Spatial Inequality in Suburban India:

Evidence from Remote Sensing and Housing Markets

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Abstract

This paper, drawing on two new data sources, offers the first systematic analysis of spatial inequality in the rapidly developing regions outside big cities in India. The analysis focuses on two urban regions where new centers of high technology have shaped peri-urban markets for land and housing (Bangalore and Pune), and one with a manufacturing base (Coimbatore). A novel classification of new housing based on high resolution remote sensing is applied to analyze dynamics of land use change in matched transition zones of each city. Data scraped from online real estate listings then enables analysis of housing inequality in these zones, and comparison with citywide patterns. In contrast with the frequent portrayal of new suburban zones as privileged, homogenous enclaves, our analysis finds diverse housing conditions and unequal prices in the most advanced zones. Housing markets reinforce similar disparities on the surburban fringes to those throughout these urban regions.

As urban development sprawls into the rural countryside of Asia and Africa (Angel et al. 2011, Seto, Güneralp, and Hutyra 2012), the emerging patterns of settlement across urban regions have become pivotal for the urban future. As parts of the developing world have prospered, globally connected firms, new economic elites and a growing middle class have shaped these new patterns. In societies still largely dominated by impoverished rural and urban residents, the growing presence of these groups has raised a specter of deepening social inequality. Although the slums and impoverished neighborhoods within developing country cities have drawn the growing attention of researchers from the developed world, we know much less about the dynamics of inequality in these rapidly changing regions around cities. Censuses and official sources of household-level data remain insufficiently calibrated or reliable to capture the local realities of this process.

Regions where high-tech development has concentrated in India since the liberalization of the 1990s exemplify the contradictions between the global corporate presence, the burgeoning prosperity and the expanding urban development that have come to parts of subcontinent, and the enduring poverty and informality of rural Indian society. A growing case study literature outlines the implantation of corporate offices, high-tech investment, and infrastructure in these regions, and often points to the creation of elite enclaves around these cities. This paper, based on a fuller view of the transition and its consequences, shows that the expansion of urban settlement has instead created new local patterns of spatial inequality within emerging suburbs. We employ high resolution remote sensing images and online real estate listings data to examine the micro-level dynamics of transition around two centers of technology parks, Bangalore and Pune. Our analysis shows how the drivers of urban land expansion extend beyond technology parks to the residential and commercial property markets of peri-urban regions. Where high technology investment has been most extensive, these markets have reinforced striking disparities in housing prices and living conditions within emerging suburban neighborhoods. Suburban inequality thus reinforces patterns of inequality found in neighborhoods across these urban regions.

Urban growth and inequality: Contemporary India in comparative perspective

A larger proportion of twenty-first century urban growth is likely to take place in India than in any other single country. From 1970 to 2015, the Indian population living in urban aggregations grew by roughly 300 million; by 2050 the UN projects that it will grow by another 465 million, to 54 percent of the country's population. Since the 1990s, the massive physical expansion of urban and suburban land use around Indian cities has increasingly been documented through remote sensing as well as population censuses (Angel et al. 2011, Sellers et al. 2016 (revise and resubmit)). Emerging forms of settlement in Indian urban regions, however, reflect a deepening inequality that contrasts starkly with the twentieth century experience of suburbanization in developed countries.

The postwar surge of suburban growth in the United States and Europe took place mainly during the Fordist era of expanding economic opportunities and broad-based middle class growth. Areas of suburban settlement emerged primarily as bastions of affluent and middle class white households. In the United States, suburbanization mainly took the form of low density development in previously unsettled urban peripheries (Jackson 1985). In Western European countries like France, middle class "rurban" settlement clustered around old village centers predominated, despite the rise of industrial suburbs (Bae and Richardson 2004). In India, the different conditions and dynamics of surburban growth in the regions of high technology clusters at the leading edge of national economic growth have made stark socioeconomic divisions a consistent feature of suburban settlement.

As steady aggregate economic growth has come to India, what was once one of the most equal large developing countries has become home to some of the fastest growing socioeconomic disparities. Since the liberalization of 1993-1994, studies from a variety of perspectives point consistently to deepening overall inequality (Jayadev, Motiram, and Vakulabharanam 2007, Motiram and Sarma 2014, Vakulabharanam and Motiram 2016, Chauhan et al. 2016, Subramanian and Jayaraj 2013). As the poverty rate declined from 46 to 22 percent from 1993-4 to 2011-12, Gini coefficients based on consumption surveys show a steady increase in relative inequality from .30 to .36 over the same period (Chauhan et al. 2016, 12). In urban India the inequality has risen to the highest levels. The Gini coefficient for urban households stood at .39 in 2009-2010 (Subramanian and Jayaraj 2013, 266). Disparities between urban and rural areas have risen more sharply since the 1990s than disparities among states, regions or castes. In 2009-2010, the log mean deviation between urban and rural consumption reached a high of 26%, or 10% higher than between states. Motiram and Sarma (2014, 313) conclude that the "rural–urban disparity is the starkest among the various disparities that exist in India today".

Especially in centers of high technology investment, new industries linked to global economy have brought a highly educated workforce to what remains a largely informal developing country economy. These corporate installations and demand from workers there have helped drive suburban expansion into regions of rural village settlement where poverty and traditional forms of agriculture have remained dominant for centuries. State policies to develop business parks and tax incentives, and infrastructure policies like development of roads, airports, etc. have played a well-documented role in this process (Kennedy 2007, Goldman 2011, Shobha, Gowda, and Mahendra 2009, Basant and Chandra 2007). The opening of mortgage markets, and loosening of credit restrictions has also facilitated access to housing finance for middle and upper income households (Verma 2012, Campbell, Ramadorai, and Ranish 2015). Economists have long argued that constraints on development in cities, such as the floor-area ratios in many cities (Vishwanath et al. 2013, Glaeser 2010), and legal limits on accumulation of land like the Urban Land Ceiling Act (ULCA) of 1976 (Srinivas 1991, Sridhar 2010) have also help drive suburbanization. In periurban and rural regions, widespread limits on agricultural landholding and its consolidation have also restricted and shaped the dynamics of land conversion in newly urbanizing regions (Chakravorty 2016, Sundar 2016). In the face of institutional conditions like these, case studies of development point to the rise of "brokers" or "mafias" beyond conventional developers or state actors in the process of development (Baka 2013, Weinstein 2008).

A growing number of case studies of the process of suburbanization have focused on the creation of new towns or enclaves of new office and housing development around the outskirts of such Indian cities as Bangalore, Chennai, Delhi, Hyderabad and Pune (E.g., Kennedy 2013, Balakrishnan 2013, Datta 2015, Goldman 2011). Such accounts suggest, as some observers have feared, that the new Indian suburbanization is taking the form of homogenous, exclusionary enclaves of affluent and foreign workers. Case studies of individual development projects like these need to be understood in the context of the wider processes of peri-urban transition. In this paper, we examine the process of peri-urban transition in a selection of sites outside three rapidly growing Indian cities. Two new data sources--systematic land use data from satellite images, and geocoded housing prices from online listings—enable a clearer view of the actual patterns of new development that are emerging. Analysis of these settings will show that the new patterns of settlement emerging in the regions around new high-technology clusters perpetuate the same wide disparities in housing conditions and socioeconomic status that pervade the older centers of Indian cities.

The three cities

This analysis focuses on two disparate urban regions where centers of information technology industries have emerged to drive suburban development. Bangalore and Pune are situated in different Indian states with partly divergent legacies of land use institutions and contemporary regulation, and also feature somewhat different types of new economic activities. To ascertain difference that high technology investment has made, we compared both cities with the older industrial city of Coimbatore, where suburban growth has taken place under conditions characteristic of most other urban regions in India.

[insert Table 1 about here]

Bangalore (or Bengaluru, as it has recently been renamed) is the capital of the state of Karnataka, the third largest agglomeration in the country, and by many measures the fastest growing metropolis. Founded as a cantonment for British troops and officials during the colonial era, it has become known as India's Silicon Valley and one of the leading centers of foreign investment.   Bangalore long housed a variety of prominent educational and research institutions, and attracted manufacturing investment in the 1970s,   The growth of jobs and population accelerated in the 1990s as successful domestic IT firms like Infosys and Wipro attracted a growing phalanx of international technology firms to a succession of new business parks outside the city, and new development zones emerged around them. These developments gave rise to a 49 percent increase in the metropolitan population between 2001 and 2011, and an aggregate GDP estimated at $83 billion, or some $35 billion higher than Pune. Bangalore emerged over this period one of the hottest markets for new housing and commercial or industrial development in the country. A 2012 projection by Cushman & Wakefield for 2013-2017 ranked the region first in predicted demand for commercial development and second after Delhi in demand for upper and middle class residential units (India Brand Equity Foundation 2017, 10-11). State level indicators for Karnataka point to a rise in urban inequality along with these other trends (Dev and Ravi 2007). Among urban households in the state, the Gini index rose from .36 in 2004-2005 to .40 in 2011-12. In 2011, annexation of a broad swath of villages surrounding the municipality brought a large portion of the peri-urban region under the jurisdiction of the city.

Pune, the eighth largest agglomeration in India with a population of 5 million, lies in the state of Maharashtra around 120 kilometers from Mumbai. Its trajectory of economic development and urban population growth over the last forty years resembles that of Bangalore as closely as that of any other Indian city. Also the site of a British cantonment during the colonial era, it emerged slightly later than Bangalore as a rapidly developing center of information technology and foreign investment. Since the 1990s, a variety of technology parks and planned development zones on the edge of the city and in neighboring jurisdictions expanded the built up area into the surrounding region. In a 2005-2006 calculation, MOSPI estimated per capita GDP for Pune slightly higher than for Bangalore.[1] Although state-level

[1] Data processed by National Planning Commission and downloaded 3/19/2017 from data.gov.in website.

figures for Maharashtra cannot be taken as indicative for Pune in particular, they show a slight decrease in urban inequality, from a Gini of .37 to .35.

In contrast with both Pune and Bangalore, the urbanizing region around the city of Coimbatore reflects patterns of peri-urban growth in most Indian cities where urban land expansion took place. In 2011 Coimbatore, located in the state of Tamil Nadu was the 16th largest agglomeration and the 23rd largest city in the country. The rate of growth in population over 2001-2011 approached the rate in Bangalore, as the agglomeration grew by 46 percent and the central city by 72 percent. Growth in Coimbatore, however, remained tied to expansion of the traditional domestic Indian economy rather than to foreign investment or high technology industry. Known as the Manchester of India, the city has long anchored a region of textile manufacturing and other industries at relatively small scales, along with informal services. The recent introduction of two small technology parks did not alter the manufacturing base for the wider urban economy. Comparable figures on the regional economy from 2005-2006 indicated a level of per capita gross domestic product less than half the levels of Pune or Bangalore (Table 1). State-level data for urban Tamil Nadu, although too aggregated to permit any inference for Coimbatore specifically, also show a slight decline in inequality.

All three cities and their surrounding regions reflected the stark disparities between urban and rural India, as well as living standards for middle class households somewhat different from those of the suburban middle class in the developed world. In the districts that included each of the cities, the 2011 census showed that a variety of household assets held by large portions of urban households were present in less than half the proportion of rural households (Table A.9). The vast majority of households in both urban and rural areas owned a television and a cellphone, and relied on two-wheel vehicles for transportation. Thirty-three percent of urban households in Bangalore and 24 percent in Pune owned a computer, compared to 11 percent and 8 percent of rural households. Eighteen percent in Bangalore and 13 percent in Pune owned four-wheel vehicles, compared to 7 and 6 percent of rural households. Disparities between urban and rural areas were especially apparent in features of housing linked to infrastructure networks (Table A.10). Although 63 percent of households in Pune District and 77 percent Urban Bangalore reported closed wastewater drainage (e.g., through sewer connections) only 21-22 percent of rural residents in either district had connections. The vast majority of urban households reported having toilet and bathing facilities and running water as well as a kitchen for food preparation within the premises. Access to these was far less widespread among rural households (Ibid, p. 67). In Coimbatore, the urban/rural disparities were most extensive. Only a third of rural households, compared to 59 percent or more of urban households, reported either a source of drinking water or a latrine facility within the premises of their residence. Only twelve percent of rural households there, and 35.8 percent of all households, had closed drainage.

Institutional and regulatory conditions for the conversion from rural to urban land use differed by state in ways that reflected wider patterns of variation among all Indian states (Table 2). Under colonial rule, Bangalore and its surrounding regions had belonged to the Mysore Sultanate, which maintained a traditional system of lord-tenant relationships in the rural countryside known as the zamindari system (Banerjee and Iyer 2005). In both Maharashtra and Tamil Nadu, the British authorities had sought instead to redistribute landed property rights to rural peasants through the ryotwari system. Over the decades following independence, all three states instituted land reforms that tended to reinforce and maintain small-holding in rural land, and other restrictions on construction in urban areas. From the 1990s onward, these restrictions continued to impose fewer restrictions on consolidation and acquisition of land in Karnataka.

The Urban Land Ceiling Act was lifted from 1999, exceptions to the restrictions on agricultural land acquisition enabled organized firms and institutions to acquire it without a ceiling, and a less restrictive floor area ratio requirement was imposed for urban areas. By contrast, Maharashtra left the ULCA in place till 2007, and even afterwards maintained some of the strictest restrictions among Indian states on the acquisition of agricultural land, along with a restrictive floor surface index for residential construction (albeit with exceptions). Restrictions on agricultural and urban land conversion in Tamil Nadu generally stood between these two extremes.

[insert Table 2 about here]

Development industries in the three settings reflected the different market opportunities from the wider economy, but also a common dispersal of real estate markets among hundreds of agents, firms and other actors. The leading online real estate service, Magicbricks, listed a total of 881 residential agents and 323 commercial agents in Bangalore in 2016. In Pune, the service listed even more agents (1129 residential and 545 commercial), and in Coimbatore only a small proportion of those in either other city (52 and 21, respectively). Predictably, agents in Bangalore listed more properties per agent than in either other setting (110 residential properties per agent, compared with 77 in Pune and 103 in Coimbatore, and 35 commercial properties per agent, compared with 24 in both others). Rather than tightly concentrated, however, the real estate industry in Bangalore was divided into dozens of large firms with divergent specialties. No agent there listed more than 611 properties, while three in Pune and one in Coimbatore listed more than 1400. Twenty-six Bangalore agents listed 200 or more properties, and thirty-nine between 100 and 200 properties, compared with 51 in both size categories in Pune. Most of the large agents in all three cities were part of national or even international firms (MG Global

Realty, C1 India Pvt, My Dream Flat LLP), but by no means all. Particularly in Pune and Bangalore, the vast majority of agents were instead relatively small firms or individuals.

