

Real Estate Prices in Mumbai: Does the Metro Rail Have an Impact?

Author(s): SAHIL GANDHI, VAIDEHI TANDEL, ABHAY PETHE, VIDYADHAR PHATAK and SUSHRUT RISBUD

Source: *Economic and Political Weekly*, MARCH 1, 2014, Vol. 49, No. 9 (MARCH 1, 2014), pp. 55-61

Published by: Economic and Political Weekly

Stable URL: <https://www.jstor.org/stable/24479177>

---

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at <https://about.jstor.org/terms>



*Economic and Political Weekly* is collaborating with JSTOR to digitize, preserve and extend access to *Economic and Political Weekly*

JSTOR

# Real Estate Prices in Mumbai

## Does the Metro Rail Have an Impact?

SAHIL GANDHI, VAIDEHI TANDEL, ABHAY PETHE, VIDYADHAR PHATAK, SUSHRUT RISBUD

The paper estimates the impact of various neighbourhood, spatial, and externality factors on residential prices in Mumbai. We find that distance from the central business district, proximity to the west coast, presence of slums, proportion of residential and commercial built-up areas, and proximity to the railway station have a significant impact on residential prices. Amenities and open spaces do not have any significant impact on prices. Further, we model the impact of the upcoming metro line on the residential prices. We find that the upcoming metro has no significant effect on prices. These findings have strong implications for policy decisions regarding introduction of land-based fiscal tools such as betterment levies for capturing land value appreciation that is expected to arise from new infrastructure.

The authors would like to thank Sirus Libeiro for providing geographical information system support and excellent research assistance, and Vidyadhar Deshpande and Rajiv Jalota for their support. The authors would also like to thank Richard Arnott, Matthew Holian, Ramakrishna Nallathiga and Kala Sridhar for their comments. The usual caveat applies.

Sahil Gandhi ([sahil.gandhi1@gmail.com](mailto:sahil.gandhi1@gmail.com)), Vaidehi Tandel ([vaidehi.tandel@gmail.com](mailto:vaidehi.tandel@gmail.com)) and Abhay Pethe ([ampethe@gmail.com](mailto:ampethe@gmail.com)) are at the Department of Economics, University of Mumbai. Vidyadhar Phatak ([vphatak@vsnl.net](mailto:vphatak@vsnl.net)) is an independent consultant. Sushrut Risbud ([sushrut7@gmail.com](mailto:sushrut7@gmail.com)) is at the Indian Institute of Management Calcutta, Kolkata.

### 1 Introduction

Mumbai is home to some of the most expensive real estate in the world (Frank 2013) and is known to be “the world’s weirdest property market” (*The Economist* 2012). The distortions in the market arise due to stringent and somewhat archaic land regulations coupled with limited supply of land and a strong oligopoly of real estate developers. These conditions naturally have had a considerable impact on real estate prices. However, although these factors generally drive real estate prices, the spatial variations in prices are equally affected by typical factors such as distance to a central business district (CBD), proximity to transport networks, and neighbourhood characteristics. This paper attempts to identify the different factors that effect real estate prices in Mumbai.

There have been a few studies on property prices in Mumbai, which have also attempted to understand the impact of different factors on prices. Tiwari et al (1999) use the hedonic price method to determine the impact of various household characteristics and distance to CBDs on house rents in the Mumbai Metropolitan Region. This was one of the first studies on modelling property prices in the Mumbai region and it estimates the price and income elasticities for housing demand.

However, this study does not include other spatial and neighbourhood factors such as distance to mass transit, amenities such as schools, hospitals, and open spaces, and the presence of slums in the vicinity. Nallathiga (2006) estimates the impact of floor space index (FSI) regulations on land prices in Mumbai. He finds that FSI regulations have an impact in the denser areas in and around the CBD and also in the suburbs. However, the study makes use of price data at a ward level and thus has a small sample. Our study adds to this sparse literature by taking into account certain factors excluded in previous studies such as distance to mass transit, proximity to the west coast, among others. Further, an important addition the paper makes is the study of property prices in 684 neighbourhoods/sub-zones in the city for 2013, and the use of geographical information systems (GIS) to arrive at accurate data for the neighbourhood and spatial characteristics of each of these sub-zones. However, a limitation of this paper is that it does not use unit-level data, and hence does not include the impact of structural characteristics such as age, type of construction, and materials used on property prices.

Further, the paper estimates the effect of an upcoming infrastructure project – such as the metro rail – on property prices in the vicinity. This is done by empirically testing the

impact of the upcoming Versova-Andheri-Ghatkopar (VAG) metro line on prices in the sub-zones close to the line. Such a study is important in order to inform decisions regarding introduction and efficacy of fiscal tools based on land value gains, for raising finances from big ticket infrastructure projects.<sup>1</sup> McMillan and McDonald (2004) conduct a similar study on the impact of a rapid transit line in Chicago on house prices. They examine the house prices in areas close to the line before and after the line was opened, and find that prices of houses close to the stations along the line started appreciating after the information regarding the upcoming line became public. They also find that increases in house prices of homes close to the stations were higher than those located farther from the transit line. Swamy (2009) studies the impact of the Delhi metro over time and across space. He finds that the metro has greater impact on residential prices in the peripheries than in areas where residential densities are already high. Land values are affected by the distance to the metro lines and the impact is higher on commercial prices than residential prices. Finally, the impact on prices has been greater after the operation of the metro rather than in the planning and construction phases.

