Impact of Gautrain stations on property prices and sales activity in the City of Johannesburg between 2006 and 2015

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Abstract

The core objective of this study was to analyse the impact of three Gautrain stations on real estate in the City of Johannesburg, looking specifically at how the Sandton, Rosebank and Midrand stations affected property prices and sales activity within 3 km of the stations between 2006 and 2015. This time period represented a temporal cross-section of the three fundamental stages of the Gautrain implementation, namely construction, commencement of operation and full operation. International literature is rich in documenting the relationship between transport infrastructure, real estate and property, although local studies are lacking, and in recent years the City of Johannesburg has recognised the Gautrain station locations as catalysts for local development, prioritising transit-orientated development as a way of promoting compact mixed-use walkable city environments. This formed the underlying motivation for conducting the study. It was predicted that the nature and impact of Gautrain-related property development and investment would vary based on its location. The research methodology relied on using GIS to apply advanced spatial analysis of the deeds database as the basis for measuring property prices and sales activity over the past ten years around the three Gautrain stations. The results of the study varied per station, indicating that closer proximity to a Gautrain station does not necessarily assure increased property value. This research is valuable for Gauteng local government in terms of urban planning, budgeting and municipal infrastructure development and in helping to inform the Gautrain Management Agency's plans to extend the services of the Gautrain.

Keywords: Gautrain, real estate, property price, sales activity, deeds data, transit-orientated development

1. Introduction

Urbanisation challenges caused by rapid population growth are confronting many cities around the world. The general challenges that face expanding cities include increasing congestion, air pollution and sprawling patterns of development. One of the biggest culprits for these problems is heavy reliance on private vehicles as a primary mode of transportation by commuters. To reduce this reliance, the construction of public transport infrastructure, including rapid rail transit projects, is often highly valued as a development solution (Bowes & Ihlanfeldt, 2001).

The development of transit systems that connect people to their jobs is often the catalyst for economic expansion and city growth. However, most cities in developing countries lack modern public transport infrastructure, and commuters are forced to rely on increasingly congested roads (Urban Landmark, 2012). It has become common practice in many major international cities around the world to link cities to international airports by rail. Investing in a rail infrastructure project that would further the development of Gauteng was therefore prioritised by the Gauteng Provincial Government in 1999 when the need for a rapid rail link between Johannesburg and Pretoria, and between Sandton and OR Tambo International Airport was confirmed (Gautrain Management Agency, 2016).

The Gautrain rapid rail link project has been regarded as a traffic solution in Gauteng province, where road traffic increased at a rate of 7% per annum between 1992 and 2000 (Du Plessis, 2003). It has been seven years since the first phase of the Gautrain rapid rail link was opened to the public for commercial use in June 2010,

and since then the rail link has been providing stress-free, reliable and fast transportation to commuters in the Johannesburg and Tshwane metropolitan areas (Gautrain Management Agency, 2016).

2. Region of interest

The Gautrain has ten stations in operation to date (Figure 1): three stations fall inside the City of Tshwane Metropolitan Municipality (Hatfield, Pretoria CBD and Centurion stations), five stations fall inside the City of Johannesburg Metropolitan Municipality (Midrand, Marlboro, Sandton, Rosebank and Park stations) and two stations fall inside the Ekurhuleni Metropolitan Municipality (Rhodesfield and OR Tambo International Airport stations) (Gautrain Management Agency, 2016). The aim of this paper was to determine whether the Gautrain stations had a notable impact on property sales prices and property sales activity in the vicinity of Sandton, Rosebank and Midrand stations between 2006 and 2015. Of the five Gautrain stations in the City of Johannesburg, Rosebank, Sandton and Midrand stations were selected for the study since they are the most comparable in terms of levels of surrounding development, but at varying stages of development.

The areas around Sandton and Rosebank stations are classified as brownfields development (Mushongahande, Cloete & Venter, 2014) in that they are situated in nodes that were already built up before the Gautrain was constructed, where existing buildings have been redeveloped. Of the five Gautrain stations in the City of Johannesburg, Rosebank and Sandton stations were selected for the study since they are the most comparable in terms of levels of surrounding development and density. The area around Midrand station is classified as a greenfields development (Mushongahande, Cloete & Venter, 2014) in that the node was not well established before the Gautrain was constructed. The line formed by the Midrand station and Gautrain railway divides the less developed, almost exclusively smallholding properties to the east of the N1 highway and Gautrain station from the mixture of business, commercial, medium residential and special zoning properties to the west; further west, beyond the N1 highway, residential properties are predominant. Midrand station was selected for comparison with Sandton and Rosebank because it has a similar mixture of residential, commercial and business properties to the west of the Gautrain line. The greenfields nature of the surroundings, particularly to the east of the line, potentially offers the best opportunity of all five stations to gain insight into whether the Gautrain could attract new development.