Surburban sample sites

To compare and analyze the peri-urban transition at the level of individual built structures and plots required examination of high resolution (1-5 square meter) satellite images over time. The design for this analysis focused on two small scale sites of 8-14 square kilometers in each urban region. Sample areas were delimited within each of the three urban regions as sites that were undergoing the transition from rural to suburban (or urban) settlement under conditions as close to identical as possible. Within each region, the samples selected included one zone of housing interspersed with business or office parks for high technology or industrial enterprises, and one zone devoted primarily to residential development. Like an agricultural experiment carried out in separate agricultural plots, this research design relied partly on a blocking logic (Bailey 2008). Although the aim was to analyze observations of a similar process rather than to carry out a randomized experiment, matched characteristics of the sample sites between each region reduced the variance to be explained. The analysis focused on the common process of transition from rural to urban or suburban land uses in all six sample sites.

The six sites selected shared several characteristics. All were located in a peri-urban area, defined both by rural low spatial density at the start of the study period (2002-2003) and a location at or near city limits. In each there was a transition of land use over the study period (2002-2016) from largely rural to a suburban or urban density. In each, major proportions of settlement devoted to residential structures. Each was also located next to major arterial roads, and accessible to major industrial or technology park locations.

In each region, one of the two sites comprised part of a cluster of new housing, commercial, office and manufacturing structures associated with one of the most prominent technology or industrial parks in the urban region. The other site was one of several primarily residential areas that had developed physically distinct from the areas where jobs had clustered. This second site offered more large lots and more suburban single-family homes in more exclusively residential neighborhoods. These two types of settings encompassed the main forms that periurban development in each urban region.

In Bangalore, one site encompassed the eastern reaches of the Whitefield area, the second of two large zones with concentrations of high technology firms and related activities that emerged to the east of the main urban agglomeration (and outside the original boundaries of the municipal corporation) from the 1990s. The central business parks and the Export Processing Zone Whitefield had already been constructed by 2002 to the west of the site. The sample site encompassed an earlier village settlement along Varthur Lake (Figure 1), along with new development along a main road corridor. Over the study period, developed land expanded from 33 percent to 67 percent of the site.

[insert Figure 1 about here]

The second site encompassed an area of South Bangalore along a new ring road that also lay beyond the boundary of the Municipal Corporation up to 2011. South Bangalore lay across the main road that connected the main urban agglomeration of the city to Electronic City, the first and one of the best known of the technology parks in greater Bangalore. Up to 2007 South Bangalore itself was an area of rural village settlement with limited planning and land use restrictions, regulated by the metropolitan development authority for Bangalore. Layouts (subdivisions), many established by the Bangalore Metropolitan Development Authority on land converted from farms, occupied much of the northern part of South Bangalore. The southern part remained mostly rural farms and villages in 2002. By 2016, developed land grew from 24 percent to 53 percent of the total.

In Pune the first sample belonged to Hadapsar, a village adjoining the city adjacent to Margapatta City, one of the two largest technology parks in Pune. One of the largest planned developments over the study period, Amanora Park, took place within the sample site. Like Margapatta City and a number of other developments in Pune, Amanora Park was planned and developed under a state-authorized framework for an Integrated Township Plan. It includes housing, offices, commercial space, various services, schools and park space. To capture the patterns of development beyond the planned zone as well as within it, the site encompassed surrounding villages in three directions, which also grew. The proportion of developed land expanded rapidly there over the study period, from 19 to 44 percent.

The second Pune sample, selected to match the predominantly residential characteristics of South Bangalore, lay in an area of expanding residential development that up to 2014 lay mostly outside the boundary of the City Corporation, and just north of the village of Yewalewadi. The site stands across Kondhwa Road from an industrial estate dominated by manufacturing firms, adjacent a variety of schools, colleges and training institutes, and around ten kilometers from Margapatta City, Pune University and other high technology facilities in the downtown. Developed land there expanded over the study period from 18 to 30 percent of the total.

In Coimbatore, where the only IT parks remain small and manufacturing still dominates the local economic base, the two sites represented the closest equivalents to those in the two high tech cities. The first sample site, Avinashi Road, encompassed the largest concentration of advanced institutes and industrial manufacturing firms in the city, along with the highest land prices outside the center. As in the other two cities, the sample was delimited next to older educational institutions and industrial and high tech facilities. The delimited area lay mostly beyond the City Corporation border. The second Coimbatore site lay south of this first sample on the other side of the main airport, and included a cluster of older settlement connected to the adjacent village of Irugur. There, in an area within the city that remained largely undeveloped at the start of the study period, the city had authorized a number of layouts (subdivisions). From 2002 to 2016, developed land expanded from 24 percent to 56 percent of the total in the Avinashi Road site, and from 17 to 33 percent in Irugur.

Neighborhood and village level demographic data from the latest census in 2011 provide a limited view of inequality in these sites (Table 2). The indicators available from the census at a scale that most closely matched the sites were confined to limited measures of soeconomic and caste (or religious) marginalization. Ten to fifteen percent of residents in each site belonged to the scheduled castes or tribes entitled to reverse discrimination due to historical disadvantage. Nine to fifteen percent of residents over 6 years old were illiterate. Three to 18 percent of workers held seasonal employment. In all but one of the small number of village and towns with separate census samples, these disadvantages were concentrated. Scheduled castes and tribes there ranged from 19 percent to 36 percent of residents, literacy averaged significantly lower, and seasonal employment was more frequent. Although the census data confirm the persistence of marginal populations, especially in the village centers, they illuminate only one element in the wider patterns of inequality that development has brought to these settings.

Data from remote sensing and land markets can fill the remaining, critical gap. In each urban region, the focus on matched sites enables comparison of this data in one residential areas linked to an exurban cluster of jobs, and another suburban site of predominantly residential development. The variations among the three regions enable comparison of several contextual influences on the peri-urban transition common to all three. Real estate markets in peri-urban Bangalore and to a lesser degree Pune reflect both the influence of corporate real estate interests and the greater consumer demand for high-end and middle class housing. In contrast, job growth in Coimbatore has centered on manufacturing, and has drawn fewer high income or middle class residents to the sample sites. In Maharashtra (Pune), institutional constraints on rural and urban land acquisition restrict the availability of land for new housing in ways likely to shape the course of development. In Karnaka (Bangalore), regulations and legacies of land use enabled assembly of larger properties for residential and other forms of peri-urban development.

Classification of built structures from remote sensing images

To employ remote sensing images to trace the land us transitions in these sites required a conceptual schema for classifying elements of the images, and a protocol for applying that schema. Our classificatory schema drew directly from approaches already employed to classify slum settlements using visual evidence from high resolution satellite images (Taubenböck and Kraff 2013, Kohli et al. 2012, Mahabir et al. 2018). The classification builds on the insight that the possibilities for analytically useful object oriented classification of built structures from satellite images extend far beyond slums. The purpose is to take a similar approaches to classification of other forms of housing as well as commercial and industrial construction.

Following the ontology for slum classification, our categorization relies on a sequence of several steps (Table A.8). The first step separates residential land use from other types, namely industrial land use, agricultural settlement, and commercial, office or institutional land use. Industrial land use is further separated into low density industrial and dense industrial to show expected densified growth over time. Residential land use is then divided into informal, semi-standardized, and standardized residential based on standardization of structures and access. An agricultural village center is an additional type of residential land use applied to historical villages in the zone of peri-urban transition. These centers usually existed since the first year of our study period. The third step of classification criteria focuses on density. In this step, informal residential settlement is subdivided into informal dense, informal moderate density, and informal low density land use. High-rise residential structures were distinguished from other residential structures for its vertical density, at five or more stories.

[insert Table A.8 about here]

The protocol specifies land uses at both the settlement level and the object level based on observations from remote sensing images from Digital Earth/Google Earth.[2] At the settlement level the primary dimensions are the shape of the layout among structures and the density of structures, as evidenced by the amount of vegetation, the scale of such land use, and the proximity of structures to each other. At the object level, settlement structures were assessed according to the features of buildings and their relationship to the access network (including roads or paths). Building features include the shape and size of the building footprint, the material used for the roof, and whether the buildings followed a uniform orientation. The access

[2] Detailed criteria for classification may be found in Appendix Tables A.16 –A.25

network is described by the road grid around and within the settlement, the type of road surface, and its width measured from the satellite images. Some land use classifications also employ additional indicators derived from the images to differentiate characteristic features from other land use types. In Google Earth, we employed intertemporal references between images from Digital Globe of the same structures as an aid to classification. Open-sourced data on places of interest from Google Maps, followed up with internet searches of identifying names or titles, served as the primary method for ground-truthing when remote sensing images provided insufficient data to determine the land use. In Bangalore, field visits to both sites in 2010 and 2016 enabled additional ground-truth observations.

In suburbanizing India, where new districts often contain dramatic contrasts in the shape and structure of the built environment, these classifications served to illuminate the dynamics of land transition, and explain emerging patterns of sociospatial disparities. Our analysis of this spatial data combines mapping tools to visualize the processes and outcomes of transition, and statistics derived from the classifications to generalize about the patterns.

Patterns of land conversion

To apply the land use classification method in all six sample sites, we acquired spatial data on land use polygon and its area in square meters. We then used these polygons to analyze land use composition and transition for each site. .

Between the two Bangalore sites, Whitefield started the study period in 2002 with a slightly higher level of development (33 percent of land compared to 24 percent). (Table 3). Thirty percent of the land devoted to residential structures lay in older villages surrounded by agricultural fields, and other areas of dense, informal settlement. In Whitefield, these included the villages of Whitefield and Gandhipuram at the northern and eastern portions of the site, and another on the north shore of Varthur Lake. Semi-standardized and standardized residential structures already occupied the largest portion of residential land. Over the study period, as development expanded to 62 percent of land, residential settlement grew from a quarter to 45 percent. Standardized development expanded to occupy the dominant share of residential land in 2010 (65%), and remained in this position in 2016 (Table 3). Agricultural settlement, semi-standardized residential, and lower density informal settlement experienced significant decreases in 2010, replaced by standardized housing and excavation sites. High-rise residential structures grew rapidly over both periods, from zero in 2002 to a total of 8.5 percent of the total residential land area in 2016. At the same time, as a map of the categories in 2016 shows, village centers expanded in size over both periods (Figure 2). In 2016, these clusters had doubled in extent, and continued to occupy 10 percent of residential land.

[insert Table 3 about here]

[insert Figure 2 about here]

Bangalore South in 2002 remained 76 percent undeveloped, and most of the land with residential structures remained in agricultural fields, in the agricultural village of Begur, or in a few other informal settlement structures. Industrial, commercial and office structures occupied only 2.6 percent of the land. Semi-standardized developments of layouts (or subdivided detached developments) occupied 9.6 percent, or 64 percent of the residential land not in agricultural settlement. By 2010, it occupied over 80% of the total residential area, and high-rise buildings had begun to appear. The same trend persisted up to 2016. Semi-standardized structures again took up the largest share of residential development, and high-rise residential structures expanded further to the second largest portion (10%). As in Whitefield, however, the village centers like Begur also grew in extent by 59 percent from 2002 to 2016. Even as agricultural settlement had virtually disappeared, and other informally settled areas had declined, the village centers had expanded to occupy 10.6 percent of all residential land (Figure 2).

By 2016, most of the land in both sites had been converted to urban uses. As Table 3 shows, residential development dominated this process. Large new expanses of standardized residential development in Whitefield, and semi-standardized housing in Bangalore South, expanded to occupy the largest single category of land use in both sites. High-rise apartment towers began to appear by 2010, and by 2016 occupied around four percent of land in both sites. Dispersed villas and other structures also appeared in the remaining open spaces of both sites. Commercial, office and institutional developments, and in Bangalore South industrial developments, grew in between the new housing complexes. In Bangalore South, the most frequent type of new institutional facilities there were new schools. Educational services, a demonstrated driver of housing markets for the affluent in U.S. metropolitan regions (Owens 2016, Galster and Sharkey 2017), grew in tandem with residential housing for families there. This surge of new more standardized residential development only partly supplanted the older informal structures of settlement in either site. In 2010- 2016, the village centers of both sites grew more in size than they had from 2002-2010. Their enduring presence helped maintain dense informal settlement on over five percent of all land in both sites. Although this amount corresponded to a decline of 2.2 percent of land from 2002 in Whitefield, in Bangalore South it represented a net growth of 1.5 percent.

In Pune these divergent trends are even more pronounced (Table 4). In 2003, the area that would become the Amanora Park township development remained in agricultural fields.

Around this area, the villages of Mundhwa on the northern perimeter of the site, and Malwadi to the south, had established clusters of informal dense structures surround by agricultural lands. As the total area of developed land doubled from 2002 to 2016 (Table 4), and the new Integrated Township sprang up, these surrounding communities also expanded (Figure 2). Commercial, institution and office development and industrial development more than doubled, and semi-standardized residential structures nearly doubled in extent. Standardized and high-rise residential structures expanded from 1.76 percent to 8.87 percent of all land. At the same time, informal dense residential settlement grew by 87.7 percent, and old village centers grew by 32.8 percent. By 2016, both forms of dense informal residential settlement occupied 10.6 percent of the site. As in the Bangalore sites, maps of the transitions in both sites showed that this expansion concentrated around existing concentrations of similar structures (See Figure A.3, in supplemental appendix).

[insert Table 4 about here]

In Pune South no areas could be identified in 2003 as distinct agricultural villages, but dense, informally arrayed residential settlement clustered on the east side of the site along the road between the villages of Kondhwa to the north and Yewalewadi to the south, and on the northwest corner of the site (Figure 2). Only eleven percent of the land was covered by residential developments in 2003. Although parts of this land lay in planned subdivisions, and nearly all of the structures consisted at the time of informally arrayed, detached houses. Most of the land development and new construction happened during 2010 – 2016. Residential high-rises first appeared after 2003, but dominated growth in more standardized forms of housing. In 2016 they occupied 7.87 percent of and land, and 34 percent of residential land. Semi-standardized housing also saw significant growth, but occupied a much smaller proportion of the total land in 2016 (at 1.4 percent) than in Amanora Park (at 8.6 percent). Although informal low density, informal moderate density, agricultural settlement decreased in extent, the area in informal dense settlement grew by 103 percent. Informal dense settlement came to occupy the largest portion of residential structures, covering 9.5 percent of all land and 41 percent of residential land.

In the Coimbatore sites, the growth in developed land was somewhat more limited. In contrast with sites in both of centers of high tech development and Bangalore South, nonresidential structures also consisted primarily of manufacturing facilities. (Table 5). At the start of the study period, low-rise development had already spread along and around Avinashi Road, and clusters of agricultural village were present on the northeast side of the study area (Figure 2). The new development that appeared over the study period consisted mainly of small, semi-standardized residential areas between existing housing of a similar type, much of it in subdivided layouts. Semi-standardized housing grew steadily in the share of total residential area over the study period, from 47 percent in 2002 to 57 percent in 2016. High-rise construction also grew dramatically, but in contrast with the other cities only occupied less than one percent of residential land in 2016. At the same time the village centers and other informal dense settlements grew gradually as a percent of all land, from 6.7 to 7.6 percent. They remained 33 percent of residential land in 2016.

