PACIFIC RIM PROPERTY RESEARCH JOURNAL, 2017
VOL. 23, NO. 3, 267–302
https://doi.org/10.1080/14445921.2017.1375620

Routledge
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The influence of rapid rail systems on office values: A case study on South Africa

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ABSTRACT

This study identifies the influence of rapid rail systems on property values, with a focus on office buildings in South Africa. It is based on a limited sample of office properties, analysed using MRA to investigate pre-implementation values and rent to post-implementation data. It attempts to confirm if distance from the train stations influences these variables. Evidence is found that distance from the station does have a positive impact on rental levels and property values. The limited data-set, however, causes inadequate levels of statistical significance in some variables, arguably due to the small sample or model specification error due to information availability for research. The positive influence of rapid rail systems found on office values has important implications for property investors, developers, financiers and taxing authorities. This is important amidst a period of extension planning, whereby this research could provide useful information for decision-making and analysis and offers a valuable contribution to the methods to measure the impact of rapid rail systems on property values, although currently limited to office buildings. Furthermore, this research is contributing to the body of knowledge, especially in developing markets, where advanced public transport systems need to be implemented for the first time.

ARTICLE HISTORY
Received 31 August 2016
Accepted 1 September 2017

KEYWORDS
Rapid rail systems; property values; urban development; Gautrain; multiple regression analysis

Introduction

Rapid rail stations offer the potential for the development of higher order nodes around these stations and the incorporation of the physical characteristics promoted in most of the planning concepts that deals with the development of nodes. However, not all stations have the same potential for development, as the local conditions and the physical context in which these stations are located differ extensively.

South Africa has only recently implemented its first urban rapid rail system, the Gautrain, linking the two largest cities in the country, Johannesburg and Pretoria, forming the economic hub of the country, which are now also being investigated for the economic viability of extension of the rail system. This research attempts to shed some light on the influence of the rail system on property values, with specific reference to office buildings and proposes the methodology to undertake such an investigation. The problematic nature of such an

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analysis is to distinguish between the causal relationship of growth in particular areas due to factors other than the construction of the rail system, causing such nodes to be the ideal location for rail stations, or to confirm that the construction of the rail system and choice of station locations had indeed an impact on the growth in these areas. Implications of this research is that if a positive impact on property values could be confirmed, it provides increased property tax backed by the increased property values, which could be a source of funding for implementation, as well as strategic decision-making advice to property developers, investors and financiers.

Methodology

The Gautrain in South Africa was implemented during 2010. The study was initiated by the Gautrain Management Agency (GMA), as part of the planning for extensions to the first phase of the rapid rail system in South Africa. The research is limited to testing the hypothesis if an influence is present or not, rather than quantifying a detailed level of impact per se. The method to analyse this, is by investigating a sample of pre-implementation data to post-implementation data. Due to the exploratory nature of this study, it was necessary to rely on publically available data and based on a limited data sample, in order to meet the constraints of the GMA support for this analysis. The aim is, however, to provide initial results that can lead to wider support for further, more detailed analysis.

From the above, the Null hypothesis can therefore be stated as:

$$\text{PV} \neq f(\text{Station access})$$

and the alternative hypothesis as:

$$\text{PV} = f(\text{Station access})$$

where:

$$\text{PV} = \text{Property value}$$

If the null hypothesis that the property value is not a function of the access to the station, either being the distance from the station or the affirmation that it is within walking distance from the station or the bus serving each station, can be rejected, then the alternative hypothesis can be accepted that the property value is indeed a function of and therefore influenced by the distance or access to the station.

The data used for analysing the impact of this implementation, is the office portfolio along the Gautrain route and neighbouring townships, owned by the largest REIT in South Africa, Growthpoint Properties (Growthpoint). The whole Gautrain consists of 10 stations. All Gautrain stations where the particular REIT owns office buildings were included, resulting in six stations included, three stations excluded due to no property ownership in the vicinity and one station which only services the airport. The selection of the sample is due to the higher level of information that is made publically available by Growthpoint than any of the other REITs in the country. The pre-implementation data used is the office portfolio owned by Growthpoint in 2008, which is two years earlier than the implementation of the Gautrain. During this period there was already planning under way, but little was known about the likelihood of success of the rail system and the exact implementation details, including methods of implementation and exact locations of the stations and the rail route itself. Due to this uncertainty, it is expected that little investment decisions were based on the implementation of the rail system itself, but rather on other value forming attributes and principles. The portfolio of properties included in the pre-implementation analysis is a total of 69. The post-implementation data is the office portfolio owned by Growthpoint during 2015, which is the most recent information available at the time of the research and consisted of 41 properties. The different number of properties at the two time periods were specifically chosen as such to also determine how the portfolio change affected the results, especially in determining the effect of the properties that were disposed of.

The pre- and post-implementation data allows to perform a regression analysis on the value forming attributes of the Growthpoint office portfolio in the nodes where the Gautrain stations were built. As mentioned earlier, due to the exploratory nature of this research, limited value forming data is available and reliance on publically available data allowed for only using three categories of variables, being location in terms of the node of each station on the route and the distance from the station, type of office building and the capitalisation rate as an indication of the perceived risk of the building. These three categories were used as independent variables by also splitting them into different actual variables, i.e. location being the node indicated by a dummy variable for each node, the distance from the station, and a dummy variable to indicate the building to be within walking distance from the bus or station, while building type is split into separate dummy variables to indicate which type of building it is.

In order to test the hypothesis, various multiple regressions were performed, using different dependent variables. In principle, the Total Property Value can be increased by either increasing the value/m^2 or by increasing the size of the building (GLA). The former is also influenced by the rental rate achieved. The GLA, value/m^2, rent/m^2 per month and Total Value as dependent variables are tested by considering the 2008 data, 2015 data and the growth from 2008 to 2015. The influence on the value/m^2 is tested in order to evaluate if access to the station creates additional value, but excluding value that is created by expansion of any buildings, and also reduces the variance in the dependent variable that is caused by the different sized buildings. Testing the rent has the same aim, but further excludes the impact of value changes due to changes in the capitalisation rate. In a similar way, the GLA is tested in order to evaluate if access to the station is influential on a decision to expand a building. The total value is then tested to combine the effects of both these dependent variables and measure the total impact.

Literature review

Various studies were found that explain the general influence of transport systems on property values. Most studies motivate the influence on property values as a means of value capture in order to finance transport development systems. Enoch, Potter, and Ison (2005) investigated the methods for funding public transport investment from specifically property owners and developers. It was found that a number of options exist, which include taxes and charges, partnership deals and endowment. The study found that taxes are the most reliable source of funding, with specific reference to property tax. It is therefore imperative that the influence of the transport infrastructure on property values be considered carefully. Ubbels and Nijkamp (2002) reported on various unconventional financing schemes for transport systems. Included in these are the funding by way of property taxation that could take the form of higher property tax due to the increase in values based on better accessibility or better business opportunities, as well as developer levies that are charged based on redevelopment of properties in the proximity of the transport infrastructure being installed. They also point out that unconventional funding schemes are highly reliant on acceptability by the payers thereof that they are indeed benefited by the development of the transport system.