The paper is organised into nine sections including the introduction. Section 2 reviews the literature on urban land values. Section 3 specifies the model and describes the variables used. Section 4 discusses the data and methodology used. Section 5 presents the results. Section 6 describes the metro rail project in Mumbai while Section 7 estimates the impact of the VAG metro line on property prices. Section 8 provides the limitations and scope for further research. Section 9 concludes the paper.

## 2 Literature on Urban Land Values

Since urban land values are determined by location decisions, this section surveys some literature that studies the different factors affecting residential location decisions. The earliest study on what determines urban land rents was undertaken by Alonso (1964).<sup>2</sup> Using a monocentric model of a city, he showed that since households prefer lower commuting costs, areas closer to the CBD would command a higher rent. Later Mills (1972) and Muth (1969) separately used housing as the final consumption good to demonstrate that house prices, land rents, and building heights decline with increasing distance from the CBD. This basic relationship between urban land rents and the CBD has been extended by others (Brueckner 1987) and many have empirically tested its veracity (Heikkila et al 1989; Ahlfeldt 2007; Ahlfeldt and Wendland 2013).<sup>3</sup>

Since transportation networks increase accessibility and reduce commuting costs (both time and monetary costs), land parcels which have access to major transport networks would have higher land values. It is important to distinguish between the different modes of transport, namely, highways and mass transit systems. Depending upon the dominant transport pattern in the city, research on land values take into consideration either roads or railway networks.

Debrezion et al (2007) find that empirical literature on the impact of railways on land values is diverse in terms of methodology used as well as findings. While some studies show a direct and positive impact of increased accessibility through railways on property values, others find a negative effect (ibid). For instance, Bowes and Ihlanfeldt (2001) empirically estimate a hedonic model to examine whether railways affect property values positively due to reduction in commuting costs and increased retail activity or negatively due to externalities such as noise and pollution, and increased neighbourhood crime. They find that all these effects are present with different intensities depending upon the distance from CBD, distance from the railway stations, and income class of the neighbourhood.

Preferences to locate in a particular area are heavily dependent upon neighbourhood characteristics such as land uses and provision of local amenities. The theoretical underpinning for location decisions according to the preference for local taxes and local public goods and services was provided by Tiebout (1956). These preferences would affect housing demand and hence would impact property prices. Oates (1969) and Hoyt and Rosenthal (1997) use hedonic price models to empirically test the Tiebout hypothesis by examining the impact of local amenities on property values. Hoyt and Rosenthal find that marginal benefits from locational amenities are not equal for all families in the same location; this does not support the Tiebout hypothesis. Oates includes the property tax rate and the output level of services in a locality as arguments in the property values function. His findings of a negative relationship between property tax rates and property values and positive relationship between per pupil school expenditure and property values validate the Tiebout hypothesis.

Besides local amenities, neighbourhood characteristics also include open or green spaces, land uses, socio-economic profile of the community, and others. Cheshire and Shephard (1995) examine the impact of neighbourhood characteristics on land values. In examining the neighbourhood, or non-structure-specific characteristics of housing, they distinguish between amenities that are pure public goods and those that are congestible, that is, there is rivalry in consumption. The relevant neighbourhood characteristics they consider include accessibility to a bus network, class of road, land-use patterns, altitude, location of a house with respect to the secondary school catchment area, ethnicity, class of labour force, and accessible and inaccessible open space. They find that the market price of land reflects the net value of non-structure-specific house characteristics.

Geoghegan (2002) estimates a hedonic model to specifically understand whether open space in close proximity to a residence affects the residential price. She finds that permanent open spaces lead to a 300% increase in the values of proximate residential land as compared to developable open spaces. Bolitzer and Netusil (2000) also empirically demonstrate the positive impact of proximity to open spaces on sale prices of houses. Focusing on the impact of the construction of two

sports complexes on neighbourhood quality in Berlin, Ahlfeldt and Maennig (2010) show that such amenities positively affect property prices in the neighbourhoods.

Song and Knaap (2004) study the impact of mixed land use on housing prices. The mixed land uses include neighbourhood commercial stores, multi-family residential units, light industrial sites, public institutions, and public parks (ibid). They find that prices of single family houses increase when single family housing dominates the land use, when there are more service jobs in the neighbourhood, and when there is an even distribution of non-residential land uses in the neighbourhood, but decline when single family houses are in close proximity to multi-family houses.

