (eighty-eight percent) respondents report having a ration card. Residents worship at a well-maintained Hindu temple at the edge of the neighborhood. A local NGO has painted murals on several buildings with public health messages. However, half of the respondents feel very insecure from eviction. The majority of respondents have not gone to school, and men largely toil in daily wage labor. Sewage runs uncovered through the neighborhood despite frequent complaints from the residents.

Policy needs vary

Life varies tremendously for the residents living in these three exemplar slums. Disparities extend beyond the differences in physical indicators used to calculate the slum score as illustrated in Figure 3.

Figure 3. Characteristics across the continuum



Levels of food and housing security vary along the continuum. In the bottom quartile, households allot an average of 59 percent of all expenditures to food. This figure decreases to 47 percent for houses in slums in the top quartile. Similarly, only 22 percent of households in the bottom quartile perceive their slum to hold collective tenure, compared with 71 percent for slums in the top quartile. Only 51 percent of households in bottom quartile slums possess ration cards, which are a prerequisite to collect government entitlements. In contrast, 88 percent of houses in top quartile slums have ration cards – which may seem like a perverse finding, except that, in general, residents of better-off slums are better provided with diverse official documents.

Respondents also express different public needs at different points along the continuum. For slums in the bottom quartile, households are divided on whether they believe the most pressing public need is water (27 percent), housing (27 percent), or toilets (25 percent). Neighborhoods in the top quartile have different concerns. The most commonly stated need for those in the top is waste management (30 percent); and the

second most cited need is employment training (14 percent). Knowing where along the continuum a slum is located helps to target public services more effectively.

Demographics vary

Scheduled Castes and Scheduled Tribes (SCs and STs) are overrepresented across all slums relative to the Indian average (consistent with Shah, 2014). Even larger concentrations of historically marginalized castes are found in the poorest slums. In bottom quartile slums, only three percent of residents are General Caste (a residual category, after excluding SCs and STs and other backward castes, OBCs), and sixty-two percent of people are Scheduled Caste or Scheduled Tribe. In contrast, in the top quartile slums, seventeen percent of households are General Caste and forty-six percent are Scheduled Caste or Scheduled Tribe. Religious demographics do not vary in the same way. The sample is majority-Hindu across the continuum.

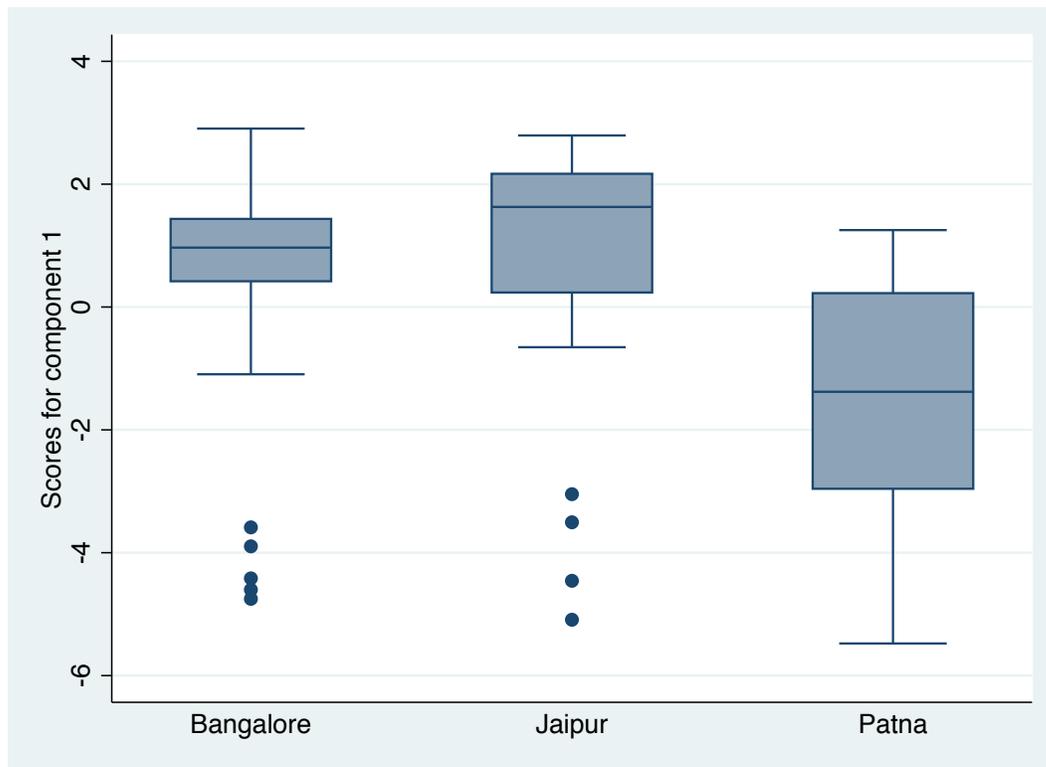
The majority (seventy percent) of slum dwellers in our sample were born in the city where they currently reside. Of the thirty percent who were not born in the city and have migrated to the city, seventy-seven percent migrated from within the same state. These statistics contrast with the rhetoric employed by policymakers in interviews who perceive slum dwellers to be mostly migrants traveling from other states and even countries.³⁶ Yet, on average, slum dwellers in our sample have lived in their current home for 21 years. While there is not a monotonic relationship between position on the continuum and the proportion of migrants in a slum, a greater share of bottom quartile slum residents are migrants than are top quartile residents (thirty-seven percent versus twenty-eight percent).

