

# VALUE CREATION AROUND TRANSPORT INFRASTRUCTURE IN SOUTH AFRICA: THE CASE OF GAUTRAIN

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## ABSTRACT

In the South African context, the infrastructure backlog is ever increasing and, with limited government funding, the reality is that the gap is unlikely to close. There are, however, numerous value capturing mechanisms applied elsewhere in the world that can help with infrastructure funding, but few or none have been applied in a South African context. This paper reviews the literature on value creation and capturing, and explores whether or not it can be applied in transport infrastructure additions in South Africa. The paper seeks to understand potential value creation in the case study of the Gautrain project in Gauteng. Secondary data is used to evaluate the effect of the newly constructed rail stations on adjacent residential property values. This is done by investigating three variables, namely: distance to station; analysis year; and housing type. The data used in the analysis is validated by means of an ANOVA analysis, which is assessed by the F-test and a consequent Tukey HSD test. The paper illustrates that value creation is possible in some South African contexts. Stations such as Pretoria and Johannesburg indicated a direct correlation between increased property values and infrastructure additions, and can therefore act as justification for value creation and consequent value capture.

## 1 INTRODUCTION

Due to South Africa's apartheid history, which is a major contributor to the country's infrastructure backlogs, municipal infrastructure expenditure now constitutes more than half of public sector capital expenditure (Brown-Luthango, 2010). Elsewhere in Africa, it is estimated that USD93 billion per year is required to address infrastructure backlogs. A massive burden is consequently placed on local governments in terms of raising revenue to further finance major infrastructure upgrades and additions. Over the past ten years, the National Treasury has contributed significantly towards transport infrastructure investment, and fund allocations are expected to increase even more within the near future. (Brown-Luthango, 2010).

While transport infrastructure provides access to various economic opportunities for individuals (World Bank, 2009), (McGaffin, 2011) sees this expenditure as something more than just access provision. He argues that this capital expenditure can be seen as an investment that can lead to possible value creation and value capture opportunities. Value creation is seen as the additional value created due to infrastructure investment, where value capture is seen as the acquisition, by public and/or private entities, of a portion of the returns for the investment (Huxly, 2009). This additional value can then be used for the financing of amortisation or further infrastructure projects.

The paper consists of the following sections: Section 1, the current section, serves as an introduction to the paper. Section 2 presents a brief review of the literature, which serves as a basis for the method used in the study. Section 3 describes the research problem at hand and discusses the method applied in the study. Section 4 describes the case study, along with data analysis and thereafter a discussion of the data analysis. Section 5 closes the paper with a summary of the main conclusions drawn from the study.

## **2 LITERATURE REVIEW**

The literature review introduces the available literature relating to the concepts important to the investigation of infrastructure investment, property values, value creation and value capturing. The section starts with a review of infrastructure investment. This is followed by a discussion of the variables that have an influence on property values. The concept of value creation and capturing and associated value creation measuring techniques and value capturing mechanisms are then discussed.

### **2.1 Infrastructure investments**

Aside from the significant expenses associated with building or maintaining infrastructure, infrastructure investments have generally proved to be beneficial for a country's gross domestic product (Perkins, 2005). History has also shown that transport infrastructure has helped to promote the growth and development of the world's greatest cities such as London and New York (ADEC, 2010).

Generally it is expected that for every dollar spent on infrastructure, the gross domestic product will increase by approximately USD 0.05 – 0.25 (World Economic Forum, 2012). Strategic infrastructure can further be described as the backbone that interconnects our modern economies, where most are functional and create the greatest impact in terms of economic growth, social uplift and sustainability (Suzuki, Murakami, Hong, & Tamayose, 2015).

In a South African context, most cities lack modern mass transit systems and users are dependent on partially gridlocked roads. As a result, South Africans are forced to spend a high share of their disposable income on transport (Statistics South Africa, 2011). This especially places a burden on low-income workers, who face a large financial and economic opportunity cost (ADEC, 2010).