### 3 Model Specification

Based on the various studies on location attributes and urban land, we arrive at the following set of characteristics that would have an impact on prices in Mumbai: distance to CBD, access to railway networks, externalities, local amenities, and land use. The specific multivariate regression equation is:

$$\ln(P) = \alpha + \beta_1 \text{Cbd\_dist} + \beta_2 \text{Prop\_builtup\_amenities} + \beta_3 \text{West} + \beta_4 \text{West\_coast} + \beta_5 \text{Prop\_slum} + \beta_6 \text{Prop\_builtup\_res} + \beta_7 \text{Prop\_builtup\_comm} + \beta_8 \text{Prop\_openspace} + \beta_9 \text{Dist\_near\_RSta} + \varepsilon \quad \dots(1)$$

We use a semi-log form for this exercise.<sup>4</sup> Residential price of an area is considered to be the dependent variable and we use log price for our model;  $\alpha$  is the constant, there are nine independent variables, and  $\varepsilon$  is the error term (see equation 1). Table 1 provides a description of the variables. These variables can broadly be classified as distance to CBD, density of amenities, variables accounting for externalities, land use, and distance to mass transit. The first independent variable is the distance of the locality to the CBD, which is an important location characteristic signifying accessibility to the major employment centre of the city. It is expected that localities closer to the CBD would have higher prices. The second independent variable is the density of local amenities. High provision of amenities in an area is likely to increase residential prices.

We also consider a set of variables that would have an externality effect on residential prices. These include the dummy variables for geographical location – areas along the west coast and areas to the west of the western railway line – and a

variable for proportion of slums within an area. Areas adjacent to the west coast will have higher residential prices. West coast faces the Arabian Sea and has beaches of significant recreational amenity. The same effect is not likely to be present along the east coast since residential development along this coast has been limited due to existence of saltpan lands, mudflats, mangroves, and much of the land belonging to the port trust. Historically, middle- and high-income development of the city has been along the western railway line and this has led to greater demand for real estate for commercial and residential purposes on the west. Thus the combined effect of proximity to the sea and historical legacy factors is likely to lead to areas located in the western parts of the city to have higher land prices. Slums have an adverse impact on the valuation of surrounding properties. Therefore, a higher proportion of slums in an area is expected to negatively affect the prices in that area.

Another set of variables taken into account are the land-use patterns in an area. These are Prop\_builtup\_res, Prop\_builtup\_comm, and Prop\_openspace. Higher residential activity in an area is likely to have a positive impact on residential prices. The rationale is that higher residential activity is likely to make a neighborhood safer. High commercial activity would also have a positive effect on residential prices in an area. In a space-constrained city like Mumbai, open space would be expected to have a positive impact on residential prices.

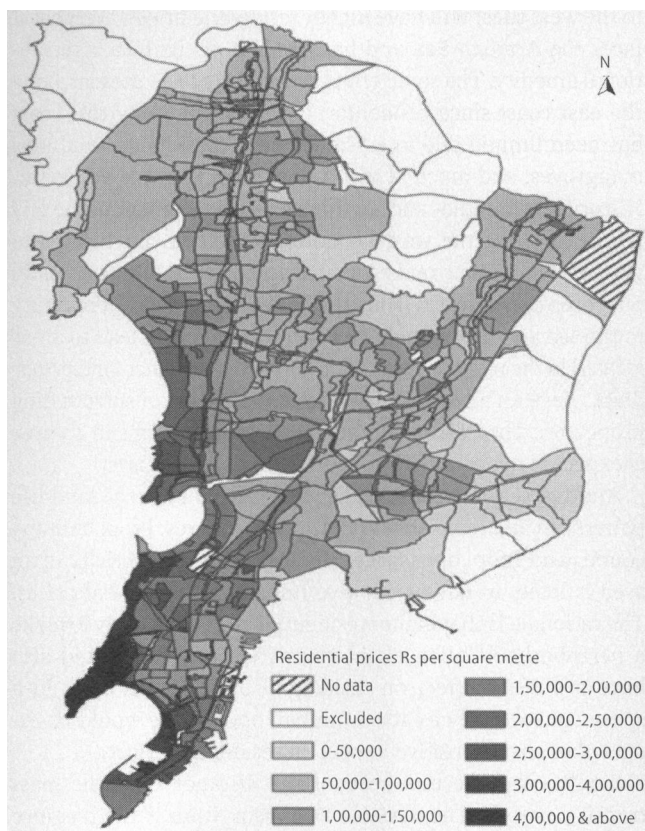
Finally, we take into account the distance from the mass transit network. The variable Dist\_near\_RSta is the distance from a locality to the nearest railway station. This variable is chosen instead of distance to highway as a major share of commuting demand is satisfied by suburban railway and not by personal vehicles. Usually, areas located closer to the railway stations have relatively higher prices. Our baseline model comprises the independent variables discussed above.