Banister and Thurstain-Goodwin (2011) considered the non-transport benefits resulting from rail investment. According to the study, traditional methods of valuation haven't been successful in accounting for non-transport benefits. This is important because it is increasingly found that transport investment cannot be justified by transport terms alone. Banister and Thurstain-Goodwin explains the factors to be considered at macro, meso and micro level, with the latter being referred to as the effects of land and property market effects that should be taken into consideration. Banister and Thurstain-Goodwin mentioned seven key factors that should be considered for evaluating the effect of transport on land and property values:

Location

The effects of specific locations was found to be difficult and had mixed results from previous studies. It was stated that it is imperative to consider the whole corridor, rather than just specific points or individual stops and stations.

Time

The effect of the transport investment would be different at different time-intervals relating to the development. It was noted that the points in time to consider in order to accurately measure the effect on the land and property values is; before a decision to develop was taken; before opening; directly after opening; and downstream.

Catchment areas

It was found that the impact on residential properties was wider than the impact on commercial development, with an up to 2½ times wider catchment area for residential properties, and is related to the distance people are prepared to walk (AtisReal, the Bartlett School of Planning & the Symonds Group, 2002). It was, however, found that values of residential properties might be depressed during the construction phase of the transport due to higher noise or crime levels (Bowes & Ihlanfeldt, 2001).

Scale of investment

It was found that smaller investments mainly affect accessibility and that larger investments have an impact on the property market (Colin Buchanan & Partners, 2003). According to Cervero and Duncan (2002) it is useful to do an accessibility analysis in order to determine the effect of accessibility on property values.

Attribution of impacts

The effects of different variables and the attribution thereof are found to be different for different situations. A vibrant market will for example be affected differently from a location with less advantageous economic conditions. The effects of the property market cycle should also be controlled for when considering time effects. It is suggested that a wider range of measures should be considered, such as changes in accessibility, ownership patterns, site consolidations, number of transactions and yields, as well as composite measures such as density of development.

Methods used

The most preferred method is found to be hedonic pricing (HP). The main difficulty with HP is the way it handles spatial data. It is noted that a more spatially sensitive approach would be the use of a Geographically Weighted Regression (GWR) within a hedonic framework.

Data

Data availability is found to be the crucial element of successful measurement. It is suggested that actual property transactions that took place within a 1000 m threshold are taken into consideration, but that there are often confidentiality constraints in the use of this.

Wrigley, Wyatt and Lane (2001), in a literature review of transport policy and property values, report that a study that investigates the impact of transport systems on property values should include:

- More than one transport system in order to capture modal split and shift
- More than one land use which could capture land use change and control for collinearity
- Longitudinal analysis rather than cross-sectional in order to control effects of anticipation and reality
- Intra-urban and regional scales to control for agglomeration effects
- A combination of area dummy variables and proximity variables
- Controlling factors for the effect of size on the explanatory power of residential property values.

Studies that specifically investigated the influence on property values, reported that accessibility and changes in land use patterns are mostly responsible for positive influences, while disruptive effects during construction, noise, increased crime levels and other social attributes might be responsible for negative impacts. Henneberry (1998) links the relationship of property value and location to accessibility. The time and cost of travel to other locations has an impact on the physical accessibility aspect of property. The investment in transport infrastructure affects the accessibility of property and due to this change a secondary influence on property values due to intensified property investment and subsequent land use changes occur. Henneberry also warns against the influence of other factors on property values which might cause difficulty in identifying the discrete impact of transport investment on property values. It is indicated that a hedonic model resolves this and can provide the influence of a single attribute on property values. In order to obtain accurate data, the different sources of data identified are actual transaction prices, asking prices by agents and actual valuations by professional valuers. Although the different sources are debatable in terms of actual indication of market activity, it was found that each offers specific profound benefits, such as asking prices that is not necessarily an indication of the true value or transaction prices that are reflected, it is normally associated with better individual attributes that are made available, allowing for more accurate analysis. The study found that prices were negatively affected before construction of the tram system in Sheffield, possibly due to the anticipation of disruptive effects during construction, but the negative impact disappeared after completion of construction. It could, however, not be confirmed that there is a positive effect on house prices, due to the study only being conducted four months after completion and it could be that the effects are not fully appreciated by homeowners yet. Gibbons and Machin (2005) on the other hand found a significant relationship between house prices and the distance to the nearest train station based on a study of new stations to be constructed to the tube system in London. They link the increase in price to the travel time value, which is based on the average commuter's hourly wage compared to the cost of travelling.

Bae, Jun, and Park (2003) investigated the effect of the installation of a sub-way line on residential property values in Seoul, Korea. It was found that anticipation effects were observed, but it vanished after opening of the line. This might be due to the fact that Seoul had various means of transport available and the extra line does not add much to the overall public transport availability. Bowes and Ihlanfeldt (2001) also confirms the positive effect of rail stations on residential property values due to reduced commuting costs and increased retail activity brought to the neighbourhood, but that these positive factors are offset by the negative impact due to crime as a result of accessibility of criminals to the neighbourhood. This is, however, dependant on the distance from the CBD and the median income of households, with high income areas close to the CBD being at the largest negative impact scale. Zamparini and Reggiani (2007) investigated the value of travel time savings, linking the willingness of passengers to pay for savings and convenience of better transport and found that a remarkable higher value is observed in Europe than in North America or Australasia. This emphasises the difference of the specific country of application and such local factors on the final influence that is experienced.

Geurs, Haaijer, and Van Wee (2006) investigated transport option values in the Netherlands that can be interpreted with regard to the risk premium that individuals with uncertain demand are willing to pay due to the availability of a transport facility which is over and above their expected user benefit. This provides the additional frame of thought that installation of additional modes of transport provides the option of using that and makes areas accessible to commuters that might have not being able to reach these destinations before. The result might be that there is a change in spatial segregation, as well as potential alternative land use.

According to Munoz-Raskin (2010), middle income housing in Bogota, Colombia were most affected by immediate proximity to the BRT system. The mobility burden for the poorest was, however, found not to be solved, due to the cost of the BRT transportation, although faster, generally being more expensive than other modes of transport. This is further aggravated by the general tendency to increase rent in the proximity of BRT stations, causing the poorest to have to move to cheaper locations, as reported by the World Bank (2007) and Transmilenio (2007). It was further found by Munoz-Raskin that there is a potential negative effect on high-income housing, due to the nuisance perception associated to the proximity to transport corridors. It is specifically pointed out that the impact of such systems cannot be generalised over all properties, but must be treated as case-specific. Hedonic modelling in urban settings in non-industrialised countries is said to be treated with caution, as it is very different to the circumstances of developed countries where most previous research of this nature is performed. Rodríguez and Mojica (2009) performed a before and after regression of the property values in Bogota, Colombia in order to measure the effect of the BRT expansion. They also found an increase, with 13 to 14% measured after the BRT was extended and similar valued anticipation effects on the property values prior to installation of the BRT. The study, however, does not discriminate between different types of property or levels of income.

Jun (2012) found that the redistributive effects of the BRT system in Seoul, Korea was more apparent in non-residential properties than in residential properties. It was furthermore found that the CBD reaped the highest benefits, with lower benefits to the outer ring zones. So, Tse, and Ganesan (1997) report that the effect of transport on house prices in Hong Kong, where more than 90% of all people are making use of public transport (Hau, 1988) and more than 80% of motorised trips are undertaken in public transport (Meakin, 1994), is particularly evident in the middleclass and closely related to the mode of transport being used, which in this case is mostly affected by pick-up points of mini-bus taxis. In two older studies by Freeman (1979) and Rosen (1974), it was noted that hedonic pricing is applicable in order to determine housing values and the impact of different attributes such as accessibility on such values.