[insert Table 5 about here]

In all six sites, either standardized, semi-standardized or high-rise residential forms have expanded significantly. In the high tech job centers with more large scale planning, high rise and standardized residential property development plays a pervasive role that is less evident in either Coimbatore site, and to some extent in South Pune. In the Bangalore Whitefield and Pune Amanora Park sites, the largest standardized housing markets feature larger developments with many residential towers and single-family houses. In Coimbatore and to some degree Pune South, patterns of semi-standardized housing and dense informal settlements play a greater role. In both Pune sites, high-rise housing rather than standardized or semi-standardized detached forms has emerged as the main form of standardized housing.

Despite the advance of more standardized residential forms, however, dense informal settlement remains an enduring feature of the emerging suburban landscape in all six settings. In each setting, pockets or larger scale areas of village and informal development have persisted and even expanded alongside the more regularized development taking place around them. The land use data provide only limited information on residences in either the standardized or the informal built structures characterized the zones of peri-urban development. They demonstrate that the juxtaposition between affluent, planned settlement and rural, informal village settlement persists on the suburban fringe of big cities in the most economically advanced regions of India. This juxtaposition is closely linked to the emerging patterns of suburban inequality.

Inequality in suburban residential property markets

To scrutinize inequality in these sites more closely, we turned to a second new source of data that has only recently become available in urban India, the online real estate listings services for residential property that have proliferated since the early 2000s. Although still imperfect indicators of actual prices, and subject to gaps in coverage beyond neighborhoods and regions with relatively high web connectivity, these data provided a clear and largely encompassing snapshot of the range of prices for different kinds of residences. Especially in Pune and Bangalore, the listings revealed significant variations in prices and conditions of housing within as well as between the different peri-urban zones, and evidence of both regional and local influences on those variations. Comparison with citywide patterns in these listings showed that the inequality in these sites was part of a larger pattern of localized inequality that has expanded with the urban regions themselves.

Since the early 2000s, online real estate listings services have become a regular feature of property markets in the larger urban regions of India. With at least 70 percent of both rural and urban households in these three regions in possession of at least a cellphone, the internet has become widely accessible to both buyers and sellers of real estate. After sampling leading property websites for listings, we arrived at MagicBricks.com as the most complete and most informative and up to date listings service.[3] Alongside the average price in each neighborhood, the analysis focused on the distribution of prices. Averages for the top ten and bottom ten percent of prices, offer a clear initial view of the disparities within the 8-12 square kilometers of each neighborhood. The Gini index, the most widely used indicator of inequality, measures the overall divergence of inequality throughout the range of the price distribution. To assess how much the neighborhood patterns reflected wider patterns across each city, a similar analysis examined a comprehensive dataset of listings scraped from Magicbricks in Fall 2017 throughout each urban region.

Several limitations of this data as a reflection of property markets must be kept in mind. First, they are also most likely incomplete in ways that have yet to be analyzed fully, and may even include a biased sample. Of the 2100 listings that could be located in the six sample sites,

[3] An initial scoping analysis compared listings from MagicBricks in the three cities with the two other leading listings services, 99acres and Commonfloor. MagicBricks appeared to have more accurate and up to date listings, and contained a number of additional useful features, such as a standardized listing of amenities and citywide district-level aggregations of prices per square foot. Only in Coimbatore, where the listings on MagicBricks numbered fewer than 10 for the sample sites, were they supplemented with listings from Commonfloor and 99acres.

only 5 could be identified in structures classified as any type of informal housing, including an agricultural village center. Especially in the sample sites of Coimbatore, where less than a dozen listings were found, it seems likely that much of the real estate market is not online. Second, the prices listed represent only offering prices, and not the final negotiate prices or even estimates for purposes of tax assessment. Finally, the listings also vary significantly in the degree of detailed information given about the property. Listings of amenities clustered in ways that reflected variations in the completeness of the listings rather than actual features of the properties themselves. These limitations are themselves illuminating, and will be taken into account in the analysis that follows.

The citywide average prices of listings confirm the overarching differences in housing markets that led us to select these cities. In Bangalore, both the citywide average price ($569,169) and the average price per square foot ($497) are highest. In Pune the average price per square foot and average price are 96 percent and 91 percent of those in Bangalore. In Coimbatore, the price per square foot is only 51 percent that of Bangalore, but larger average square footage contributes to an average price 81 percent that of the other city. The overall disparities between the top ten percent and the rest of listings in Bangalore and Pune are especially striking. The average of top decile is 21 times the bottom decile in Bangalore, and 28 times in Pune. Comparison among the sample sites also demonstrates remarkable variations in both the distribution and the average prices that are partly tied to these city wide patterns, but also reflect the contrasts in built structures evident from the satellite imagery.

We have seen that much more of housing in Whitefield and Amanora Park, the two sample sites closely integrated into zones of technology parks and corporate offices, has taken the form of fully standardized or high-rise units. Not do the average prices in these two sites correspond closely, but a remarkably similar distribution of prices in each site points to similarly wide disparities in housing costs for a single neighborhood. In both sites, the price of the lowest ten percent of listings averages just over $200,000 US. The price of the top ten percent of listings averages 8.6 times that of the lowest ten percent in Whitefield, and 8.3 times in Amanora Park. Gini coefficients of .37 in Whitefield and .36 in Amanora Park confirmed significant, very similar overall patterns of inequality in the two sites. Despite the contrasts between an integrated zoning plan over much of Amanora Park and the mostly unplanned development in Whitefield, the similar composition of prices as well as the similar mix of standardization and informality underscore the convergence in these kinds of sites. In the closest corresponding site of Coimbatore, Avinashi Road, the few available listings pointed to lower prices in the top market segments. Disparities between the top and bottom decile averages were less than half those in the Bangalore and Pune.

In the Bangalore South and Pune South sites, despite a simlar peri-urban transition toward semistandardized, detached residential structures with some high-rise development, the distribution of housing prices contrasted starkly. In Bangalore South the average price of the top ten percent of listings was more than double that in Pune South, but the average of the bottom ten percent was 24 percent below the average there. With prices in the top ten percent more than ten times those in the bottom ten percent, Bangalore South registered the highest Gini coefficient of any of the sites, at .38. In Pune South, by contrast, the disparities between top and bottom deciles were less than half those in each of the sites within the standardized, high technology development zones, and the Gini coefficient of .23 was the lowest of any site. Even in Coimbatore, where the Irugur neighborhood also featured more detached, semistandardized housing, higher prices in the top decile produced a Gini coefficient of .29.

As the citywide figures confirm, these patterns in the sample sites bore a different relation to the housing markets of the wider region in Pune from that in Bangalore. Although the Gini coefficients for the two sites in Bangalore approach the coefficient of .45 for the entire city, even the coefficient of .36 in Amanora Park is much lower than the .57 for listings throughout Pune. To compare how far inequality in these sample sites in fact reflect wider patterns, we examined Theil indexes of inequality, or generalized entropy indexes (Table.7). These indexes offered alternative measures with sensitivity to the bottom or the top of the price distribution. Unlike the Gini coefficient, Theil indexes can also be decomposed by spatial units to ascertain how much of inequality occurs within units, rather than between them (Cowell 2000). In Bangalore, a Theil index sensitive toward the top of the distribution, with a sensitivity parameter of 2, showed that 88 percent of the inequality in distribution occurred within neighborhoods. The same index demonstrated that 87 percent of inequality in the upscale market segments in Pune took place within neighborhoods. In the overall housing market and at the bottom, however the spatial distribution of inequality diverged. In Bangalore, over 70 percent of inequality in either an equally weighted index (with a parameter of 1) or one geared toward the lower end (with a parameter of 0) took place within localities. In Pune 71 percent of inequality in the index sensitive to the lower end occurred between localities rather than within them, as did 60 percent in an equally weighted index. The wider regional variations in these market segments resemble those for all three indicators in Coimbatore. Regardless of the index there, 60 to 66 percent of the inequality occurred between localities rather than within them.

[insert Table.7 about here]

Breakdowns of the region-wide patterns of inequality showed the peri-urban areas of Bangalore and Pune stood at the leading edge of these tendencies.[4] Comparison of outlying and transitional neighborhoods with listings with those in the older built-up neighborhoods of each city showed inequality in prices to be higher on average in these transition zones. In the entropy index most sensitive to inequality the higher end of the market (GE(2)), average values of 0.51 in the periurban areas of Bangalore and .46 in Pune compared to 0.24 and 0.20 in the urban centers of the two regions. Gini coefficients of 0.30, 0.40 or higher also occurred more frequently in the surburban localities.

In Bangalore, then, the sample sites reflect more general patterns of neighborhood inequality in localities across the urban region. In Pune, the starker inequalities are a consequence of widespread local concentrations of inequality at the higher end of the housing market, and spatial variations across the region in the rest of the market. Alongside the less broad-based demand for higher end housing from a smaller skilled information technology sector in Pune, the patterns there probably partly reflect constraints on conversion of land for new development in Maharashtra. The remote sensing images showed a generally smaller physical footprint for new development in the Pune sites than in Bangalore. The square footage of listings in Pune averaged 641, compared to 1638 in Bangalore and 1484 in Coimbatore. The differences in size are especially striking at the lower end of the distribution. In Pune, the smallest ten percent of residences averaged 641 square feet, compared to 1000 and 1060 square feet in both other cities. Restricted land supply in Pune also appears to have contributed to

[4] Peri-urban localities were selected according to somewhat different criteria in each setting. In Bangalore, where growth was widely distributed, we selected areas beyond the boundary that preceded the annexation of 2011. In Pune, selection focused on peripheral areas incorporated into the new boundary of 2014. In Coimbatore, where the boundary extended beyond the urban agglomeration, selection was based on expansion of settlement from 2003.

higher overall prices per square foot in the lowest decile citywide as well as in the two sample sites. Prices per square foot there were 167 percent to 246 percent higher than in the other regions. In the planned district of Amanora Park, any such constraints have been overcome. The largest ten percent of residences there average twice the size of the same group in Whitefield, and up to four times the means for the top ten percent in either of the two Coimbatore sites.

[insert Table 6 about here]

The addresses available from the listings made it possible to map 85 percent or more onto the remote sensing classifications. This process revealed that only in the two Bangalore sites were any of the listings located in agricultural village centers, and only one listing in another area characterized by informal dense settlement. Prices in these settings were consistently the lowest among the categories. In Whitefield, where the 96 village center listings comprised 21 percent of the total, prices of those listings averaged 67 percent of the overall average. In Bangalore South, the five agricultural village listings (2 percent of the total) averaged 60 percent of the overall average, and the single listing in an informal dense area listed a price 58 percent below it. The prices of the more standardized categories varied with the sites, but were generally higher. In Bangalore South and both Pune sites, high-rise complexes averaged the highest prices. In Whitefield, semi-standardized structures also registered higher averages, and the four percent of listings in buildings classified as commercial, office or institutional averaged 330 percent of the overall average. In hedonic regressions the remote sensing classifications explained 30 percent of the price variation in Whitefield, compared to no more than 10 percent in the other settings.

Full hedonic regressions of the types of structures and various features from the listings showed that the disparities in housing prices within each site reflected differences in the size and numbers of rooms of properties. Because the sites in Coimbatore included too few listings to be analyzed statistically, this analysis focused only on the sites in Bangalore and Pune. In ordinary least squares models, the square footage of the dwelling combined with the numbers of rooms and bathrooms, the type of dwelling and the type of seller accounted for 63 percent of the variation in price in Whitefield, 57 percent in Bangalore South, 85 percent in Amanora Park, and 87 percent in Pune South (Appendix Tables A.11-A14). A variety of amenities and services were also listed in 90 percent or more of the listings in Whitefield and Amanora Park, forty percent in South Bangalore and twenty percent in Pune South.[5] Along with the land classifications from the remote sensing analysis, these accounted for another 11 percent of the variation in Whitefield and fourteen percent in Bangalore South, but only 2 percent in Amanora Park. The regressions nonetheless underscored that the disparities in price were a consequence of unequal offerings in the housing stock itself.

Online property listings thus further illuminate the structure of the residential land markets now emerging in the peri-urban regions around Indian cities. In Bangalore especially, but also in Pune, this new suburban inequality is increasingly widespread. Beyond technology parks, planned developments and governmental initiatives, it reflects the demand of the affluent, a growing development industry, and the implantation of services like education and commercial amenities. The continuing presence and even growth of informal settlements with deficits in

[5] The amenities included Water Storage, Power Back Up, Security, Piped Gas, Waste Disposal, Rain Water Harvesting, Fire Fighting Equipment, a reverse osmosis Water System, Air Conditioning, Internet, Elevators, Parking, and Maintenance Staff (Appendix Table A.10).

amenities has made developing peri-urban areas new settings of local spatial inequality. The new suburban settlement reflects the socioeconomic disparities of Indian society at least as much as the cities.

Conclusions

The rise of a new urban India, and the concomitant emergence of what is likely to become the world's largest middle class, has been under way for more than two decades now on the fringes of urban agglomerations in that country. Analysis of the course of development and real estate markets in the matched settings points to dynamics under way across the Subcontinent that are likely to have wider implications for social inequality, for policy, and for politics. The common dynamic evident in economically advanced regions like Bangalore and Pune extends well beyond the immediate confines of technology parks and related facilities. On the one hand, areas of sparse agricultural settlement have been supplanted by new denser, more standardized, more urban forms, including new single-family and multifamily housing, alongside industrial, commercial and office development. On the other hand, older agricultural village centers and densifying informal settlements have not only persisted, but generally grown alongside other forms. Further research remains necessary to sort out how land prices, property rights, employment opportunities, and enduring influences like caste have shaped these dynamics. What is clear from our analysis is that suburban development in India is reproducing the same stark juxtapositions of advantage and disadvantage that mark India's urban centers. .

Comparison between Bangalore and Pune also points to consequential variations in this process. In Bangalore, where the nationwide constraints on agricultural land acquisition have been more limited, the conversion to new areas of offices, institutions and commercial facilities has been most extensive. In Pune, greater constraints in the supply of land have contributed to the smaller size of residences, the higher prices per square foot outside planned townships, and the more limited conversion of land and the smaller footprint of development. More limited residential demand from middle class and affluent households and the later onset of technology park development have also contributed to these contrasts.

Finally, this analysis demonstrates the potential of data sources that have only recently become available to illuminate the dynamics of developing world cities more systematically than has been possible before. Remote-sensing based classifications based on high resolution images can supply critical, calibrated information on neighborhood change beyond the scope of available census data. Online real estate listings, when combined with corroborative data, offer an unparalleled window into the micro-level dynamics of advantage and disadvantage. These new resources have the potential to illuminate the dynamics of settlement patterns and inequality in many other developing countries.

References

Angel, Shlomo, Jason Parent, Daniel L. Civco, Alexander Blei, and David Potere. 2011. "The dimensions of global urban expansion: Estimates and projections for all countries, 2000–2050." *Progress in Planning* no. 75 (2):53-107.

Bae, Chang-Hee Christine, and Harry G. Richardson, eds. 2004. *Urban sprawl in western Europe and the United States*. London: Routledge.

Bailey, Rosemary A. 2008. *Design of Comparative Experiments*. Cambridge: Cambridge University Press.