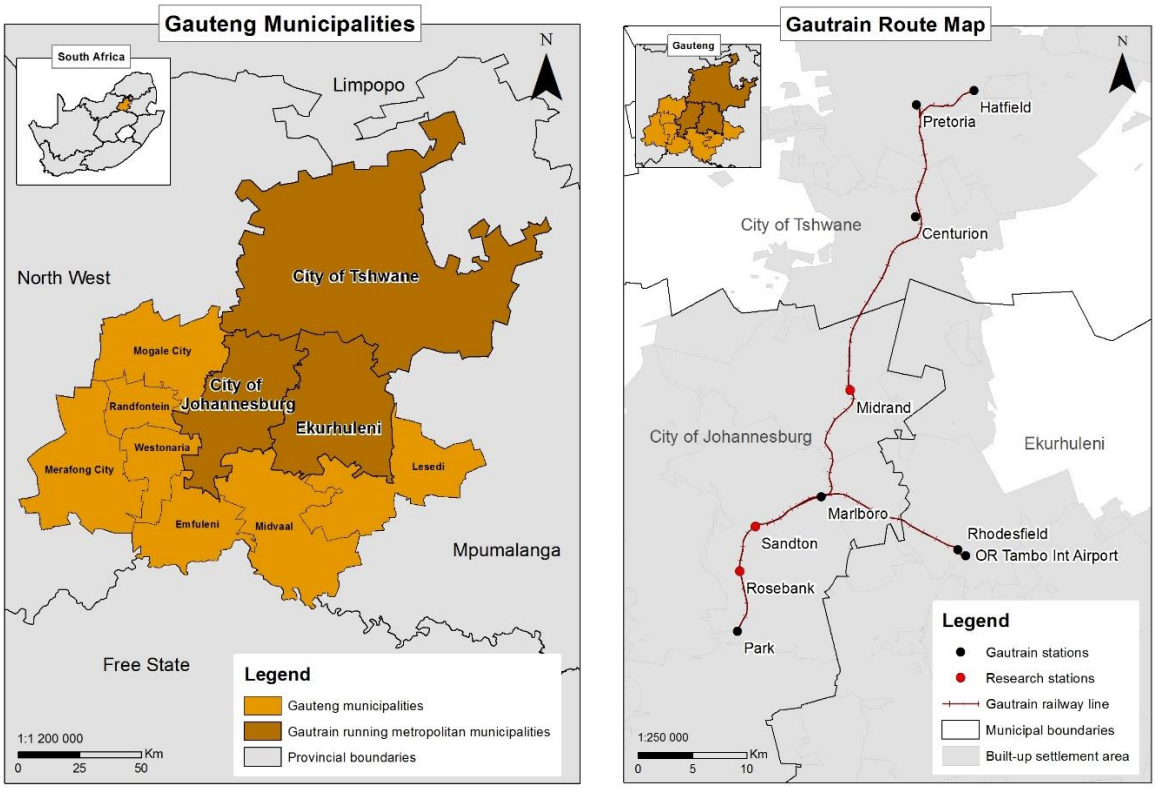

Figure 1. Location of Gauteng province and Gautrain route

3. Background

3.1 Transit-orientated development

Transit-orientated development (TOD) is defined as compact development within close walking distance of transit stations. Development around the stations is mostly of concentrated moderate to high-density housing typologies along with public uses and services, and retail in mixed-use developments located at strategic points along the regional transit system. TOD policy generally makes use of mass public rail-based transit to influence mixed-use private and/or institutional development. In this way, property development is focused towards, and maximised at, public transit nodes (Reconnecting America & CTOD, 2007; Urban Landmark, 2012; South African Cities Network, 2011). In South Africa, TOD is used to reduce urban sprawl through sustainable transport-integrated compact and mixed-use neighbourhoods, while improving the relationship between employment and housing (South African Cities Network, 2011). Each TOD node has a centrally located transit station, surrounded by both core commercial and accompanying residential uses within an average of 400m to 800m walking distance to a central station (Wilkinson, 2006; South African Cities Network, 2011).

If implemented correctly, TOD principles could provide a solution to the current suburban sprawl and vehicle-dominated trends in South African cities by emphasising pedestrian-oriented urban environments and encouraging the use of public transportation over private vehicle use. Transport interchanges such as the Gautrain stations, Gautrain bus networks and bus rapid transit (BRT) stops linked with mini-bus taxi systems provide opportunities to adopt a transport-oriented approach to development in thriving nodes (South African Cities Network, 2011).

The success of TOD initiatives is driven by a number of factors, including (Motsoanakaba, 2012):

- Having a good investment climate created by favourable market conditions
- Locating stations near attractive sites or in areas with an availability of land
- Supportive governance that prioritises land-use policies
- Active municipal public-sector participation.

TOD stimulates greater passenger loads and improves the exposure of the area surrounding the transport node. As a result, local businesses in the area receive a boost, new businesses may choose to locate there due to improved exposure, and increasing numbers of residents may wish to move to the area to benefit from more accessible convenient transport. The subsequent rise in the demand for nearby land often increases property values in the area (Urban Landmark, 2012).

3.2 Transport infrastructure, real estate and property prices

The most obvious determinant of the value of land and property is its characteristics, but land and property values also vary over time and with location due to neighbourhood and accessibility characteristics (Bowes & Ihlanfeldt, 2001). Access to transport infrastructure services such as train stations can impact on the development and values of the property surrounding them (Mohammad, Graham, Melo & Anderson, 2013; Debrezion, Pels & Rietveld, 2007). Several theories exist to explain the relationship between property value and relative distance to a train station amenity. One of these theories is the bid-rent theory, namely that the price that a consumer is willing to pay for a certain property is the inverse function of the distance of that property to the amenity (e.g. a train station) due to the perceived benefits that it realises (O'Sullivan, 2012). Thus, if a train station has perceived benefits to residents, commuters or developers, it can affect the property values around it.

The radius of influence of rail systems on property values varies in different locations and according to different types of surrounding land use, as well as the transport systems that support and provide transport to the train station from the surrounding areas. For residential areas, the biggest influence occurs within 1 km of a train station (increasing to 2 km in exceptional circumstances), and for commercial areas, the extent of influence is generally within 400m of a train station (increasing to 1.2 km in exceptional circumstances) (Mohammad *et al*., 2013).

Bowes and Ihlanfeldt (2001) argue that four main location-dependent factors affect the value of property around train station infrastructure. The access advantage and increased neighbourhood commercial services provided by rail stations may cause higher property values, while crime, pollution, noise and the visual unsightliness of the station may cause lower property values in station areas. It is evident from the literature that not all authors studying the property impacts of rail transit projects reach similar conclusions, although most agree that rail transport projects do impact on property purchase prices and rental values (Anderson, Shys & Fu, 2010; Bae, Jun & Park, 2003; Dubé, Thériault & Des Rosiers, 2013; Efthymiou & Antoniou, 2013; Mohammad *et al*., 2013; Munoz-Raskin, 2010; Papon, Nguyen-Luong & Boucq, 2015).