Studies that reported specific levels of influence reported mostly positive results. On a study of house price values in the Netherlands, Debrezion, Pels, and Rietveld (2011) found that dwellings close to train stations could be up to 25% more expensive than those at a distance of 15 kilometres or more. They report that a doubling of the frequency of trains have a positive effect that ranges between 2.5 and 3.5% for houses close to stations and 1.3% for house that are located far from the station. Finally they found a negative effect of the distance to the railway line, probably due to noise effects. Rodrigues and Targa (2004) reported on a study of the BRT system in Bogota, Colombia, that every 5 min of extra walking time to a BRT station, results in a rent decrease of between 6.8 and 9.3%. Doherty (2004) indicates a significant difference between the impact of transport on residential properties, with an increase of 5 to 10% and commercial properties, where an increase of between 10 and 30% is evident. Although the study by Doherty is mainly applied to fixed rail systems, they do not rule out the influence of other modes of transport on property values, due to the general increase in accessibility. Doherty states that in Australia there is evidence of increased values at all levels of household income.

From the literature, it is evident that most previous studies consider the influence of transport systems on house prices. This is particularly linked to the ability of commuters to reach their destinations, but does not take the impact of transport systems on the destination itself into consideration. This could largely be due to the difficulty in obtaining sufficient reliable data to rule out other influences and conclude on the impact of transport systems on non-residential property. Due to this shortcoming in other studies, this study is of particular importance due to the unique example in South Africa, where an entire new rapid rail system is implemented for the first time, enabling the analysis of pre- and post-implementation data.

Analysis

Pre-implementation results

The first analysis on the pre-implementation data is a linear MRA of the gross lettable area (GLA) as dependent variable against the distance from the Gautrain station, a dummy variable to indicate if the property is within 500 m of a bus stop or within 1 km of the station (1) or not (0), three dummy variables for the type of building, where 1 is used as affirmative in either one of three types being an office park, high rise office or low rise office, six dummy variables for location, where 1 is used as affirmative to indicate the location as being either Hatfield, Centurion, Midrand, Sandton, Rosebank or Park station and lastly the capitalisation rate as determined by the rent divided by the value/m^2. The reason for the choice of variables is to determine if the distance from the station locations had an influence of the size of office buildings in the particular locations. Due to unacceptable tolerance levels in the collinearity of the location variables, Sandton as the location with the most individual data points are excluded and was modelled independently. The results are therefore split to show the impact of all locations other than Sandton and the results for Sandton separately. This is the case for all results to follow using other dependant variables as well.

The results of the analysis are provided in the tables at the end of this paper under "Annexures". Annexure 1(a) is the results of the GLA in 2008 with an adjusted R^2 of .123, indicating that only 12.3% of the variability in the GLA is explained by the model. The F-value of 1.870 indicates a significance of .063, i.e. between 90 and 95% level of confidence. When considering the individual variables, Rosebank has the highest standardised β with a negative relationship to GLA, indicating that if a property is situated in Rosebank, it is likely to be smaller than other properties. Next to that is the distance to the Gautrain station, with a negative standardised β value of −.253, with the t-test indicating a significance for this variable of .141. This provides some evidence that if a property is further located from the station, it is likely to have a lower value. Annexure 1(b) provides similar statistics, but for properties situated in the Sandton node only. In this, high rise offices have the highest standardised β, which is expected as high rise office is usually larger than other types of buildings. The next variable is the distance from the station, albeit with a relationship that is less evident and significant than properties located in nodes at the other stations.

Annexures 1(c) and 1(d) indicates the results for the dependant variable "Total Value" and independent variables the same as in the previous test. In both these tables, the adjusted R^2 is slightly higher and with a higher F-value, indicating an improved significance. This is, however, due to the variable for "High Rise Offices" that has the highest standardised β, which is expected to be high due to the bigger size of these offices having a higher value. The relationship of this variable is, however more prominent and with a higher significance in this case than when compared to size only, suggesting the influence of a higher value/m^2. In these two tables, a number of variables have higher standardised βs than the variable for distance from the station and also have better levels of significance. This suggests that in 2008, not much evidence exists that the distance from the station is influencing the total value of an office property.

In Annexures 1(e) and 1(f), the model explaining the dependant variable "value/m^2" has an adjusted R^2 of .301 and .327, respectively. Although only 30.1 and 32.7% of the variability in the value/m^2 is explained by these models, the f-test indicates a significance of .001 and .000 respectively, indicating a level of confidence in excess of 99% in both cases. It is, however, seen from the standardised βs and t-test, that distance from the station has very low scores with insignificant levels of confidence. In these tables, other variables, including the location or node, type of building and capitalisation rates are more prominent in explaining the variability in the value/m^2.

Similar results than the previous paragraph are found in Annexures 1(g) and 1(h), where rent/m^2 is the dependant variable, but overall statistical significance and model specification is slightly weaker. It is, however, again seen that other variables explain the variability in rent, while distance from the station has low standardised βs and t-test scores, indicating insignificant statistical confidence.

In all of the above tests, the dummy variable indicating if a property is within a 500 m distance from a Gautrain bus-stop or within 1 km from the station, has very low standardised βs and t-test scores. This confirms irrelevance of this variable in overall model specification.

Post-implementation results

In Annexures 2(a) to 2(h), the data for 2015 property values and attributes are used. The overall model specification for GLA as noted in Annexures 2(a) and 2(b) is found to be highly insignificant, with very low F-values for the overall model and poor t-test scores on individual variables.

When considering Annexures 2(c) and 2(d), the overall model specification for total value is still problematic and found to be insignificant. The individual variables, however, indicates the distance from the train station to be the only variable to have t-test scores to indicate a confidence level in excess of 90%.

The analysis for value/m^2 as dependent variable as indicated by Annexures 2(e) and 2(f), has lower Adjusted R^2 values and f-test results than the equivalent 2008 data, but when considering the individual variables, Distance from the station is in both cases very prominent variables. The standardised βs are above .5 in both cases, with a negative relationship, indicating that there is clear evidence that property values decline as the distance from the station increases. This is found to be the case with t-scores indicating a confidence level in both cases of approximately 99%.

Annexures 2(g) and 2(h) have slightly lower overall R^2 values and F-values, but interesting have higher standardised βs in both cases, albeit at a slightly lower t-test score, than in the preceding test. It is, however, found to be the most significant variable in both cases, suggesting that the distance from the station must have an impact on office property values.

Growth results

In the third set of tests, displayed in Annexures 3(a) to 3(f), the growth in values, value/m^2 and rent is analysed. Office Parks were found to be the most significant in overall value growth in nodes other than Sandton, while the second most significant variable in these nodes and most significant in Sandton, is the distance from the station (refer Annexures 3(a) and 3(b)). It should be noted, however, that overall model specification indicates fairly low levels of confidence in estimating overall value.

The value/m^2 growth in nodes other than Sandton, as indicated in Annexure 3(c), were found to have the second most significant results of all tests conducted, with a R^2 value of .302 and a F-value of 2.919, indicating a significance of .013. The variable with the highest standardised β is the dummy variable indicating that a property is situated in Rosebank. From earlier discussions, it was indicated that Rosebank was typified by smaller properties prior to implementation of the Gautrain, while now it has the highest levels of growth/m^2. Second in line is office parks and closely behind it is the distance from the train. The same model for Sandton properties does not have the same overall level of significance, but distance from the station is the only variable singled out to have a meaningful level of statistical confidence.