## 2.2 Transport infrastructure and property values

There are many theories behind what exactly it is that determines the value of a property, from which choices of location can be deemed as one of the most crucial. This is a topic frequently discussed by urban economists. Early studies (Von Thünen, 1863) suggest that land values are derived from transportation savings afforded by the location of the stand or land parcel. This principle later developed into the bid-rent theory, which assumes that the price of a land parcel increases due to proximity to the relative accessibility of a location, and land sizes increase with increasing distance from the CBD (Fujita, 1989). 'Bid rent curves' represent the price that a household or firm would be willing to pay at varying locations in a city in order to reach a certain level of satisfaction or 'rent'. In this theory, the land use activity having the highest 'bid' will occupy a certain location.

Transport system improvements often lower the costs of transporting goods or people in a city and improve the level of accessibility. In the case of a 'polycentric city', the rent gradient will in theory change, where the CBD will no longer be the most accessible place. This is evident in various developed cities around the world, where sub centres start emerging at a distance from the CBD. A so-called 'polycentric city' with different bid-rent curves from the 'monocentric city' is subsequently developed.

Furthermore, it is argued by some that location close to a nearby transport facility increases the accessibility of the property and therefore the value of the transport facility is capitalised in the property's value, although there are also negative implications which are often raised (Debrezion, Pels, & Rietveld, 2003). But land value is not only dependent on the location of the site. Various authors have conducted studies to determine what the different determinants for increased property values are, and most authors agree on three broad categories that include:

1. physical;
2. environmental; and
3. accessibility factors (Bowes & Ihlanfeldt, 2001).

Physical factors speak to the quantitative and qualitative features associated with a certain property, such as the size, type of land use and existing infrastructure on the land parcel. Environmental amenities are the externalities that emerge from the surrounding neighbourhood. These externalities, such as parks, public spaces, pollution etc. are secondary costs and benefits incurred by communities as a whole (Kumares & Labi, 2007). Accessibility relates to the cost and time incurred by people to get to places of interest (employment centres, amenities and desirable living areas) using different modes of travel.

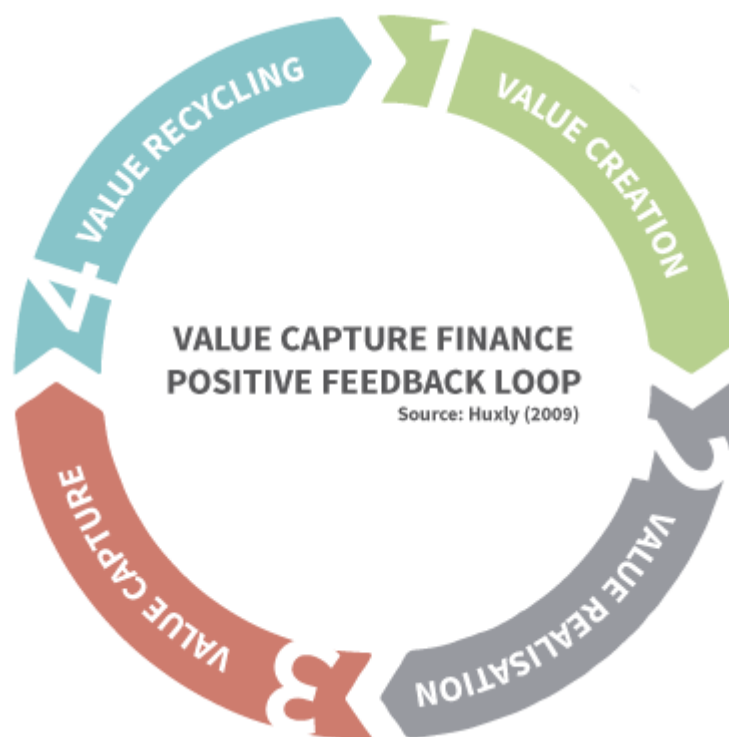
## 2.3 Value creation and capturing

Huxly (2009:7) describes Value Capture Finance (VCF) as *'the appropriation of value, generated by public sector intervention and private sector investment in relation to an*

*underused asset (land and/or structure), for local re-investment to produce public good and potential private benefit.* The benefit from value capturing is thus seen as not only quantitative (private monetary benefit), but also qualitative (public good). VCF is however often confused with other developmental finance mechanisms. This can be due to the rather complex financial and contractual arrangements associated with VCF. These arrangements can also change according to the local development context, legal frameworks and the purpose of funding.