Notably, nearly all slum residents are employed in the informal sector. Fewer than five percent of respondents report having jobs that come together with tenure security, health care and retirement benefits. However, the proportion of male slum dwellers employed in some of most grueling jobs decreases with slum score. In bottom quartile slums, 48 percent of men rely on daily wage labor, factory work, or construction work; this number reduces to twenty-five percent for men in top quartile slums. Correspondingly, human capital levels systematically increase along the continuum. The average education level is 1.9 standard deviations higher in the top quartile than the bottom.

Geographic differences

Wellbeing varies across our sample cities. Figure 2 shows that slums in Patna are more likely to score along the bottom half of the continuum, Bangalore slums dominate the third quartile, and Jaipur slums are most common in the fourth quartile. Though Bangalore and Jaipur slums cluster along the top half of the continuum, there are slums in both cities with squalid conditions as terrible as those found in Patna's Harding Park. Figure 4 plots the distributions of slum scores within each city.

Figure 4. Distribution of scores by city



Conditions span a wide range in all three cities, but not all sections of the continuum are represented in every city. The boxplots reveal that there is a statistically significant gap between the poorest slums in Jaipur and Bangalore and the rest of the slums in those cities. In Patna, however, the range of difference is narrower; service provision levels are lower than in the other two cities.

While there appear to be two highly distinct groups in Bangalore, the groups are fuzzier in Jaipur. Who lives in these outlier groups and why are they distinct?

The outliers in Bangalore are blue polygon slums. These slums are comprised of recent migrants with one foot in the city and one foot in the rural village. On average, these slums are smaller (104 versus 802 households) and younger (settled 8 versus 52 years ago) than other Bangalore slums. In Jaipur, the poorest slums are more rooted in the city than Bangalore's blue polygons, but they remain just as segregated from city infrastructure. Residents have lived in Jaipur's least well off slums for 21 years on average, which is more than three times the average length of the residents of Bangalore's blue polygons. While less transient than Bangalore's blue polygons, Jaipur's poorest settlements remain as peripheral to government services as Bangalore's poorest circular migrants.

6. A SLUM'S POSITION ON THE CONTINUUM – AND WHY THAT MATTERS

We see that slums in Patna are generally quite deprived, with Jaipur and Bangalore slums generally better off in comparison. There are clusters of slums in Bangalore and

Jaipur, though, that are as deprived as Patna's poorest slums, consistent with our finding that conditions vary more across neighborhoods than across cities.

Undertaking a series of regression analyses we investigate the relationships between a slum's score (reflecting its location on the slum continuum) and neighborhood-level characteristics, household characteristics, tenure security and presence of informal slum leadership. The independent variables are described in Table 4. Understanding the relationships between slum score and each of these independent variables is an important first step in developing targeted policy prescriptions.

Neighborhood-level characteristics may be related to a slum's ability to attract and procure government services (Fox, 2014; Krishna, Sriram and Prakash, 2014; Kundu and Sarangi, 2007). We include slum age and number of households. In interviews, policymakers and activists have speculated that both age and size may contribute to de facto acceptance of the slum by the government.³⁷ We also include a score for services other than water and sanitation, two services integral to the UN-HABITAT definition of a slum. We do not include whether permission was obtained to settle on the land because interviews reveal permissions can be nebulous and reversible.

Household characteristics are likely related to household wealth (Mitra 2006). We also include indicator variables to examine differences by caste and religious groups. We examine migration status to the city to determine whether migrants are collectively less well off, years in the current slum to determine whether there is relationship between time settled and well being, and expenditures on travel to rural villages to identify circular migrants as a special class of transient migrants. We do not include the stated reason for migration because nearly all migrants report relocating for job opportunities. Human capital measures, education and job type, are commonly employed in analyses of wealth, and we incorporate these measures in our model. Finally, we include a measure of social mobility to examine whether upwardly mobile individuals are more likely to live in slums with higher scores.³⁸

Tenure security may be a prerequisite to well being (Subbaraman et al. 2012). We include three measures relevant to security. First is the proportion of residents who perceive their slum to be recognized. We use the household perception variable rather than actual status because actual recognition status is nearly impossible to discern. Household perception is highly correlated with how secure the household feels from eviction. House and land titles are included as tangible evidence of formal access to land. Ration cards are included as tangible examples of formal individual identification. We include ration cards rather than voter ID cards or unique IDs because variation is highest for ration cards.

There is a growing body of literature on the crucial role that informal slum leaders play in procuring services for their neighborhoods, and helping residents navigate bureaucratic hurdles to access services (Auerbach 2013, 2016; Auerbach and Thachil 2016; Auyero 2000; Krishna 2011; Paller 2015). We include an indicator for whether or not the slum has a local leader.

We regress slum score on each of these independent variables and cluster standard errors by city to account for characteristics that could systematically influence errors within each city. The regression coefficient on each independent variable can be interpreted as the extent to which the slum score increases when that variable has increased by one unit. These independent variables and their units of measurement are given in Table 4. Collinearity diagnostics are given in the Appendix.