3.3 What affects property prices in South Africa?

The South African residential property market is driven by economic trends, consumer confidence and household finances. These factors affect the affordability of housing and the accessibility of and demand for mortgage finance. Property prices keep changing with inflation over time, particularly if the property is in an area or suburb that is sought after (ABSA, 2015).

Factors that affect property developments at a macro level include area-specific factors such as location, sectoral economic structure, physical infrastructure, and the level and degree of economic growth and development. These factors affect property demand and supply conditions, market activity, consumer buying patterns, transaction activity volumes and price margins. The performance of the South African property market at a regional level is affected by national macro-economic trends (ABSA, 2015). Supply and demand factors play a major role in property value trends. The demand for housing in major South African metro areas (including Johannesburg) is underpinned by the rapid and unyielding urbanisation of the South African population. With this rise in urbanisation, metro housing markets have become more dominant within the national housing market, and progressively independent of national trends (BusinessTech, 2016).

Other factors that heavily influence South African house price inflation at a regional level are geographic and topological location. With the highest property price growth rate in South Africa, Cape Town's coastline and mountains act as a major constraint to the city's ability to expand, creating a market of high demand with limited supply opportunities. In contrast, the Johannesburg Metropolitan Municipality does not have the same land and space constraints, and the rising demand for housing, generated by the inflow of young people from across the country, has seen an increase in new townships in recent years – including Midrand's Waterfall Estate (BusinessTech, 2016).

4. Methodology

The core objective of this study was to analyse the impact of three Gautrain stations on real estate in the City of Johannesburg, looking specifically at how the Sandton, Rosebank and Midrand stations affected property prices and sales activity within 1 km, 2 km and 3 km buffer areas around each of the stations between 2006 and 2015, an analysis time period that represents a temporal cross-section of the three fundamental stages of Gautrain implementation, namely construction (2006–2010), commencement of operation (2010–2011) and full operation (2011–present). The project data-handling methodology involved data sourcing, cleaning and storage; validation; and analysis.

4.1 Data sourcing

The project required access to deeds data to meet the analytical requirements of the objective to analyse the impact of the Sandton, Rosebank and Midrand stations on property price and sales activity. The South African deeds dataset was sourced for the purpose of the project. The South African Deeds Registry is the custodian of the deeds dataset, thereby holding the copyright to the data they produce, as well as being responsible for the accuracy and maintenance of their datasets. The Deeds Registry was an invaluable data source in determining the impact of the Sandton, Rosebank and Midrand Gautrain stations on property price and sales activity in this research, even though storing data for gauging trends in property markets is not the reason for the existence of the registry (Aliber, 2016).

4.2 Data cleaning

The first step in analysing the deeds dataset was validation. Data were validated twice in the data analysis process. Firstly, a thorough data-checking process was conducted upon initial receipt of the original dataset, and secondly a general checking process was conducted after the data-cleaning process. Given the extensive spatial and temporal scope of the research, covering an area of 3 km around three Gautrain stations over ten years, data validation was an essential step in overcoming data anomalies. Errors were mostly due to incorrect spatial, temporal and attribute selections in the extractions received from the original datasets, which were readily identified and corrected.

The project faced larger data-cleaning challenges that were more difficult to identify and required additional processing to rectify. These included aggregating property scheme sectional title sales data to a single cadastral land parcel value. Another challenge was that not all property selling price data referred to a single property transaction, but sometimes to bulk purchase property deals (i.e. a number of properties sold collectively at a joint price). In these cases, the property purchase price in the data referred to the total selling price of all properties in the deal, and not the proportional price per property based on the area of the property. Deals were identified in the deeds data as rows where the purchase price, registration date, owner name and station name were all equal in more than one deeds transaction. The purchase price was then calculated for each of these properties as the proportion of total selling price, based on the proportion of the single property's area relative to the net property area of the deal.

The deeds data also contained some noticeable outliers; in some cases this seems to have been due to property transfers that did not use market value (e.g. transfers between family members) and in other cases this was probably the result of data capture errors, which had to be removed from the data analysis. These were relatively few in number, and insufficient to invalidate the overall results of the study. Data for properties with excessively low selling prices in relation to the average for the area were eliminated below a certain threshold. Once the data had passed the validation process, the data were cleaned for analysis.

4.3 Data analysis

The deeds dataset was used to analyse the influence of the Gautrain stations on property prices and sales activity in the vicinity of Sandton, Rosebank and Midrand stations. The sample for this analysis was all properties within 3 km of the stations sold between 2006 and 2015. In order to form a basis for comparison that removed the influence of inflation on property prices, thus enabling an investigation of price increases that could be attributed to the Gautrain, the prices were adjusted for inflation to a 2015 baseline. An inflation-adjusted property selling price per square metre (Rand/m^2) (using 2015 as the base year) was calculated for all transactions. Percentage changes in property selling prices in this research are therefore increases or decreases over and above inflation-related increases. These results were then graphed and mapped.

Where deeds transactions were counted per buffer area, the count results were then divided by the area of the buffer area to calculate the number of deeds transactions per square kilometre. This was done to remove any bias in the results resulting from the different buffer area sizes between the 1 km, 2 km and 3 km zones, making the results comparable between buffer areas.

5. Results and discussion

Despite the challenges that arose in using the data, the deeds data produced significant results in analysing the impact of the Sandton, Rosebank and Midrand Gautrain stations on property prices and sales activity in this research. The key findings are summarised below, followed by detailed results and discussions of each station individually.

5.1 Property price analysis

Sandton had the highest property selling prices of all three stations in all three buffer areas (1 km, 2 km and 3 km radius of the station). On average, property prices around Midrand station were lowest in comparison with Rosebank and Sandton. Of the three stations, Sandton showed the most pronounced relationship between the distance to the Gautrain station and property sales price. The average property sales prices between 2006 and 2015 within 1 km of Sandton station were 38% higher than those in the 2 km buffer area and 91% higher than those in the 3 km buffer area. Midrand showed a similar trend to Sandton, with a noticeable relationship between the distance to the Gautrain station and property sales prices around Midrand station, but to a lesser extent. Average property sales prices between 2006 and 2015 within 1 km of Midrand station were 13% higher than those in the 2 km buffer area and 22% higher than those in the 3 km area. In contrast, Rosebank showed no distinction between average property sales prices in the 1 km, 2 km and 3 km buffer areas around the station in that average property sales prices in the three areas differed by only 1% (Figure 2).