There are a number of mechanisms, which can be used in order to capture additional value and will be discussed in section 2.3.3. These mechanisms, although different, all form part of the same intricate cycle. The cycle includes four components, namely: value creation; value realisation; value capture; and local value recycling (Huxly, 2009). The cycle can be seen in Figure 1 and the four components are discussed below:

1. Value creation: The unlocking of under-utilised assets' potential value increases. This is done by the public sector to increase the demand for private sector investment.
2. Value realisation: The actual investment from the private sector, ensuring the value increase is realised.
3. Value capture: Public sector arrangements, which involve the arrangement that a portion of the private sector investment is returned locally (monetary or in-kind contributions).
4. Local value recycling: The re-investment from the public sector, which might lead to further funding arrangements.



**Figure 1:** *An idealised VCF positive feedback loop* (Huxly, 2009)

### 2.3.1 Value creation

When infrastructure provision in an area does not change the level of spend or investment in that particular area, it is very unlikely that any additional value will be generated. With any infrastructure additions, one has to ensure that there must be a change in the level of income that can be attracted and captured. As seen in the VCF positive feedback loop above, value has to be created first before it can be captured. Thus, an increase in spend after an infrastructure investment is expected to happen through complex market mechanisms in an increased demand for space in the specific area which will eventually result in higher rentals being paid, and in turn create higher residual values. The potential to capture these increased values therefore exist and can ultimately be used to pay for, or at least offset some of the cost of, transport infrastructure.

### **2.3.2 Value creation measuring methods**

Value creation can take place in various forms as discussed above. How the additional value is calculated is also an important feature in the value creation and capturing process. There are different measuring methods, all leading to different results that are discussed below. It is important to understand all of these methods and to see how exactly they differ in order to avoid public and private sector disputes.

- Hedonic pricing method:

Cervero (2003) explains that the hedonic pricing theory assumes that most consumer goods consist of a number of attributes (e.g. size of structure, quality of neighbourhood, etc.) or variables. The transaction price of certain goods will then comprise of the component or 'hedonic' price of each attribute. The hedonic pricing method attempts to isolate the different attributes and measures how much change in one attribute (or variable) has an effect on another attribute. It is assumed that people value attributes of a land parcel, rather than the land parcel itself, meaning that the value of a parcel of land will reflect the value of a set of attributes (Royal Institution of Chartered Surveyors, 2002).

- Meta-analysis model:

Meta-analysis models are similar to hedonic pricing models in nature, however a meta-analysis identifies the results of underlying studies which are then treated as dependent variables that could potentially explain the variations in land prices. It is important that meta-analysis models are in the same measuring unit (Debrezion, Pels, & Rietveld, 2007).

- Residual valuation model:

In a South African study conducted by (McGaffin, 2011) the residual valuation method was used instead of the hedonic price approach. The estimates from this method are based on calculations prior to the infrastructure investment, so additional value created is estimated before the infrastructure investment. The residual valuation method has a number of shortcomings, namely if the input variables (such as income received, development costs and required profit levels) change, the calculated residual value will differ considerably. Incorrect or poor input data will lead to misleading results.

- Repeat sales method:

The repeat sales (or fixed effects) method is applied when panel data is available. Time-invariant but unobservable neighbourhood or parcel effects can be controlled. The model assumes there are unobservable individual- or neighbourhood-specific attributes that contribute to price.

### **2.3.3 Value capture mechanisms**

Various mechanisms to capture value have been developed across different continents. Although all mechanisms work differently, all of them can be divided into two broad categories:

- mechanisms where the value is captured from income-related value capture mechanisms to pay for transport or other urban infrastructure (monetary mechanisms): and
- mechanisms where the added value is used to facilitate broader planning outcomes (for example densification and inclusionary housing).

Some mechanisms used elsewhere in the world are listed below:

- zoning tools;
- land banking;
- betterment tax or special assessment;
- business improvement districts;
- development impact fees;
- joint development agreements or local service agreements;
- land value increment taxes;
- air rights; and
- tax increment financing.

## **3 RESEARCH METHOD**

It was decided to conduct a case study on the Gautrain rail network in order to see if there is any correlation between public transport infrastructure investments and adjacent property price increases. The Gautrain was chosen as a case study, seeing that it is a unique project in South Africa and required considerable investment when constructed. The potential for this additional value being captured was also considered.

