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Impact of proximity to cell phone tower base stations on residential property prices in the City of Johannesburg, South Africa

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Abstract

Purpose – With revolutions in the telecommunication sector having led to wide unprecedented consequences in all facets of human life, this paper aims to examine the relationship between cell phone tower base stations (CPTBSs) and residential property prices within the City of Johannesburg (CoJ), South Africa.

Design/methodology/approach – The authors align their work with global literature and assess how the impact of CPTBSs influences residential property values in South Africa. The authors use a semi-log hedonic pricing model to test the hypothesis that proximity of CPTBSs to residential properties does not account for any variation in residential property prices.

Findings – The results show a significant impact that proximity of CPTBS has on residential property sale prices. However, the impact of CTPBSs' proximity on residential property prices depends on their distance from the residential properties. The closer a residential property is to the CTPBS, the greater the impact that the CTPBS will have on the selling price of the residential property.

Originality/value – With international studies offering mixed findings on the impact of CPTBSs on residential property values, there is limited research on their impact in South Africa. The findings of this study offer crucial insights for the real estate practitioners, property owners, telecommunications companies and the public, providing a nuanced understanding of the relationship between CPTBSs and property values. This research helps property owners understand the effects of CPTBSs on their properties, and it assists property valuers in gauging the impact of CPTBSs on property values.

Keywords South Africa, Impact, Proximity, City of Johannesburg, Cell phone tower base station, Residential property prices

Paper type Research paper

1. Introduction

The surge in cell phone demand has triggered an unprecedented rise in network connectivity, thus leading to a growth of cell phone tower base stations (CPTBSs) globally (Locke and Blomquist, 2016). These CPTBSs, facilitating wireless communication for mobile devices, are integral to the

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transmission of information through ultra-frequency radio waves (Bond and Wang, 2005). In South Africa, the implementation of the 1996 Telecommunication Act marked a significant shift that opened opportunities for new mobile network operators (MNOs) to enter the South African market (Makhaya and Roberts, 2003). This influx of MNOs sparked the expansion of CPTBS infrastructure across the country (GSMA, 2014). This expansion of CPTBS infrastructure has raised questions regarding its impact on residential property prices and densities, particularly in South Africa.

Surprisingly, despite the critical role of CPTBSs in communication, there is limited literature exploring this dynamic in South Africa. Internationally, studies have analyzed the effect of CPTBSs on residential property prices, revealing divergent outcomes. For instance, Bond (2007a, 2007b) found a 15% decrease in property prices within a 300-m radius of CPTBSs in New Zealand, contrasting with Smaqae and Anwar (2022) discovery of a positive impact on property prices in Erbil, Iraq. In the USA, studies by Affuso *et al.* (2018) and Bond and Squires (2007) reported property value decreases within certain proximities to CPTBSs, while Olukolajo *et al.* (2013) in Nigeria observed varied impacts across different neighborhood densities.

The scarcity of South African-specific research on this subject and the limited exploration of CPTBS effects on various residential densities necessitates a comprehensive investigation. Hence, this study aims to fill this void by examining the impact of CPTBS proximity on residential property prices within the City of Johannesburg (CoJ). It also seeks to assess if the findings align with existing international literature, thereby contributing valuable insights to this field. Drawing from prior studies' recommendations, this research will evaluate the impact of the proximity of CPTBSs on property prices in South Africa. By undertaking this study, we aim to bridge the gap in literature, providing localized insights into the relationship between CPTBSs and residential property values.

It is from this backdrop that this study tests the following hypotheses:

H0. The proximity of CPTBSs to residential properties does not account for any variation in residential property prices.

H1. The proximity of CPTBSs to residential properties does account for a variation in residential property prices.

These hypotheses form the foundation for examining the nuanced relationship between CPTBS proximity and residential property values, contributing to a more comprehensive understanding of this dynamic in the context of CoJ, South Africa. This study's findings will help property owners who have telecommunication towers on their properties, owners of neighboring properties, telecommunication companies and the public to understand the implications of having a telecommunication tower on or near their properties. The research findings will raise property owners' consciousness with regard to the CPTBSs' effects and receive improved compensation when there is a loss in their properties' values. It can also be advantageous for property valuators to understand the impact of telecommunication towers on properties.

After the introduction, this paper is structured as follows: Section 2 dwells on related literature on the telecommunication sector, telecommunication infrastructure, what influences the residential property market, theoretical framework and the specific impacts of CPTBSs on residential property prices. Section 3 focuses on data and methods, while Section 4 dwells on presentation and discussion of results. Section 5 offers concluding remarks and possible areas of future research.

2. Literature review

2.1 The history of telecommunication sector: an overview

The advent of telecommunication in 1870 and the innovation of new information and communications technologies (ICTs), such as the internet in 1980s, changed the traditional ways of communication that was considered slow and ineffective (Thornton *et al.*, 2006). The new ICTs have enhanced communication by reducing cost and led to unprecedented consequences in all facets of human life. Castells (2002) further argues that the internet in particular has lowered transaction costs, shortened transactions and short-circuited barriers in a way never experienced in history.

The telecommunication sector involving telecommunications (e.g. fixed, mobile and internet) and broadcasting (e.g. radio) has faced monumental transformation over the years (Stats SA, 2019). Its growth has seen a decline of fixed landline services and the upsurge of cell phones for data and voice services (Makhaya and Roberts, 2003). Now, mobile phones account for two-thirds of mobile connections globally (GSMA, 2014). As such, there has been the continuous construction, and maintenance of the CPTBSs ensures the latest technology to secure dependable network quality and connectivity over large geographical areas (Mpwanya and Letsoalo, 2019).

During the apartheid era [1], South Africa's telecommunication services were distributed unequally among different ethnic groups and income levels, with infrastructure predominantly concentrated in white-dominated neighborhoods. This resulted in a 1% teledensity (number of fixed (landline) telephone connections per 100 people) in black rural areas compared to high teledensity in white regions (Gillwald, 2005). Post- apartheid, the democratic government sought to regulate the industry as a public utility to ensure access, as it implemented anti-monopoly oversight to prevent overpricing (Thornton *et al.*, 2006). In 1991, Telkom was the sole state-owned entity providing telecommunication services, but in 1993, new players like Vodacom and MTN entered the market (Henry, 2019). The 1996 Telecommunication Act (RSA, 1996) aimed at creating efficient services and infrastructure, leading to the entry of additional operators (Gillwald, 2005). In particular, the post-apartheid government prioritized the expansion of telecommunication infrastructure to underserved areas (Hodge, 2004).

The shift from fixed landlines to mobile phones starting around the year 2000 transformed the sector (Makhaya and Roberts, 2003; Henry, 2019). The rise of MNOs and increased cell phone subscribers in South Africa further boosted economic growth (Buys *et al.*, 2009). This growth prompted the proliferation of CPTBSs with South Africa having the highest number in Africa by 2014 (GSMA, 2014). The telecommunication sector's ongoing transformation is driven by the increasing importance of the internet for both business and individual communication (Henry, 2019; Smaqae and Anwar, 2022).