Table 4. Description of regression variables

Variable	Construction	Units	Observed range
<i>Neighborhood characteristics</i>			
Age of slum	Focus group estimate of slum age	Years	(3, 250)
Neighborhood size	Focus group estimate of number of households	Households	(20, 4018)
Other services	Principal component score of indicators for road quality and garbage disposal services, which were not included in the slum score	Principal component score	(-2.3, 1.2)
<i>Household characteristics</i>			
Proportion General Caste	Proportion of respondents indicating they are General Caste	Percentage	(0, .5)
Proportion SC/ST	Proportion of respondents indicating they are either Scheduled Caste or Scheduled Tribe	Percentage	(0, 1)
Proportion Muslim	Proportion of respondents indicating they are Muslim	Percentage	(0, 1)
Proportion migrant	Proportion of respondents indicating they migrated to the city during their lifetime	Percentage	(0, .8)
Average years lived in slum	Average number of years respondents have lived in their current home	Years	(3.6, 34.5)
Spending on travel to rural village	Average expenditure on travel back to rural areas as a percentage of total expenditures	Percentage	(0, .4)
Education level	Education was measured differently across waves. Respondents either recorded the number of years in school or highest academic milestone achieved. To standardize across waves, responses are scaled from 0 to 1.	Scale from least to most education	(0, 1)
Proportion manual labor	Proportion of respondents employed in construction, factory, sanitation, or other manual work	Percentage	(0, .93)
Economic mobility	Average change in stages of progress as described in Krishna, 2010. This method asks respondents the highest level of 10 needs they can afford now and ten years ago.	Levels afforded	(-.5, 4.2)
<i>Tenure security</i>			
Perceived recognition	Proportion of respondents who respond that the slum is notified by the government	Percentage	(0, 1)
Proportion with house and land titles	Proportion of respondents possessing titles for their home and land	Percentage	(0, .90)
Proportion with ration cards	Proportion of respondents possessing ration card	Percentage	(0, .98)
<i>Slum leadership</i>			
Percentage reporting local leader	Proportion of respondents indicating there is a local leader residing in the slum	Percentage	(0, .98)
<i>City-level controls</i>			
Patna	Statistical diagnosis revealed that including indicator variables for Bangalore and Jaipur could bias the results due to the strong correlation between scores in these cities. We instead add an indicator variable for slums in Patna. Diagnostics are shown in the Appendix.	Yes or no	(0, 1)

The regression relationship between slum score and the independent variables is reported in Table 5. The model explains 86% of the variation in the data. Two slums are dropped because data are missing on the age of the settlement.

Table 5. Regression output (Slum Score is the dependent variable)

VARIABLES	Slum score
<i>Neighborhood characteristics</i>	
Age of slum	0.00194 (0.000884)
Neighborhood size	2.31e-05 (0.000119)
Other services	0.316* (0.0929)
<i>Household characteristics</i>	
Proportion General Caste	0.570 (0.564)
Proportion SC/ST	0.486 (0.471)
Proportion Muslim	0.676* (0.216)
Proportion migrant	-0.622** (0.118)
Average years lived in slum	-0.0157 (0.0230)
Spending on travel to rural village	-0.564 (0.723)
Education level	3.485* (0.876)
Proportion manual labor	-1.426 (1.349)
Economic mobility	-0.107 (0.223)
<i>Tenure security</i>	
Perceived recognition	1.175 (0.963)
Proportion with house and land titles	0.632 (1.005)
Proportion with ration cards	1.443** (0.287)
<i>Slum leadership</i>	
Percentage reporting local leader	0.0414

	(0.107)
<i>City-level controls</i>	
Patna	-0.715 (0.419)
Constant	-2.805 (1.718)
Observations	126
R-squared	0.860

Robust standard errors in parentheses

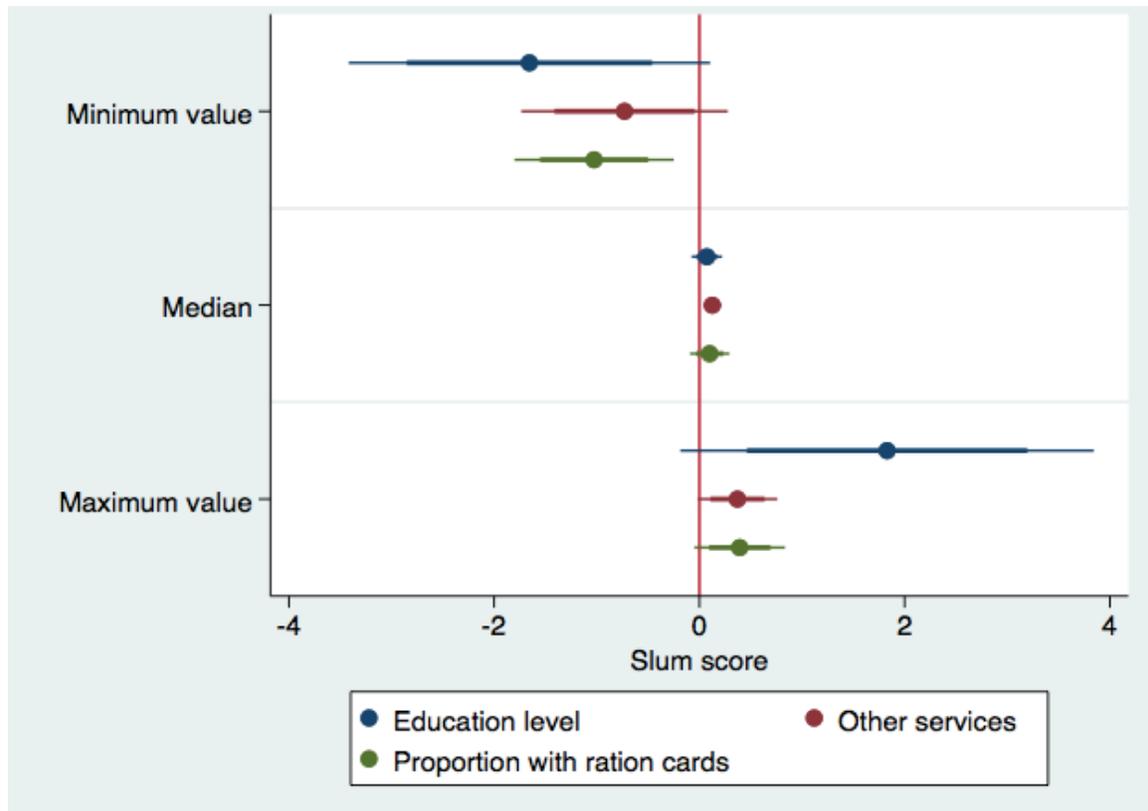
*** p<0.01, ** p<0.05, * p<0.1

Notably, we do not find a significant linear relationship between perceived tenure security and slum score. However, the proportion of slums indicating they are notified increases for each quartile. Furthermore, of the 20 slums with the lowest scores, only 1 reports being notified by the government. In contrast, of the 20 slums with the highest scores, 15 report being notified by the government.