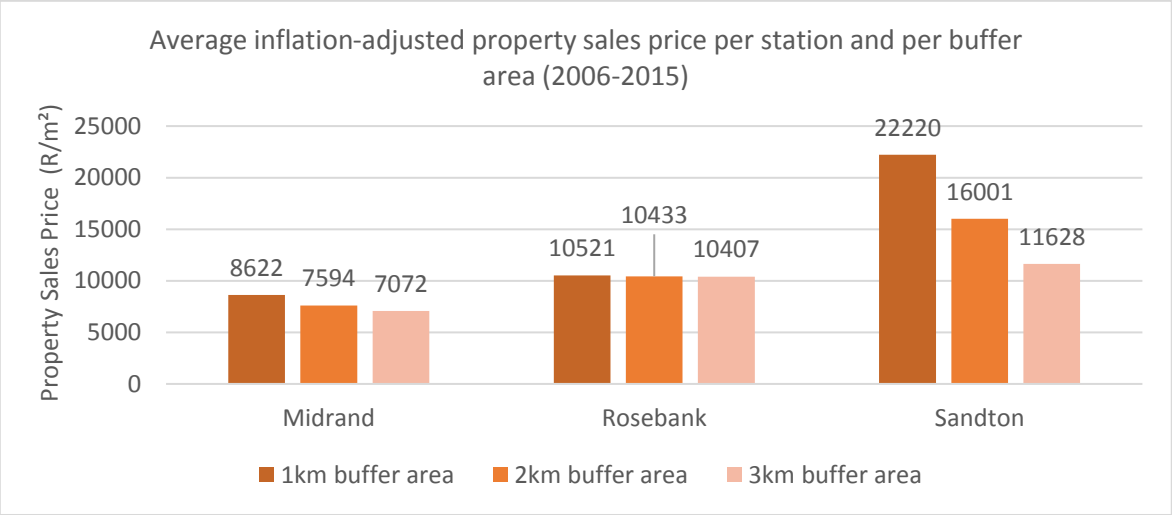

Figure 2. Average inflation-adjusted property sales price per station and per buffer area (2006–2015)

5.1.1 Sandton station

As illustrated in Figure 2, Sandton showed the most distinct relationship between the distance to the Gautrain station and property sales prices, with average selling prices between 2006 and 2015 in the 1 km buffer area outperforming those 2 km and 3 km away from the station. The station also showed the strongest property-related supply and demand trends of the three stations, which were most pronounced in the 1 km buffer area (Figure 3). In Sandton, the property prices in the 1 km, 2 km and 3 km buffers were very similar in 2006, but with the start of Gautrain construction, property prices in the 1 km buffer increased by 87% within a year (Figure 3). Between 2007 and 2008, the impact of the global economic recession on property prices in Sandton can been seen but was short-lived, as the Sandton property market bounced back with property prices rising by 49% between 2008 and 2010, and peaking in 2010 in the 1 km buffer area when buying demand was at its highest with the opening of the station. After the hype from the opening of Sandton station, property prices dipped in 2011 and have since begun to stabilise in the 1 km buffer area, but still outperform prices 2 km and 3 km away (Figure 3).

The overall changes in Sandton property sales prices per buffer area, when comparing the 2006 start figures with the 2015 end figures, were an average property price increase of 63% in the 1 km buffer area, substantially higher than in the 2 km and 3 km areas (Figure 3). It is therefore evident that the Gautrain has had a positive influence on increasing property prices in close proximity to Sandton station, and this trend is visualised by the time series maps in Figure 4. The maps also indicate a noticeable increase in property prices along Rivonia Road to the north in the 2 km and 3 km buffer areas (in the vicinity of Morningside Hills), although the selling price increases have not been as significant or steep as those around Sandton station.

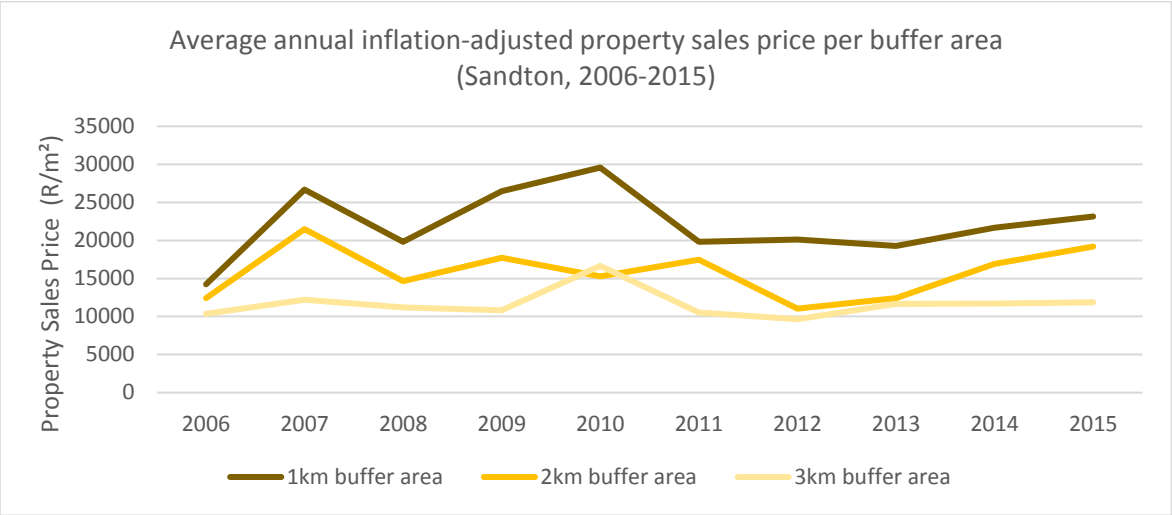

Figure 3. Average annual inflation-adjusted property sales price per buffer area (Sandton, 2006–2015)