2.2 Types of cell phone tower base stations infrastructure

CPTBSs facilitate the art and science of "communicating" over a distance by telephone, telegraph and radio (RSA, 1996). This follows the transmission, reception and the switching of signals, such as electrical or optical, by wire, fiber or electromagnetic (fields) (i.e. through-the-air) (Thornton, *et al.*, 2006). With communication, receipt and sending of communication information through the diverse channels, key concepts in the above definition, CPTBSs offer two functions: a line of communication and sufficient infrastructure to facilitate communication through various avenues, such as radio, telephone, television and data (Thornton *et al.*, 2006).

Dictated by various governing policies, laws and topographical features, there are various CPTBSs permitted in residential neighborhoods. The height of the various CPTBSs range from 5 to 60 m (Szmigielski and Sobiczewska, 2000). The location and topography of a given area can determine the structure height permitted for a CPTBS (Yahya, 2019). Location is crucial to ensure the best network coverage with little to no interference with other CPTBSs and to avoid triggering environmental harm to the surrounding areas (Bond, 2007a, 2007b).

There are several types of CPTBS infrastructure, comprising monopole, self-supporting/lattice, rooftop antenna, steeple tower, guyed tower and camouflage/palm tree (Yahya, 2019). Plate 1 shows the various CTBPSs. The image on the left in Plate 1 displays the camouflage

Plate 1. Types of CPTBSs

Source: Geocaching (2012), XH Tower (2024) and Jeff (2009), respectively

CPTBS infrastructure. Palm tree/camouflage CPTBS has similar features to a tree. CPTBSs are artificial palm trees and have a limited capacity. The purpose of the camouflage is to blend in with the surrounding area. In addition, the camouflage CPTBS addresses the visual pollution or aesthetics and the visual impact of CPTBSs on the environment (Yahya, 2019).

The image in the middle in Plate 1 presents monopole CPTBS antennas attached to the exterior (XH Tower, 2024). A monopole CPTBS can be either single or armed (Rajapaksa *et al.*, 2018). The CPTBS reduces the visual impact, and its construction timeline is shorter than that of a self-supporting CPTBS (KMB, 2015). Its height varies from 15 to 60 m (Steel in the Air, 2024).

The image on the right in Plate 1 depicts the self-supporting CPTBS (Jeff, 2009). A self-supporting/lattice CPTBS has between three and four legs with an angular base of a steel structure (Rajapaksa *et al.*, 2018). The CPTBS can modify itself to cater for electricity transmission and radio towers. In addition, the self-supporting CPTBS can accommodate intense winds. Its height varies from 30 to 120 m.

2.3 Location and functionality of cell phone tower base stations

The evolution of cell phone technology, spanning from 1G to 5G, has driven the development of CPTBSs, impacting their placement and coverage. As technology advances, the proximity of CPTBSs becomes crucial, with more advanced networks requiring close placement for uninterrupted coverage (Yahya, 2019; Bello, 2007). The coverage area, influenced by factors like population density, communication channels and physical obstructions varies and optimal CPTBS location is vital for maximum capacity operation (Yahya, 2019; Barnes, 1999; Rajapaksa *et al.*, 2018). Interconnected cells are essential for continuous network coverage as users move between them, and the changes from 1G to 5G impact CPTBS infrastructure to support high-speed data transfer, reducing the world into a global village through wireless communication (Filippova and Rehm, 2011). However, this growth poses challenges such as increased demand for land and concerns about electromagnetic field exposure (Olukolajo *et al.*, 2013; Szmigielski and Sobiczewska, 2000). The construction and maintenance of CPTBSs entail prohibitive costs, emphasizing the need for strategic placement to meet evolving telecommunication demands influenced by consumer behavior and technological advancements (Bharadwaj *et al.*, 2020; Filippova and Rehm, 2014).

2.4 Theoretical framework

This paper adopted the hedonic theoretical framework (Rosen, 1974). The hedonic regression analysis estimates the marginal contribution of the individual characteristics to house price. Given that it is challenging to evaluate the price of a house because it has unique features, the hedonic pricing model breaks housing expenditures into individual components. As such, the hedonic regression approach is the most feasible housing market analysis tool. The paper used unbalanced panel data, combining time series and cross-sectional house sales:

$$Y_{it} = \quad \beta_0 + \beta_1 X_{it} + \beta_2 N_{it} + \beta_3 T_{it} + \varepsilon \tag{1}$$

where Y_{it} denotes the house price (and the dependent variable) measured over time t, X_{it} denotes property specific attributes; N_{it} denotes neighborhood specific attributes, T_{it} denotes time-specific attributes, β_0 and β_1–$\beta 3$ are the intercept and slopes, respectively, of the hedonic model to be estimated. ε is the random error term that varies over i and t and i.i.d.

Based on the hedonic regression modeling framework, the property's price is a function of the physical characteristics and external factors – broadly broken into properties-specific structural features, and other neighborhood and environmental features. Structural characteristics include lot size, age, square foot, garage, fireplace, size, beds, baths, swimming and distance (from CTBPS in the present paper). Neighborhood characteristics include location, crime, distance, trees and school district, while environmental include lake view, lake front and ocean view (Sirmans *et al.*, 2005).

2.5 Impacts of cell phone tower base stations on residential property prices

2.5.1 Perceptions about cell phone tower base stations' impact on residential property prices based on primary data. The concern over the impact of CPTBSs on residential properties stems from visual appeal and health and safety concerns related to electromagnetic fields they emit (radiation) (Bond, 2007a, 2007b; Bello, 2007). Most residents believe CPTBSs are a visual disamenity and pose health complications and environmental issues (Szmigielski and Sobiczewska, 2000; Filippova and Rehm, 2011; Randburg Sun, 2017). Communities negatively perceive CPTBSs as reducing property values (Filippova and Rehm, 2011). Bond and Beamish (2005) revealed negative perceptions from future buyers and researchable information on purchasing a property near a CPTBS (Bond and Beamish, 2005). The installation of CPTBSs is a public concern due to the potential health implications and other effects of living near a CPTBS (Bond, 2007a, 2007b).

With that in mind, CPTBSs affect perceptions about property values and trigger fear among the population. Using an opinion survey, Bond and Beamish (2005) investigated residents' perceptions of living close to CPTBSs and how this proximity might affect property values in Christchurch, New Zealand. Ten case studies with all the suburbs having similar living environments (in socio-economic terms) were used, except that the five case studies were areas where a CPBS is located within 300 m, while the latter five case studies were located over 1 km away from any CPTBS. The results indicate that residents who lived close to CPTBSs were less concerned than those who lived 1 km from the infrastructure. Participants in Bond and Beamish's (2005) study discounted the property prices by 10% to 19% for a property close to the CPTBSs. Other authors relying on perception surveys have similarly found respondents discounting residential property prices and expressing concerns about property value, health and aesthetics in relation to the presence of pylons (Bond and Hopkins, 2000; Sims and Dent, 2005).

Aliyu *et al.* (2015) investigated the impact of CPTBSs on residential property values in the Bauchi Metropolis (Nigeria) through transaction sales using a questionnaire and interview surveys. The findings indicate that residential property prices decreased by 15% after construction of CPTBSs within 275 m from the property. Residents prefer to live in neighborhoods without CPTBS to avoid health risks associated with CPTBS. The findings indicate negative perceptions from buyers about living close to CPTBSs. Residents who lived 100 m away from the CPTBSs were not concerned about the CPTBS infrastructure (Aliyu *et al.*, 2015).