As seen in the literature, property price increases are dependent on various variables. For the purpose of the case study, emphasis was placed on three important variables: housing type; distance from station; and analysis year. The research problem and data used are discussed in the paragraphs below.

### **3.1 Research problem**

The research questions answered in the paper essentially looked at whether or not a property value increase occurred and to what extent. In order to answer this, the scope was limited to three questions, of which all relate to a specific variable. These questions were:

1. What impact did the Gautrain have on different housing types?
2. Where did this value change occur?
3. When did this value change happen?

The three variables to be examined in each research question therefore are housing type and land use; distance from station and analysis year respectively.

### **3.2 Data**

Lightstone Property provided secondary data, which was used for the analysis. Data used in the analysis included Deeds Office Property Registrations for developed properties. Purchase dates since 2008 for properties within eight kilometres of the Centurion, Hatfield, Johannesburg, Marlboro, Midrand, Pretoria, Rhodesfield, Rosebank and Sandton Gautrain stations were included in the data. Lightstone Residential has a flag that was used as a filter to select only residential sales. For a property to be defined as residential it must meet one of the following criteria:

- The property must be registered under a private name (or CC's/Trusts with fewer than five properties).
- The property is in an area where the majority of properties are privately owned.
- The property is zoned as residential.
- The property is not a farm.
- Purchase price is less than R 40 million.
- The zoning is the overriding criteria, and regardless of anything else a property zoned as non-residential will be deemed non-residential.

The total number of properties and average number of property sales per year evaluated per station are as follows:

**Table 1: Dataset Details**

<b>Station</b>	<b>Number of Properties</b>	<b>Average Number of Property Sales Per Year</b>
Rosebank	12024	5743
Pretoria	16753	3147
Johannesburg	18049	4270
Hatfield	10798	4210
Sandton	12703	5596
Midrand	5036	3471
Marlboro	3838	4088
Rhodesfield	2656	4139
Centurion	13766	4158

The residential properties analysed included freehold and sectional title property types. Freehold (full title) ownership describes the full transfer or ownership when you buy a property. Sectional title ownership refers to a partial ownership of a complex or development when a property is bought or transferred (Private Property, 2010).

Lightstone's Hayley Greenstein specified their methodological approach for analysing the data as follows: "If a purchase price was deemed to be non-market related or an outlier value, its value was nullified before calculating any figures mentioned in the results below. Examples of non-market related sales include portion of title deed sales, or transfer of the property from a family member (non-arm's length transaction) (Greenstein, 2015)."

Repeat sales methodology (see section 2.3.2) was employed in the analysis to avoid the pitfalls associated with changes in the types of properties that transact in one year versus another year. Using the repeat sales methodology, the inflation is measured on an individual property that transacted sometime since 2008 onwards. The previous sale price for the same property would be used to calculate the property's growth over the ownership period. The growth for the property would then be apportioned per year according to the same growth values observed for other properties in the same Automated Valuation Model (AVM) segment using Lightstone's AVM Repeat Sales indices (Greenstein, 2015).

#### **4 DATA ANALYSIS**

Residential property increases cannot truly be reflected when there is no base to compare increases to. As per Lightstone Properties' advice, properties had to be analysed by using the average inflation due to location (the market trends are separated from structural factors such as infrastructure expenditure).

The period from 2008 – 2010 is defined as 'Before' operation (Construction phase) and 2011 – 2014 as 'After' (Operation phase).

Average inflation increase due to location is defined as: (Average inflation of properties 0-2 km or 2-5 km of Gautrain station) – (Average inflation of properties within 5-8 km of



station). It is assumed that the Gautrain does not affect properties 5-8 km away from stations. This then serves as the base residential property trend for a certain area. For example: In 2010 at the Hatfield station, property values within 0-2 km from the station had a 5% increase while properties within 5-8 km had a 3% increase. Therefore, the average inflation due to location for 0-2 km properties is 2% (5% - 3%). By applying this logic, the results are presented and then discussed below.

In order to test the reliability of the data, it was decided to test the data using a multiple regression model. In statistics, the term multivariate in “multivariate regression model” means that there are several/multiple response variables analysed simultaneously. Similarly, M in “MANOVA” stands for multivariate, also meaning multiple response variables (Carey, 1998). In the study at hand however, there is only one response variable of interest (average inflation) but four predictors (property type, distance from the station, year of investigation, and station). The resulting model is therefore the multiple regression model, or the four-way analysis of variance (ANOVA).