When considering rental levels, although the overall model is found largely insignificant, the distance from the station is again found to be the only variable with some level of statistical significance, as indicated in Annexures 3(e) and 3(f).

Findings

A summary of the most important statistics is provided in Table 1. It is important to note that there is evidence of model specification errors that are visible in the low R squares, which is mostly due to the limitations mentioned previously, in that not all value forming attributes are considered at this stage. Working with the data at hand, it is evident that the R squares is almost throughout higher in the 2008 models than the 2015 models. It appears thus as if the earlier data is better explaining the various dependant variables. If one, however, consider the individual independent variables, the *Distance from Gautrain* variable had very low βs, with very low significance p-values. The stronger relationships were caused by variables other than the distance from the positions where the Gautrain would have been built two years later, as evident in Annexure 1.

Table 1. Summary of model statistics.

	Total value 2008 excl. Sandton		Total value 2008 Sandton		Value/m^2 2008 excl. Sandton		Value/m^2 2008 Sandton		Rent 2008 excl. Sandton		Rent 2008 Sandton	
Adj. R^2	.153		.190		.301		.327		.255		.247	
F	2.119		3.278		3.659		5.722		3.121		4.182	
Sig.	.033		.005		.001		.000		.002		.001	
	β	p	β	p	β	p	β	p	β	p	β	p
Distance from Gautrain	−.178	.291	−.160	.317	−.096	.528	−.084	.564	−.147	.352	−.113	.466
	Total value 2015 excl. Sandton		Total value 2015 Sandton		Value/m^2 2015 excl. Sandton		Value/m^2 2015 Sandton		Rent 2015 excl. Sandton		Rent 2015 Sandton	
Adj. R^2	−.119		−.034		.123		.157		.172		.285	
F	.573		.779		1.563		2.238		1.665		3.122	
Sig.	.822		.592		.166		.063		.153		.019	
	β	p	β	p	β	p	β	p	β	p	β	p
Distance from Gautrain	−.405	.091	−.374	.095	−.555	.011	−.599	.004	−.653	.016	−.665	.007
	Total value growth excl. Sandton		Total value growth Sandton		Value/m^2 growth excl. Sandton		Value/m^2 growth Sandton		Rent growth excl. Sandton		Rent growth Sandton	
Adj. R^2	.108		.028		.302		.013		.012		.126	
F	1.538		1.234		2.919		1.105		1.044		1.927	
Sig.	.179		.314		.013		.375		.437		.123	
	β	p	β	p	β	p	β	p	β	p	β	p
Distance from Gautrain	−.349	.067	−.366	.059	−.343	.044	−.343	.079	−.350	.124	−.343	.100

Source: Author.

In contrast, the 2015 values for the *Distance from Gautrain* variable had throughout all models the highest βs and most significant p-values. It is thus evident that the location relative to the stations' positions did not impact in 2008, but in 2015 a fairly strong impact is evident. An exception is the test if the distance from the stations had an impact on the GLA, i.e. was there a tendency to increase the size of the properties close to the station more than those further away by way of additions or redevelopment? Although the *Distance from Gautrain* variable still has the highest βs and significant p-values, the p-values are not very strong and would fail to reject the null hypothesis. The tests for the impact on the GLA are thus not included in Table 1, but the fact that it does indicate some form of relationship, warrants further research in this regard. A further observation is that rent has the best β and p-values compared to the other studies, followed by value/m^2 and then total value. This probably caused by the fact that the number of factors affecting these dependent variables, are more in the same order. The sample size, however is different for Rent than the other two due to information availability, which might also have an impact, but it still indicates the same observation of *Distance from Gautrain* has a higher impact than the other independent variables considered.

For tests performed on Value Growth, the value/m^2 growth for all properties not located close to Sandton, a fairly descriptive model is evident, as discussed in the previous section. It appears as if specific areas had significant growth after installation of the train. Particularly the area Rosebank is found to be such an example and in combination with the other variables that also show fairly significant p-values, an overall higher model result is seen. A more important observation is that all tests had very similar βs and p-values for *Distance from Gautrain*.

In order to formally accept or reject the Null-hypothesis, *Distance from Gautrain* as only independent variable is regressed against the various independent variables as shown in Table 2.

Only 2.6% of the variability in the total value of properties in 2015 is indicated to be explained by the distance from the Gautrain, at a level of confidence between 75% and 90%. This is considered as too low to confidently reject the Null hypothesis and there are additional factors that need to be considered. A similar situation applies for the total growth in values between 2008 and 2015, with 4.4% of the variability explained at the 90% level of confidence. This is considered moderately accurate, and partly rejects the Null hypothesis, indicating that there is a moderate indication that the distance from the Gautrain can be accepted to have an impact on the total value growth.

The variability in the 2015 value/m^2 of properties are indicated to be explained 11.9% by the distance from the Gautrain and with a p-value of .015, it rejects the Null hypothesis above the 95% level of confidence, just failing to reject it at the 99% level. It is, however safe to say that there is a fairly high indication of impact. 7.8% Of the variability in the growth of

Table 2. Regression with distance from Gautrain as only independent.

	Total value 2015	Value/m^2 2015	Rent 2015	Total value growth	Value/m^2 growth	Rent growth
Adj. R^2	.026	.119	.250	.044	.078	.187
F	2.084	6.415	11.670	2.846	4.388	8.376
Sig.	.157	.015	.002	.100	.043	.007

Source: Author.

the value/m^2 is explained by the distance from the Gautrain, at the 95% level of confidence. It therefore also rejects the Null hypothesis at a moderately high level and the alternative hypothesis can therefore be accepted that there is an impact on the value/m^2 of properties by the distance from a Gautrain station.

With rent, 25% of the variability in the 2015 rent and 18.7% in the variability of the growth in rent is explained by the distance from the Gautrain, both above the 99% level of confidence. The Null hypothesis that there is no impact by the Gautrain on property values can be rejected at a high level of confidence, in so far as rent has an impact on the income and thus the value of properties. The alternative hypothesis can therefore be accepted and it is evident that there is indeed an impact by the distance from a Gautrain station on property values.

Summary

From the analysis performed, it was found that the distance from the station had little, if any effect on the value of property prior to the implementation of the Gautrain rapid rail system. Five years after implementation, the distance from the station dominated various models as most significant or close thereto in predicting the levels of overall value, value/m^2 or rent/m^2. It was furthermore also found that areas that were previously less attractive for investment purposes, now experience high levels of growth in values. The fact that distance from the station had very little effect on the determination of property or rental values, prior to implementation, but weighed heavily after implementation, is clear evidence that the null-hypothesis of no impact can be rejected.

The study is, however, limited by sample size, property type and information on value forming attributes, which if available, could enhance this research significantly, while it is currently lacking in terms of model specification and reliable hedonic model accuracy and significance. The study is nevertheless considered to show sufficient evidence of an impact of the Gautrain Rapid Rail system on office values, to warrant further research including more variables, property types and data points. In order to enable this, it would require support from industry players, such as property investors, developers, financiers and taxing authorities to make available information at their disposal, which could be included in such an analysis.

Further research could include extensive hedonic modelling, whereby value forming attributes are used as independent variables and similar other variables such as distance from the station, that can be included in order to compare the relevance of attributes pertaining to the rail system to other traditional value forming attributes.