Bond's (2007a, 2007b) study in Christchurch, New Zealand, that focused on opinion survey and an econometric analysis of sales transactions found that residents who lived further away from the CPTBSs were more concerned about the health risks, aesthetics and property values than those who lived near the CPTBSs. Respondents preferred a discounted property price or rental of 20% if they lived close to a CPTBS (Bond, 2007a, 2007b).

In Akure town, Nigeria, Olukolajo *et al.* (2013) focused on residents who rented a property within three residential areas with differing densities ranging from high to medium and low. The rentals were located within a 300-m radius of the CPTBSs. From their perception surveys, Olukolajo *et al.* (2013) findings showed that 73% of the respondents had no issues with the presence of the CPTBSs in their neighborhood. The low- and high-density renters ranked good network coverage as a factor for living within the community. Olukolajo *et al.* (2013) also found that residents were concerned about the loss of the aesthetic value of neighboring properties, but this still needs to change the economic value of the properties and rental charges (Olukolajo *et al.*, 2013). Regression analysis findings indicated that the location of the CPTBSs does not affect the property values within high- and medium-density neighborhoods. However, for the low-density neighborhoods, there is a positive relationship between the rental amounts and the CPTBSs (Olukolajo *et al.*, 2013).

Smaqae and Anwar (2022) demonstrated increased selling and rental prices for properties with rooftop antennas in the city of Erbil in the Kurdistan region of Iraq. Their findings from administered questionnaires showed that residents were more aware of health risks caused by CPTBSs, but probably by property owners who lived close to CPTBSs receiving benefits, such as free electricity and free recharging, saw that as adequate trade off (Smaqae and Anwar, 2022).

2.5.2 Impacts of cell phone tower base stations on residential property prices based on secondary data. Locke and Blomquist (2016) found out that residential properties comparable to CPTBSs sold at a discounted price compared to houses located further away from the CPTBSs in Central Kentucky, USA. Using housing data covering a period of 12 years from 2000 to 2011, Locke and Blomquist (2016) found that a residential property was purchased after the construction of the CPTBS, there is a slight decrease in the house sale price, and that decreases declines with distance further away from the CPTBSs (Locke and Blomquist, 2016). Filippova and Rehm (2011, 2014) investigated residential property sales in Aukland's largest territories (Auckland, Manukau, North Shore and Waitakere), and Christchurch, New Zealand, for different periods, respectively. They focused on properties within specific radius distance of cell phone towers located in residential areas in their studies. Controlling for the contribution of other house structural and neighborhood variables, overall, there was no significant impact of CPTBS on residential property prices. However, the authors found a price discount related to the most visually disruptive armed monopoles. The authors explained that the overall insignificant results could be related to the mature plantings, making CPTBS to be camouflaged in the surroundings and thus less noticeable (Filippova and Rehm, 2011, 2014).

Rajapaksa *et al.* (2018) examined the impact of the distance of CPTBS on residential property prices using the market transaction data in Brisbane, Australia. The findings indicate that the distance of CPTBS significantly affects house prices. For example, a 1 m distance from the CPTBS increased the property price by 0.018%. With a dummy variable introduced instead of a direct distance to tower to capture the distance effect, there was a negative impact of the distance from CPTBSs on the property prices within a 150 m radius; the property prices decreased by 20%. Property sale prices within a 200 m radius are highly affected and discounted by 15%. Although several types of CPTBS have different visual disruptiveness for respondents, CPTBSs did not affect the property prices (Rajapaksa *et al.*, 2018).

Bond (2007a, 2007b) investigated the effect of the distance of CPTBSs on residential property prices in Florida, USA. Using hedonic modeling technique, Bond (2007a, 2007b) found that price of a residential property is significantly impacted by proximity to the towers – with a suggested noticeable increase in value of the residential property as distance increases from the tower.

Brandt and Maennig (2012) evaluated the impact of CPTBSs on prices of condominiums in Hamburg metropolis, Germany. Distinguishing between grouped CPTBSs and individual CPTBSs, they found that only immediate proximity to groups of antenna masts is perceived as harmful to health by residents of nearby condominiums in relation to a group of masts. There was no significant impact from individual CPTBSs (Brandt and Maennig, 2012).

Affuso *et al.* (2018) examined the impact of the proximity of CPTBSs on residential property prices for the period 1999 and 2015 in Mobile County, AL, USA, using hedonic spatial autoregressive model. The authors considered CPTBSs that were visible and invisible with a specified radius for properties sold after the construction of the CPTBSs. The authors found that property prices decreased if the CPTBS was visible from a distance. Specifically, the findings indicate a discount of 2.46% to 9.78% for residential properties within a radius of 0.72 km (Affuso *et al.*, 2018).

3. Study area, data and methods

3.1 Study area and unit of analysis

Based on the availability of data on residential property prices, the study area covered the residential suburbs in the CoJ, South Africa (Figure 1). In the government structure of South Africa, there are district municipalities, metropolitan municipalities, local municipalities, wards and sub-places. As shown in the inset of Figure 1, CoJ is one of the three metropolitan municipalities in Gauteng province and the largest in South Africa. As such, it is in the CoJ that one finds more telecommunication infrastructure, and thus a fertile ground to test the impacts of CPTBSs on residential property prices. The study considered all the suburbs spread across Regions A–G.

The unit of analysis for this study was residential suburbs with the presence of CPTBSs, as the study was concerned with the distance of properties from the CPTBSs. To determine the distance, a radius from 0 to 1,000 m, increasing by 250 m was chosen, hence the distances 250, 500, 750 and 1,000 m from CPTBSs. Various studies have used distance radii to determine the impact of proximity of HVOLTs, such as Hamilton and Schwann (1995), who used 100 and 200 m distances, as did Strand and Vågnes (2001); Reichert (1997), who used four 2,250 ft (658 m) concentric zones; Colwell *et al.* (1990), who used 50 ft (15 m), 200 ft (60 m) and more than 200 ft (60 m); and Bond and Hopkins (2000) and des Rosiers (2002), who used 50 m (165 ft) concentric zones (Bond, 2007a, 2007b).