There are three variables that are systematically positively correlated with slum score: average education level, access to additional services, and proportion of households possessing ration cards.^{39,40,41} These results suggest that slums with higher scores either have higher human capital levels or have had other success with government, or both. The magnitudes of these relationships are illustrated in Figure 5. Figure 5 shows the slum scores predicted by the regression for slums with various levels of education, proportion of residents with ration cards, and access to additional infrastructure. For each of these three variables of interest, we use the regression output to predict the continuum score for slums with ranging values for the variable of interest, with all other covariates held constant at their mean values. For example, to examine the magnitude of the relationship between education and slum score, we predict the expected score for a slum with education levels at the observed minimum, median, and maximum education level, with all other covariates held constant at their average values. As shown in Figure 5, the predicted score of a slum with average covariates increases from -1.66 to 1.83 as the education level ranges from the minimum to maximum education levels observed in the sample. This corresponds to an increase in position on the slum continuum from the bottom to the top quartile.

For the other two variables, an increase from their minimum to maximum values corresponds to an expected shift in the slum score from one part of the second quartile to another. The figure suggests that variation in education levels has the largest substantive effect on slum score.

Figure 5. Predicted continuum score across range of human capital and service access values



The inference is not that these factors are causally related to better living conditions, but that better living conditions, as seen in the slum score, tend to go together with higher education levels, stronger connection with government, and greater access to official papers. On multiple dimensions, conditions of life are consistently better in slums higher along the continuum.

The survey data, collected at one point in time, do not help paint a clear picture of whether individual settlements move up the continuum over time, whether class is overcome, and what factors assist with these transitions. The notion that connections and political savvy can result in secular improvements in the settlement came through, however, in interviews with long-term slum residents, and in the slum histories narrated by neighborhood focus groups. We were told of numerous occasions when a particular service – such as street lights, or drinking water, or storm water drainage – had been provided to a slum because of the intervention of a powerful politician. This is supported by the emergent literature on the importance of local leaders acting as intermediaries between slums and the government. We also see examples in our data of slums with much higher scores than expected that have long histories of prominent, politically connected activists residing in their neighborhoods.⁴² However, it is not merely the presence of a local leader that explains variation in slum well being. Most slums have local leaders, regardless of position on

continuum. Interviews with local leaders in Patna and Jaipur reveal that 94 percent of these intermediaries know someone in the government. Why some leaders are more successful than others is an important area for future inquiry.⁴³

7. LIMITED EVIDENCE OF UPWARD MOBILITY

Other data need to be consulted for ascertaining the extent of upward mobility that has been experienced by specific settlements and among individual residents. So far we have shown that the depth and breadth of urban poverty exceeds what is captured in the official data and that these and other conditions vary regularly along a slum continuum. What are the implications for the expectation that urbanization will lift those in the Global South out of poverty?

To examine this question, we analyze the evidence we have on two aspects of upward mobility. Do entire neighborhoods experience secular improvements? Or could it be that as individuals become wealthier, they move to neighborhoods with higher slum scores? We provide preliminary evidence on both aspects.

Neighborhood dynamics

The regression analysis in Table 4 reveals no overall relationship between the age of the settlement and slum score. All slums formed within the past 20 years score in the bottom half of the continuum, but these younger slums comprise less than 10 percent of the sample. Further, it is not necessarily the case that slums become better off with age. The average age of the other slums in the bottom quartile is 57 years. In each of the three cities considered individually, as well, there is no relationship between slum age and slum score.

We also examine longitudinal satellite images of a random sample of 40 slums. Comparing images from different years we were able to identify the changes that had occurred in each of these slums over the period between 2000 and 2015.⁴⁴ In 17 of the random sample of 40 slums that we studied, there was no change in essential physical characteristics (building height, roofing materials, external roads, width of inner lanes, etc.). In another 17 slums, there were small positive changes over this 15-year period. Some experienced a transition from unpaved to paved roads; in others, buildings grew taller as additional stories were constructed; in the remaining slums, roofs changed from a brown color (signifying cheaper construction) to a gray or white color (signifying a better type of roofing material). These changes aren't emblematic of any huge improvement in lifestyles. In only 3 out of the 40 cases we studied was there evidence of substantial improvements. These 3 settlements moved up the continuum, becoming visibly better off. Simultaneously, some other slums, which had existed 15 years earlier, showed evidence that the slum had been relocated, or had remained without experiencing improvements in living conditions. Overall, thus, the thesis of secular improvement does not receive unqualified support. Few among the lower or intermediate types of slums are progressing toward a higher type of existence.

As an additional check, we examine longitudinal satellite data for the slums with households that have experienced the greatest levels of economic mobility in our sample. There are 17 slums where at least three households experienced increases in economic mobility in the 99th percentile of all increases. We examine satellite data from 2015 and ten years prior, in 2005, for each of these slums.⁴⁵ We find no evidence of neighborhood level improvements for 10 of these settlements (59%). In other cities, too, scholars have found that relatively little has changed for the majority of slum settlements, which have mostly remained as they were, experiencing little notable or sustained progress (Dewit 2001; Harriss 2005; Jha, Rao, and Woolcock 2007; Mitra 2006).