Baka, Jennifer. 2013. "The Political Construction of Wasteland: Governmentality, Land Acquisition and Social Inequality in South India." *Development and Change* no. 44 (2):409-428.

Balakrishnan, Sai Swarna. 2013. *Land conflicts and cooperatives along Pune's highways: Managing India's agrarian to urban transition*, Graduate School of Arts and Sciences, Harvard University.

Banerjee, Abhijit, and Lakshmi Iyer. 2005. "History, Institutions, and Economic Performance: The Legacy of Colonial Land Tenure Systems in India." *The American Economic Review* no. 95 (4):1190-1213.

Basant, Rakesh, and Pankaj Chandra. 2007. "Role of Educational and R&D Institutions in City Clusters: An Exploratory Study of Bangalore and Pune Regions in India." *World Development* no. 35 (6):1037-1055.

Campbell, John Y., Tarun Ramadorai, and Benjamin Ranish. 2015. "The Impact of Regulation on Mortgage Risk: Evidence from India." *American Economic Journal: Economic Policy* no. 7 (4):71-102.

Chakravorty, Sanjoy. 2016. "Land acquisition in India: The political-economy of changing the law." *Area Development and Policy* no. 1 (1):48-62.

Chauhan, Rajesh K., Sanjay K. Mohanty, S. V. Subramanian, Jajati K. Parida, and Balakrushna Padhi. 2016. "Regional Estimates of Poverty and Inequality in India, 1993–2012." *Social Indicators Research* no. 127 (3):1249-1296.

Cowell, F. A. 2000. "Chapter 2 Measurement of inequality." In *Handbook of Income Distribution*, 87-166. New York, NY: Elsevier.

Cushman & Wakefield. 2014. Indian real estate: Poised for higher growth. In *Cushman & Wakefield Research Publication*. New Delhi: Cushman & Wakefield.

Datta, Ayona. 2015. "New urban utopias of postcolonial India: 'Entrepreneurial urbanization' in Dholera smart city, Gujarat." *Dialogues in Human Geography* no. 5 (1):3-22.

Dev, S. Mahendra, and C. Ravi. 2007. "Poverty and Inequality: All-India and States, 1983-2005." *Economic and Political Weekly* no. 42 (6):509-521.

Galster, George, and Patrick Sharkey. 2017. "Spatial Foundations of Inequality: A Conceptual Model and Empirical Overview." *RSF: The Russell Sage Foundation Journal of the Social Sciences* no. 3 (2):1-33.

Glaeser, Edward. 2010. Making Sense of Bangalore Legaturm. London, UK: Legatum Institute.

Goldman, Michael. 2011. "Speculative Urbanism and the Making of the Next World City." *International Journal of Urban and Regional Research* no. 35 (3):555-581.

Haritas, Bhragu. 2018. Richest Cities of India. *BW Businessworld*, June 28, 2017.

India Brand Equity Foundation. 2017. Real Estate. New Delhi: India Brand Equity Foundation.
India, Planning Commission of. 2011. District wise GDP and Growth Rate at Current Price (2004-05). edited by Planning Commision of India. New Delhi.
Jackson, Kenneth. 1985. *Crabgrass frontier: The suburbanization of the United States*. Oxford: Oxford University Press.
Jayadev, Arjun, Sripad Motiram, and Vamsi Vakulabharanam. 2007. "Patterns of Wealth Disparities in India during the Liberalisation Era." *Economic and Political Weekly* no. 42 (38):3853-3863.
Kennedy, Loraine, ed. 2013. *The Politics of Economic Restructuring in India: Economic Governance and State Spatial Rescaling*. New Delhi: Routledge.
Kennedy, Lorraine. 2007. "Regional industrial policies driving peri-urban dynamics in Hyderabad, India." *Cities* no. 24 (2):95-109.
Kohli, Divyani, Richard Sliuzas, Norman Kerle, and Alfred Stein. 2012. "An ontology of slums for image-based classification." *Computers, Environment and Urban Systems* no. 36 (2):154-163.
Mahabir, Ron, Arie Croitoru, Andrew Crooks, Peggy Agouris, and Anthony Stefanidis. 2018. "A Critical Review of High and Very High-Resolution Remote Sensing Approaches for Detecting and Mapping Slums: Trends, Challenges and Emerging Opportunities." *Urban Science* no. 2 (1):8.
Motiram, Sripad, and Nayantara Sarma. 2014. "Polarization, Inequality, and Growth: The Indian Experience." *Oxford Development Studies* no. 42 (3):297-318.
Owens, Ann. 2016. "Inequality in Children's Contexts." *American Sociological Review* no. 81 (3):549-574.
Sellers, Jefferey M., Jingnan Huang, T.V. Ramachandra, and Uttam. Kumar. 2016 (revise and resubmit). "Patterns of changing peri-urban form: A comparison of Chinese and Indian cases." *Computers, Environment and Urban Systems*.
Seto, Karen C., Burak Güneralp, and Lucy R. Hutyra. 2012. "Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools." *Proceedings of the National Academy of Sciences*.
Shobha, MN, Krishne Gowda, and B Mahendra. 2009. "Infrastructure for Information Technology Industry in Bangalore City." *ITPI Journal*:55-68.
Sridhar, Kala Seetharam. 2010. "Impact of Land Use Regulations: Evidence from India's Cities." *Urban Studies* no. 47 (7):1541-1569.
Srinivas, Lakshmi. 1991. "Land and Politics in India: Working of Urban Land Ceiling Act, 1976." *Economic and Political Weekly* no. 26 (43):2482-2484.
Subramanian, Sreenivasan, and Dhairiyarayar Jayaraj. 2013. "The Evolution of Consumption and Wealth Inequality in India: A Quantitative Assessment." *Journal of Globalization and Development* no. 4 (2):253-281.
Sundar, G. Shyam. *Property Registration, Land Records and Building Approval Procedures followed in various States in India* 2016 [cited April 18, 2017. Available from http://propertylandrecords.in/fsi-far-and-land-measurement-terminologies/.
Taubenböck, H., and N. J. Kraff. 2013. "The physical face of slums: a structural comparison of slums in Mumbai, India, based on remotely sensed data." *Journal of Housing and the Built Environment* no. 29 (1):15-38.
Vakulabharanam, Vamsi, and Sripad Motiram. 2016. "Mobility and inequality in neoliberal India." *Contemporary South Asia* no. 24 (3):257-270.

Verma, R. V. 2012. "Evolution of the Indian Housing Finance System and Housing Market." In *Global Housing Markets*, 319-342. John Wiley & Sons, Inc.
Vishwanath, Tara, David Dowall, Somik V. Lall, Nancy Lozano-Gracia, Siddharth Sharma, and Hyoung Gun Wang. 2013. Urbanization beyond Municipal Boundaries: Nurturing Metropolitan Economies and Connecting Peri-Urban Areas in India. In *Directions in Development: Countries and Regions*. Washington, D.C.: World Bank.
Weinstein, Liza. 2008. "Mumbai's Development Mafias: Globalization, Organized Crime and Land Development." *International Journal of Urban and Regional Research* no. 32 (1):22-39.

Figure 1) Sample Sites

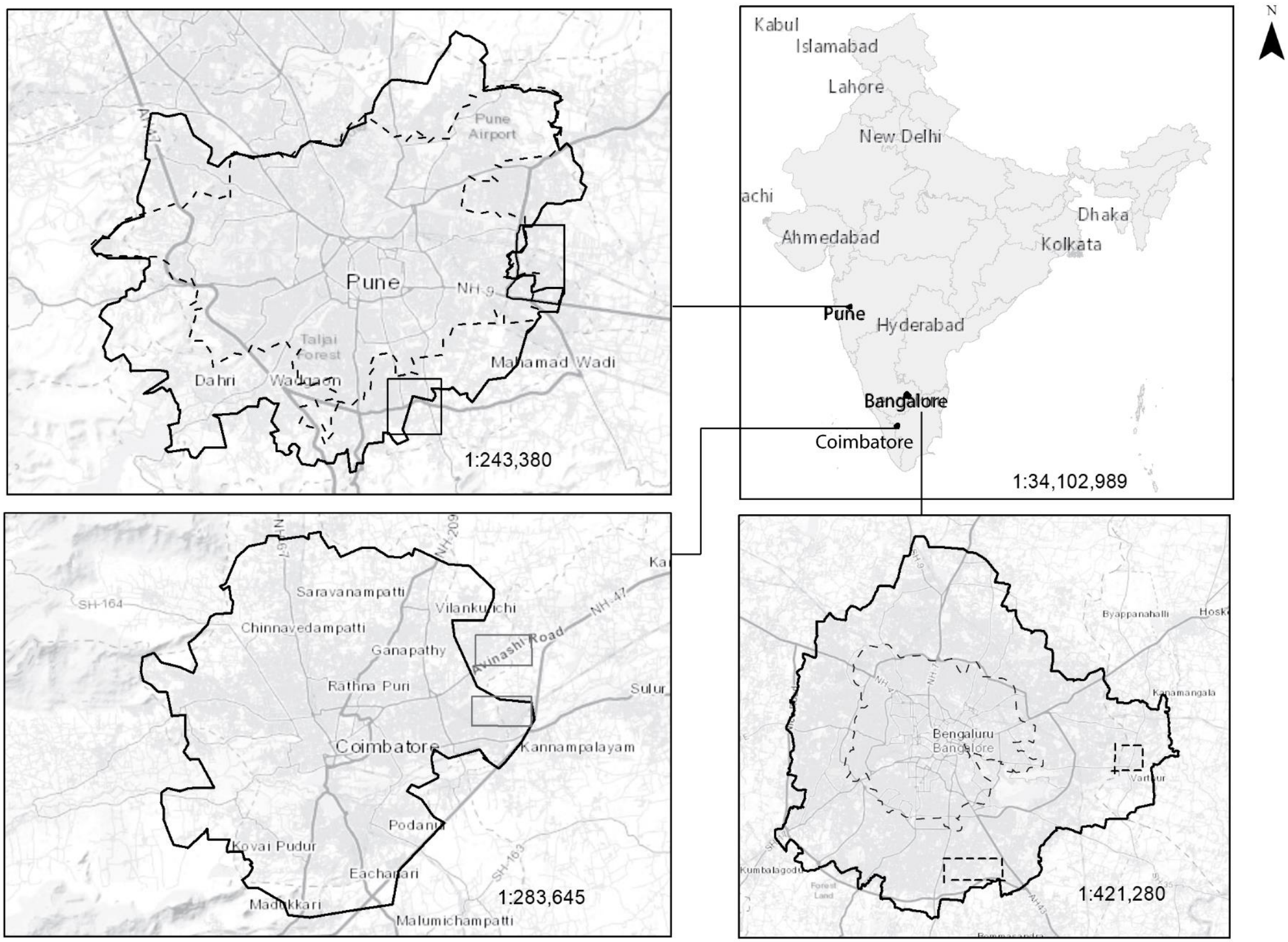

Figure 2 Housing Standardization in sample sites, 2016

Table 1 City Characteristics

		Bengaluru		Pune		Coimbatore	
		City	*Agglom.*	*City*	*Agglom.*	*City*	*Agglom.*
Population	2001	4,301,326	5,701,446	2,538,473	3,760,636	930,882	1,461,139
	2011	8,443,675	8,520,435	3,124,458	5,057,709	1,601,438	2,136,916
	Increase (%)	96%	49%	23%	34%	72%	46%
	Size Rank (2011)	3	5	9	8	23	16
GDP	2005-2006 (10 m rupees)	37,628		38,148		16,845	
	2017 (est)	$110 Bn		$69 Bn		NA	
	Rank (2017)	4		7		NA	
Urban inequality in consumption (state)	Gini 2011-2012	0.403		0.35		0.326	
	2004-2005	0.365		0.371		0.358	
Real estate market 2013-2017	Upper and middle income residential demand (000 units)	400		165		NA	
	Rank	2		7			
	Commercial demand (msqft)	32		16		NA	
	Rank	1		4			

SOURCE: (Haritas 2018, Cushman & Wakefield 2014, Jayadev, Motiram, and Vakulabharanam 2007, India 2011).

Table 2 Regulatory, institutional and demographic contexts, by city and sample

	Bangalore		Pune		Coimbatore	
	Whitefield	B. South	Amanora Park	Pune South	Avinashi Rd	Irugur
Colonial land regimes	zamindari (landlord) system		ryotwari (peasant ownership)		ryotwari (peasant ownership)	
Urban land ceiling act	No		yes (to 2007)		no	
Agricultural land acquisition						
Persons who can purchase	Agriculturalist only; must earn under 200,000 rs/year		Agriculturalist only		No restriction (except Indian citizensh	
Others	Social or industrial organizations		None			
Ceiling on purchase	None		54 acres		59 acres (but conversion of untilled la	
Floor area ratio (FAR) or floor size index (FSI)						
Residential	1.5 - 2.5 (FAR)		1.33 (FSI)		1.5 (FSI)	
Exceptions	(higher for thick and moderate density areas)		(+1 with fees, also multifamily and multistory)		(+1 with fees, also multifamily and multistory)	
Nonresidential	1.75		2		3	
Industrial/high tech sites	hi-tech	to east	hi-tech	to north	industrial	to north
Special economic zones or plans	(adjacent)	no	Yes	no	(adjacent)	no
Types	2 SEZs		Integrated township		2 SEZs	
Local regulation						

Zones	Residential 2007-2011, Activities 2011-	Residential, 2007-	Residential (with integrated township)	Residential	Residential, some industrial, 2011-	Residential
Authority	BMDA 2007-2011, City 2011-	BMDA 2007-2011, City 2011-	Partly city, partly PMDA, state ITP	Partly city, partly PMDA	CLPA,2011-	City
Demographics (2011)						
Population of closest census units	105,181	138,392	14,883	26,838	11,055	75,710
(Villages)	Varthur	Arakere, Begur	Hadapsar	Yewalewadi (town)	Mylampatti	(Ward 11)
Scheduled castes/tribes (%)	15	11	14	15	10	13
(Villages)	36	30, 0		19	21	21
Literacy (%)	87	88	88	87	85	91
(Villages)	72	74, 57		80	79	91
Seasonal workers (%)	4	4	3	3	18	3
(Villages)	16	3		4	30	9

SOURCES: Sridihar 2010; Sundar 2017; city and planning authority websites; Indian National Census 2011