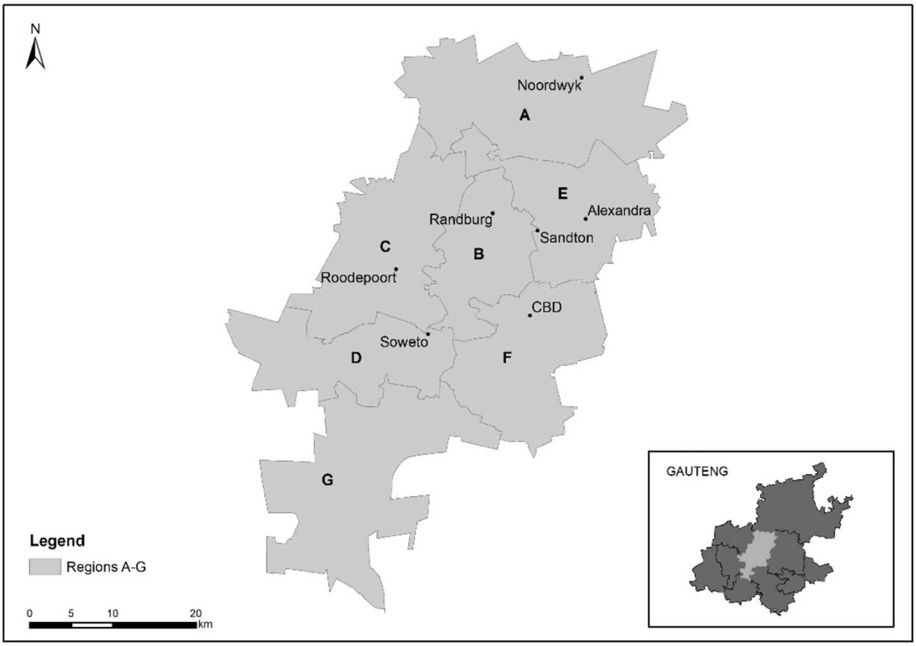


Figure 1. Location of suburbs across different regions in the CoJ, South Africa

Source: Authors' own creation

The study only considered residential suburbs with CPTBSs from the year 2010 to 2020. Affuso *et al.* (2018) considered a visibility study to verify the location of the CPTBSs. They assumed that the spatial correlation between property values and tower locations affects the value of a property. If the CPTBS is visible from other properties, then it can influence the neighboring properties' values. Therefore, CPTBSs that are further yet visible from a property have the potential to affect the property's value. The Haversine distance formula calculates the distance from the residential property to the closest CPTBS. However, for the present study, the Euclidean distance formula calculated the distance between the residential property (centroid based on the sub-place level) and the CPTBS. The Euclidean distance calculates the distance between two points. Equation (2) is the Euclidean distance formula (Cuemath, 2024). Equation (2) determines the distance between the residential property (centroid) and the CPTBS for the current study:

$$d = \sqrt{(x_2 + x_1)^2 - (y_2 - y_1)^2}, \tag{2}$$

where (x_1, y_1) are the coordinates of the first point, (x_2, y_2) are the coordinates of the second point and d is the distance between (x_1, y_1) and (x_2, y_2).

3.2 Data

Following an extensive review of existing literature (see Section 2.6) and guided by the theoretical framework, the paper used residential house prices and other data obtained from various sources. The following data were considered for the study:

- Adjusted house sale prices – The property sale transaction data were obtained from Lightstone Property Ltd covered 2010 to 2020. The property sale prices were deflated by using the consumer price index (CPI) with a base year of 2015. This was needed as time affects the overall residential property sale. House sales data had other structural and neighborhood characteristics – property density type (single-dwelling homes (FH) or sectional-title flats (SS), property size, suburb, town, municipality, year the property sold and numbers of bathrooms and bedrooms).
- Distance of CPTBS from residential properties – As one of the key variables in the study, it was calculated as the distance from the suburb centroid to the nearest CPTBS using nearest analysis tool in ArcGIS software version 10.8.2 (ESRI, 2023), as depicted by equation (2), the Euclidean distance equation. The suburb centroids were used because specific residential address were not available. This was feasible because suburbs are small in sizes, and the centroid would be a good distance proxy. The CPTBS data, which were clipped to the CoJ, were obtained from the South African Civil Aviation Authority (SACAA) website. SACAA publishes all applications for infrastructure with a height that can cause interference with aviation communication. The SACAA data are categorized based on the type of infrastructure. The CPTBS data were filtered from the SACAA data to obtain the CPTBS coordinates. The data cleaning exercise ensured that CPTBS coordinates duplicates were corrected and only singly captured CPTBS data were used in the study. Confirmed through a manual check in Google Earth, the final CTPBS data had the following attributes: location (commercial, industrial or residential location), application status, CPTBS type, the year CPTBS was constructed (as in Filippova and Rehm, 2014). The data focused on CPTBSs constructed before 2010 and not later than 2019, to coincide with the available house sales data that covered 2010–2020 (Rajapaksa *et al.*, 2018). The residential property prices before and after the construction of CPTBSs are crucial to one’s understanding of the impact of CPTBSs on residential property prices and prices of the surrounding properties. The distance variable was captured in radii of 0–250 m, 251–500 m, 501–750 m and 751–1,000 m.
- Crime data – Neighborhood crime is postulated to exert an impact on residential property prices (Ihlanfeldt and Mayock, 2010). Crime data were extracted from Quantec (EasyData, 2023), which captures crime statistics as announced by the South African Police Services (SAPS).
- Income – The income variable from EasyData (2023) was measured as household disposable income. It is hypothesized that as income increases following economic growth, for instance, so does the number of people who are able to budget for housing demand. Several scholars agree that household income is a major determinant of housing affordability, thus the supply- and demand-side of the housing market (Bajari and Kahn, 2005).
- The number of unemployed – Unemployment has a dampening effect on housing demand as it causes household income to decline. The number of the data was extracted from Quantec (EasyData, 2023).
- Prime lending rate (%) – This rate related to the South African Reserve Bank’s repo rate and is anticipated that higher prime lending rate makes the cost of home loans expensive, thus dampening sales.
- Year dummies – m–1 year dummies were included in the panel model to control for time or trend effects.

- Residential density – 0 if it is a freehold title. 1 if it is a sectional title.
- D* – a dummy = 1 if property sale occurs after CPTBS construction; 0 otherwise.

3.3 *Hedonic modeling*

A semi-log hedonic pricing model was estimated to examine the impact of CPTBSs on residential property prices [equation (3)]. The dependent variable is the adjusted house sale price, and the independent variables include property structural and neighborhood attributes:

$$\begin{aligned} In(\text{Price})_{it} = {} & \beta_0 + \beta_1 \mathit{lnDistance}\ (\mathit{or\ Inverse\ of\ lnDistance}) + \beta_2 \mathit{Interaction} \\ & + \beta_3 \mathit{Bedrooms} + \beta_4 \mathit{Beds\ square} + \beta_5 \mathit{Bathrooms} + \beta_6 \mathit{Area} \\ & + \beta_6 \text{Residentialdensity} + \beta_7 D^* + \beta_8 \mathit{lnCrime} + \beta_9 \mathit{lnlabour} + \mathit{lnincome} \\ & + \beta_{11} \mathit{Primelendingrate} + \beta_{12} \mathit{Saleyeardummy}_i + e_{it} \end{aligned} \tag{3}$$

where $In(Price)_{it}$ is the sale price for residential property i in time t; $Saleyeardummy_i$ is m-1 dummies for sale years, for $i = 1$–10 (i.e. 2011 through to 2020); ε is the random error term that varies over i and t as well as i.i.d.; $\beta_0 - \beta_{11}$ are estimated regression coefficients of explanatory variables; and β_{12} allowing for m-1 year dummy coefficients as described in Table 1. The excluded dummy variables were used as base year or reference group(s). The adjusted house sale price and some of the explanatory variables were log-transformed because they were skewed – this was necessary as the regression analysis is based on the normality assumption. Data were analyzed in Stata 17.

4. Results and discussion

4.1 *Spatial analysis*

After cleaning the SACAA data that comprised of masts at various statuses, a total of 1,195 masts were identified to have been constructed. A majority of the CPTBSs were constructed before 2010, with the highest numbers for all the CPTBS types. Out of the 1,195 constructed masts, the camouflage/palm tree was the most constructed type of CPTBS in the CoJ (750), accounting for 63% of all CPTBSs, followed by the monopole CPTBS at 311 (26%). Finally, the number of lattices CPTBSs constructed in the CoJ was 127 (11%).