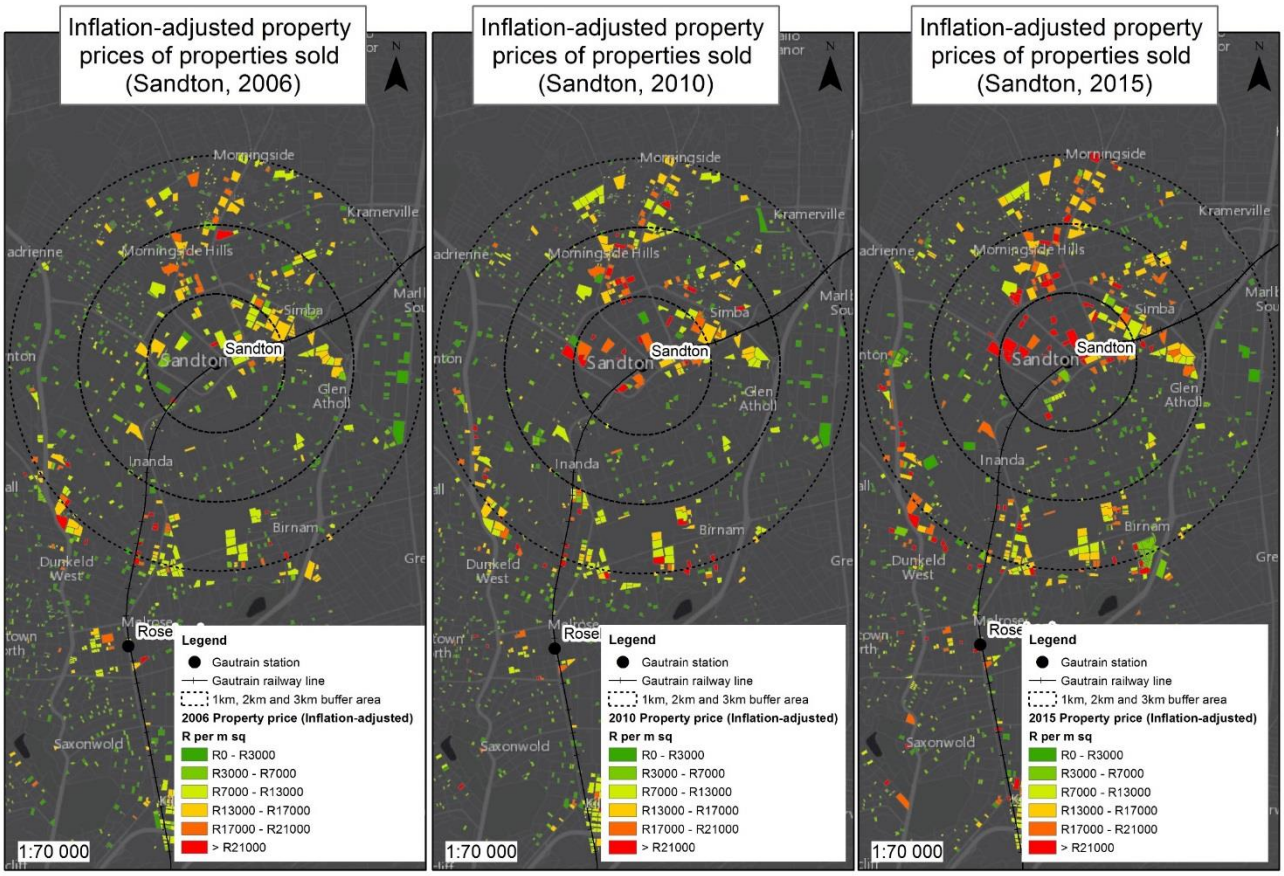

Figure 4. Time-series maps (2006, 2010 and 2015) of inflation-adjusted prices of properties sold around Sandton station

5.1.2 Midrand station

The relationship between the distance to the Gautrain station and property sales prices around Midrand station is also noticeable, but to a smaller extent than around Sandton station. Midrand is the only one of the three stations where property prices in the 1 km buffer area started off significantly lower than in the 2 km and 3 km buffer areas before Gautrain construction began, but property sales prices soared between 2006 and 2007 in the 1 km buffer area with the start of construction, increasing by 113% in just one year and overtaking average property prices in both the 2 km and 3 km buffer areas (Figure 5). Buyer and development confidence

were therefore more heavily influenced by the start of actual station construction than by earlier announcements and planning.

The overall changes in Midrand property sales prices per buffer area, when comparing the 2006 start figures with the 2015 end figures, were an average property price increase of 91% in the 1 km buffer area, and decreasing average property prices in the 2 km and 3 km buffer areas (Figure 5). The Gautrain has therefore had a positive influence on increasing property prices in close proximity to Midrand station, but these property sales prices were low in comparison with the average selling price of properties in Sandton and Rosebank. This is evident in the low to medium selling prices of properties (Figure 6).