In the four-way ANOVA, one needs to specify, besides the main effects of the four predictors, potential interactions between them. The size of the data allows one to include all interactions up to order three, i.e. interactions of up to any three predictors. However, it is hard to interpret interactions, especially those of order three or higher. If the interaction between type and distance is included, for instance, one can compare the effects of different property types on the average inflation only when the distance from the station is at a fixed level.

#### **4.1 What impact did the Gautrain have on different housing types?**

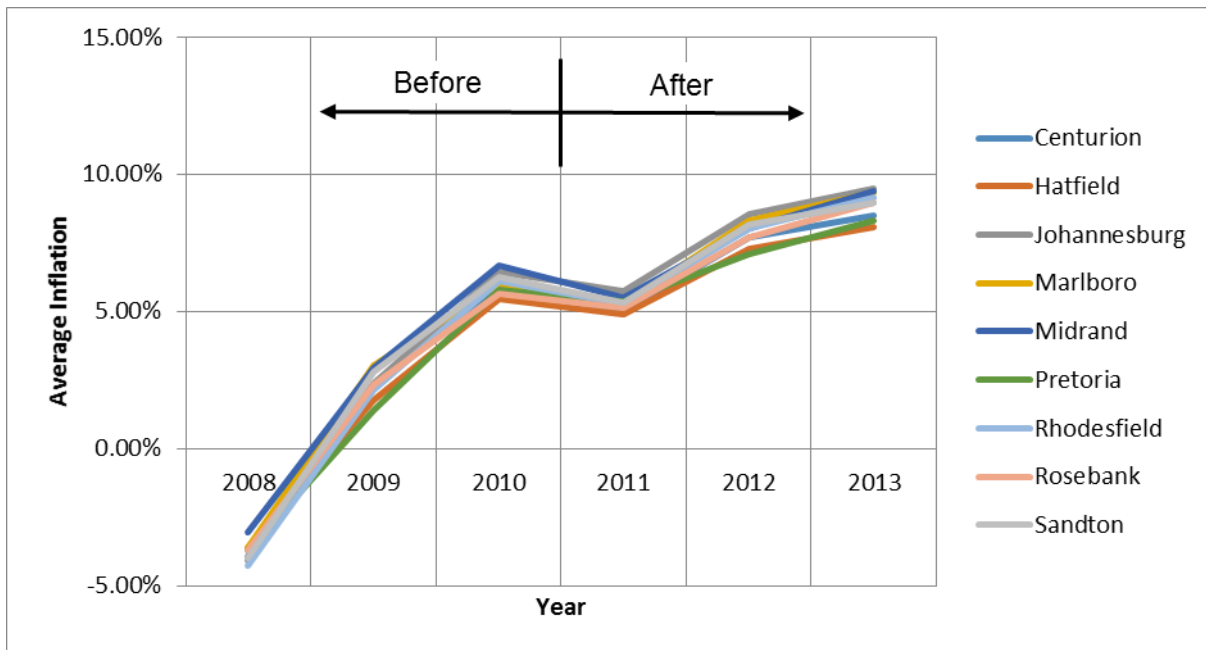
Except for the case of Johannesburg and Marlboro stations, sectional title properties had a higher percentage increase than freehold properties. The aggregated average increases for freehold properties and sectional title properties are 0.75% and 1.21% respectively. This may be due the fact that sectional title properties are cheaper in general than freehold properties and more in demand. The type of built environment around properties also has an influence – in a city’s business districts, one would typically not have more sectional title properties. It can be said that the implementation of the Gautrain led to densification seeing that freehold properties are lower density and sectional title properties are higher density.

#### **4.2 Where did this value change occur?**

After the construction phase, properties started to increase more significantly. Hatfield, Marlboro and Pretoria started to show signs of increased values, whereas Rosebank and Sandton increased even more than before. The aggregated averages for the 0-2 km and 2-5 km categories are 0.81% and 0.48% respectively. As for the vicinity, there does not seem to be a clear trend in which one performs better, but properties in the 0-2 km category increased from 0.57% to 0.81%.