### 4 Data and Methodology

Table 1 provides information regarding the various sources, which were used for procuring data regarding the variables of interest. The data source for the dependent variable, that is, the property prices for Mumbai is the *Stamp Duty Ready Reckoner* (henceforth referred to as the Ready Reckoner). The Ready Reckoner is published annually and provides the rates for residential, commercial, industrial properties and open

**Table 1: Description of Variables**

Variable	Description	Units	Source
P	Residential prices for 2013	Rs Per sq metre	Stamp Duty Ready Reckoner
Cbd_dist	Distance from CBD to sub-zone centre	Kilometres	GIS map
Prop_builtup_amenities	Built up area of amenities to total built-up of sub-zone	Ratio	Property data – MCGM
Externality			
West	Dummy variable; 1 for sub-zones to the west of western railway line	1,0	GIS map
West_coast	Dummy variable; 1 for sub-zones contiguous to western coast	1,0	GIS map
Prop_slum	Proportion of area occupied by slums in sub-zones	Ratio	ELU+GIS map
Land use			
Prop_builtup_res	Built up area of residences to total built-up of sub-zone	Ratio	Property data – MCGM
Prop_builtup_comm	Built up area of commercial activity to total built-up of sub-zone	Ratio	Property data – MCGM
Prop_openspace	Area of open spaces to area of sub-zones	Ratio	ELU+GIS map
Distance to mass transit			
Dist_near_RSta	Distance from sub-zone centre to nearest railway station	Kilometres	GIS map

**Figure 1: Residential Prices for the Year 2013 across Sub-zones in Mumbai**

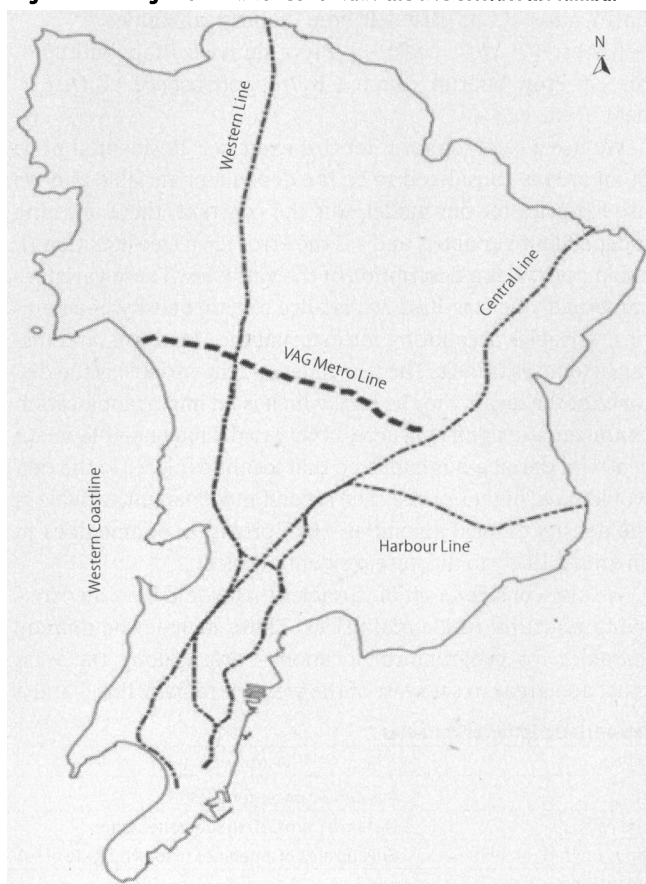
land at the sub-zone level. There are various other sources that provide property prices for Mumbai. These include data collected by private real estate companies as well as property price data published weekly in the *Accommodation Times*. However, we use the data from the Ready Reckoner since it provides information about prices at a fairly disaggregated level for the entire city and also because it is the basis on which the soon-to-be introduced capital-based property taxes will be calculated.<sup>5</sup> The Ready Reckoner is used by the state government to determine the market value of the area in which the property is located in order to levy a stamp duty.

The Ready Reckoner divides the city into different zones depending on the population, physical features, and other special features. These zones are further divided into sub-zones based on criteria such as roads and landmarks and rates are affixed to each sub-zone. The rates are based on transactions registered within the past three to five years, information collected from different government organisations and special land acquisition officers, valuations done by town planning and valuation department, government approved valuers, and financial institutions.

The Ready Reckoner for the year 2013 (Kumar and Gupta 2013) provides rates in rupees per square metre for 743 sub-zones. For our analysis, we initially considered the residential and commercial prices – expressed as rate of building + land in Rs/metre – in the Ready Reckoner for the year 2013. However, since both the prices are highly correlated (having a correlation coefficient of 0.98), we use the residential prices for the analysis.

Of the 743 sub-zones, the Ready Reckoner does not provide residential prices for 19 sub-zones. Of the remaining 724 sub-zones, 23 have little or no residential activity since they are creeks, mangroves, forest areas, atomic research centre and other green areas on the peripheries. These sub-zones have been excluded from our analysis (Figure 2). Further, 17 sub-zones have not been considered in our analysis since the data for the independent variables Prop\_amenities, Prop\_builtup\_res, Prop\_builtup\_comm, procured from the property tax cell of Municipal Corporation of Greater Mumbai (MCGM) did not provide the details for these sub-zones.

Thus, the final analysis considers 684 sub-zones. The dimensions of these sub-zones range from 6,361 sq mt to 1,32,10,778 sq mt, with an average area of 1,28,338 sq mt, and a median of 2,08,975 sq mt. The per square metre prices in the Ready Reckoner range from Rs 26,800 to Rs 6,72,000. The mean price is Rs 1,28,338 and the median is Rs 98,600. Figure 1 provides the detailed distribution of residential prices in Mumbai.