Individual dynamics

While the regression and satellite evidence suggests that conditions in neighborhoods do not necessarily improve over time, it is possible that individuals relocate to nicer slums as they improve their individual status. To shed light on this possibility, we examine basic temporal and migration data.

First, the regression output shown in Table 5 reveals no relationship between economic mobility over the past ten years and slum score.⁴⁶ The regression output suggests that people living in nicer slums have not necessarily experienced more mobility on average. We also measure social mobility as the difference between the ranking of occupational prestige of the respondent and that of his father. An occupational prestige index is developed specifically for India in Iversen, Krishna, & Sen, 2016. Following this classification, we find that the majority of respondents remain in the same occupational class as their father. Furthermore, we find no relationship between whether the respondent is employed in a more prestigious occupation than his father and position on the continuum.⁴⁷ These analyses suggest that nicer slums are not usually comprised of residents who have experienced greater intergenerational mobility.

Additionally, we examine the extent to which households move in and out of different slums. In the focus group discussions, we ask whether families have moved in or out of the slum in the past two years. The majority of slums have not had families move in or out recently. 38 percent of slums experienced inward migration in the past two years. Of these, half came from outside of the city, and half relocated from within the same city. Migration was dispersed along the continuum.⁴⁸ In 29 percent of slums, families have moved out in the last two years. On average, focus group discussants believed that at most three percent of households had moved somewhere nicer. Taken together, these figures suggest that there may be some within-city relocation to nicer slums, but it is certainly far from the norm.

None of the evidence presented here is definitive on its own, but all of it points in the same direction: slums and slum dwellers are more likely to experience stasis than upward mobility. The evidence is summarized in Table 6.

Table 6. Summary of evidence on mobility

Unit of analysis	Data	Evidence	Implication
Neighborhood	NH and HH survey data	No relationship between age of the settlement and slum score	Slum conditions do not necessarily improve over time
Neighborhood	Satellite data	No systematic evidence of visibly improved infrastructure	Slum conditions do not necessarily improve over time
Neighborhood	HH survey data and satellite data	Most neighborhoods with households experiencing economic mobility do not show visibly improved infrastructure	Slums with households that have experienced greatest improvements in purchasing power are not necessarily improving at the neighborhood level

Individual	NH and HH survey data	No relationship between stages of progress over ten years and slum score	People who have experienced relatively greater improvements in purchasing power are not necessarily moving to nicer slums
Individual	NH and HH survey data	No relationship between the difference in father-son class and the slum score	People who have experienced intergenerational mobility are not necessarily moving to nicer slums
Individual	NH data	Inward-migration is dispersed along the continuum	Migrants settle across the continuum
Individual	NH data	Focus group discussants believed that only three percent of outward-migrants moved to a nicer slum	People are unlikely to move to nicer neighborhoods

The variation in the continuum seems to tell a story of *assortative residential selection* – slums and their residents enter the continuum at different points and tend to remain where they had started. People with higher levels of education, better occupational status, and bigger asset stocks tend to gravitate toward others with similar characteristics, living in settlements with larger dwelling sizes (even if service provision is somewhat better in some respects in other slums). It is evidence of assortative selection, more than evidence of economic mobility, that accounts for the variety of living conditions in the slum settlements of these three cities. Examinations in other countries and continents have arrived at similar conclusions (including Fox 2014; Marx, Stoker, and Suri 2013a).

CONCLUSION AND POLICY IMPLICATIONS

We collect and analyze a variety of evidence in three large Indian cities with diverse economic and political histories to demonstrate that slum neighborhoods span a continuum of wellbeing. Official data omits neighborhoods along the bottom half of this continuum, leading to faulty conclusions about the depth, breadth, and persistence of poverty. Each of these data inaccuracies has important and distinctive policy implications.

These omissions lead to underestimates in the overall number of people living in poverty as well as in the depth of deprivation. For instance, official data estimates that *only 3 percent* of Patna’s households reside in slums. It is not difficult to imagine how unreliable estimates can have dangerous consequences. Basing budgetary allocations and planning priorities on flawed figures will lead to deprioritizing urgent poverty challenges.

The official data also obscure the wide range of policy needs. Those at the bottom of the continuum indicate that they need sturdier shelter to protect them from summer

monsoons and winter frostbite before they can consider taking advantage of vocational training. Meanwhile, a well-intentioned latrine delivery policy would be futile for those at the top of the continuum. Effective local policies must appreciate the wide range of living conditions. Greater clarity and targeting may also serve to reduce the inertia resulting from ambiguous policies and responsibilities.

Finally, we do not find that lived experiences reflect evidence of urbanization as a path to upward mobility for the poor. Instead, there is evidence of assortative residential selection, with conditions varying considerably across neighborhoods. The majority of slum residents across the continuum, 70 percent, were born in slums. Better off slums are either more educated or more politically connected than slums occupying lower positions on the continuum. Disconnected neighborhoods must be integrated into the city – to the education system and to basic services. There must be greater accountability, so that a neighborhood needn't be politically connected to secure access to basic water and sanitation services. More inclusive plans must be developed if the poorest are to see benefits.