Table 3 Land Use Transition – Bangalore sites

	Whitefield					Bangalore South				
	2002		2010	2016		2002		2010	2016	
	Total square meters	Percent of Land	Percent of Land	Percent of Land	Change 2002-2016 (%)	Total square meters	Percent of Land	Percent of Land	Percent of Land	Change 2002-2016 (%)
Agricultural Settlement	24697	0.5%	0.3%	0.8%	74.1%	678111	7.0%	1.7%	0.3%	-96.0%
Agricultural Village Center	122683	2.3%	2.6%	4.6%	100.2%	273183	2.8%	3.7%	4.5%	59.1%
Residential Informal Low Density	0	0.0%	0.0%	0.0%		0	0.0%	0.0%	0.2%	
Residential Informal Moderate Density	0	0.0%	1.7%	0.8%		0	0.0%	0.0%	0.0%	
Residential Informal Dense	283896	5.3%	2.8%	0.8%	-84.2%	126577	1.3%	1.6%	1.1%	-12.6%
Residential Semi-Standardized	610751	11.4%	5.9%	7.1%	-37.9%	936472	9.6%	27.7%	30.9%	221.5%
Residential Standardized	359095	6.7%	27.1%	28.0%	319.4%	115733	1.2%	1.0%	1.2%	-0.8%
Residential High-rise	0	0.0%	1.0%	3.8%		0	0.0%	0.4%	4.2%	
Total Residential Land (excluding Agricultural Settlement)	1376426	25.6%	41.2%	45.2%	76.4%	1451966	14.9%	34.5%	42.1%	182.3%
Industrial Low Density	0	0.0%	0.0%	0.1%		150720	1.5%	1.9%	3.0%	94.2%
Industrial Dense	31706	0.6%	0.2%	0.0%	-100.0%	51689	0.5%	1.3%	0.6%	15.9%
Commercial/Office/Industrial	297488	5.5%	6.2%	8.1%	47.0%	46114	0.5%	2.2%	3.7%	673.6%
Total Industrial, Commercial/Office Land	329194	6.1%	6.4%	8.2%	34.4%	248523	2.6%	5.3%	7.3%	185.5%
Excavation	43064	0.8%	5.5%	8.4%	941.7%	0	0.0%	3.1%	3.0%	
Total Land Developed	1773381	33.0%	53.4%	62.6%	89.5%	2378600	24.4%	44.7%	52.7%	115.5%

Table 4 Land Use Transition – Pune Sites

	Amanora Park					Pune South				
	2002 (Base Year)		2010	2016		2002 (Base Year)		2010	2016	
	Total square meters	Percent of Land	Percent of Land	Percent of Land	Change 2002-2016 (%)	Total square meters	Percent of Land	Percent of Land	Percent of Land	Change 2002-2016 (%)
Agricultural Settlement	61948	0.7%	1.5%	1.6%	137.5%	116209	1.5%	0.3%	0.3%	-83.4%
Agricultural Village Center	140709	1.5%	1.8%	2.0%	32.8%	0	0.0%	0.0%	0.0%	
Residential Informal Low Density	34910	0.4%	0.2%	0.0%	-100.0%	165321	2.2%	0.8%	1.1%	-49.3%
Residential Informal Moderate Density	224320	2.4%	0.4%	0.4%	-83.0%	296290	3.9%	1.1%	3.2%	-17.8%
Residential Informal Dense	50692	0.5%	3.3%	3.6%	580.7%	354902	4.7%	7.7%	9.5%	103.7%
Residential Semi-Standardized	435343	4.6%	8.0%	8.6%	87.7%	13670	0.2%	1.1%	1.4%	677.6%
Residential Standardized	59254	0.6%	2.2%	2.7%	335.0%	0	0.0%	0.0%	0.0%	
Residential High-rise	106950	1.1%	3.4%	6.2%	444.5%	15343	0.2%	3.7%	7.9%	3787.9%
Total Residential Land (excluding Agricultural Settlement)	1052178	11.1%	19.3%	23.5%	111.7%	845527	11.2%	14.3%	23.2%	107.6%
Industrial Low Density	82672	0.9%	1.1%	2.0%	134.5%	255900	3.4%	2.5%	2.7%	-20.3%
Industrial Dense	16362	0.2%	0.3%	0.4%	130.4%	59614	0.8%	2.5%	2.0%	150.2%
Commercial/Office/Industrial	350974	3.7%	4.7%	8.0%	115.9%	71277	0.9%	1.6%	1.8%	88.3%
Total Industrial, Commercial/Office Land	450008	4.8%	6.2%	10.5%	119.9%	386791	5.1%	6.7%	6.4%	26.0%
Excavation	240380	2.5%	8.2%	8.1%	217.2%	1946	0.0%	0.5%	0.4%	1374.3%
Total Land Developed	1804515	19.1%	35.2%	43.6%	128.7%	1350472	17.8%	21.8%	30.2%	69.6%

Table 5 Land Use Transition – Coimbatore Sites

	Avinashi Road					Irugur				
	2002 (Base Year)		2010	2016		2002 (Base Year)		2010	2016	
	Total square meters	Percent of Land	Percent of Land	Percent of Land	Change 2002-2016 (%)	Total square meters	Percent of Land	Percent of Land	Percent of Land	Change 2002-2016 (%)
Agricultural Settlement	74349	1.2%	1.5%	1.4%	18.1%	24057	0.4%	0.7%	0.9%	121.0%
Agricultural Village Center	301577	4.9%	5.4%	5.7%	16.1%	190785	3.1%	3.1%	3.2%	4.1%
Residential Informal Low Density	0	0.0%	0.0%	0.0%		2921	0.0%	0.9%	0.4%	711.2%
Residential Informal Moderate Density	0	0.0%	0.0%	0.0%		28497	0.5%	0.9%	1.1%	134.0%
Residential Informal Dense	108865	1.8%	1.8%	1.8%	3.2%	122360	2.0%	3.3%	4.4%	125.8%
Residential Semi-Standardized	365882	6.0%	11.1%	13.1%	118.7%	481952	7.7%	10.4%	13.8%	79.4%
Residential Standardized	1364	0.0%	1.7%	1.9%	8574.6%	1364	0.0%	1.6%	1.9%	8574.6%
Residential High-rise	0	0.0%	0.0%	0.2%		0	0.0%	0.0%	0.0%	
Total Residential Land (excluding Agricultural Settlement)	777688	12.7%	20.0%	22.8%	79.2%	827878	13.2%	20.2%	24.8%	87.0%
Industrial Low Density	526592	8.6%	10.6%	11.3%	30.8%	147473	2.4%	3.8%	5.4%	127.4%
Industrial Dense	62421	1.0%	1.5%	2.3%	128.3%	45806	0.7%	1.1%	1.2%	67.4%
Commercial/Office/Industrial	0	0.0%	0.8%	0.9%		8734	0.1%	0.4%	0.4%	194.9%
Total Industrial, Commercial/Office Land	202013	3.3%	5.4%	7.2%	116.7%	202013	3.2%	5.3%	7.0%	116.7%
Excavation	86608	1.4%	0.1%	0.2%	-85.6%	3729	0.1%	0.1%	0.2%	188.9%
Total Land Developed	1527658	25.0%	34.5%	38.9%	56.0%	1057677	16.9%	26.4%	32.8%	93.8%

Table 6 Prices for residential properties, by sample site and city

	Price	Price/sq. ft.	Sq ft	Price	Price/sq. ft.	Sq ft	Price	Price/sq. ft.	Sq ft
Bangalore	(Whitefield) (n=470)			(Bangalore South)(n=442)			(Bangalore region)(n=8229)		
Average	$561,191	$313	1671	$469,468	$288	1638	$569,159	$497	1589
First decile (avg.)	$210,540	$171	1110	$119,942	$91	1000	$103,719	$60	661
First decile/average	38%	55%	66%	26%	31%	61%	18%	12%	42%
Tenth decile (avg.)	$1,808,079	$628	5800	$1,255,270	$554	13550	$2,091,892	$2,270	4114
Tenth decile/average	322%	201%	347%	267%	192%	827%	368%	457%	259%
Tenth/first (percent)	859%	366%	523%	1047%	611%	1355%	2017%	3782%	622%
Gini coefficient (price)	0.369			0.379			0.45		
Pune	(Amanora Park) (n=881)			(Pune South) (n=298)			(Pune region (n=7669))		
Average	$611,043	$398	1473	$326,560	$306	1088	$518,863	$480	990
First decile (avg.)	$203,313	$284	634	$158,608	$224	641	$96,584	$175	420
First decile/average	33%	71%	43%	49%	73%	59%	19%	36%	42%
Tenth decile (avg.)	$1,692,521	$548	12400	$583,546	$399	11495	$2,722,712	$1,944	2487
Tenth decile/average	277%	138%	842%	179%	130%	1056%	525%	406%	251%
Tenth/first (percent)	832%	193%	1955%	368%	178%	1794%	2819%	1113%	593%
Gini coefficient (price)	0.356			0.229			0.571		
Coimbatore	(Avinashi Road) (n=8)			(Irugur) (n=13)			(Coimbatore region (n=187)		
Average	$493,868	$214	2347	$295,824	$199	1484	$460,864	$254	1759
First decile (avg.)	$261,021	$160	1100	$133,411	$134	1060	$125,109	$133	657
First decile/average	53%	75%	47%	45%	67%	71%	27%	52%	37%
Tenth decile (avg.)	$1,073,086	$286	4521	$623,550	$342	2800	$1,510,054	$501	4634
Tenth decile/average	217%	134%	193%	211%	172%	189%	328%	197%	263%
Tenth/first (percent)	411%	178%	411%	467%	256%	264%	1207%	377%	705%
Gini coefficient (price)	0.297			0.293			0.401		

NOTE: Values in U.S. dollars at purchasing power parity (17.24 rupees/USD, from OECD Data).

SOURCES: MagicBricks.com, (supplemented for Coimbatore from 99acres.com)

Table.7 . Indexes of inequality in residential property prices, by location within urban regions

	Generalized entropy (Theil) index						Gini index			
	GE(0)		GE(1)		GE(2)		All	>0.40	>0.30	n
Within localities	0.26	71%	0.33	74%	1.08	87%				
Between localities	0.10	29%	0.12	26%	0.16	13%				
Overall	0.36		0.45		1.24		0.45			
Peri-urban localities (average)	0.22		0.24		0.51		0.32	22%	55%	193
Urban localities (average)	0.17		0.18		0.24		0.28	14%	45%	120
Within localities	0.18	29%	0.75	40%	116.88	88%				
Between localities	0.43	71%	1.14	60%	16.58	12%				
Overall	0.61		1.89		133.45		0.57			
Peri-urban localities (average)	0.27		0.24		0.46		0.28	16%	32%	44
Urban localities (average)	0.14		0.13		0.20		0.22	9%	24%	340
Within localities	0.09	34%	0.11	36%	0.21	40%				
Between localities	0.17	66%	0.20	64%	0.32	60%				
Overall	0.26		0.31		0.52		0.29			
Peri-urban localities (average)	0.12		0.12		0.14		0.22	10%	40%	10
Urban localities (average)	0.10		0.10		0.11		0.20	9%	9%	11

Table A.8 Land use classification categories and criteria

Classification		Attributes		
Function	Standardization	Density	Object level	Settlement level
Residential	Informal	High density	Irregular building shape with little vegetation and few yards	Irregular road network with unpaved dirt roads; some structures do not have direct access to roads
		Moderate density	Small-sized structures with some vegetation and small shared yards	Unclear road grids
		Low density	Structures scattered and separated; many open spaces and vegetation	Few clear dirt road network
	Semi-standardized		Building orientation aligns with road orientation; some vegetation and shared yards	Straight dirt roads intersected at various angles; each building directly accessible to streets
	Standardized	1-4 floors	Standard spacing between buildings with lawns or pools	Unified building size and style; planned paved street grids
	High-rise	5+ floors	Concrete or metal roof with standard orientation and designed building shape	Planned vegetation and pools; paved, tree-lined street grid
Agricultural		Agricultural settlement	Lots of vegetation with shared yards; adjacent to farmlands	Cluster or stand-alone structures ;no clear access network
		Village center	Lots of vegetation; small-sized houses with tin and brown roofs	Organic dirt path network; cluster of buildings growing along major roads

	Low density	Rectangular structures with large dirt yards	Irregular dirt road network with possible residential buildings nearby
Industrial	High density	Large structures with few yards	Semi-standardized dirt road network, connected to local or major roads
Commercial/institutional/office/other		Regular building shape with brick or concrete roof; little or some vegetation	Commercial corridor along major roads; clear access to major roads

Figure A.3 Types of Development, by Sample Site

Figure A.3(a)