**Figure 2: Existing Mass-Transit Network and the VAG Corridor in Mumbai**

For extraction of spatial data we use the software QuantumGIS with layers for the Ready Reckoner sub-zones and the railway and metro lines. With the help of GIS we identify sub-zones lying to the west of the western railway line and contiguous to the west coast, and we calculate distances of sub-zones to the CBD, and the railway lines. Distances have been calculated as straight lines between two points.<sup>6</sup> Nariman Point in South Mumbai has been considered as the CBD for calculating the distances

from sub-zone centres to the CBD.<sup>7</sup> For calculating distances from railway stations, distances of all 684 sub-zone centres to railway stations on the western, central and harbour lines are calculated and the shortest distance among the three is considered. The mean distance in this case is 1.265 kilometres.

The residential, commercial, and amenity proportions are calculated from a data set on properties in Mumbai for 2011 procured from the property tax cell of the MCGM. Residential, commercial, and amenities proportions provide the ratios of residential, commercial, and amenity built-up area to the total built-up in a sub-zone respectively. The data set contains information regarding various characteristics of 2.45 million units in Mumbai. For calculating residential proportions we consider categories such as rooms, flats, apartments, tenements,

**Table 2: Results**

Variables	Dependant Variable: Ln(P)			
	(1)	(2)	(3)	(4)
Intercept	12.188780** (0.037634)	12.064800** (0.035929)	12.085400** (0.036336)	11.963070** (0.056257)
Cbd_dist	-0.034306** (0.001866)	-0.033201** (0.001757)	-0.0319395** (0.001794)	-0.032684** (0.0018744)
Prop_builtup_amenities				-0.119295 (0.215292)
West		0.438158** (0.034732)	0.405391** (0.036138)	0.393059** (0.036112)
West_coast		0.267470** (0.070198)	0.277630** (0.069847)	0.250799** (0.070860)
Prop_slum			-0.344721** (0.112506)	-0.344799** (0.111881)
Prop_builtup_res				0.193191** (0.055442)
Prop_builtup_comm				0.137024* (0.074979)
Prop_openspace				0.182945 (0.211970)
Short_dist_RSta		-0.060899** (0.016999)	-0.059762** (0.016899)	-0.054841** (0.0168584)
Observations	684	684	684	684
R-square	0.331	0.508	0.515	0.524
Adj R-square	0.330	0.505	0.511	0.518
F-statistic	337.66**	175.35**	143.89**	82.54**

Standard errors are in parentheses.

\* Significant at 10% level. \*\* Significant at 1% level.

bungalows, row houses, duplex flats, and pent houses. Commercial activities include shops, offices, hotels, banks, restaurants, among others. Amenities include educational institutions, hospitals, nursing homes, nurseries and kids' corners. Locations of slums and open spaces have been identified from the Existing Land Use (ELU) maps for 2012 that have been prepared by the MCGM as part of their exercise for preparing the Development Plan of Mumbai.<sup>8</sup> There are eight Special Planning Areas in Mumbai for which MCGM is not the planning authority.<sup>9</sup> The slums and open spaces in these planning areas have been identified using satellite images provided by Google Earth and Google Maps.<sup>10</sup>

## 5 Results

Table 2 provides the results of equation 1 by using the ordinary least squares (OLS) method. Regression (4) estimates the full model whereas the other regressions – (1) to (3) – show results

for restricted versions of the model. Regression (1) estimates the impact of distance from CBD on the log of residential prices. It explains 33% of the variation in the model. The sign is as expected and significant at 1%. A one kilometre move away from the CBD results in a decline in residential prices by 3.4%.

Regression (2) adds the variables west, west\_coast, and short\_dist\_RSta. We find that the signs of all three are as expected and statistically significant at 1% and the regression explains 50.5% of the variation in dependent variable.

Regression (3) adds Prop\_slum to the earlier regression. Here too the sign is expected and significant at 1%. An increase by 1% in the density of slums within a sub-zone results in a decline in residential prices by 34.5%.

Regression (4) estimates the effect of all the variables in equation 1. We find that Prop\_builtup\_amenities does not have the expected sign but is not statistically significant and Prop\_openspace, though having the expected sign, does not turn out to be statistically significant. Prop\_builtup\_res and Prop\_builtup\_comm are significant at 1% and 10% respectively. Further, a percentage increase in the built-up area for residential and commercial use as a proportion of total built-up area, that is, Prop\_builtup\_res and Prop\_builtup\_comm, leads to an increase in residential prices by 19.3% and 13.7% respectively. This model explains around 52% of the total variation in dependent variable.<sup>11</sup>

## 6 Metro Rail Project in Mumbai

Mumbai is an island tapering towards the south. The major commercial and administrative centres have been located at the southern end, in the CBD, whereas much of the residential development has taken place in the suburbs to the north. As a result, the travel pattern of many regular commuters is from north to south. The only mass transit system serving these commuters is the suburban railway, which has three lines – the western, central, and harbour lines – running north to south. However, the railways are extremely overburdened, prompting transport authorities and the government to plan for other mass-transit systems in the city. Moreover, with offices and commercial buildings now coming up in other parts of the city, most notably, in the Bandra Kurla Complex, Andheri Kurla Road (an east-west route), and Malad, travel patterns are changing and there arises a need to increase east-west connectivity.