ACKNOWLEDGEMENTS

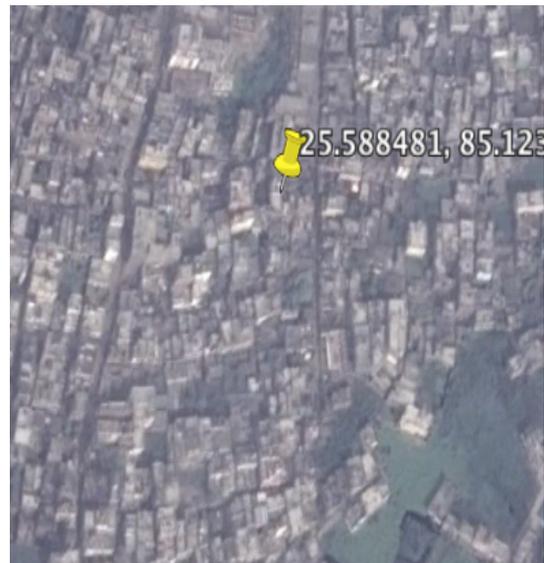
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APPENDIX

A1. Example images of Jaipur satellite types



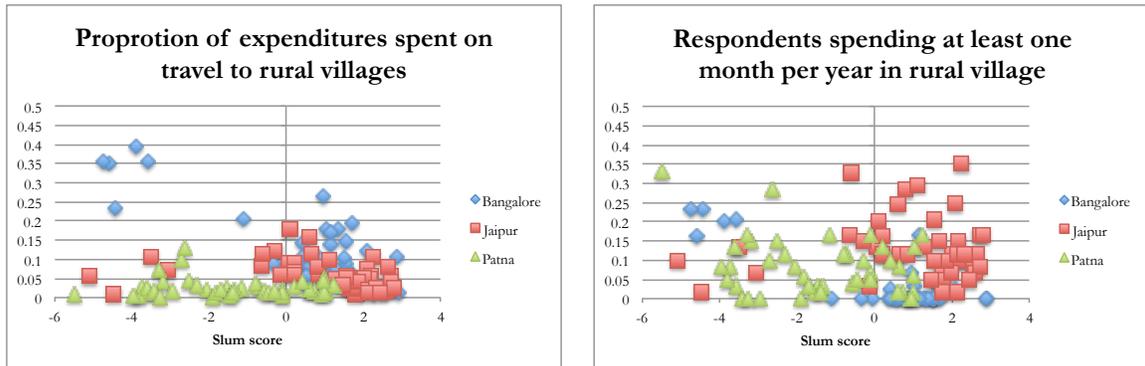
A2. Images of satellite images of Patna slums



A3. Principal component loadings

Variable	Component 1	Component 2	Component 3	Component 4	Component 5	Component 6	Component 7
Asset score	0.444	-0.115	-0.1122	0.1392	-0.2868	-0.6316	-0.5259
Area per person	0.3542	-0.4469	-0.2194	0.5127	0.5791	0.1289	0.1088
Water score	0.2581	0.7505	0.1611	0.5686	-0.0588	0.0828	0.1026
Drain score	0.3501	0.4269	-0.283	-0.5598	0.537	-0.0762	-0.0869
Toilet score	0.4402	-0.0969	-0.2301	-0.1665	-0.3998	-0.1023	0.7388
Roof score	0.4431	-0.1008	0.0224	-0.1472	-0.3052	0.7374	-0.3666
Building height	0.313	-0.1485	0.8831	-0.1778	0.1938	-0.1331	0.1154

A4. Expenditures on and time spent travelling to rural villages



A5. Test for collinearity among independent variables

VARIABLES	VIF
Patna	4.30
Slum recognition	4.29
House and land papers	4.04
Stages of progress	4.02
School score	3.49
Ration card	2.94
SCST	2.92
Years in slum	2.93
Migrant	2.81
General Caste	2.66
Expenditure on rural	2.40

Manual labor	2.28
Muslim	2.23
Other services	1.90
Slum age	1.73
Leader in slum	1.56
Number of households	1.31
Mean VIF	2.81

NOTES

¹ See http://mirror.unhabitat.org/documents/media_centre/sowcr2006/SOWCR%205.pdf

² Different estimates of the slum population are provided by NSSO because, instead of the Census' threshold number of 60-70 households, it utilizes a different definition of the third category, counting as slum even such settlements as have a minimum of 20 homes. Further, NSSO has changed its definition several times over the previous decades, revising the minimum number from 50 to 25 to the current definition of 20 homes. The estimates provided by Census and NSSO consequently differ, but both agencies' statistics are under-estimates. Krishna (2017) examines the reasons for underestimation. See also <http://www.cn.undp.org/content/dam/china/docs/Publications/UNDP-CH-PR-2013-IPF-background-report-on-Urbanization.pdf> and http://mospi.nic.in/Mospi_New/upload/concepts_golden.pdf; <http://indiasanitationportal.org/18551>.

³ The national census of 2001 for the first time separately assessed the slum population in a few cities of India, considering three separate categories: (i) All areas in a town or city notified as 'Slum' by a state or local government; (ii) All areas recognized as 'Slum' by a state or local government, which may have not been formally notified; (iii) 'A compact area of at least 300 population or about 60-70 households of poorly built congested tenements, in unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities.' While slums of Categories (i) and (ii) exist on official records, Category (iii) slums are of a different type. Such types of slum settlements – neither notified nor recognized – are springing up all the time, often without well-known name or other indication of stable existence. They rarely form part of government records or city maps, so are harder to pin down, far less, enumerate. Census estimates of both 2001 and 2011 have missed out on the shabbiest settlements, as evidenced by the fact that, in 2011, an unbelievably larger share (81 percent) of these slum dwellings have bathrooms; 93 percent are of permanent (pukka) or semi-permanent construction; 74 percent have piped water connections; 53 percent have bank accounts; and 51 percent use LPG for cooking. Many states report no slums at all, which is also unrealistic. See Bhan & Jana, 2013; GOI, 2010.