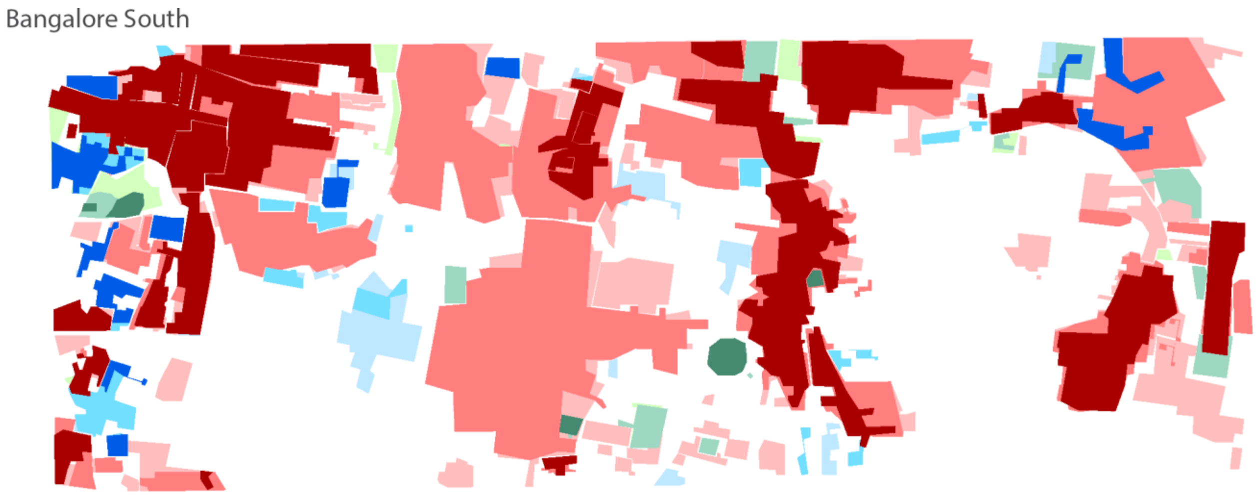

Figure A.(b) Types of Development – Whitefield, Bangalore

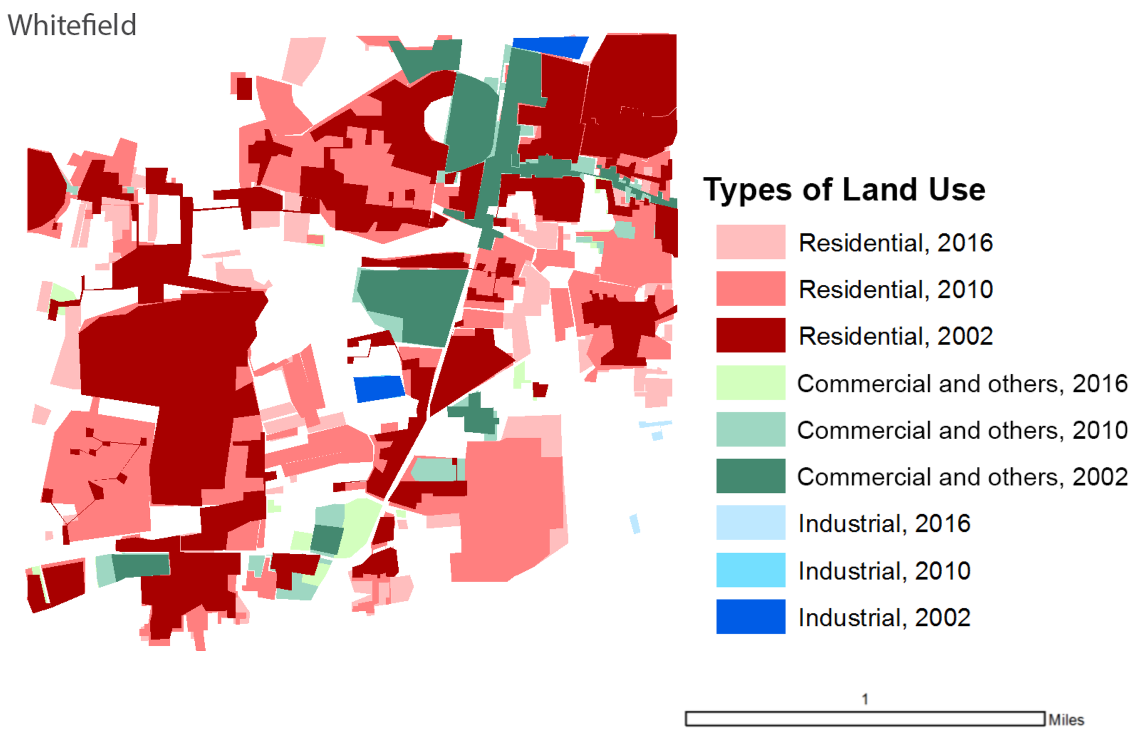

Figure 5(c) Types of Development - Amanora Park, Pune

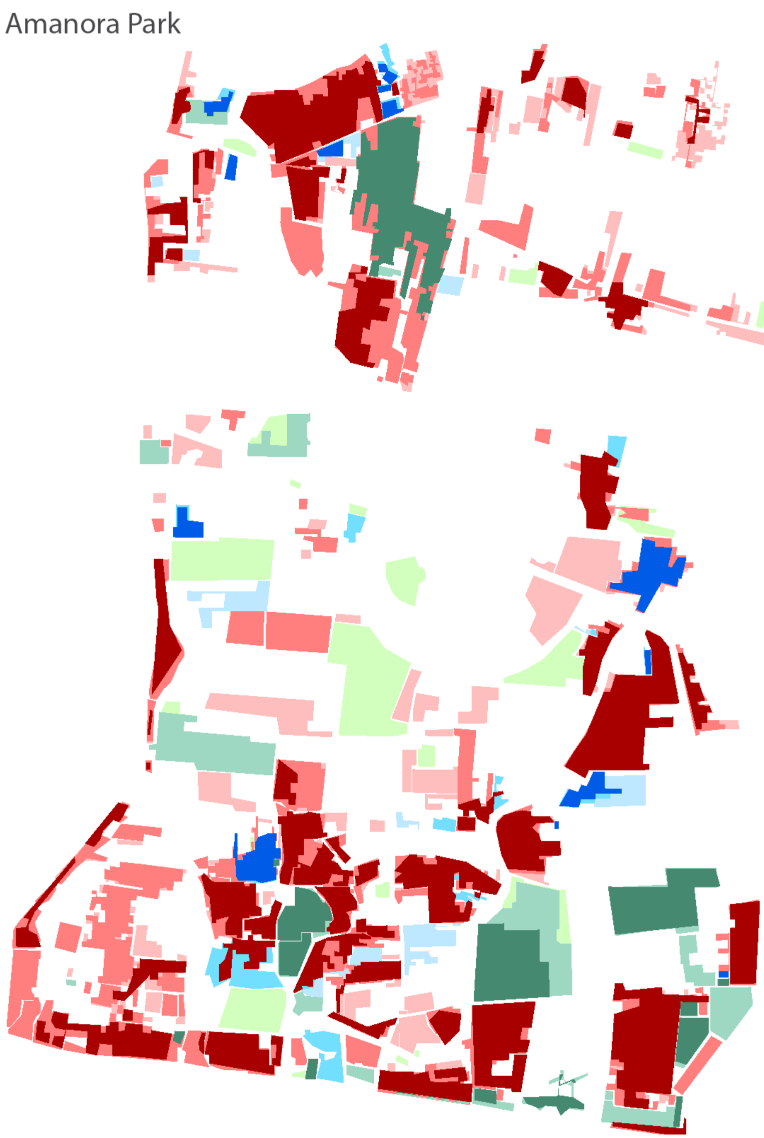

Figure 5(d) Types of Development - Pune South, Pune

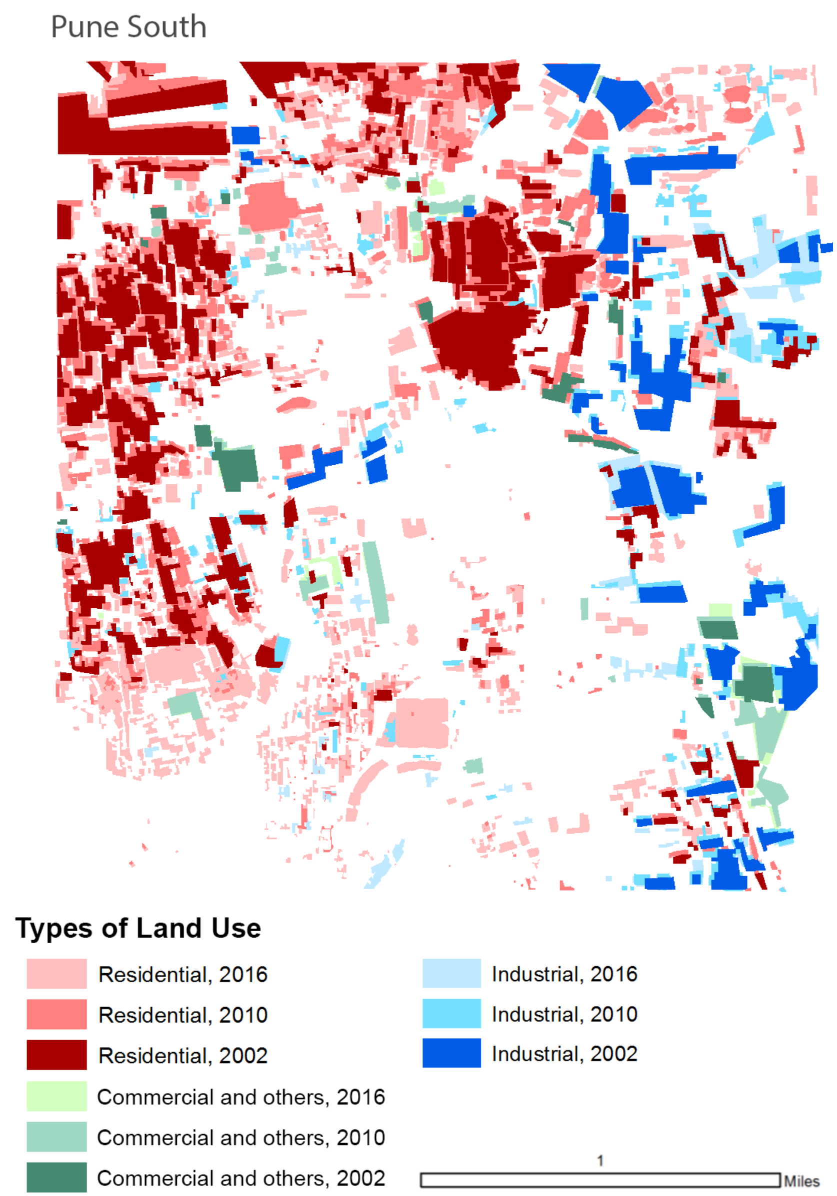

Figure 5(e) Types of Growth – Avinashi Road, Coimbatore

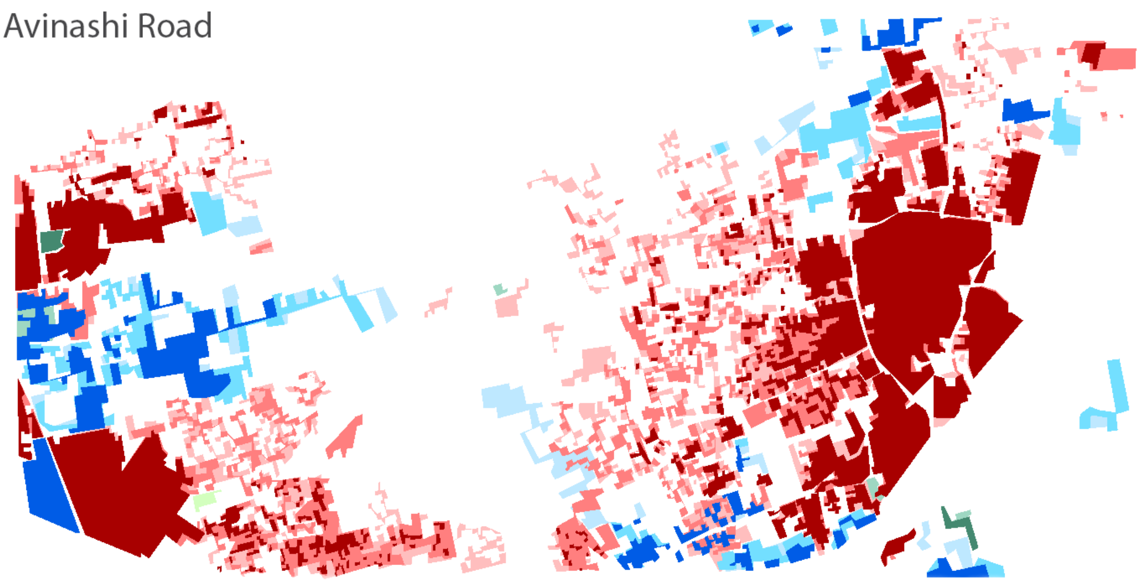

Figure 5(f) Types of Growth – Irugur, Coimbatore

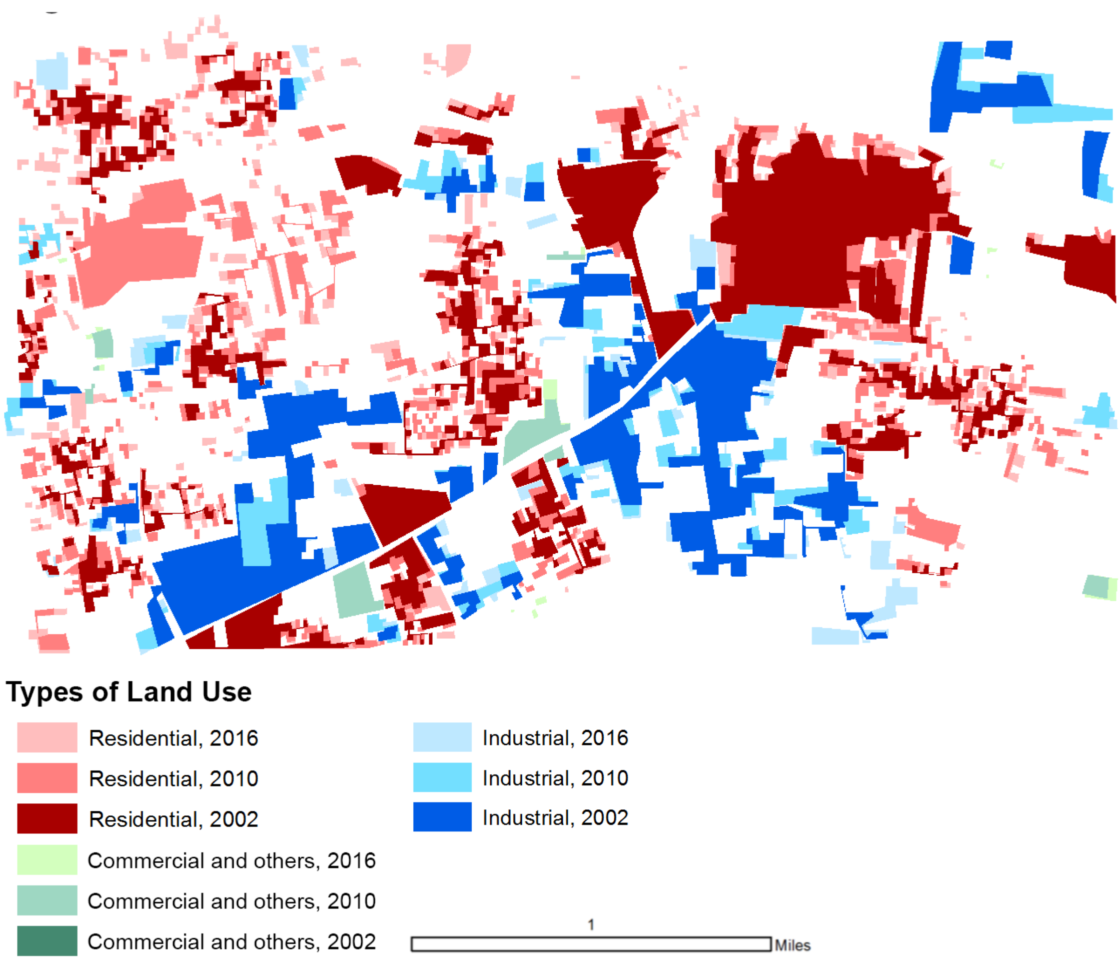

Table A.9 Urban Residents

	Bangalore Urban district		Pune district		Coimbatore district	
	all	Rural	All	rural	all	rural
Dwelling:						
Owned	38.4	54.6	66.6	79	59.4	82.5
Rented	58.7	41.5	29.5	16	36.6	14.5
Vehicles:						
Car/Jeep/Van	17.5	6.5	13.2	6	9.2	4.4
Scooter/Motorcycle/Moped	44.3	30.7	48.8	39	47.1	39.7
Bicycle – Households	22.9	27.5	35.4	40	37.4	37.9
Connectivity:						
Computer/laptop	33.2	11	23.6	7.9	15.8	6.9
Computer/laptop - with internet	18.1	3	11.3	2	6.7	1.7
Telephone/Mobile Phone	91.7	81.7	86.3	76	82.2	69.7
Telephone/Mobile Phone - Mobile only	67.7	72.8	69.9	69	67.2	59.7
Television	85.9	73.6	74.9	58	89	84.3
Radio/Transistor	42.4	30.6	32.5	17	30.2	27.9
TV, Computer/Laptop, Telephone/mobile phone and Scooter/Car	23.6	4.8	18.4	4.3	11.6	3.4
Availing banking services	66.9	51.1	80.8	75	59.2	44.8

Source, Indian National Census, 2011.