To address the growing transportation needs of the population, the Government of Maharashtra, through the Mumbai Metropolitan Region Development Authority (MMRDA) – the apex body for planning and coordination of development activities in the Mumbai Metropolitan Region – tried to assess the viability of various mass-transit systems. A study conducted in 1997-2000 by a few consultancy firms recommended a mass-transit corridor from Andheri to Ghatkopar. The study was later updated by MMRDA in 2004. The master plan prepared by the MMRDA lays down three phases of the metro project covering the entire city (see Appendix 1, p 62). The plan also extended the Andheri Ghatkopar section to Versova and identified it as a priority corridor for implementation. In June 2006, the first phase of the Mumbai metro project was inaugurated.

For our model, we consider the VAG metro line since it is the only line, which is under construction and was proposed to be completed by the end of 2013. The VAG line goes from west to east and has a length of 11.07 km. This part analyses the impact of the VAG metro line on property prices.

### 7 The Impact of the VAG Metro Line

For examining the impact of the metro line on the residential prices we introduce the dummy variables  $M\_dist\_0$  to 500,  $M\_dist\_500$  to 1,500, and  $M\_dist\_1,500$  to 2,500 (see equation 2), which measure the distance of 500 metres from the nearest metro station, a range of 500 to 1,500 metres from the nearest metro station, and the range of 1,500 to 2,500 metres from the nearest metro station respectively. The ranges would take into account the effects of varying distances from the metro stations.

$$\begin{aligned} \ln(P) = & \alpha + \beta_1 Cbd\_dist + \beta_2 Prop\_builtup\_amenities \\ & + \beta_3 West + \beta_4 West\_coast + \beta_5 Prop\_slum + \beta_6 Prop\_builtup\_res \\ & + \beta_7 Prop\_builtup\_comm + \beta_8 Prop\_openspace \\ & + \beta_9 Dist\_near\_RSta + \beta_{10} M\_dist\_0 \text{ to } 500 + \beta_{11} M\_dist\_500 \\ & \text{to } 1,500 + \beta_{12} M\_dist\_1,500 \text{ to } 2,500 + \varepsilon \end{aligned} \quad \dots(2)$$

For determining the dummy variables related to distance from metro station, we use GIS to calculate straight line distances from all proposed stations on the VAG metro line to all

**Table 3: Impact of VAG Metro Line**

Variables	(5)
$M\_dist\_0$ to 500	0.047161 (0.077542)
$M\_dist\_500$ to 1,500	0.040435 (0.054779)
$M\_dist\_1,500$ to 2,500	0.011774 (0.059997)
Observations	684
R-square	0.525
Adj R-square	0.516
F-statistic	61.78**

The base model is same as in regression (4) of Table 2. Further, three more dummy variables are added to see the effect of upcoming metro line on log of residential prices. The coefficients and standard errors of variables of the base model do not change by much after including these dummy variables.

Standard errors are in parentheses.

\*\* Significant at 1% level.

metro line the signs are as expected. Moreover, the effect on residential prices declines as we move away from the metro line. However, the impact of these variables on residential prices is not statistically significant. This result requires careful albeit tentative interpretation.

For mass-transit projects such as the metro to have an information impact on residential prices, we require a well functioning real estate market. Mumbai's real estate market suffers distortions due to the stringent regulatory environment. Areas along the VAG corridor are already developed. Since the FSI along the corridor has not been revised as yet, there is little scope for redevelopment and building additional area. As a result, information on an upcoming metro

might not have led to many transactions, and hence would not have affected/showed up in the Ready Reckoner values. Further, the marginal information effect of the upcoming metro could be too small so as to be dwarfed. Once the metro is in operation the study should be repeated and we might see a significant, positive impact of the metro line(s). It is also likely that the extension of metro to peripheries or less developed areas would have a higher impact on prices.

### 8 Limitations and Scope for Further Research

Our analysis relies on the Ready Reckoner for the residential prices generalised over a zone. We do not undertake an analysis at the level of individual transactions, thereby not accounting for the impact of various structural attributes on prices. There is scope to undertake this exercise using unit-level data and prices at which actual transactions have taken place along with the neighbourhood characteristics, externality effects, and distance to CBD and mass-transit networks. This exercise could also be repeated with the use of more refined statistical tools and methodological changes. The same exercise may also be conducted using a polycentric model for Mumbai. Finally, adding variables such as actual FSI consumed (arising out of the FSI regulations) would be useful for empirically determining the impact of regulations on prices.

To repeat, a caveat needs to be borne in mind whilst undertaking any hedonic studies of property prices in developing countries. The severe distortions in the real estate market as well as the incomes and income distribution of the population might act as constraints for people to actually exercise their preferences (Gandhi 2012) and transform them into observable (revealed) choices.