The importance of the outcome of this research, as well as the necessity of new research, is to enable decision-making on the possible extension of the rapid rail system. The positive impact on property values have a direct and indirect impact on the economy due to the value capture nature of real estate. It furthermore provides property investors, developers and financiers with some insight into the impact on their investment and the prices that should be paid, where to invest and how much is warranted to finance. With a more detailed analysis, it would be possible not only to confirm the impact, but also measure and forecast such impact on future property values.

The unique contribution of this research is in the fact that similar testing like this in other countries, especially developed countries, are assuming that the population is accustomed to public transport. In this study, the Gautrain construction is the first rapid rail system and pricing thereof is in a part of the population that is only accustomed to private transport. The success of implementation thereof was therefore very uncertain, but this research shows the success in terms of the value capture principles entrenched in property. This research is therefore a contribution, especially for developing countries that are considering investment in more advanced public transport. It is, however, limited in accurately testing the level of impact, and had as aim only to confirm or reject that an impact does exist.

Disclosure statement

No potential conflict of interest was reported by the author.

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Annexures 1.

Annexure 1a. 2008 Gross lettable area, Sandton excluded

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients	t	Sig.	Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β			Tolerance	VIF
Dependent variable: GLA 2008		8063.43	8434.240	69							
Predictors	(Constant)				13184.486	8106.371		1.626	.109		
	Distance from Gautrain	3.675	3.3983	69	−629.004	421.025	−.253	−1.494	.141	.448	2.232
	Within 500 m from bus stop / 1 km of station	.783	.4155	69	1310.541	3121.055	.065	.420	.676	.545	1.834
	Office parks	.420	.497	69	−897.062	6346.091	−.053	−.141	.888	.092	10.858
	High rise offices	.072	.261	69	5804.838	7319.144	.180	0.793	.431	.251	3.984
	Low rise offices	.478	.503	69	−2992.542	6043.322	−.179	−.495	.622	.099	10.084
	Hatfield	.087	.284	69	−1107.003	3776.177	−.037	−.293	.770	.798	1.253
	Centurion	.058	.235	69	−7125.397	4426.626	−.199	−1.610	.113	.845	1.184
	Midrand	.130	.339	69	−475.952	3111.152	−.019	−.153	.879	.823	1.215
	Rosebank	.217	.415	69	−5544.862	3229.123	−.273	−1.717	.091	.509	1.963
	Park	.043	.205	69	5954.356	4979.365	.145	1.196	.237	.876	1.141
	Cap_rate2008	.114	.03438	69	−8133.002	31248.361	−.033	−.260	.796	.794	1.259

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.515	.265	.123	7896.684	2.203
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	1282890566.52	11	116626415.14	1.870	.063
Residual	3554384554.44	57	62357623.76		
Total	4837275120.96	68			

Annexure 1b. 2008 Gross lettable area, Sandton only

Model		Descriptive statistics			Unstandardized coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: GLA 2008		8063.43	8434.24	69							
Predictors	(Constant)				7382.168	7861.771		.939	.351		
	Distance from Gautrain	3.675	3.3983	69	−467.463	420.176	−.188	−1.113	.270	.471	2.123
	Within 500 m from bus stop/1 km of station	.783	.4155	69	2659.587	3132.809	.131	.849	.399	.567	1.765
	Office parks	.420	.497	69	2679.133	6038.329	.158	.444	.659	.107	9.388
	High rise offices	.072	.261	69	8858.875	6967.183	.274	1.272	.208	.290	3.448
	Low rise offices	.478	.503	69	−390.576	5940.207	−.023	−.066	.948	.107	9.305
	Cap_rate2008	.114	.03438	69	−20069.01	29456.557	−.082	−.681	.498	.936	1.068
	Sandton	.464	.502	69	2221.360	2301.907	.132	.965	.338	.718	1.393

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.420	.177	.082	8080.350	1.922
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	854459851.63	7	122065693.09	1.870	.090
Residual	3982815269.33	61	65292053.60		
Total	4837275120.96	68			

Annexure 1c. 2008 Total value, Sandton excluded

Model		Descriptive statistics			Unstandardised Coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: value 2008		82.95	158.195	69							
Predictors	(Constant)				214.253	149.437		1.434	.157		
	Distance from Gautrain	3.675	3.3983	69	−8.265	7.761	−.178	−1.065	.291	.448	2.232
	Within 500 m from bus stop/1 km of station	.783	.4155	69	38.210	57.535	.100	.664	.509	.545	1.834
	Office parks	.420	.497	69	−9.289	116.987	−.029	−.079	.937	.092	10.858
	High rise offices	.072	.261	69	217.026	134.925	.358	1.608	.113	.251	3.984
	Low rise offices	.478	.503	69	−13.899	111.406	−.044	−.125	.901	.099	10.084
	Hatfield	.087	.284	69	−87.753	69.612	−.157	−1.261	.213	.798	1.253
	Centurion	.058	.235	69	−141.101	81.603	−.210	−1.729	.089	.845	1.184
	Midrand	.130	.339	69	−77.169	57.353	−.165	−1.346	.184	.823	1.215
	Rosebank	.217	.415	69	−79.723	59.527	−.209	−1.339	.186	.509	1.963
	Park	.043	.205	69	−9.813	91.792	−.013	−.107	.915	.876	1.141
	Cap_rate2008	.114	.03438	69	−808.287	576.049	−.176	−1.403	.166	.794	1.259

Model summary					
Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.539	.290	.153	145.572	2.243
ANOVA					
Model	8	df	Mean square	F	Sig.
Regression	493856.66	11	44896.06	2.119	.033
Residual	1207895.13	57	21191.14		
Total	1701751.79	68			

Annexure 1d. 2008 Total value, Sandton only

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity Statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: value 2008		82.95	158.20	69							
Predictors	(Constant)				119.719	138.526		.864	.391		
	Distance from Gautrain	3.675	3.3983	69	−7.463	7.404	−.160	−1.008	.317	.471	2.123
	Within 500 m from bus stop/1 km of station	.783	.4155	69	46.938	55.201	.123	.850	.398	.567	1.765
	Office parks	.420	.497	69	−9.180	106.397	−.029	−.086	.932	.107	9.388
	High rise offices	.072	.261	69	206.674	122.763	.341	1.684	.097	.290	3.448
	Low rise offices	.478	.503	69	−13.728	104.668	−.044	−.131	.896	.107	9.305
	Cap_rate2008	.114	.03438	69	−773.708	519.032	−.168	−1.491	.141	.936	1.068
	Sandton	.464	.502	69	81.492	40.560	.259	2.009	.049	.718	1.393

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.523	.273	.190	142.378	2.164
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	465195.27	7	66456.47	3.278	.005
Residual	1236556.53	61	20271.42		
Total	1701751.79	68			