Table A.10 Infrastructure, by household

	Banglore Urban District		Pune District		Coimbatore District	
	all	rural	all	rural	all	rural
Kitchen:						
Cooking inside house:	98.4	95	94.5	88.9	94.7	86.1
Has Kitchen	96.1	91.3	74.7	66.3	86.2	69.6
Type of fuel used for cooking: LPG/PNG	75.3	47.8	67.9	41.7	71.4	48.1
Type of fuel used for cooking: Fire-wood	6.5	31.7	19.8	48.6	17.9	45.5
Main source of lighting: Electricity	98	95.8	92.7	83.3	94.8	90.1
Drinking water:						
Main source of drinking water: Tapwater	79.1	68.1	80.6	51.4	93.8	84.7
Tapwater from treated source	66.6	29.7	74.1	36.1	87.6	74.7
Handpump, tubewell or borewell	16.9	28.8	8.6	21.3	3.3	8.6
Location of drinking water source: Within the premises	76.8	41.3	75.9	53.6	59.2	35.5
Near the premises	16.8	46.7	17.7	31.4	37	58.9
Away	6.4	12	6.4	14.9	3.9	5.6
Bathing and toilet facilities						
Having latrine facility within the premises: Total	94.8	74.8	73.8	61.8	66.7	33.3
Having bathing facility: Total	98	91.2	92.2	82.9	90.1	77
Type of bathing facility: Bathroom	96.2	86.3	78.8	61.1	73.6	45.2
Waste water outlet						
Closed drainage	77.1	21.3	62.8	21.9	35.8	12
Open drainage	18.2	55.5	13.5	20	37.9	37.8
No drainage	4.7	23.2	23.7	58.1	26.3	50.2

Source, Indian National Census, 2011.

Table A.11 Amenities in listings, by site

	Water Storage	Power Back Up	Security	Piped Gas	Waste Disposal	Rain Water Harvesting	Fire Fighting Equipment	RO Water System	Air Condition	Internet	Lift	Parking	Maintenance Staff	Total Amenities (average)
Bangalore														
Whitefield	70%	78%	91%	21%	67%	52%	51%	25%	6%	19%	77%	86%	47%	6.9
B. South	44%	40%	40%	14%	24%	29%	9%	3%	1%	3%	38%	39%	26%	4.4
Pune														
Amanora Park	63%	95%	97%	51%	66%	62%	71%	54%	45%	52%	90%	81%	68%	9.0
Pune South	15%	16%	16%	2%	11%	15%	14%	3%	3%	3%	15%	17%	15%	1.4
Coimbatore														
Avinashi Rd	46%	15%	8%	0%	8%	23%	0%	0%	0%	0%	0%	54%	0%	2.1
Irugur	38%	0%	23%	0%	15%	0%	0%	0%	0%	0%	8%	23%	8%	1.2

Table A.12 Hedonic regressions on residential property prices, Whitefield

	Model A		Model B		Model C		Model D	
Sold by builder	-2071098.5**	(765026.0)	-3112591.4***	(765033.4)	-1830506.2*	(909600.8)	-2276229.3*	(904521.7)
Sold by owner	-428541.2	(973024.5)	-1051630.8	(937950.5)	525057.0	(946100.4)	-1092286.0	(944055.8)
House	2888518.7	(2239915.7)	2862686.0	(2074940.5)	5647675.3*	(2246529.7)	4447139.2*	(2218017.6)
Builder floor	-2348187.4**	(826216.7)	-3154320.2**	(954669.7)	-2742033.0*	(1104922.1)	-3160583.3**	(1103300.6)
Villa	4927289.2***	(768262.3)	3803471.4***	(739774.2)	7267530.1***	(1343143.6)	5812574.2***	(1418520.7)
Penthouse	-7373665.2***	(2126402.0)	-5629941.3**	(1978888.6)	-3727630.7	(2026514.1)	-3474601.7	(1958544.6)
Studio	0	(0)	0	(0)	0	(0)	0	(0)
Two rooms	0	(0)	0	(0)	3983055.5*	(1690202.1)	2067538.4	(1723449.6)
Three rooms	-3146803.8**	(987977.3)	-1687287.3	(937336.7)	1909757.1	(1343203.9)	410108.9	(1355986.7)
Four rooms	-9335034.7***	(1798859.0)	-4192377.0*	(1797726.5)	0	(0)	0	(0)
Five or more rooms	0	(0)	0	(0)	0	(0)	0	(0)
Two bathrooms	-32639.7	(786620.3)	-1114343.5	(744255.7)	1796550.1	(1265634.8)	637401.8	(1276656.5)
Three bathrooms	820400.3	(934285.8)	145402.8	(891299.3)	3695158.5*	(1511514.2)	2437314.7	(1512272.8)
Four bathrooms	1540724.0	(1416845.5)	-265882.3	(1343330.2)	2930268.2	(1794651.2)	1212570.3	(1796335.6)
Five bathrooms	-5706835.1**	(2008312.2)	-4711928.9*	(1893069.6)	-2029333.6	(2247434.1)	-3136130.4	(2254445.1)
Square feet	9946.9***	(569.5)	7386.8***	(617.8)	7501.6***	(575.6)	6380.8***	(649.9)
Leasehold	12115510.9**	(4011302.7)	6774990.6	(3828849.9)	9057524.3*	(3628589.8)	6561125.1	(3706774.9)
Cooperative	2937091.1	(3177834.9)	1026580.9	(3068246.6)	-151372.0	(2893494.0)	-599116.0	(2913174.1)
High-rise residential			1715022.5*	(862542.8)			418694.4	(1073166.2)
Semistandardized residential			7549849.0**	(2689130.7)			5044670.9	(2766630.5)
Agricultural village center			857848.0	(833558.1)			-2295389.2	(1322548.6)
Standardized residential			5928157.0***	(924388.3)			6370181.6***	(1418078.5)
Commercial\institutional\office			10344991.5***	(1532693.0)			4957067.8**	(1895768.9)
Industrial low density			0	(0)			0	(0)
Industrial dense			0	(0)			0	(0)
Parking					2686313.8*	(1260721.7)	3557858.5**	(1248818.6)
Water storage					-4713597.9**	(1527908.7)	-4986295.1***	(1492696.8)
Power backup					1190620.9	(1413079.4)	-680463.3	(1434913.9)
Security staff					-4252148.0**	(1412195.6)	-5133417.8***	(1413565.0)
Piped gas					8310453.9***	(1535083.9)	7414956.9***	(1652247.1)
Waste disposal					-3880413.5**	(1183606.5)	-2539081.9*	(1270467.7)
Rainwater Harvesting					-1106100.6	(931572.3)	-716788.6	(955076.9)
Fire fighting					1738441.8	(976209.8)	1357512.0	(983299.7)
Water treatment (RO)					936174.2	(1425851.3)	-2770751.1	(1674421.5)

Air conditioning					-5665689.6**	(2114477.8)	-3635891.1	(2208988.7)
Internet					-2367068.7	(1424977.8)	675662.3	(1640882.3)
Elevator					2132392.5*	(1036451.3)	1589126.0	(1043389.0)
Maintenance					4515937.6***	(1104527.1)	3999543.1***	(1090554.4)
Furnished					-1545606.0	(1589483.4)	-231675.4	(1590901.9)
Semifurnished					-530727.8	(747694.5)	-793991.7	(754552.5)
Facing garden/park					-340648.1	(636376.2)	-168058.7	(613592.6)
Facing main road					-314989.4	(615149.5)	-595774.6	(613187.1)
Constant	-4999311.4***	(1041068.3)	-1915331.1	(1047615.3)	-6446951.2*	(2669645.8)	8940.9	(3199197.5)
Observations	452		452		451		451	
Adjusted R-squared	0.630		0.684		0.719		0.742	
Standard errors in parentheses								
="* p<0.05	** p<0.01	*** p<0.001"						

Table A.13. Hedonic regressions on residential property prices, Bangalore South

	Model A		Model B		Model C		Model D	
Sold by builder	101022.4	(736175.2)	-1556052.1*	(752679.6)	1843181.9*	(827843.0)	138647.0	(950668.9)
Sold by owner	-373108.2	(591477.9)	151049.0	(570362.2)	-268194.5	(669222.3)	352195.0	(668795.4)
House	1804923.5*	(786388.1)	3218900.6***	(763470.1)	2229764.7*	(876556.4)	3225499.2***	(869266.2)
Builder floor	433035.1	(1380718.1)	559599.9	(1277466.3)	2874694.5*	(1308388.3)	2404152.3	(1274951.9)
Villa	4550568.4***	(897649.7)	4784821.4***	(845388.9)	4343853.7***	(879243.4)	4311019.2***	(853222.7)
Penthouse	80456.4	(2731912.5)	2157201.4	(2670411.2)	-436437.7	(2516844.2)	1516097.7	(2513981.1)
Studio	0	(0)	0	(0)	0	(0)	0	(0)
Two rooms	741684.3	(1752179.3)	348004.9	(1621635.9)	1351747.8	(1584911.5)	1380964.8	(1527521.3)
Three rooms	2255166.7	(1869606.2)	1798300.3	(1727728.5)	2792038.8	(1696597.1)	2738165.4	(1633055.6)
Four rooms	8128305.7***	(2163020.9)	7252135.1***	(2018426.6)	8549750.4***	(1958173.4)	7755644.9***	(1892835.6)
Five or more rooms	1311104.9	(2944839.6)	372748.9	(2723295.7)	2078737.5	(2625233.2)	1332186.7	(2569199.5)
Two bathrooms	293971.5	(1180441.6)	-76303.6	(1102075.5)	219234.7	(1098660.5)	-210913.9	(1086377.0)
Three bathrooms	2353283.5	(1364990.7)	1299806.3	(1281387.4)	1909503.8	(1261596.5)	1258082.3	(1247865.1)
Four bathrooms	2630479.7	(1745328.4)	2223580.9	(1627831.2)	910646.2	(1615508.3)	1367806.5	(1589524.4)
Five bathrooms	6095503.7***	(1600771.4)	5215358.9***	(1495994.1)	5220959.0***	(1494829.6)	4437210.5**	(1465512.2)
Square feet	855.7**	(277.3)	780.5**	(256.3)	745.5**	(248.2)	695.6**	(239.1)
Leasehold	-1823161.2	(4008381.1)	-766241.0	(3700192.7)	-2952053.2	(3554797.1)	-2284503.8	(3421545.3)
Cooperative	0	(0)	0	(0)	0	(0)	0	(0)
High-rise residential			-311154.8	(977789.5)			903312.8	(1241708.4)
Semistandardized residential			-3816464.2***	(641049.5)			-3377652.1***	(873985.3)
Agricultural village center			-2852518.1	(1754412.1)			-2393957.6	(1795226.6)
Standardized residential			0	(0)			0	(0)
Commercial\institutional\office			0	(0)			0	(0)
Industrial low density			0	(0)			0	(0)
Industrial dense			0	(0)			0	(0)
Parking					-1959602.5**	(684350.1)	-1603303.9*	(682598.2)
Water storage					-457240.4	(761506.5)	338737.3	(779301.0)
Power backup					934539.1	(888261.0)	-468574.9	(1022466.8)
Security staff					-1481069.6	(886795.4)	-239080.1	(1058551.9)
Piped gas					233858.9	(775665.1)	-650977.7	(808329.7)
Waste disposal					-245773.1	(900135.2)	439099.6	(902447.2)
Rainwater Harvesting					-1226802.6	(735525.7)	-1424116.3*	(716378.5)
Fire fighting					2932651.3**	(1086490.1)	-625353.9	(1317349.1)
Water treatment (RO)					4650315.5***	(1229479.7)	4882308.3***	(1183417.5)
Air conditioning					1100352.3	(2130523.2)	-132551.8	(2069100.3)
Internet					-277507.5	(1248869.3)	-1223684.3	(1345859.2)
Elevator					336833.3	(777024.4)	372816.9	(750329.3)
Maintenance					1362281.0	(828383.9)	797213.3	(807084.6)

Furnished					-1876404.6**	(681119.7)	-1227097.2	(669360.0)
Semifurnished					-111735.0	(559601.1)	289298.5	(559365.6)
Facing garden/park					3254079.8***	(621566.3)	2290592.6***	(634746.4)
Facing main road					2044139.2**	(648251.0)	1978215.7**	(622116.0)
Constant	2573137.9	(1694549.5)	5697061.4***	(1646975.2)	2239992.3	(1559165.4)	4625349.9**	(1657330.1)
Observations	237		237		236		236	
Adjusted R-squared	0.570		0.634		0.685		0.711	

Standard errors in parentheses

Table A.14 Hedonic regressions on residential property prices, Amanora Park

	Model A		Model B		Model C		Model D	
Sold by builder	-1054266.1*	(413181.3)	-645719.7	(437868.4)	-480223.3	(425891.3)	-126036.8	(433104.4)
Sold by owner	521587.2	(474074.4)	367398.8	(474571.1)	472581.8	(491884.6)	603584.2	(487346.9)
House	27370006.4***	(2274422.2)	27752291.7***	(2267832.1)	25150648.9***	(2194790.8)	25317782.2***	(2162260.5)
Builder floor	-2471579.5**	(863855.8)	-2174924.5*	(869524.0)	-1498009.7	(842113.6)	-478369.6	(847880.8)
Villa	20282463.4***	(2007614.5)	20453684.7***	(2003502.1)	16761678.8***	(2079539.2)	17601184.5***	(2054456.6)
Penthouse	18365.9	(1060110.0)	-199089.0	(1057660.1)	-151218.2	(1009781.0)	-145806.5	(993975.6)
Studio	153087.0	(1302278.5)	250216.4	(1304494.7)	25496.3	(1236343.4)	-232815.7	(1220885.8)
Two rooms	157547.5	(380953.7)	222796.3	(387978.7)	68241.1	(377925.0)	228223.5	(373070.3)
Three rooms	1012421.3*	(512549.3)	1090723.4*	(517003.5)	559238.1	(499132.8)	586837.7	(493131.1)
Four rooms	5583844.6***	(983768.5)	5805469.6***	(988634.9)	4862727.6***	(955547.2)	5062039.1***	(946806.7)
Five or more rooms	2631573.1	(1683463.6)	2993327.8	(1689114.8)	2578393.5	(1618578.4)	2660491.6	(1594806.7)
Two bathrooms	121431.9	(299966.3)	84813.8	(302803.3)	-324002.6	(320569.2)	-230039.0	(316810.6)
Three bathrooms	411402.6	(350194.7)	390748.0	(349946.2)	-346352.4	(377362.8)	-20019.0	(381037.5)
Four bathrooms	903603.9	(570952.3)	864250.7	(569339.1)	-7279.3	(609764.0)	431861.3	(610335.1)
Five bathrooms	743363.5	(739732.5)	783492.2	(737526.4)	-258958.3	(745876.0)	453545.5	(748036.7)
Square feet	6388.7***	(278.2)	6223.3***	(284.5)	6695.0***	(296.0)	6414.4***	(296.7)
Leasehold	264785.0	(402209.7)	141768.7	(405752.1)	226674.6	(394868.8)	147471.5	(393453.8)
Cooperative	-607239.7*	(285679.8)	-810023.3**	(298092.9)	-129622.0	(311086.8)	-156681.2	(311533.3)
High-rise residential			903742.5**	(284775.2)			1914333.7***	(454104.3)
Semistandardized residential			90739.8	(922523.7)			-2627980.8*	(1038513.4)
Agricultural village center			0	(0)			0	(0)
Standardized residential			0	(0)			0	(0)
Commercial\institutional\office			340699.6	(318591.1)			474941.0	(354936.5)
Industrial low density			0	(0)			0	(0)
Industrial dense			0	(0)			0	(0)
Parking					-1695980.1*	(749260.2)	-1134565.7	(748640.6)
Water storage					149734.7	(572781.4)	575435.1	(582141.8)
Power backup					-3884134.6***	(1148159.0)	-3359502.6**	(1134291.1)
Security staff					4979735.1***	(1235110.6)	5228525.4***	(1215831.7)
Piped gas					-348530.0	(597288.3)	-609827.4	(628085.0)
Waste disposal					1301305.9	(900186.5)	-464766.9	(951436.1)
Rainwater Harvesting					-1108166.3*	(514683.0)	-100133.8	(550269.6)
Fire fighting					-1785261.7*	(773083.2)	-230714.9	(850212.4)
Water treatment (RO)					626681.4	(809016.0)	1081427.3	(802520.6)
Air conditioning					2542586.3***	(505610.4)	3246208.8***	(535501.8)
Internet					-2653048.9**	(896741.3)	-2635875.2**	(902813.2)
Elevator					3288799.0***	(961192.6)	2187242.0*	(984201.8)
Maintenance					34161.0	(487852.1)	-841579.2	(524370.2)