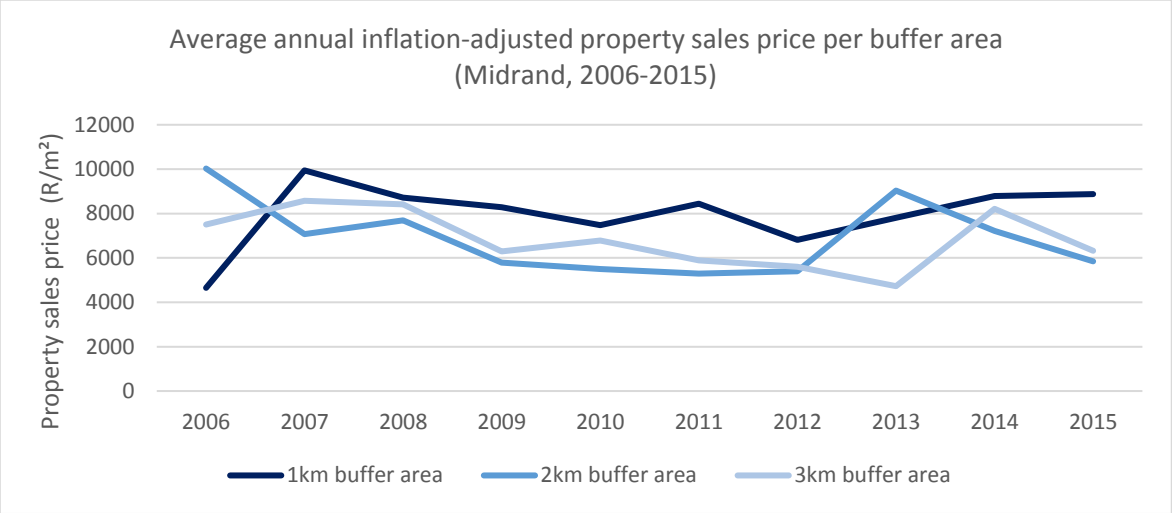

Figure 5. Average annual inflation-adjusted property sales price per buffer area (Midrand, 2006–2015)

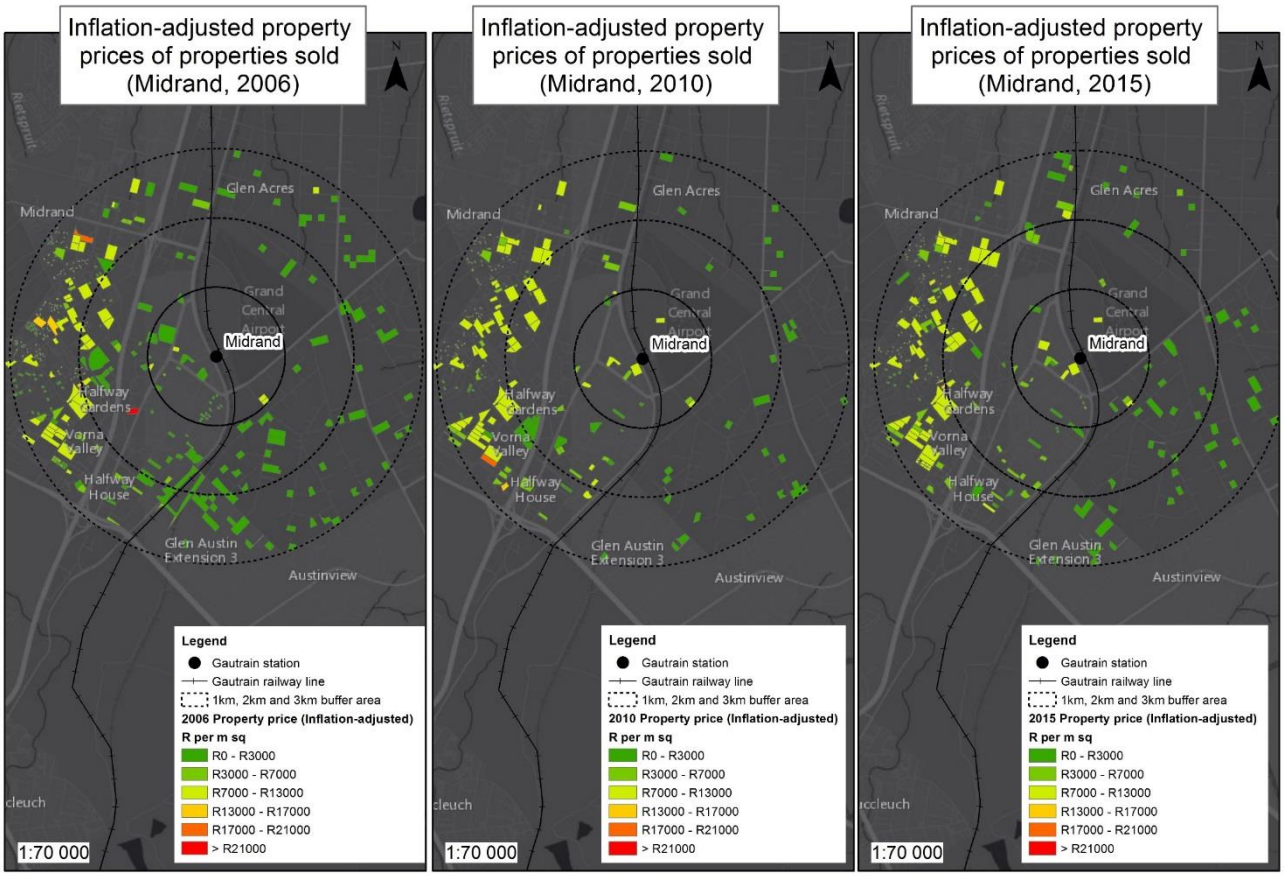

Figure 6. Time-series maps (2006, 2010 and 2015) of inflation-adjusted prices of properties sold around Midrand station

Midrand showed an interesting trend in the variance in property prices between the west and east of the Gautrain line and N1 highway. Property prices to the east of the Gautrain line and N1 were substantially lower than properties to the west in each year between 2006 and 2015. This trend was influenced by the different nature of the properties in the two areas, in that properties to the east are predominantly smallholdings, and properties to the west generally comprise sectional title developments and freehold houses (Figure 6). An interesting observation is that the divide separating the variation in property prices between western and eastern Midrand shifted from the N1 highway in 2006 to the Gautrain line in 2015, with properties between the highway and the train line increasing in value according to this trend.

5.1.3 Rosebank station

Rosebank showed no distinction between average property sales prices in the 1 km, 2 km and 3 km buffer areas around the station (Figure 3), and is the only station that showed a decrease in property values in the 1 km area surrounding the station. The overall changes in the Rosebank property sales price per buffer area, when comparing the 2006 start figures with the 2015 end figures, were an average property price decrease of 9% in the 1 km buffer area, an increase of 15% in the 2 km buffer area and increase of 16% in the 3 km buffer area (Figure 7).