Figure 2 depicts the constructed CPTBSs across the CoJ's suburbs and the centroids for each of the suburbs. The figure displays the CPTBSs constructed before 2010 to 2023, where one can observe an even distribution of the CPTBSs throughout the suburbs. The property data excluded physical addresses and erf descriptions of the properties sold from 2010 to 2020. The red dots represent centroids in each of the suburbs (defined by Statistics South Africa as a subplace). Figure 2 indicates that there are multiple CPTBSs in each centroid. The majority of the CPTBSs catered for the central suburbs in the CoJ.

Figure 3 illustrates the radius of the centroids from 0 to 1,000 m. The centroids had four ranges of radii from the CPTBSs of 0–250 m (D1), 251–500 m (D2), 501–750 m (D3) and 751–1,000 m (D4); only these CPTBSs included in the radius formed part of this study. Distance 0–250 m was the control group, and the radii increased by 250 m until 1,000 m. In some instances, there are multiple CPTBSs within one centroid radius. The distance from the centroid to the nearest CPTBS was calculated using the near analysis on ArcMap software version 10.8.2, where the input variable is the centroids, and the output is the CPTBSs.

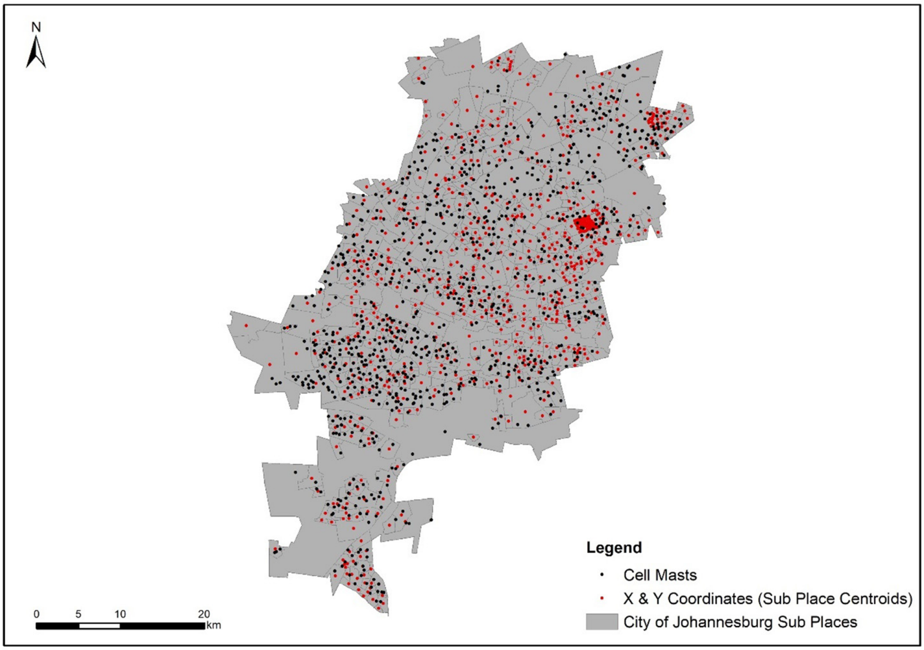
Table 1.
Description of model variables used in the study

Variables	Description
Dependent variable	
Adjusted property price	Amount in rands
Independent variables	
Structural variables	
Plot area	Plot area size in sq m
Bedrooms	Number of bedrooms
Bathrooms	Number of bathrooms
Residential density	0 if it is a single freestanding (freehold title). 1 if it is a sectional flat (sectional title, SS)
D*	1 if property sale occurs after CTPBS construction, 0 otherwise
Neighborhood variables	
Log of distances in each of the four radii (i.e. of 0–250 m, 251–500 m, 501–750 m and 751–1,000 m)	Specific distance in m in relation to each of the residential property to the CPTBSs in each of the radii
Interaction	D* x lndistance
lnCrime	Log of number of crimes
lnlabor	Log of number of the unemployed
lnIncome	Log of amount of household income in rands
Prime lending rate	The interest rate at which banks lend to customers
Sale year of the property	
2010	Defined as base year – excluded in the estimation
2011	0 if sales occur before 2011. 1 if sales occur in 2011
2012	0 if sales occur before 2012. 1 if sales occur in 2012
2013	0 if sales occur before 2013. 1 if sales occur in 2013
2014	0 if sales occur before 2014. 1 if sales occur in 2014
2015	0 if sales occur before 2015. 1 if sales occur in 2015
2016	0 if sales occur before 2016. 1 if sales occur in 2016
2017	0 if sales occur before 2017. 1 if sales occur in 2017
2018	0 if sales occur before 2018. 1 if sales occur in 2018
2019	0 if sales occur before 2019. 1 if sales occur in 2019
2020	0 if sales occur before 2020. 1 if sales occur in 2020

Source: Authors' own creation

4.2 Empirical analysis

4.2.1 Descriptive analysis. Table 2 presents the descriptive statistics from a sample of 79,691 observations obtained after cleaning of the data (Table 1 for all model variables) from Lightstone Property Limited. Lightstone is a private company that supplies data in bulk for various uses as requested by clients. The statistics are given for the full sample and for the proximity categories (0–250 m, 251–500 m, 501–750 m and 751–1,000 m). The logged averages were (13.71, 13.37, 13.88, 13.78 and 14.00) for the adjusted property price, (5.26, 5.30, 5.18, 5.37 and 5.37) for the property size, (1.73, 1.54, 1.81, 1.82 and 1.84) for the number of bedrooms and (1.18, 0.98, 1.26, 1.25 and 1.30) for the number of bathrooms. The averages of distances from the CPTBSs were 6.01 for the full sample, 5.20 for those that ranged from 0–250 m, 5.95 for 251–500 m, 6.38 for 501–750 m and 6.75 for 751–1,000 m. The average logs were (12.05, 12.20, 11.96, 12.00 and 11.98) for crime, (10.99, 10.99, 10.97, 10.98, 11.06) for household income, (13.36, 13.58, 13.24, 13.30 and 13.26) for the number of unemployed people



Source: Authors' own creation

Figure 2. Constructed CPTBSs and centroids in the CoJ

(labor) and (9.71, 9.66, 9.72, 9.77 and 9.74) for the lending rate. The standard deviations were all below the averages.

4.2.2 Correlation analysis. Table 3 presents correlations between the model variables in this paper. The number of bedrooms and the property size have the highest correlation that is statistically significant, followed by the number of bathrooms, sale prices, distance from the CPTBSs, the number of unemployed people and crime in logs. The adjusted price is positive and statistically significantly correlated with the size of the property, the number of beds, the number of bathrooms, the general distance from the CPTBSs, the single-family home property density and the prime lending rate. Whereas, crime, income and unemployment (ln labor) are negatively correlated with the log of adjusted price. Income was expected to be positively correlated with price, contrary to our finding here. This could be due to estimation error, or sampling problem. Among all variables, there is no severe collinearity, which could pose a problem during estimating the regression results.