Furnished					240663.3	(418712.8)	403205.0	(412831.3)
Semifurnished					246450.3	(252548.6)	193077.0	(248953.2)
Facing garden/park					60118.4	(237192.5)	-64316.0	(239876.5)
Facing main road					-150804.1	(230347.0)	-222030.1	(229093.5)
Constant	202904.6	(345660.6)	-58393.5	(389918.3)	-1417014.0	(770249.5)	-2984913.6***	(875014.7)
Observations	857		857		857		857	
Adjusted R-squared	0.854		0.856		0.873		0.877	

Standard errors in parentheses

="* p<0.05 ** p<0.01 *** p<0.001"

Table A.15 Hedonic regressions on residential property prices, Pune South

	Model A		Model B		Model C		Model D	
Sold by builder	108795.6	(180675.0)	106733.2	(180610.1)	95480.6	(202251.9)	101990.4	(204034.6)
Sold by owner	602807.4***	(178750.5)	642451.4***	(184612.2)	478908.0*	(211347.5)	516055.9*	(223058.9)
House	139790.3	(260680.6)	233584.9	(270639.0)	129140.5	(262981.8)	150081.8	(270110.6)
Builder floor	-129910.2	(486490.2)	-167916.0	(488716.3)	488297.5	(699390.4)	459238.1	(708859.9)
Villa	0	(0)	0	(0)	0	(0)	0	(0)
Penthouse	0	(0)	0	(0)	0	(0)	0	(0)
Studio	0	(0)	0	(0)	0	(0)	0	(0)
Two rooms	48026.1	(343991.2)	84658.9	(346366.1)	840831.9*	(359187.0)	857781.2*	(363393.4)
Three rooms	-1669944.9*	(721471.2)	-1755861.3*	(724855.9)	-972712.9	(700055.2)	-1004924.0	(708893.6)
Four rooms	62822.5	(1056279.4)	104004.2	(1060357.4)	2559991.0	(1463262.1)	2586593.6	(1577078.4)
Five or more rooms	0	(0)	0	(0)	0	(0)	0	(0)
Two bathrooms	-545523.9	(332450.6)	-586939.0	(333557.0)	-1191491.3**	(361066.7)	-1203361.3**	(364869.7)
Three bathrooms	1277944.6	(709054.6)	1364563.0	(711315.5)	1106742.8	(704588.9)	1134396.4	(713404.3)
Four bathrooms	2037298.8	(1076017.1)	2148364.0*	(1078646.6)	1359062.4	(1028192.0)	1424198.7	(1042345.8)
Five bathrooms	0	(0)	0	(0)	0	(0)	0	(0)
Square feet	6723.5***	(428.0)	6686.3***	(432.3)	6217.2***	(424.8)	6210.0***	(428.1)
Leasehold	0	(0)	0	(0)	0	(0)	0	(0)
Cooperative	64814.4	(197559.1)	58076.5	(200311.6)	6181.2	(194957.8)	8425.2	(197230.5)
High-rise residential			-21964.3	(592460.1)			187016.9	(720851.8)
Semistandardized residential			0	(0)			0	(0)
Agricultural village center			0	(0)			0	(0)
Standardized residential			0	(0)			0	(0)
Commercial\institutional\office			-740505.5	(751866.0)			-73218.4	(894427.4)
Industrial low density			0	(0)			0	(0)
Industrial dense			0	(0)			0	(0)
Parking					-549394.1	(777788.5)	-537009.2	(784791.1)
Water storage					985275.0	(574427.6)	1016127.3	(583289.2)
Power backup					527400.3	(600233.1)	514100.7	(605834.4)
Security staff					34660.4	(844322.0)	32940.1	(855967.5)
Piped gas					-1433346.7	(1212433.1)	-1451443.9	(1228378.9)
Waste disposal					647201.4	(440706.2)	673245.4	(447448.9)
Rainwater Harvesting					-2170921.6**	(724784.2)	-2157357.0**	(751741.8)
Fire fighting					863951.0	(501401.5)	819198.2	(561437.1)
Water treatment (RO)					483961.4	(718063.9)	560539.4	(928017.7)
Air conditioning					476974.2	(694105.3)	413237.4	(764770.0)
Internet					-1118462.1	(687561.9)	-1171386.4	(752207.2)
Elevator					927214.5	(1039696.8)	942139.6	(1047992.4)
Maintenance					-1015049.3	(823714.1)	-1048754.3	(847722.8)

Furnished					1324638.5***	(337857.0)	1306633.3***	(341784.7)
Semifurnished					604943.2**	(213107.8)	582184.3**	(218648.9)
Facing garden/park					-38610.3	(159759.1)	-19932.4	(164271.1)
Facing main road					107934.0	(160872.5)	106494.3	(162063.1)
Constant	-873253.0*	(351279.6)	-810911.5	(666301.8)	-618201.1	(389979.5)	-809627.7	(815887.1)
Observations	146		146		146		146	
Adjusted R-squared	0.869		0.869		0.887		0.885	
Standard errors in parentheses								
="* p<0.05	** p<0.01	*** p<0.001"						

Table A.16 Informal Dense Residential Settlement

Level	Indicators	Interpretation Element	Observation
Settlement level	Shape	Pattern	Irregular shape
	Density	Vegetation	Very little vegetation, no yards separating properties, mostly dirt, few open spaces, no lawns
		Proximity	Very dense: structures touch or overlap, very little space between buildings in a block
Object Level	Building	Shape	Irregular, Square or rectangular
		Size	small, roughly 20-100 sq. m
		Roof Material and Color	Tin, concrete, plastic
		Orientation	Clumped together, irregular or some evidence of planned streets depending on the settlement.
	Access Network	Shape	Irregular networks, settlements break the regular grid patterns.
		Type	Unpaved dirt road
		Connectivity	Some structures are not directly connected with pathways or roads.
		Width	Variable

Table A.17 Informal Moderate Density Residential Settlement

Level	Indicators	Interpretation Element	Observation
Settlement level	Shape	Pattern	Irregular shape, buildings clumped together, less dense than Informal dense
	Density	Vegetation	Yards with 1-3 structure per yard, mostly dirt. Vegetations around buildings
		Proximity	Less dense than Informal dense, often groups of 10-20 very close together within settlement
Object Level	Building	Shape	Rectangular or square
		Size	Small, roughly 14-130 sq. m
		Roof Material and Color	Tin, concrete, plastic
		Orientation	Clumped together, semi-standardized, some developments follow clear pattern while others do not
	Access Network	Shape	Irregular or blur grid lines
		Type	Dirt paths
		Width	Variable

Table A.18 Informal Low Density Residential Settlement

Level	Indicators	Interpretation Element	Observation
Settlement level	Shape	Pattern	Irregular shape, no pattern, groups of structures or individual outliers. Evenly spread out in a relatively large scale Can consist of individual houses or villas, with or without yards.
	Density	Vegetation	Many open and green spaces and surrounding fields
		Proximity	Houses clearly on separate land claims, very few individual yards, some structures grouped together
Object Level	Building	Shape	Rectangular or square
		Size	Varies
		Roof Material and Color	Tin, concrete, plastic and tiles
		Orientation	Irregular
	Access Network	Shape	Very few clear access networks, those that exist are dirt paths
		Type	Dirt
		Width	n\a

Table A.19 Semi-standardized Residential

Level	Indicators	Interpretation Element	Observation
Settlement level	Shape	Pattern	Semi-standardized, clearly distinguished rows
	Density	Vegetation	Some vegetation, some open spaces in small yards
		Proximity	Denser than Standardized Residential, multiple structures per yard, many houses touch or have overlapping roofs
Object Level	Building	Shape	Square, rectangle, U and L shaped, with very few traditional houses
		Size	Variable—can be as small as 50 sq m
		Material	Tin, iron sheets, concrete, plastic
		Orientation	Regular
	Access Network	Shape	Regular. Grid somewhat recognizable.
		Type	Dirt roads
		Location	developed from major road to inland.
		Width	Varies throughout the settlement, 7-8 m or less

Table A.20 Standardized Residential Settlement

Level	Indicators	Interpretation Element	Observation
Settlement level	Shape	Pattern	Regular patterns, in rows, distinguished as residential communities
	Density	Vegetation	Lawns, open spaces
		Scale	Residential community size varies from 400,000 sq m to a few single-family houses.
		Proximity	Standard spacing between structures
Object Level	Building	Shape	Regular, some residential properties with multiple buildings (garage)
		Size	Standard size for each residential community. Property size may vary. Usually one or two story
		Roof Material and Color	Standard - red, brown orange. No tin roofs
		Yard	Yes; 1 house per yard
		Orientation	Standard
	Access Network	Shape	Planned roads, driveway to house, cul-de-sac
		Type	Paved access streets
		Width	Constant width - roughly 10 m

Table A.21 High-rise Residential Settlement

Level	Indicators	Interpretation Element	Observation
Settlement level	Shape	Pattern	Regular patterns. Stand-alone or recognized as a residential community
	Density	Vegetation	Lawns, open spaces, and sometimes pools
		Scale	Residential community size may vary.
		Proximity	standard spacing between buildings
Object Level	Building	Shape	Regular, sometimes curvey shape building footprints
		Size	Standard size for each residential community. More than 5 stories. Building height can be determined by Google Map thumbnail of the same location, or MagicBricks listings (search by property name).
		Roof Material and Color	Concret, plastic or metal
		Yard	Can have community gardens or open spaces
		Orientation	Standard
	Access Network	Shape	no particular patterns.
		Type	Paved access streets
		Width	Constant width throughout settlement- roughly 10 m

Table A.22 Industrial Low Density Settlement

Level	Indicators	Interpretation Element	Observation
Settlement level	Shape	Pattern	Irregular
	Density	Vegetation	Some, many large open spaces, usually dirt
		Proximity	Not very dense together, many open spaces, yards and empty yards
Object Level	Building	Shape	Rectangle
		Size	about 100-4000 sq m structures
		Material/color	Varies - tin, concrete, plastic
		Residential Structure	More residential buildings scattered around development, also likely to have large residential community nearby
		Orientation	Irregular or Semi-standardized
	Access Network	Shape	Irregular or Semi standardized
		Connectivity	Connect with local roads or major highways
		Type	Dirt roads
		Width	Around 7-10 m

Table A.23 Industrial High Density Settlement

Level	Indicators	Interpretation Element	Observation
Settlement level	Shape	Pattern	Irregular, no distinguishable pattern besides streets separating plots
	Density	Vegetation	Very little to none, few large open spaces
		Proximity	Very dense - buildings attached, overlap, yards are harder to identify
Object Level	Building	Shape	Rectangle, L and U shapes
		Size	about 100-4000 sq m
		Material/color	Varies - some tin, concrete, red/blue/green plastic.
		Residential Structure	Few residiential developments within the development, more likely to have large residential community nearby
		Orientation	Irregular or Semi-standardized
	Access Network	Shape	Irregular or Semi standardized
		Type	Dirt roads, few paved roads
		Connectivity	Connected with local or major roads
		Width	7-10 m

Table A.24 Agricultural Settlement

Level	Indicators	Interpretation Element	Observation
Settlement level	Shape	Pattern	Irregular, groups of buildings
	Density	Vegetation	Few yards with 2-5 structures sharing yard, lots of vegetation, distinguished from rural village by shape and proximity to farmland
		Structures per settlement	Usually low rise and low density
		Scale	Size vary from 500 square meters to over 100,000 square meters.
		Proximity	Modearte to low density. Size of each strucuture may vary. Some clumped together, few outliers
Object Level	Building	Shape	Round traditional or square shaped
		Size	Usually individual structure is small.
		Material	Traditional and regular houses mixed - tin and brown roofs. Also includes any agricultural structure as barns, warehouses and plastic film for farmlands
		Orientation	Irregular
	Access Network	Shape	No clear access network. Some settlements are defined by surrounding farmlands. Only land with built structures should be classified, but not cultivated fields next to them.
		Location	Built by farmlands
		Type	likely dirt path
		Width	n\a

Table A.25 Agricultural Village Center

Level	Indicators	Interpretation Element	Observation
Settlement level	Shape	Pattern	Irregular. cluster of buildings often around a center rather than spread apart
	Density	Vegetation	Lots of vegetation
		Structures per settlement	>50
		Proximity	Clearly separate houses, some clustered together. Few yards with 2-5 structures per yard
Object Level	Building	Shape	Round traditional or square
		Size	40 - 60 sq. m. larger than in dense urban areas
		Material and color	Traditional and regular houses mixed - tin or brown roofs
		Orientation	Irregular
	Access Network	Shape	No clear paved access. Very organic network pattern.
		Type	Likely dirt paths
		Location	Few surrounding commercial or industrial structures nearby in base year. Grow along major roads, instead of extending from major roads to inland.
		Width	n/a

Table A.1 Commercial,,Institutional and Office Structures

Level	Indicators	Interpretation Element	Observation
Settlement level	Shape	Pattern	Commercial usually developed along major corridor, or in cluster. Ground truthing with Google Map, as it would show places of interest.
	Density	Vegetation	Little or some
		Proximity	Educational facilities usually contain open spaces and playgrounds, not necessarily paved.
Object Level	Building	Shape	Rectangular
		Size	Varies from low-rise buildings to multi-storey towers.
		Material/color	Brick, concrete
		Residential Buildings?	Some high-rise office towers might be mixed use.
		Orientation	Irregular or Semi-standardized
	Access Network	Shape	Irregular or Semi standardized
		Connectivity	Connect with local roads or major highways
		Type	Paved road
		Width	Around 7-10 m