Property prices in the 1 km buffer area started off highest of the three buffer areas (although only slightly), but decreased steadily between 2006 and 2010, reaching the lowest average property sales price of all buffer areas in 2010. Between 2010 and 2011 (Rosebank station become operational in 2011), there was a 35% increase in property sales price within 1 km of the station, in stark contrast to the steady decline between 2006 and 2010. The overall property prices within the Rosebank area peaked in 2009 in the 2 km buffer area, a 36% increase over prices for 2008 in that buffer area (Figure 7).

Figure 8 shows that there was no clear pattern in the spatial clustering or increase in property prices within 1 km of Rosebank station. Rosebank station has had little influence on increasing property prices in the vicinity of the station. However, an interesting spatial trend was that property sales prices in the 2 km and 3 km buffer areas around Rosebank station showed an increasing tendency between 2006 and 2015 along main arterial roads, particularly along Jan Smuts Drive in Dunkeld West and Craighall Park.

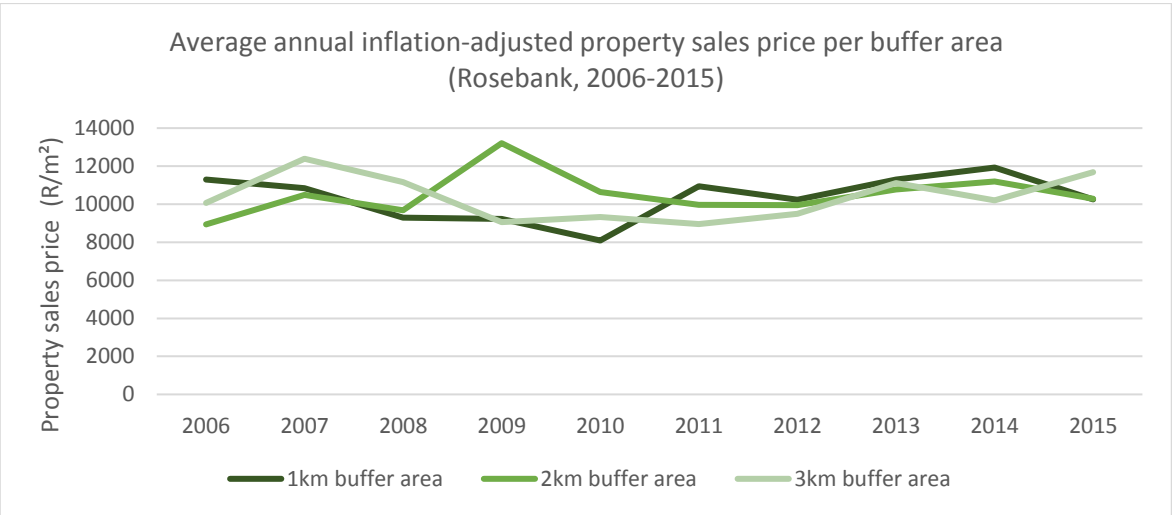

Figure 7. Average annual inflation-adjusted property sales price per buffer area (Rosebank, 2006–2015)

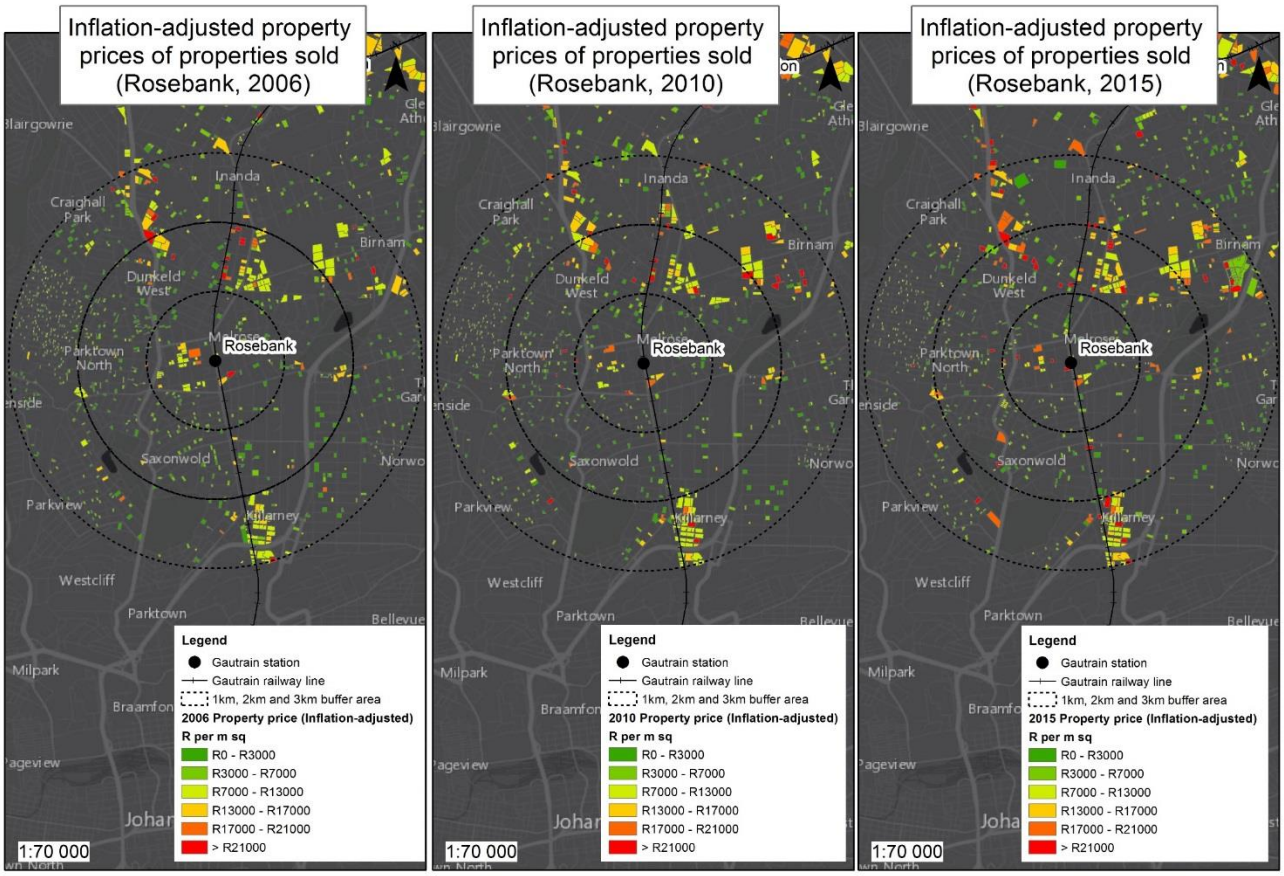

Figure 8. Time-series maps (2006, 2010 and 2015) of inflation-adjusted prices of properties sold around Rosebank station