4.2.3 Hedonic analysis. Table 4 presents estimation results obtained by estimating the effect that CPTBS proximity, which was the variable of interest, has on the residential property prices in the CoJ suburbs. The use of 250 m distance increment allows for a more adequate "microspatial" study (des Rosiers, 2002). Sections 4.2.3.1 and 4.3.2.2 present the hedonic model results for the log of distance and the hedonic model results for the inverse of the log of distances 0–250 m, 251–500 m, 501–750 m, 751–1,000 m, respectively. In both Sections 4.2.3.1 and 4.2.3.2, all the property-specific structural and neighborhood variables are included as shown in Table 4. Table 4 presents the OLS for each of the sub-samples defined by distance of 0–250 m (Column 1), 251–500 m (Column 2), 501–750 m (Column 3)

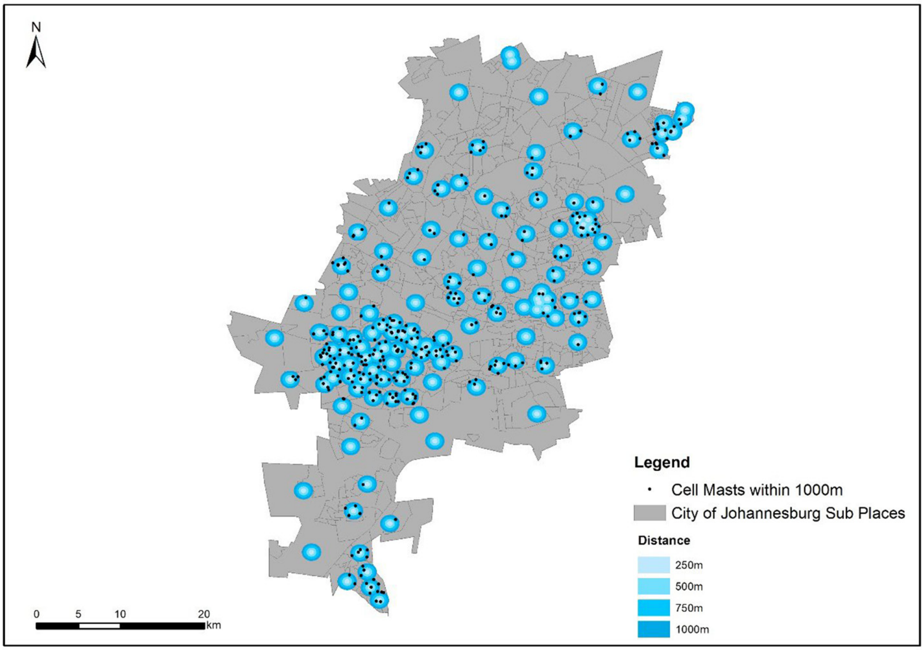


Figure 3. Distance from centroids increasing by 250 m

Source: Authors' own creation

Table 2. Descriptive statistics

Variable	Full sample Mean	Full sample SD	Sample 1 (0–250 m) Mean	Sample 1 (0–250 m) SD	Sample 2 (251–500 m) Mean	Sample 2 (251–500 m) SD	Sample 3 (501–750 m) Mean	Sample 3 (501–750 m) SD	Sample 4 (751–1,000 m) Mean	Sample 4 (751–1,000 m) SD
lnPrice	13.71	0.717	13.37	0.744	13.88	0.630	13.78	0.730	14.00	0.528
Beds	1.734	1.483	1.548	1.438	1.812	1.486	1.823	1.514	1.838	1.503
Bath	1.175	1.134	0.981	1.042	1.261	1.165	1.248	1.154	1.299	1.169
lnIncome	10.99	0.254	10.99	0.214	10.97	0.281	10.98	0.250	11.06	0.256
lnLabor	13.36	0.434	13.58	0.566	13.24	0.289	13.30	0.258	13.26	0.317
lnSize	5.262	1.092	5.301	0.993	5.184	1.100	5.367	1.193	5.340	1.160
lnCrime	12.05	0.431	12.20	0.638	11.96	0.228	12.00	0.198	11.98	0.286
lnDistance	6.005	0.458	5.194	0.291	5.949	0.171	6.375	0.0985	6.745	0.137
Density (SH)	0.428	0.495	0.368	0.482	0.477	0.499	0.406	0.491	0.427	0.495
D*	0.780	0.414	0.733	0.442	0.808	0.394	0.783	0.412	0.798	0.402
Prime lending rate	9.711	0.931	9.663	0.894	9.718	0.943	9.766	0.960	9.744	0.941

Source: Authors' own creation

and 751–1,000 m (Column 4). The sample size varies for each sub-sample because the control variables (i.e. structural and neighborhood variables) had missing values in some cases.

The model fitting was stable across all models, with the lowest variation of 41% explained (see Adj R^2 in Table 4). Most of the regression coefficients are statistically significant, have expected signs and are in the expected direction. The reported results control for heteroscedasticity and multicollinearity in OLS. The variance inflation

Table 3.
Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) lnPrice	1.000									
(2) lnSize	0.348*	1.000								
(3) Beds	0.264*	0.386*	1.000							
(4) Bath	0.324*	0.324*	0.824*	1.000						
(5) lnDistance	0.153*	0.029*	0.015*	0.037*	1.000					
(6) lnCrime	–0.242*	0.121*	–0.041*	–0.062*	–0.042*	1.000				
(7) Density (SH)	0.040*	–0.007	0.004	0.016*	0.057*	–0.004	1.000			
(8) lnIncome	–0.031*	0.015*	–0.021*	–0.027*	0.057*	0.152*	–0.001	1.000		
(9) lnLabor	–0.266*	0.135*	–0.079*	–0.115*	–0.100*	0.447*	–0.062*	0.143*	1.000	
(10) Prime lending rate	0.034*	0.030*	0.022*	0.015*	0.010*	0.132*	0.024*	–0.022*	–0.048*	1.000

Notes: $***p < 0.01$; $**p < 0.05$; $*p < 0.1$
Source: Authors' own creation

coefficients were all below 5, thus no potential multicollinearity problem in the estimated models.

4.2.3.1 Proximity of cell phone tower base stations to residential properties – with the log of distance as the key variable. Column 1 (in Table 4) shows OLS results of the effect of CPTBS proximity on residential property prices for 0–250 m. The estimated results show positive and statistically significant coefficients. This implies that for every 1% increase in distance from a CPTBS, the residential property price increases by 1.14%. In terms of CPTBS proximity of 251–500 m, presented in Column 2, the coefficient remains positive and significant; however, the size of the coefficient drops significantly to 0.52%. The results concur with those of Bond and Wang (2005), Affuso *et al.* (2018) and Rajapaksa *et al.* (2018) who suggest that the location of CPTBS has a significant effect on residential property prices. However, these results differ from Brandt and Maennig's (2012) findings who found a negative coefficient within a radius of 100 m from the CPTBS. Filippova and Rehm (2014) found no statistically significant results in their study.

For CPTBS proximity of 501–750 m, the distance is negative and statistically significant, implying that for every 1% increase distance from the CPTBS, residential property prices decrease by 2.58%. Affuso *et al.* (2018) obtained similar results for residential properties within the 0.03–0.72 km in their study in the USA. Finally, for residential properties, which were within 751–1,000 m radius of the CPTBS, the residential property prices decrease by 3.83% for every 1% increase in the distances from the CTPBS. The results clearly show CPTBS negatively influences adjacent property values, although the effect tends to diminish as the distance from the CTPBS increases from the property. This finding validates the conclusion reached by Filippova and Rehm's (2014) study in New Zealand with regard to proximity effect on residential property value.