⁴ City-level governments are dependent for their revenues and for their senior personnel upon the state government. There are several aspects of city government that fall within the jurisdiction of state rather than city governments. Of course, there is variation across states in the nature of these relationships. Urban policies therefore are partly dependent on city policies, but are also largely dependent on state policies. While most states have notified at least a few slums in capital cities, in Patna (Bihar) no slum has been officially notified.

⁵ The criteria used to draw these distinctions are extremely vague. For example, the state of Bihar's slum policy asserts that slums on disputed land can be evicted, but the policy does not define disputed land or include any sort of plan for relocating these slum dwellers (GOB 2010).

⁶ See, for example, <https://terraurban.files.wordpress.com/2014/01/jaipur-status-report.pdf> and <http://www.jaipur.org.uk/history.html>

⁷ See, for example, <http://www.archinomy.com/case-studies/1906/jaipur-evolution-of-an-indian-city> and

⁸ See <http://www.indiaonward.com/transforming-jaipur-from-a-heritage-city-to-a-world-class-smarter-city/> and <http://www.forbesindia.com/blog/economy-policy/small-cities-are-indias-emerging-business-locations/>

⁹ See, for example, <http://www.forbesindia.com/blog/economy-policy/small-cities-are-indias-emerging-business-locations/>

¹⁰ This was explained in interviews with Jaipur Development Authority officials on June 28, 2016 and in a relocation plan for 14 slums.

¹¹ 2011 census data can be downloaded from

http://www.censusindia.gov.in/2011census/population_enumeration.html. Census data indicate that 3 percent of households are located in slums (13,696 out of 413,049). In contrast, Rodgers & Satija, 2012 estimate that 64 percent of Patna's population lives in slums.

¹² The official list in Bangalore included only notified slums. We were not able to get a reliable or authorized list of non-notified slums in Bangalore and Jaipur. Patna has no official list of slums.

¹³ We found that examining images at an altitude of 4,000 feet was most helpful for our purposes. The shortlisted criteria identified were lack of space between shelter units; roofs that appeared to be low-quality based on their weathered brown or grey colours; a hodgepodge pattern of shelter units; lack of proper roads (if there are roads, they are brown, narrow and unpaved); lack of shadows adjoining the shelter units, signifying that they are low to the ground, thus not multi-storied. More details are provided in Krishna, Sriram, & Prakash, 2014.

¹⁴ For most settlements, there are satellite images starting in 2000. However, some only have images dating back to 2002 or 2004. Similarly, the vast majority has an updated 2011 image, but some only some have images dating to 2010. The equivalents of blue-polygon slums in the other two cities, Jaipur and Patna, have tarp roofs of different colors, though many of them are also blue. Thatched roofs in Patna are also associated with some of the lowest-end slums.

¹⁵ We identified slums that were neither on the official lists nor blue polygons through successive iterations between Google Earth image analysis and field verification.

¹⁶ This list was provided to us by Adam Auerbach. He received a list of slums and an accompanying map from PDCOR Limited, a government of Rajasthan joint venture, which he then independently built on for the purpose of his fieldwork.

¹⁷ The characteristics visible in Jaipur were lack of space between shelter units, a hodgepodge pattern of shelter units, and homogeneity of shelter density – a subset, once again, of the UN definition.

¹⁸ We stratified the slums into groups based on the rudimentary satellite classification and location within the city. We then randomly selected slums from each group to ensure that different slum characteristics are represented in the same proportions in the study sample as in the overall sample. For example, if 10 percent of all Jaipur slums are located in the Northeast quadrant and are of the poorest type according to satellite images, then 4 out of 40 slums of the poorest type from the Northeast quadrant were randomly selected for the study sample. We added five additional slums to our sample based on discussions with local partners. We worked with our local partner, IDS, and a survey company, MORSEL, who we trained and monitored. Sujeet Kumar, a PhD student at Jawaharlal Nehru University, conducted all qualitative interviews.

¹⁹ Support Programme for Urban Reforms (SPUR) is a partnership between the Government of Bihar and the Department for International Development (DFID). SPUR works on issues of urban poverty, slum mapping, and slum improvement in Bihar.

²⁰ We have recently begun looking at higher-resolution images, including through a collaboration with an urban geographer and a computer scientist.

²¹ These data contain information ranging from number of households to drainage connection. Cluster analysis on flood tendency, access to drainage and sewage, access to streetlights, and proportion of households built from sturdy materials reveals pseudo-F is maximized for two groups, implying there are two clusters with statistically distinct infrastructure characteristics. We did not include information on whether there is a road leading to the slum or whether dwellings have electricity. There is little variation in responses on roads (89% have roads travelable by car leading up to the slum), yet it is not correlated with the other infrastructure

variables. For electricity, there is a neighborhood level variable on whether or not the slum has streetlights. We assume this to be more accurate and used this instead of household electrification.

²² We again stratified slums into groups and randomly selected slums to be representative of the proportions in each group. We stratified by infrastructure quality based on survey data, the quadrant within the city, and population and randomly selected 40 for the sample. We also added three additional slums based on discussions with local organizations.

²³ Other scholars have similarly adopted and refined this definition to map health disparities in Accra, Ghana. See Jankowska, Weeks, & Engstrom, 2012.

²⁴ Three official agencies in Bangalore include Karnataka Slum Development Board (KSDB), Brihut Bangalore Mahanagar Palike (BBMP), and the Bengaluru Development Authority (BDA). Each agency is responsible for different aspects of urban land management and has different responsibilities with respect to slum management.