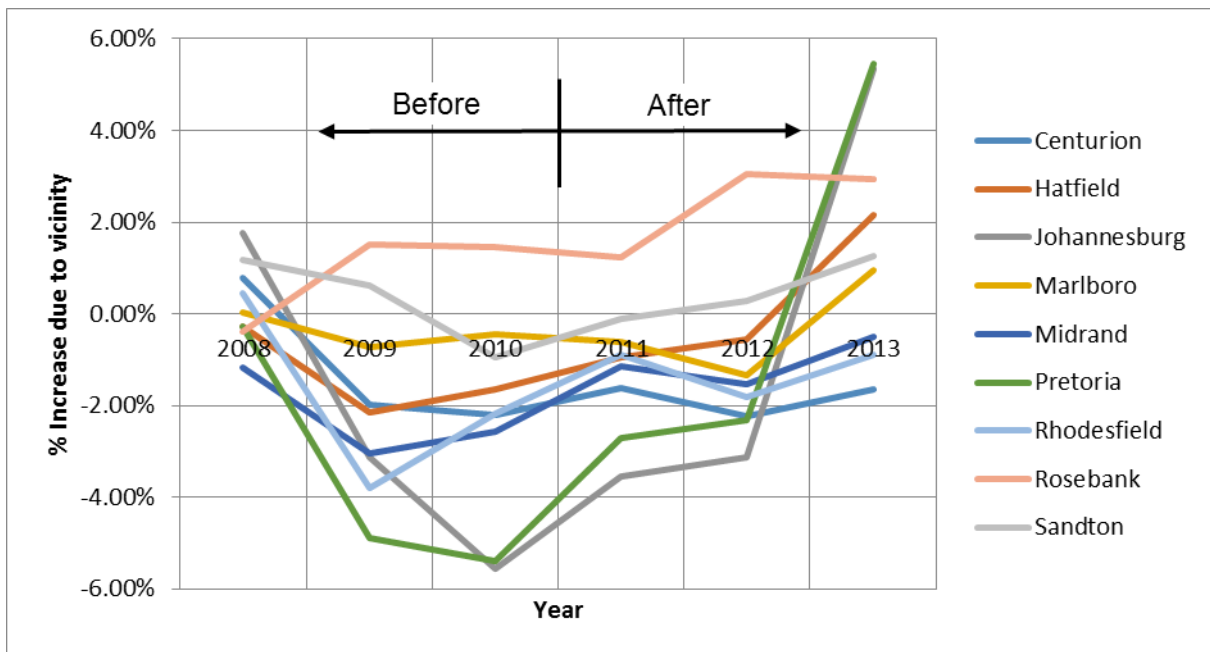
### 4.3 When did this value change happen?

In order to evaluate the analysis year, property types and distances had to be kept constant. Therefore, three graphs all representing different distances from the stations were drawn for the respective stations. A general market trend for properties 5-8 km away from stations is clearly seen in Figure 2. An overall increasing property value is clearly seen from 2008 to 2010. The market tends to decline in 2011 and could partially be because of the economic recession. The market seems to stabilise after 2011 again.