Annexure 1e. 2008 Total value per square meter, Sandton excluded

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity Statistics	
		Mean	Std. deviation	N	B	Std. error	*β*	*t*	Sig.	Tolerance	VIF
Dependent variable: value/m² 2008		8719.30	3131.865	69							
Predictors	(Constant)				14492.924	2688.388		5.391	.000		
	Distance from Gautrain	3.675	3.3983	69	−88.566	139.628	−.096	−0.634	.528	.448	2.232
	Within 500 m from bus stop/1 km of station	.783	.4155	69	839.711	1035.063	.111	.811	.421	.545	1.834
	Office parks	.420	.497	69	−1759.773	2104.611	−.279	−.836	.407	.092	10.858
	High rise offices	.072	.261	69	1759.092	2427.313	.147	.725	.472	.251	3.984
	Low rise offices	.478	.503	69	−552.243	2004.201	−.089	−.276	.784	.099	10.084
	Hatfield	.087	.284	69	−1137.886	1252.327	−.103	−.909	.367	.798	1.253
	Centurion	.058	.235	69	−3038.643	1468.041	−.228	−2.070	.043	.845	1.184
	Midrand	.130	.339	69	−1695.881	1031.779	−.184	−1.644	.106	.823	1.215
	Rosebank	.217	.415	69	−2199.657	1070.903	−.292	−2.054	.045	.509	1.963
	Park	.043	.205	69	−2923.343	1651.351	−.192	−1.770	.082	.876	1.141
	Cap_rate2008	.114	.03438	69	−36116.99	10363.172	−.397	−3.485	.001	.794	1.259

Model summary

Model	*R*	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.643	.414	.301	2618.848	2.209
ANOVA					
Model	Sum of squares	df	Mean square	*F*	Sig.
Regression	276056800.37	11	25096072.76	3.659	.001
Residual	390926717.16	57	6858363.46		
Total	666983517.53	68			

Annexure 1f. 2008 Total value per square meter, Sandton only

Model		Descriptive statistics			Unstandardised coef-ficients		Standardisd coefficients			Collinearity Statistics	
		Mean	Std. deviation	N	B	Std. error	β	*t*	Sig.	Tolerance	VIF
Dependent variable: value/m² 2008		8719.30	3131.87	69							
Predictors	(Constant)				12377.099	2499.585		4.952	.000		
	Distance from Gautrain	3.675	3.3983	69	−77.591	133.591	−.084	−.581	.564	.471	2.123
	Within 500 m from bus stop/1 km of station	.783	.4155	69	990.705	996.051	.131	.995	.324	.567	1.765
	Office parks	.420	.497	69	−1496.467	1919.837	−.238	−.779	.439	.107	9.388
	High rise offices	.072	.261	69	1968.936	2215.158	.164	.889	.378	.290	3.448
	Low rise offices	.478	.503	69	−458.520	1888.639	−.074	−.243	.809	.107	9.305
	Cap_rate2008	.114	.03438	69	−38238.58	9365.468	−.420	−4.083	.000	.936	1.068
	Sandton	.464	.502	69	1999.902	731.872	.321	2.733	.008	.718	1.393

Model summary

Model	*R*	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.630	.396	.327	2569.080	2.143
ANOVA					
Model	Sum of squares	df	Mean square	*F*	Sig.
Regression	264372982.88	7	37767568.98	5.722	.000
Residual	402610534.65	61	6600172.70		
Total	666983517.53	68			

Annexure 1g. 2008 Rent per square meter, Sandton excluded

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	*t*	Sig.	Tolerance	VIF
Dependent variable: rent 2008		78.73	22.719	69							
Predictors	(Constant)				64.646	20.124		3.212	.002		
	Distance from Gautrain	3.675	3.3983	69	−.981	1.045	−.147	−.938	.352	.448	2.232
	Within 500 m from bus stop/1 km of station	.783	.4155	69	1.781	7.748	.033	.230	.819	.545	1.834
	Office parks	.420	.497	69	−24.810	15.754	−.543	−1.575	.121	.092	10.858
	High rise offices	.072	.261	69	−8.653	18.169	−.099	−.476	.636	.251	3.984
	Low rise offices	.478	.503	69	−10.482	15.002	−.232	−.699	.488	.099	10.084
	Hatfield	.087	.284	69	−4.643	9.374	−.058	−.495	.622	.798	1.253
	Centurion	.058	.235	69	−20.977	10.989	−.217	−1.909	.061	.845	1.184
	Midrand	.130	.339	69	−9.595	7.723	−.143	−1.242	.219	.823	1.215
	Rosebank	.217	.415	69	−23.258	8.016	−.425	−2.901	.005	.509	1.963
	Park	.043	.205	69	−26.586	12.361	−.240	−2.151	.036	.876	1.141
	Cap_rate2008	.114	.03438	69	362.714	77.572	.549	4.676	.000	.794	1.259

Model summary

Model	*R*	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.613	.376	.255	19.603	2.262
ANOVA					
Model	Sum of squares	df	Mean square	*F*	Sig.
Regression	13194.23	11	1199.48	3.121	.002
Residual	21903.83	57	384.28		
Total	35098.06	68			

Annexure 1h. 2008 Rent per square meter, Sandton only

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: rent 2008		78.7349	22.71889	69							
Predictors	(Constant)				45.107	19.185		2.351	.022		
	Distance from Gautrain	3.675	3.3983	69	−.753	1.025	−.113	−.734	.466	.471	2.123
	Within 500 m from bus stop/1 km of station	.783	.4155	69	3.670	7.645	.067	.480	.633	.567	1.765
	Office parks	.42	.497	69	−16.251	14.735	−.356	−1.103	.274	.107	9.388
	High rise offices	.07	.261	69	.719	17.002	.008	.042	.966	.290	3.448
	Low rise offices	.48	.503	69	−5.256	14.496	−.116	−.363	.718	.107	9.305
	Cap_rate2008	.1143	.03438	69	312.677	71.881	.473	4.350	.000	.936	1.068
	Sandton	.46	.502	69	15.267	5.617	.338	2.718	.009	.718	1.393

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.569	.324	.247	19.71804	2.072
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	11381.193	7	1625.885	4.182	.001
Residual	23716.870	61	388.801		
Total	35098.063	68			

Annexure 2a. 2015 Gross lettable area, Sandton excluded

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients	t	Sig.	Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β			Tolerance	VIF
Dependent variable: GLA 2015		9935.85	8184.526	41							
Predictors	(Constant)				13583.574	8794.423		1.545	.133		
	Distance from Gautrain	3.367	2.9878	41	−866.308	620.624	−.316	−1.396	.173	.519	1.925
	Within 500 m from bus stop/1 km of station	.854	.3578	41	−1501.500	4619.168	−.066	−.325	.747	.654	1.530
	Office parks	.488	.506	41	2821.224	3029.160	.174	.931	.359	.760	1.316
	High rise offices	.073	.264	41	−813.911	5756.936	−.026	−.141	.889	.775	1.290
	Hatfield	.098	.300	41	−500.448	5059.546	−.018	−.099	.922	.773	1.294
	Centurion	.049	.218	41	−6174.531	6474.933	−.165	−.954	.348	.896	1.117
	Midrand	.146	.358	41	1533.694	4242.348	.067	.362	.720	.775	1.290
	Rosebank	.146	.358	41	−5596.676	4858.479	−.245	−1.152	.258	.591	1.692
	Park	.073	.264	41	5790.077	5613.921	.187	1.031	.311	.815	1.227
	Cap_rate2008	.1139	.02627	41	−2150.754	60675.170	−.007	−.035	.972	.703	1.423

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.447	.200	−.066	8452.005	1.763
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	536367014.08	10	53636701.41	.751	.673
Residual	2143091867.04	30	71436395.57		
Total	2679458881.12	40			