²⁵ Field visits reveal dozens of different types of papers that correspond to differing levels of perceived security, independent of actual legal meaning. Field visits also reveal that absent formal government recognition, informal markets may emerge with their own paperwork. Taken together, legal tenure status appears to be quite nebulous. Ongoing work investigates how to best measure tenure security.

²⁶ For simplicity, we do not include the pre-2015 Bangalore waves in the principal components analysis. This is because the 2015 wave includes slums from all sampling categories, and the survey instrument in 2015 was nearly identical to the survey instrument used in Jaipur and Patna in 2016.

²⁷ We calculate scores by running principal components analysis on the indicators. Principal components analysis is frequently used to reduce multiple indicators to a single score, essentially weighting each indicator by how well that indicator explains differences across observations (James et al. 2013). For example, if the value of an indicator does not change across slums, then that indicator does not explain the observed range of conditions very well, and this indicator would receive a lower weight.

²⁸ To decompose variation in scores, we run a random effects model on the first component score from the household indicators. As an additional check, we calculate the simple average of each of these indicators scaled from 0 to 1, and run a random effects model on the simple averages. The results do not meaningfully differ.

²⁹ The first component from the principal component analysis explains the majority of the variance (62.42%). Therefore, we utilize the predicted first component score in our analyses. We refer to the predicted first component score as the “slum score.” As a robustness check, we verify that the principal component score and the simple average of the indicators are highly correlated (.80) and that the position on the continuum does not meaningfully change between the two measurements. This check makes us confident that the continuum scores are meaningful and easily interpreted.

³⁰ It is possible that our measurements for building height omit instances where different floors are rented to or owned by different families, or that having a piped water connection is not better than having access to other types because of intermittent access. As further robustness checks, we calculate the index scores by a.) dropping height from the calculation, b.) dropping water source from the calculation, and c.) dropping both. The correlations with the slum score including all of these variables are .99, .99, and .98.

³¹ Exploratory factor analysis and cluster analysis reveal that there are no statistically distinct groups among the aggregated slum data. The analysis did robustly identify blue polygons as distinct from the rest of the continuum within Bangalore, but the blue polygons are not distinct from other slums in Jaipur or Patna when the sample is disaggregated.

³² Interview with residents, July 12, 2016.

³³ All respondents report there are conflicts with other residents over water or other resources in the slum. All respondents say it is impossible or very unlikely to conceive of a selfless leader, and there are no community meetings or organizations.

³⁴ The slum ranking is 13 out of 128.

³⁵ The slum ranking is 78 out of 128.

³⁶ Interviews with policymakers and implementers from Jaipur’s Department of Urban Legal Bodies, Jaipur Development Agency, and Jaipur Municipal Corporation from June 27-29, 2016.

³⁷ Interviews with policymakers and implementers from Jaipur’s Department of Urban Legal Bodies, Jaipur Development Agency, and Jaipur Municipal Corporation from June 27-29, 2016 and with activists from Society for the Promotion of Area Resource Centers (SPARC) in Mumbai, July 31-August 1, 2016.

³⁸ As described in Table 4, the measure of social mobility that we utilize is based on a robust recall method, Stages of Progress, linked to lumpy assets and core capabilities less susceptible to recall bias. For a fuller description of this methodology and its applications, see Krishna (2010).

³⁹ The regression analysis shows a significant and positive correlation between slum score and proportion of Muslim residents. This trend is driven by three majority-Muslim outliers in Jaipur with slum scores in the top 10 percent. When these three slums are dropped from the sample, the coefficient on migration is no longer significant.

⁴⁰ Slums in Patna have significantly lower numbers of ration cards, which is consistent with the pervasive institutional failure. To verify that it is not the low level of ration cards in Patna driving the significant relationship between ration cards and slum score, we run Model 1 only on Jaipur and Bangalore. The relationship remains significant. More households have ration cards in slums where more households perceive the slum is notified.

⁴¹ The regression analysis shows a significant and negative correlation between slum score and proportion of migrants. This trend is driven by the Bangalore blue polygon slums. When Bangalore's five blue polygon slums are dropped from the sample, the coefficient on migration is no longer significant. Apart from Bangalore's bottom end, therefore, the slum continuum is relatively equally populated by native-born residents and recent migrants.

⁴² For example, based on human capital levels, we would expect Mahadev Nagar in Jaipur to be ranked 94 out of 128, but it is actually the 3rd most well off slum. The Congress Party helped the local leader secure his position as a leader in the slum, and he has been leading for 20 years. In Patna, East Lohanipur would be ranked 96 based on human capital levels but it is instead ranked 39th. There are two politically connected local leaders in East Lohanipur – a long time, politically connected activist and a local businessman whose brother is active in the BJP.

⁴³ Based on prior work by A. Auerbach & Thachil, 2016 and Krishna, 2002, we expect that a metric that captures quality of leadership or connections would explain higher service scores and access to ration cards.

⁴⁴ The year 2000 is as far back as publicly-available Google Earth images enable comparisons. We have just started working with higher-resolution images going further back in time.

⁴⁵ Economic mobility is assessed with the help of the Stages of Progress method (Krishna, 2010), in which respondents identify level (among 10 or more sequentially achieved “stages of progress,” comprised of core capabilities, such as sending children to school, or lumpy assets, such as two-wheelers) that they had achieved, respectively, 10 years ago and at the present time.

⁴⁶ Footnote 40 describes the metrics that we used for these comparisons.

⁴⁷ We regress the slum score on the difference between father and respondent occupation, clustering standard errors by city. The p-value of the coefficient on class difference is .127.

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