### 9 Conclusions

This paper makes two important contributions to the study of real estate markets in Mumbai. It attempts to identify the crucial factors that affect residential prices in Mumbai and it studies the impact of an upcoming metro line on the property prices in the vicinity. It makes use of sub-zone-level data on residential prices for 2013 and other neighbourhood and distance variables. It finds distance from the CBD, presence of slums, and distance from a railway station to have a negative and significant impact on prices. Sub-zones located in the west, those located along the western coast and those having higher proportion of residential built-up and commercial built-up have statistically significant higher residential prices. On the other hand, presence of open spaces and amenities such as schools and hospitals in the sub-zones has no effect on residential prices. However, the paper does not account for the impact of structural characteristics on house prices.

The paper also finds that the upcoming VAG metro line does not affect residential prices of sub-zones located close to the line. However, this result could change once the metro becomes operational. The experience of tools such as betterment levy in other countries has been unsatisfactory. This is largely due to the considerable difficulty in estimating the

exact incremental impact of any infrastructure development on land values (Peterson 2009: 37). Given this problem and our empirical results, perhaps this is not the opportune time for public organisations to introduce betterment levy for

financing infrastructure projects. Instead a simple one-time value-based development charge levied at the time of granting development permission would be easier to administer and perhaps be more fruitful.

## NOTES

- 1 Mumbai Metropolitan Region Development Authority (MMRDA) Act 1974 empowers MMRDA to levy and collect betterment charge equal to 50% of land value gains attributable to its infrastructure projects. Despite news papers reports (*The Indian Express* 2013) no formal proposal seems to have been made.
- 2 Johann von Thünen was the first to study how rural land rents were affected by access to a central marketplace in 1826 (Arnott and McMillen 2008: 75).
- 3 Some location models make use of a polycentric city, having more than one sub-centres of employment, in order to capture a more realistic urban spatial pattern (see Anas et al 1998). However, Kraus (2008:96) argues that despite the complex urban spatial structures that have emerged it is still useful to assume a monocentric model and McMillen (2008: 128) states that the results derived in the monocentric model would continue to apply for polycentric cities.
- 4 Rinchumphu et al (forthcoming) reviews various studies that use hedonic pricing models and find that the semi-log form is the most used functional form since it is simple to apply and helps estimate the percentage change in the dependent variable due to changes in the independent variables.
- 5 Technically, the value reported in the document of transaction is the basis of stamp duty. Stamp duty in the context of real estate is a kind of tax collected by Government of India. It is payable when any property or contractual transactions are entered into, in India or even abroad. However there was large-scale evasion of stamp duty by under-reporting transaction price. The reported transaction is carried out through payment by cheque and parallel unrecorded payment is made in cash called "black". To overcome the problem of duty evasion in this manner, the government adopted a system of assessing and publishing real property values every year via the Ready Reckoner. The prices in the Ready Reckoner now form the basis of stamp duty irrespective of the recorded value in the transaction document. Although there is general apprehension that Ready Reckoner rates are still lower than the true market values, though the spatial variations captured in it could be considered as credible.
- 6 The distances could also have been calculated along the transport network of the city however since we do not have access to this layer, we calculate distances as straight lines.
- 7 Nariman Point is sub-zone 16 as per the Ready Reckoner and is defined as the Nariman Road Area from Netaji Subhash Road to Churchgate station.
- 8 These maps are available on the official website of the MCGM.
- 9 These Special Planning Areas are the Recreation and Tourism Development Zone at Manori, International Airport, Maharashtra Industrial Development Corporation area at Andheri, Bandra Kurla Complex, Dharavi, Wadala Truck Terminal, Backbay Reclamation Area, and Oshiwara District Centre.
- 10 This exercise has not been done for the Special Planning Area of Manori since it has little residential activity on account of having mangroves and green areas and is thus among the 23 sub-zones excluded from the data set.

- 11 To check for multicollinearity, we estimated the Variance Inflationary Factor (VIF). The VIF is less than 10 (it is 2.102) thus indicating that there is no multicollinearity.