In the case of the dummy (D*), which took a value of 1 if the property sale occurred after the CPTBS construction, the results are also interesting. D* captured the impact of the CPTBS on the value of property. Its coefficients with the radii of 0–250 m and 251–500 m are positive and significant in explaining residential property prices. This means that for residential properties that were sold after the construction of the CTPBS and are within the radii of 0–250 m and 251–500 m, their prices increased by 5.57% and 4.67%, respectively, compared to those that were not within the above distance bands. Affuso *et al.* (2018) obtained similar results for properties within the 0.03–0.72 km in their study. However, the

Table 4. Estimation results adjusted sale price regressed on distance categories (D1–D4) and other control variables

Variables	(1) 0–250 m	(2) 251 m–500 m	(3) 501 m–750 m	(4) 751 m–1000 m
lnSize	0.262*** (0.006)	0.250*** (0.003)	0.267*** (0.004)	0.203*** (0.006)
Beds	–0.121*** (0.010)	–0.071*** (0.005)	–0.005 (0.007)	0.005 (0.011)
Beds square	0.010*** (0.001)	0.011*** (0.001)	0.004*** (0.001)	0.006*** (0.002)
Bath	0.225*** (0.009)	0.091*** (0.004)	0.070*** (0.007)	0.042*** (0.009)
lnCrime	–0.100*** (0.035)	–0.385*** (0.013)	–0.300*** (0.034)	–0.240*** (0.027)
Density (SH)	–0.065*** (0.012)	0.125*** (0.005)	–0.072*** (0.011)	–0.081*** (0.013)
lnIncome	–0.790*** (0.054)	0.084*** (0.010)	0.321*** (0.022)	0.511*** (0.042)
lnLabor	0.080*** (0.023)	–0.290*** (0.009)	–0.206*** (0.025)	–0.888*** (0.036)
Prime lending rate	–0.341*** (0.019)	–0.201*** (0.007)	–0.099*** (0.014)	–0.276*** (0.017)
D*	5.565*** (0.310)	4.667*** (0.213)	–16.300*** (0.856)	–12.226*** (0.985)
lnDistance	1.141*** (0.058)	0.517*** (0.031)	–2.578*** (0.117)	–3.828*** (0.178)
Interaction (ln Distance x D*)	–1.053*** (0.060)	–0.793*** (0.036)	2.608*** (0.134)	1.777*** (0.145)
2011 dummy	–0.516*** (0.032)	–0.437*** (0.013)	–0.249*** (0.025)	–0.489*** (0.031)
2012 dummy	–0.818*** (0.045)	–0.577*** (0.018)	–0.320*** (0.035)	–0.726*** (0.041)
2013 dummy	–0.739*** (0.049)	–0.602*** (0.019)	–0.328*** (0.037)	–0.717*** (0.043)
2014 dummy	–0.662*** (0.052)	–0.540*** (0.020)	–0.319*** (0.041)	–0.714*** (0.047)
2015 dummy	–0.490*** (0.042)	–0.387*** (0.016)	–0.130*** (0.034)	–0.482*** (0.038)
2016 dummy	–0.295*** (0.035)	–0.286*** (0.015)	–0.066** (0.029)	–0.404*** (0.034)
2017 dummy	0.107*** (0.026)	–0.005 (0.011)	0.048** (0.021)	–0.070*** (0.024)
2018 dummy	0.036 (0.026)	–0.019* (0.011)	0.102*** (0.020)	–0.013 (0.023)
Constant	18.485*** (0.770)	19.072*** (0.292)	32.163*** (0.804)	50.861*** (1.226)
Observations	9,173	32,805	10,472	3,544
R^2	0.435	0.405	0.434	0.547
Adj. R^2	0.434	0.405	0.433	0.544

Notes: Standard errors in parentheses; ***$p < 0.01$; **$p < 0.05$; *$p < 0.10$; the year dummy for 2010 was used as a base year, while year dummies for 2019 and 2020 were excluded because of multicollinearity
Source: Authors' own creation

estimated results of D* for properties located within 501–750 m and 751–1,000 m (presented in Columns 3 and 4 in Table 4) from the closest CTPBS show a negative and statistically significant relationship between residential property prices.

The findings of this study show that residential property sale prices purchased from 2011 to 2016 have negative and statistically significant regression coefficients within all sub-sample bands (i.e. 0–250 m, 251–500 m, 501–750 m and 751–1,000 m), compared to the baseline year of 2010. Conversely, properties purchased in 2017 and within the 0–250 m, 501–750 m have positive and statistically significant regression coefficients compared to the base year (2010). However, in 2017, properties within the 751–1,000 m from the closest CTPBS (Column 4), have negative and statistically significant regression coefficients compared to those in the base year (2010). The same estimate is statistically different from zero for those properties located within 251–500 m and 501–750 m in 2018. Affuso *et al.* (2018) and Rajapaksa *et al.* (2018) obtained similar results in their study related to time effect on residential property prices.

The interaction variable – defined as the product of log of distance and the dummy (D*) variables – also suggests a decrease in the price of property sold after CPTBS construction for those properties in the 0–250 m and 251–500 m proximity distance bands. However, as the distance from the CTPBS increases, the effects become positive and significant. The *t*-statistics associated with this interaction provide strong evidence that the price of residential properties, while highly associated with the site and structural characteristics may be significantly impacted by proximity to CTPBS. As anticipated, the number of bathrooms, bedrooms and household income are vital drivers of residential property prices. Nevertheless, it appears that the effect of these variables is relative to property location with respect to the CPTBS (Brännlund and Kriström, 2015; Locke and Blomquist, 2016).

For the size of the property (InSize) within the four sub-samples, the estimates are positive and statistically significant (Columns 1, 2, 3 and 4 in Table 4). Regarding the number of bedrooms (Beds) in the four sub-samples, the coefficients are negative and statistically significant for the properties located within (0–250 m; 251–500 m) (Columns 1, 2 in Table 4). For the square of bedrooms, which captures the non-linearity impact of the number of bedrooms on residential property value, the coefficient is positive and statistically significant, although the magnitudes of the coefficient are small. In terms of the number of bathrooms (Bath) within the four sub-samples, the estimated results are positive and statistically significant for every one-unit increase in the number of bathrooms in a property (Columns 1, 2, 3 and 4 in Table 4). Filippova and Rehm (2014) obtained similar results for the number of beds and property size.

The effect of household income (lnIncome) on residential property prices within the four sub-samples is as follows. The closer the property is to the CTPBS, the more household income has a negative effect on property value (Column 1 in Table 4). However, as the distance from the CTPBS increases, household income becomes positive and statistically significant in driving the residential property prices (see Columns 2, 3 and 4 in Table 4). Rajapaksa *et al.* (2018) obtained similar results for income, the size of the property, the number of beds and bathrooms in their study. In terms of the effect of unemployment (lnLabor), the results show that the closer a residential property is to the CTPBS, unemployment has a positive and significant effect on property value, which is unexpected (Column 1 in Table 4). In terms of the number of crimes recorded (lnCrime) within the four sub-samples, the estimated results show negative and statistically significant coefficients for property size located within 0–250 m, 251–500 m, 501–750 m and 751–1,000 m (Columns 1, 2, 3 and 4 in Table 4).

With sectional flats residential properties within the 0–250 m, 501–750 m and 751–1,000 m radius from the CTPBS, the regression coefficients are negative and statistically significant. Given the expectation that lending cost adversely affects property prices, in this study, the prime lending regression coefficients are negative and statistically significant across all estimated models.