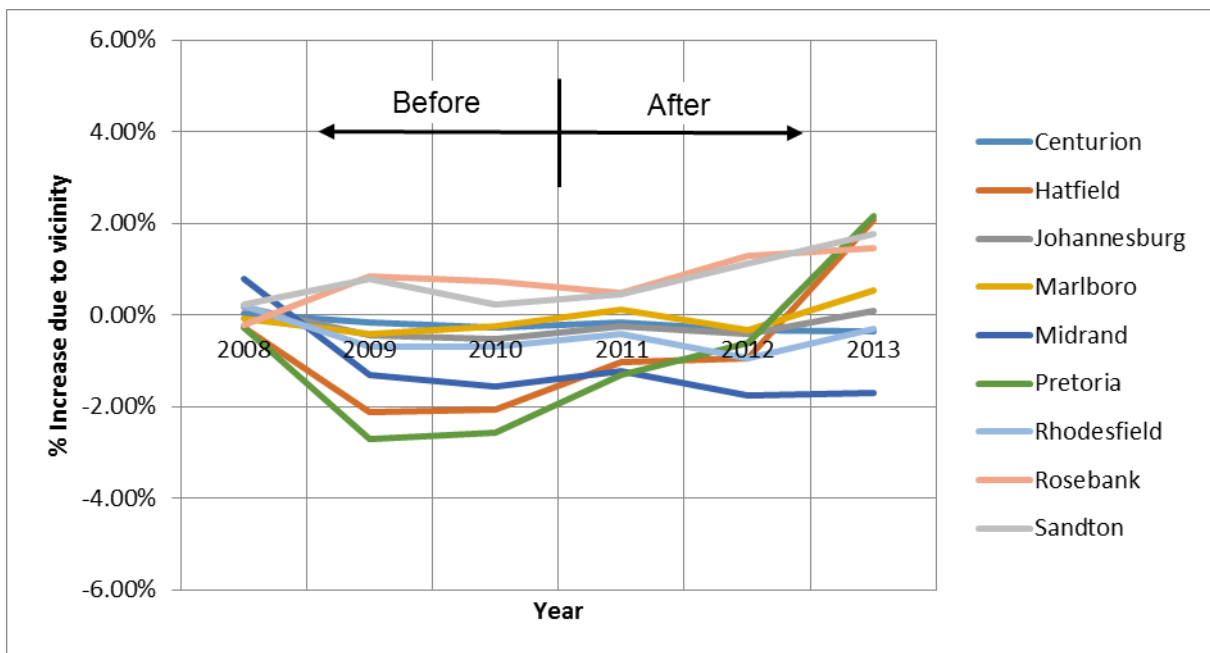
**Figure 2: Weighted mean annual residential property value percentage change between 5 and 8 km from the station between 2008 and 2013**

The results displayed in Figure 3 indicate the residential property trends for each station. Not all stations indicated property value increases, especially in the construction phase. Noise implications might be one of the factors for decreasing trends during this phase. The Rosebank station seems to have the overall best performance regarding property value increase. Pretoria and Johannesburg stations performed poorly prior to operation, but outperformed the other stations in 2013, during the operation phase. This might be due to city revitalisation projects and initiatives taking place in the city centres. In Johannesburg, properties within a 0-2 km radius from stations increased by an additional 10.92% and similarly in Pretoria by 10.84% during the operation phase.



**Figure 3: Weighted mean annual residential property value percentage change between 0 and 2 km from the station between 2008 and 2013**

From Figure 4 it is clear that properties 2-5 km away from the Gautrain stations are not affected by the system as much as in the case of 0-2 km. Hatfield and Pretoria stations only started to show higher increases in 2013. This is possibly because of numerous accommodation projects taking place in the Hatfield area. Both Rosebank and Sandton performed well throughout the construction and operation phases and coincide very well with the results seen in the Distance from station results.



**Figure 4: Weighted mean annual residential property value percentage change between 2 and 5 km from the station between 2008 and 2013**

#### 4.4 Analysis of Variance (ANOVA)

During the ANOVA analysis, it was found that the Station and Distance, Station and Year and Year, Station and Distance models have p-values of less than 0.05 when conducting the F-test, as seen in the table below. They are therefore statistically significant and subjected to a post-hoc test (Tukey HSD test). In the post-hoc tests it was found that all the means of the variables, except for the Midrand station, are not significantly different.

**Table 2: ANOVA Analysis Results**

Model No	Variable 1	Variable 2	F	Pr>F
1	Year	Distance	0.86	0.5472
2	Station	Distance	2.14	0.0239
3	Station	Year	1.90	0.0287
4	Year, Station, Distance		1.73	0.0453

## 5 CONCLUSIONS

The primary observation from the case study analysis was a general increase in residential property values in close vicinity to rail stations. Sectional title properties generally performed better than freehold properties after the construction of the Gautrain. This might be an indication of increasing density around station nodes taking place after construction of the Gautrain. Residential properties closer to stations indicated a more significant price increase than properties further away, except for Sandton station. All properties performed better after the operation of the Gautrain started. The decline in property prices experienced at some stations might be because of noise implications during the construction phase. In the ANOVA analysis, for all variables, except for the Midrand station, it can be concluded that the dataset is reliable.

Value capturing mechanisms are seldom considered when planning and financing transport infrastructure in a South African context, and might lead to a significant amount of finance in projects. In general, property values within the close vicinity of transport infrastructure have shown increased values and the opportunity to capture these additional values consequently arises. Transport infrastructure investment can also be used to change urban shape and to stimulate development and rejuvenation, especially in areas susceptible to urban decay.

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