## REFERENCES

- Ahlfeldt, G M (2007): "If Alonso Was Right: Accessibility as Determinant for Attractiveness of Urban Location", *Hamburg Contemporary Economic Discussions*, 12.
- Ahlfeldt, G M and W Maennig (2010): "Impact of Sports Arenas on Land Values: Evidence from Berlin", *The Annals of Regional Science*, 44(2), 205-27.
- Ahlfeldt, G M and N Wendland (2013): "How Polycentric Is a Monocentric City? Centers, Spillovers and Hysteresis", *Journal of Economic Geography*, 13(1), 53-83.
- Alonso, W (1964): *Location and Land Use: Toward a General Theory of Land Rent* (Cambridge, MA: Harvard University Press).
- Anas, A, R Arnott and K A Small (1998): "Urban Spatial Structure", *Journal of Economic Literature*, 36(3), 1426-64.
- Arnott, R and D P McMillen (2008): *A Companion to Urban Economics* (Malden, MA: Blackwell).
- Bolitzer, B and N R Netusil (2000): "The Impact of Open Spaces on Property Values in Portland, Oregon", *Journal of Environmental Management*, 59(3), 185-93.
- Bowes, D R and K R Ihlanfeldt (2001): "Identifying the Impacts of Rail Transit Stations on Residential Property Values", *Journal of Urban Economics*, 50(1), 1-25.
- Brueckner, J (1987): "The Structure of Urban Equilibria: A Unified Treatment of the Mills-Muth Model" in E S Mills (ed.), *Handbook of Urban and Regional Economics*, Vol 2, 821-45.
- Cheshire, P and S Sheppard (1995): "On the Price of Land and the Value of Amenities", *Economica*, 62(246), 247-67.
- Debrezion, G, E Pels and P Rietveld (2007): "The Impact of Railway Stations on Residential and Commercial Property Value: A Meta-Analysis", *The Journal of Real Estate Finance and Economics*, 35(2), 161-80.
- Frank, Knight (2013): *The Wealth Report 2013: The Global Perspective on Prime Property and Wealth* (London: Knight Frank).
- Gandhi, S (2012): "Economics of Affordable Housing in Indian Cities: The Case of Mumbai", *Environment and Urbanisation Asia*, 3(1), 221-35.
- Geoghegan, J (2002): "The Value of Open Spaces in Residential Land Use", *Land Use Policy*, 19(1), 91-98.
- Heikkila, E, P Gordon, J I Kim, R B Peiser, H W Richardson and D Dale-Johnson (1989): "What Happened to the CBD-Distance Gradient? Land Values in a Policentric City", *Environment and Planning A*, 21(2), 221-32.
- Hoyt, W H and S S Rosenthal (1997): "Household Location and Tiebout: Do Families Sort According to Preferences for Locational Amenities?", *Journal of Urban Economics*, 42(2), 159-78.
- Kraus, M (2008): "Monocentric Cities" in R Arnott and D P McMillen (ed.), *A Companion to Urban Economics* (Malden, MA: Blackwell), pp 96-108.
- Kumar, S and S Gupta (2013): *Stamp Duty Ready Reckoner and Market Value of Properties in Mumbai 2013* (Mumbai: The Architects Publishing Corporation of India).

- McMillen, D P (2008): "Testing for Monocentricity" in R Arnott and D P McMillen (ed.), *A Companion to Urban Economics* (Malden, MA: Blackwell), pp 128-40.
- McMillan, D P and J McDonald (2004): "Reaction of House Prices to a New Rapid Transit Line: Chicago's Midway Line, 1983-1999", *Real Estate Economics*, 32(3), 463-86.
- Mills, E S (1972): *Studies in the Structure of the Urban Economy* (Baltimore: Johns Hopkins Press).
- Muth, R F (1969): *Cities and Housing: The Spatial Pattern of Urban Residential Land Use* (Chicago, IL: University of Chicago Press).
- Nallathiga, R (2006): "An Evaluation of the Impact of Density Regulation on Land Markets in Mumbai", *International Real Estate Review*, 9(1), 132-52.
- Oates, W E (1969): "The Effects of Property Taxes and Local Public Spending on Property Values: An Empirical Study of Tax Capitalisation and the Tiebout Hypothesis", *The Journal of Political Economy*, 77(6), 957-71.
- Peterson, G E (2009): *Unlocking Land Values to Finance Urban Infrastructure, Trends and Policy Options No 7, Public-Private Infrastructure Advisory Facility (PIAF)*, World Bank.
- Rinchumphu, D, C Eves and C Susilawati (forthcoming): "Brand Value of Property in Bangkok Metropolitan Region (BMR), Thailand", *International Real Estate Review*.
- Song, Y and G J Knaap (2004): "Measuring the Effects of Mixed Land Uses on Housing Values", *Regional Science and Urban Economics*, 34(6), 663-80.
- Swamy, H (2009): "Impact of Delhi Metro on Real Estate", Conference on Urban Mobility in India - 2009, New Delhi.
- The Economist* (2012): "The Minimum City: Is the World's Weirdest Property Market Strangling the City that Hosts It?", *The Economist*, 9 June.
- The Indian Express* (2013): "MMRDA Will Develop, Sell Plot to Raise Funds", *The Indian Express*, 7 June.
- Tiebout, C M (1956): "A Pure Theory of Local Expenditure", *Journal of Political Economy*, 64(5), 416-24.
- Tiwari, P, K Parikh and J Parikh (1999): "Effective Housing Demand in Mumbai (Bombay) Metropolitan Region", *Urban Studies*, 36(10), 1783-1809.

## Appendix 1: Phases of Metro Railway in Mumbai

Phase I	
Versova-Andheri-Ghatkopar	- 11.07 km
Colaba-Bandra-Charkop	- 38.24 km
Bandra-Kurla-Mankhurd	- 13.37 km
Total	- 62.68 km
Phase II	
Charkop-Dahisar	- 7.5 km
Ghatkopar-Mulund	- 12.4 km
Phase III	
BKC-Kanjur Marg via airport	- 19.5 km
Andheri(E)-Dahisar (east)	- 18 km
Hutatma Chowk-Ghatkopar	- 21.8 km
Sewri-Prabhadevi	- 3.5 km
Total length	146.5 km

Source: MMRDA.