5.2 Sales activity analysis

Sales activity in the property market is a useful indicator of buyer interest and investor confidence. Figure 9 shows a combined view of the annual number of property deeds transactions (per square kilometre) per buffer area and per station between 2006 and 2015. A similar sales activity trend is evident for all three stations.

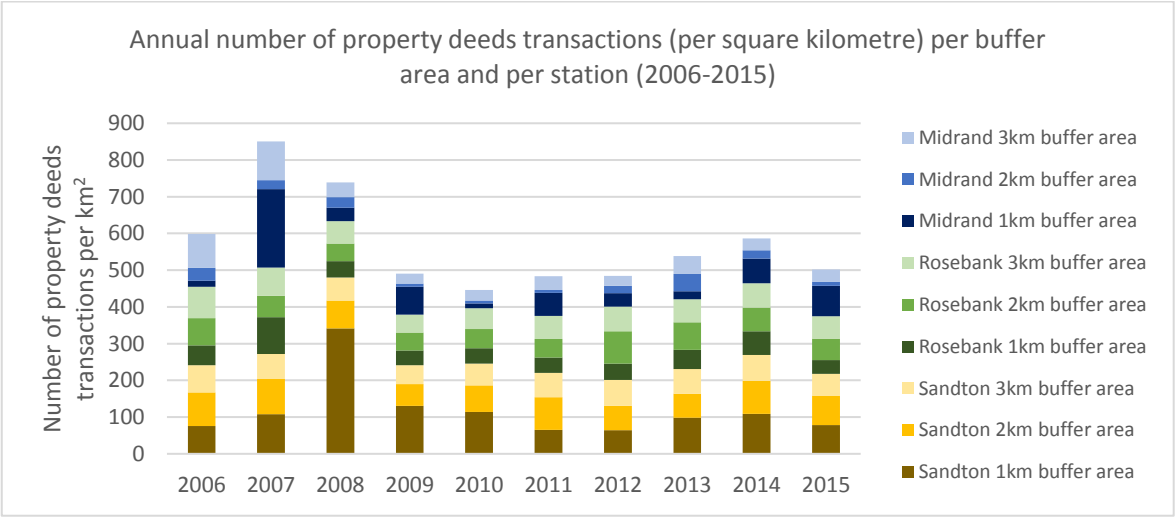

Figure 9: Annual number of property deeds transactions (per square kilometre) per station and per buffer area (2006–2015)

With the start of Gautrain construction in late 2006/early 2007, the number of deeds transactions around Midrand station spiked due to increased sales activity in the 1 km buffer area (Figure 9). From 2010 onwards, deeds activity continued to rise in Midrand, coinciding with the start of the Midrand station operation in 2011. Around Midrand station, transactions have remained highest in the 1 km buffer area almost annually since 2009, indicating that the Gautrain has influenced increased sales activity in close proximity to the station. The number of deeds transactions around Sandton station peaked in 2008, with the overwhelmingly vast majority of sales transactions in the 1 km buffer area (Figure 9). Transactions in the 1 km buffer area remained substantially higher than in the 2 km and 3 km areas in the years leading up to the opening of the station, indicating that the Gautrain has influenced increased sales activity in close proximity to Sandton station. Rosebank station showed decreased activity in the number of deeds transactions between 2006 and 2009 when construction of the Gautrain stations was under way (Figure 9), indicating that construction on Rosebank station had little impact on the levels of sales activity in the area (unlike the trends in Sandton and Midrand).

6. Conclusion

This research is the first of its kind to use geographical information to spatially analyse real estate trends around the Gautrain stations and assess the impact of three Gautrain stations on real estate in the City of Johannesburg between 2006 and 2015, with specific reference to how the Sandton, Rosebank and Midrand stations have affected property prices and sales activity within 3 km of the stations. The project data handling methodology, rooted strongly within a GIS framework, involved data sourcing, cleaning and storage, validation and analysis. The data presented a number of challenges related to cleaning and validation, including the challenge of aggregating property scheme sectional title deeds transactions to cadastral properties; the challenge of multiple properties being sold jointly as a deal; as well as human error in capturing and coding the data. Advanced spatial analysis was used to adjust the deeds dataset to account for inflation over the ten-year period of the study so that property price trends could be comparatively analysed and compared from a 2015 baseline.

The deeds dataset produced significance results in analysing the impact of the Sandton, Rosebank and Midrand Gautrain stations on property price and sales activity. As predicted, the nature and impact of Gautrain-related property development and investment was found to vary based on location, with properties within 1 km of Sandton and Midrand experiencing significant increases in property prices and sales activity related to the Gautrain and local government transit-orientated development policies being realised in these areas. These results were in contrast to those in Rosebank where the property market was slow in responding positively to the Gautrain station (only responding after the station was commissioned in the case of property prices). Rosebank showed more of an increase in property prices along the main development corridors north of the station than in the 1 km buffer area nearest to the station, where average selling prices were lower in 2015 than in 2006 before Rosebank station was built. From the study, it is evident that closer proximity to a Gautrain station does not necessarily assure increased property value or higher sales activity, although two of the three Gautrain stations in this research are shown to have had a positive impact on the property markets surrounding them.

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