Annexure 2b. 2015 Gross Lettable area, Sandton only

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: GLA 2015		9935.85	8184.53	41							
Predictors	(Constant)				16162.138	8779.356		1.841	.074		
	Distance from Gautrain	3.367	2.9878	41	−678.752	610.209	−.248	−1.112	.274	.546	1.831
	Within 500 m from bus stop/1 km of station	.854	.3578	41	56.434	4548.850	.002	.012	.990	.685	1.460
	High rise offices	.073	.264	41	−2853.192	5615.780	−.092	−.508	.615	.828	1.208
	Low rise offices	.439	.502	41	−3541.528	2872.861	−.217	−1.233	.226	.871	1.148
	Cap_rate2008	.114	.02627	41	−22278.51	52131.500	−.072	−.427	.672	.968	1.033
	Sandton	.488	.506	41	638.968	3028.752	.040	.211	.834	.773	1.294

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.28	.079	−.084	8521.243	1.531
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	210664857.12	6	35110809.52	.484	.816
Residual	2468794024.00	34	72611588.94		
Total	2679458881.12	40			

Annexure 2c. 2015 Total value, Sandton excluded

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: value 2015		148.63	169.487	41							
Predictors	(Constant)				387.614	186.588		2.077	.046		
	Distance from Gautrain	3.367	2.9878	41	−22.998	13.168	−.405	−1.747	.091	.519	1.925
	Within 500 m from bus stop/1 km of station	.854	.3578	41	−33.599	98.003	−.071	−.343	.734	.654	1.530
	Office parks	.488	.506	41	5.159	64.268	.015	.080	.937	.760	1.316
	High rise offices	.073	.264	41	−27.203	122.143	−.042	−.223	.825	.775	1.290
	Hatfield	.098	.300	41	−78.900	107.346	−.140	−.735	.468	.773	1.294
	Centurion	.049	.218	41	−148.575	137.376	−.191	−1.082	.288	.896	1.117
	Midrand	.146	.358	41	−67.657	90.008	−.143	−.752	.458	.775	1.290
	Rosebank	.146	.358	41	−122.949	103.080	−.260	−1.193	.242	.591	1.692
	Park	.073	.264	41	12.508	119.108	.019	.105	.917	.815	1.227
	Cap_rate2008	.1139	.02627	41	−803.130	1287.321	−.124	−.624	.537	.703	1.423

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.401	.160	−.119	179.323	1.908
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	184329.59	10	18432.96	.573	.822
Residual	964699.92	30	32156.66		
Total	1149029.51	40			

Annexure 2d. 2015 Total value, Sandton only

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: value 2015		148.63	169.49	41							
Predictors	(Constant)				303.024	177.594		1.706	.097		
	Distance from Gautrain	3.367	2.9878	41	−21.218	12.344	−.374	−1.719	.095	.546	1.831
	Within 500 m from bus stop/1 km of station	.854	.3578	41	−18.663	92.017	−.039	−.203	.840	.685	1.460
	High rise offices	.073	.264	41	−26.357	113.599	−.041	−.232	.818	.828	1.208
	Low rise offices	.439	.502	41	−9.082	58.114	−.027	−.156	.877	.871	1.148
	Cap_rate2008	.114	.02627	41	−876.213	1054.545	−.136	−.831	.412	.968	1.033
	Sandton	.488	.506	41	79.310	61.267	.237	1.294	.204	.773	1.294

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.348	.121	−.034	172.372	1.822
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	138813.12	6	23135.52	.779	.592
Residual	1010216.39	34	29712.25		
Total	1149029.51	40			

Annexure 2e. 2015 Value per square meter, Sandton excluded

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: value/m^2 2015		14025.73	4042.478	41							
Predictors	(Constant)				23956.968	3938.016		6.084	.000		
	Distance from Gautrain	3.367	2.9878	41	−750.305	277.906	−.555	−2.700	.011	.519	1.925
	Within 500 m from bus stop/1 km of station	.854	.3578	41	−1435.853	2068.397	−.127	−.694	.493	.654	1.530
	Office parks	.488	.506	41	−230.408	1356.414	−.029	−.170	.866	.760	1.316
	High rise offices	.073	.264	41	913.476	2577.873	.060	.354	.726	.775	1.290
	Hatfield	.098	.300	41	−3393.415	2265.592	−.252	−1.498	.145	.773	1.294
	Centurion	.049	.218	41	−3261.350	2899.382	−.176	−1.125	.270	.896	1.117
	Midrand	.146	.358	41	−4019.573	1899.662	−.356	−2.116	.043	.775	1.290
	Rosebank	.146	.358	41	189.519	2175.557	.017	.087	.931	.591	1.692
	Park	.073	.264	41	−2159.675	2513.833	−.141	−.859	.397	.815	1.227
	Cap_rate2008	.1139	.02627	41	−43244.22	27169.467	−.281	−1.592	.122	.703	1.423

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.585	.343	.123	3784.686	2.264
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	223949599.72	10	22394959.97	1.563	.166
Residual	429715516.33	30	14323850.54		
Total	653665116.05	40			

Annexure 2f. 2015 Value per square meter, Sandton only

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: value/m^2 2015		14025.73	4042.48	41							
Predictors	(Constant)				19228.108	3824.967		5.027	.000		
	Distance from Gautrain	3.367	2.9878	41	−810.579	265.854	−.599	−3.049	.004	.546	1.831
	Within 500 m from bus stop/1 km of station	.854	.3578	41	−2087.583	1981.831	−.185	−1.053	.300	.685	1.460
	High rise offices	.073	.264	41	729.348	2446.668	.048	.298	.767	.828	1.208
	Low rise offices	.439	.502	41	945.520	1251.641	.118	.755	.455	.871	1.148
	Cap_rate2008	.114	.02627	41	−21329.63	22712.517	−.139	−.939	.354	.968	1.033
	Sandton	.488	.506	41	2602.613	1319.559	.326	1.972	.057	.773	1.294

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.532	.283	.157	3712.513	2.212
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	185051478.89	6	30841913.15	2.238	.063
Residual	468613637.16	34	13782754.03		
Total	653665116.05	40			

Annexure 2g. 2015 Rent per square meter, Sandton excluded

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: rent 2015		121.67	26.990	33							
Predictors	(Constant)				196.624	30.346		6.479	.000		
	Distance from Gautrain	3.341	3.0511	33	−5.779	2.206	−.653	−2.620	.016	.416	2.403
	Within 500 m from bus stop/1 km of station	.848	.3641	33	−24.864	16.641	−.335	−1.494	.149	.513	1.948
	Office parks	.485	.508	33	−7.614	10.442	−.143	−.729	.474	.671	1.490
	High rise offices	.091	.292	33	7.904	18.405	.085	.429	.672	.653	1.532
	Hatfield	.121	.331	33	−3.179	15.062	−.039	−.211	.835	.756	1.322
	Centurion	.030	.174	33	−3.698	26.264	−.024	−.141	.889	.902	1.109
	Midrand	.061	.242	33	.599	20.381	.005	.029	.977	.773	1.294
	Rosebank	.152	.364	33	9.001	16.338	.121	.551	.587	.533	1.877
	Park	.091	.292	33	3.463	16.774	.037	.206	.838	.786	1.272
	Cap_rate2008	.1194	.02548	33	−274.694	207.152	−.259	−1.326	.198	.677	1.477

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.656	.431	.172	24.560	2.390
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	10040.79	10	1004.08	1.665	.153
Residual	13270.55	22	603.21		
Total	23311.33	32			