4.2.3.2 Proximity of cell phone tower base stations to residential properties with inverse of the log of distance. To ensure consistency and reliability of the results, the estimation was performed with the inverse of the log of distance and the interaction variables (defined as D*x Inverse of lndistance). Broadly, Table 5 presents results where the regression coefficients of most of the explanatory variables maintain the same signs and magnitudes. However, the regression coefficients for the inverse of log of distance and the interaction variable have their signs changing from either positive to negative or negative to positive, respectively. Property size, number of bedrooms, number of bathrooms, number of crimes recorded, property density, income level, unemployment rate, prime lending rate and the time effect variables are statistically significant and maintained expected signs as discussed in Section 4.2.3.1.

As shown by the variation in the magnitude from Column 1 to 4 in Table 5, coefficient sizes show that proximity to CTPBS has a significant influence on residential property prices. Regarding distance, the results show that the increase in distance from the CTPBS reduces the residential property sale price. Properties within the 0–500 m range of CTPBS

Table 5.
Estimation results with inverse of log of distance for D1–D4

Variables	(1) 0–250 m	(2) 251–500 m	(3) 501–750 m	(4) 751–1,000 m
lnSize	0.254*** (0.006)	0.250*** (0.003)	0.268*** (0.004)	0.207*** (0.006)
Beds	–0.125*** (0.010)	–0.072*** (0.005)	–0.004 (0.007)	0.005 (0.011)
Beds square	0.010*** (0.002)	0.011*** (0.001)	0.003*** (0.001)	0.006*** (0.002)
Bath	0.229*** (0.009)	0.092*** (0.004)	0.070*** (0.007)	0.043*** (0.009)
lnCrime	–0.070** (0.034)	–0.389*** (0.013)	–0.298*** (0.034)	–0.239*** (0.027)
Density (SH)	–0.075*** (0.012)	0.128*** (0.005)	–0.071*** (0.011)	–0.080*** (0.013)
lnIncome	–1.036*** (0.047)	0.094*** (0.010)	0.311*** (0.022)	0.512*** (0.041)
lnLabor	0.115*** (0.023)	–0.289*** (0.009)	–0.204*** (0.025)	–0.921*** (0.036)
Prime lending rate	–0.379*** (0.018)	–0.199*** (0.007)	–0.099*** (0.014)	–0.281*** (0.017)
D*	4.435*** (0.265)	4.444*** (0.217)	–15.466*** (0.811)	–13.073*** (1.001)
Inverse	–122.305*** (6.404)	–170.453*** (11.211)	1,448.218*** (64.830)	3,415.128*** (155.392)
Interaction (Inverse x D*)	–0.832*** (0.051)	–0.756*** (0.036)	2.476*** (0.127)	1.900*** (0.147)
2011 dummy	–0.571*** (0.031)	–0.435*** (0.013)	–0.250*** (0.025)	–0.498*** (0.030)
2012 dummy	–0.896*** (0.045)	–0.575*** (0.018)	–0.321*** (0.035)	–0.738*** (0.040)
2013 dummy	–0.820*** (0.048)	–0.599*** (0.019)	–0.329*** (0.037)	–0.732*** (0.042)
2014 dummy	–0.769*** (0.051)	–0.536*** (0.020)	–0.321*** (0.041)	–0.728*** (0.047)
2015 dummy	–0.568*** (0.041)	–0.384*** (0.016)	–0.131*** (0.034)	–0.490*** (0.038)
2016 dummy	–0.351*** (0.035)	–0.285*** (0.015)	–0.066** (0.029)	–0.412*** (0.034)
2017 dummy	0.081*** (0.026)	–0.002 (0.011)	0.049** (0.021)	–0.071*** (0.023)
2018 dummy	0.034 (0.026)	–0.018 (0.011)	0.105*** (0.020)	–0.012 (0.023)
Constant	27.426*** (0.581)	22.532*** (0.212)	13.314*** (0.548)	21.475*** (0.565)
Observations	9,173	32,805	10,472	3,544
R^2 Adj. R^2	0.434 0.433	0.404 0.404	0.435 0.433	0.549 0.546

Notes: Standard errors in parentheses; $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.10$; the year dummy for 2010 was used as a base year, while year dummies for 2019 and 2020 were excluded because of multicollinearity
Source: Authors' own creation

tend to have reduced sale prices, while those situated beyond 500 m, specifically within the 501–1000 m range, show higher and statistically significant residential property sale prices. Locke and Blomquist (2016) obtained similar results when they used the inverse of distance instead of distance in their study in the USA.

In case of the dummy (D*), which took a value of 1 if the property sale occurred after the CPTBS construction, the results are also interesting. D* variable captured the impact of the CPTBS on value of property sold after CPTBS construction relative to value of property before the construction of the CPTBS. The coefficients with the radii of (0–250 m) and (251–500 m) are positive and significant, implying that the construction of CTPBS impacted positively residential property value prices relative to when CPTBS were not constructed. Affuso *et al.* (2018) obtained similar results for properties within 0.03 km-0.72 km in their study. However, the model estimated results of D* of dummy for properties located within 501–750 m and 751–1,000 m (presented in Columns 3 and 4 in Table 5) show that the construction of CTPBS impacted negatively residential property value prices relative to when CPTBS were not constructed.

5. Conclusion

The shift from fixed landlines to mobile phones starting around the year 2000 transformed the telecommunication sector and has led to unprecedented consequences in all facets of human life. These include lowering of transaction costs, shortening of transactions and short-circuiting of barriers in a way never experienced before in history.

This paper set out to test whether proximity of CPTBSs to residential properties account for any variation in the residential property prices in the CoJ, South Africa. The results show a significant impact on the proximity of CPTBS to the residential property sale prices. However, the impact of CTPBSs on residential property prices depends on the distance of such CTPBSs from the residential properties. The closer to the CTPBSs a residential property is, the higher the impact that CTPBSs has on its residential sale price. In other words, the impact of proximity of CTPBBs on the residential sale prices seems to decrease as the distance from the CPTBSs increases. This was evident from the estimation results that was based on different interval distance bands of 0–250 m, 251–500 m, 501–750 m and 751–1,000 m.

The paper has provided a nuanced understanding of the relationship between CPTBSs' proximity and residential property values. Such knowledge will help property owners who have CPTBSs on their properties, their neighbors, telecommunication companies and the public to understand the implications of having CPTBS on or near their properties. Property owners will become conscious of the CPTBSs' effects and receive improved compensation when there is a loss in their properties' values. It can also be advantageous for property valuers to understand the impact of CPTBSs and related towers on property values.

Possible future research lends itself. First, future research can include a visibility study to assess whether the visibility of and distance from the CPTBSs can affect the property prices, as suggested by previous studies. Second, the centroids radii can be increased to determine the impact of distance on residential property prices. Third, a study can be conducted to compare whether CPTBSs have similar or differential impacts on residential property prices for various metropolitans and municipalities (i.e. developed and undeveloped suburbs). Finally, future research can assess whether the CPTBSs have differential impacts on different land uses, such as commercial and industrial land uses, beyond the present study that focused on residential properties.

Note

1. Apartheid denotes the formalized segregation of races that was established in South Africa and South West Africa and persisted from 1948 until the early 1990s.

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