Annexure 2h. 2015 Rent per square meter, Sandton only

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: rent 2015		121.67	26.99	33							
Predictors	(Constant)				183.384	29.443		6.228	.000		
	Distance from Gautrain	3.341	3.0511	33	−5.884	2.003	−.665	−2.938	.007	.436	2.293
	Within 500 m from bus stop/1 km of station	.848	.3641	33	−25.175	15.363	−.340	−1.639	.113	.520	1.922
	High rise offices	.091	.292	33	14.625	15.767	.158	.928	.362	.769	1.301
	Low rise offices	.424	.502	33	9.456	8.806	.176	1.074	.293	.834	1.199
	Cap_rate2008	.119	.02548	33	−211.799	170.847	−.200	−1.240	.226	.860	1.163
	Sandton	.545	.506	33	−1.380	9.794	−.026	−.141	.889	.664	1.506

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.647	.419	.285	22.828	2.414
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	9762.59	6	1627.10	3.122	.019
Residual	13548.75	26	521.11		
Total	23311.33	32			

Annexure 3a. 2008–2015 Total value growth, Sandton excluded

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: value growth		.088%	.051%	41							
Predictors	(Constant)				.089	.023		3.818	.001		
	Distance from Gautrain	3.367	2.9878	41	−.006	.003	−.349	−1.896	.067	.657	1.522
	GLA 2008	9308.610	7935.3560	41	.000	.000	−.060	−.361	.721	.799	1.251
	Office parks	.488	.506	41	.039	.017	.383	2.249	.032	.768	1.302
	High rise offices	.073	.264	41	.011	.033	.057	.337	.738	.781	1.280
	Hatfield	.098	.300	41	−.029	.029	−.173	−1.018	.316	.774	1.292
	Centurion	.049	.218	41	−.002	.038	−.007	−.045	.964	.863	1.159
	Midrand	.146	.358	41	−.019	.023	−.135	−.823	.417	.832	1.202
	Rosebank	.146	.358	41	.046	.026	.321	1.787	.084	.692	1.444
	Park	.073	.26365	41	.027	.032	.141	.862	.395	.836	1.196

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.556	.309	.108	.000	2.081
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	.032	9	.004	1.538	.179
Residual	.073	31	.002		
Total	.105	40			

Annexure 3b. 2008–2015 Total value growth, Sandton only

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: value growth		.088%	.051%	41							
Predictors	(Constant)				.133	.022		6.072	.000		
	Distance from Gautrain	3.367	2.9878	41	−.006	.003	−.366	−1.949	.059	.689	1.452
	GLA 2008	9308.610	7935.3560	41	.000	.000	−.117	−.725	.473	.932	1.073
	High rise offices	.073	.264	41	−.044	.033	−.225	−1.322	.195	.840	1.190
	Low rise offices	.439	.502	41	−.027	.017	−.262	−1.541	.132	.840	1.191
	Sandton	.488	.506	41	−.004	.018	−.038	−.214	.831	.781	1.281

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.387	.150	.028	.001	1.868
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	.016	5	.003	1.234	.314
Residual	.089	35	.003		
Total	.105	40			

Annexure 3c. 2008–2015 Value per square meter growth, Sandton excluded

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: value/m^2 growth		.076%	.041%	41							
Predictors	(Constant)				.074	.016		4.518	.000		
	Distance from Gautrain	3.367	2.9878	41	−.005	.002	−.343	−2.103	.044	.657	1.522
	GLA 2008	9308.610	7935.3560	41	.000	.000	−.012	−.081	.936	.799	1.251
	Office parks	.488	.506	41	.026	.012	.322	2.134	.041	.768	1.302
	High rise offices	.073	.264	41	.014	.023	.092	.617	.542	.781	1.280
	Hatfield	.098	.300	41	−.019	.020	−.138	−.916	.367	.774	1.292
	Centurion	.049	.218	41	−.040	.026	−.216	−1.521	.138	.863	1.159
	Midrand	.146	.358	41	−.010	.016	−.090	−.622	.539	.832	1.202
	Rosebank	.146	.358	41	.054	.018	.475	2.990	.005	.692	1.444
	Park	.073	.26365	41	.032	.022	.210	1.454	.156	.836	1.196

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.677	.459	.302	.000	2.089
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	.030	9	.003	2.919	.013
Residual	.036	31	.001		
Total	.066	40			

Annexure 3d. 2008–2015 Value per square meter growth, Sandton only

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: value/m^2 growth		.076%	.041%	41							
Predictors	(Constant)				.105	.017		6.000	.000		
	Distance from Gautrain	3.367	2.9878	41	−.005	.003	−.343	−1.811	.079	.689	1.452
	GLA 2008	9308.610	7935.3560	41	.000	.000	−.040	−.244	.808	.932	1.073
	High Rise Offices	.073	.264	41	−.022	.026	−.144	−.842	.406	.840	1.190
	Low Rise Offices	.439	.502	41	−.013	.014	−.156	−.909	.369	.840	1.191
	Sandton	.488	.506	41	−.008	.014	−.100	−.560	.579	.781	1.281

Model summary					
Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.369	.136	.013	.000	1.528
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	.009	5	.002	1.105	.375
Residual	.057	35	.002		
Total	.066	40			

Annexure 3e. 2008–2015 Rent per square meter growth, Sandton excluded

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: rent growth		.062%	.036%	33							
Predictors	(Constant)				.065	.019		3.490	.002		
	Distance from Gautrain	3.341	3.0511	33	−.004	.003	−.350	−1.595	.124	.642	1.557
	GLA 2008	9790.455	8588.2517	33	.000	.000	−.019	−.092	.928	.725	1.380
	Office parks	.485	.508	33	.006	.015	.091	.433	.669	.702	1.425
	High rise offices	.091	.292	33	.023	.027	.187	.857	.400	.646	1.548
	Hatfield	.121	.331	33	.008	.022	.076	.375	.711	.754	1.326
	Centurion	.030	.174	33	−.007	.038	−.032	−.175	.863	.908	1.101
	Midrand	.061	.242	33	.014	.031	.093	.439	.664	.687	1.455
	Rosebank	.152	.364	33	.012	.021	.118	.560	.581	.696	1.437
	Park	.091	.29194	33	.028	.024	.230	1.181	.250	.817	1.223

Model summary					
Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.538	.290	.012	.000	2.170
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	.012	9	.001	1.044	.437
Residual	.029	23	.001		
Total	.041	32			

Annexure 3f. 2008–2015 Rent per square meter growth, Sandton only

Model		Descriptive statistics			Unstandardised coefficients		Standardised coefficients			Collinearity statistics	
		Mean	Std. deviation	N	B	Std. error	β	t	Sig.	Tolerance	VIF
Dependent variable: rent growth		.062%	.036%	33							
Predictors	(Constant)				.083	.017		4.877	.000		
	Distance from Gautrain	3.341	3.0511	33	−.004	.002	−.343	−1.701	.100	.670	1.493
	GLA 2008	9790.455	8588.2517	33	.000	.000	.022	.128	.899	.905	1.105
	Sandton	.55	.506	33	−.013	.014	−.183	−.947	.352	.735	1.361
	High rise offices	.09	.292	33	.015	.023	.125	.677	.504	.806	1.241
	Low rise offices	.42	.502	33	−.006	.013	−.085	−.461	.649	.803	1.245

Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate	Durbin-Watson
1	.513	.263	.126	.000	2.162
ANOVA					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	.011	5	.002	1.927	.123
Residual	.030	27	.001		
Total	.041	32			