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RESEARCH REPORT

MIXED INCOME HOUSING DEVELOPMENTS EFFECTS ON SURROUNDING PROPERTY VALUES: A CITY OF JOHANNESBURG CASE STUDY

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Abstract

Mixed income housing models and inclusionary housing policy are among the leading solutions used internationally to foster inclusion and achieve restructuring (Huang 2015; Tajani and Morano 2015; Klug et al, 2013; (Onatu, 2010). The focus of this research is on Mixed Income Housing (MIH) developments as an alternative to the mass Reconstruction and Development Progamme (RDP) roll out. The myths and facts on the benefits of mixed income housing developments are debated in literature. The benefits (or perceived benefits) of mixed developments include a positive social impact and addressing the culture of poverty, a concept that states a concentration of poor households further enable negative behaviour such as drug abuse and joblessness (Landman, 2012) (Brophy and Smith, 1997). The benefits and myths have yet to prove that in the South African context.

Low income housing and mixed income housing projects are argued to impact the surrounding property values. The study analysed the impact of the mixed income housing (MIH) development Cosmo City, located in the City of Johannesburg, on the surrounding single stand residential property values seen through the purchase prices of houses in the market. The study uses hedonic modelling to carry out the analysis. Three (3) variables are included in the model, purchase price as the dependent variable and the two (2) independent variables; municipal assessed values and distance from the MIH.

The main variable of interest is the Distance from the MIH, as it gives indication of whether properties closer to Cosmo City actually has lower property prices (i.e. the purchase price) than those located farther away. This variable was found to be statistically significant with the expected positive sign, thus confirming that the farther a property is located from the MIH the higher the purchase price.

The remaining independent variable, Municipal Assessed Value, is also found to be statistically significant. However, when outliers were excluded this variable became statistically insignificant. The model has a strong predictive power. For every 1 unit increase of the Municipal Assessed Value (X1) the purchase price increases by 0.00001398% (i.e. 0.0000001398 *100); and for every 1 unit increase of Distance from MIH the purchase price increases by 0.1% (i.e. 0.001 * 100).

CHAPTER ONE: INTRODUCTION

Chapter One
Introduction

1.1 Research background

Mixed income housing developments presents an alternative to the mass roll out of the Reconstruction and Development Programme (RDP) houses that continue to create segregated cities and neighbourhoods in South Africa. Mixed income housing has been defined in literature in various ways. It is defined in terms of tenure, density and household earnings but also the mix of social groups and land uses (Landman, 2012). The scale at which the mixed income development occurs is recognised as being varied. A number of countries including the UK, New Zealand, Canada and the USA have been implementing mixed income developments (Landman, 2012).

Mixed income housing seeks to meet market forces in the middle by providing secure high quality housing while also including affordable housing for low income earners and assist the market (i.e. private developers) to supply adequate housing for all income earners (Myerson, 2003). It presents a sustainable way of creating socially integrated neighbourhoods. The purpose and proved benefits of mixed income housing are established around it being a strategy for addressing the problems associated with poverty- deconcentrating poverty and creating socioeconomic diversity in an area, achieving economic desegregation, poverty alleviation and urban revitalisation (Levy, McDade and Bertumen, 2013) Applying this type of residential development in South Africa may result in similar social and economic benefits.

Mixed income housing developments in South Africa (as is the case in many countries) vary in terms of the “mix” and definition. These housing developments usually “mix” building types, tenures, social groups, land uses and income; and the scale at which this occurs also varies in one development (Landman, 2012). Mixed income housing developments are therefore inclusive of low cost/affordable housing. Low cost housing can provide input and guidance into the investigations around mixed income housing developments, however the extent at which this can be done is unknown and unproved.

Delivery of mixed income housing has been done through Public Private Partnerships (PPPs) worldwide including Brazil, cities in Canada, China, Europe and the U.S.A. Public Sector, typically Local Governments, have the advantage of owning and controlling land parcels that are well located and serviced (Klug, Rubin and Todes, 2013; Yuniati and Setiawan, 2013). Developers (i.e. Private Sector) can benefit financially from this and government subsidies made available to them. This is a great mechanism for successfully delivering housing to low income earners in a way that does not exclude and segregate. Policy framework becomes essential in these housing implementations. South Africa has housing subsidies that are accessible to and seek to incentivise developers in the implementation of mixed income housing. Using the mixed income housing developments of Cosmo City, Lady Selborne and Fleurhof as references, the Finance-Linked Individual Subsidy Programme (FLISP) was accessed to carry out part of the developments. The subsidy seeks to reduce monthly repayments on mortgage loans for the gap market i.e. those individuals earning between R3501 and R15 000 (Dlamini, 2012).

These subsidies continue to be accessed and South Africa has begun with the roll out of mixed income housing, with eighteen (18) mixed income housing developments introduced as the first round (or national flagship projects) in mixed housing development. The developments will deliver permanent clinics, schools, parks which have sports and recreational facilities, multi-purpose community centres that will include municipal offices, sports fields, swimming pools and libraries (Gauteng Partnership Fund, 2012). Table 1 below lists the national symbol mixed income housing.

PROJECT NAME	LOCATION	NUMBER OF UNITS
Lufhereng	City of Johannesburg Metropolitan Municipality	24 100
Cosmo City	City of Johannesburg Metropolitan Municipality	14 800
K206 (Alex)	City of Johannesburg Metropolitan Municipality	3199
Droogeheuwel/Middlevlei	Randfontein Local Municipality	9 900
Mohlakeng Ext 11	Randfontein Local Municipality	3495
Westonaria Bowra	Westonaria Local Municipality	16 000
Chief Mogale	Mogale City	6800
Thorntree View	City of Tshwane Metropolitan Municipality	11 700
Nellmapius New	City of Tshwane Metropolitan Municipality	3597
Olievenhoutbosch	City of Tshwane Metropolitan Municipality	4452
Leeuwpoort	Ekurhuleni Metropolitan Municipality	17 899
Chief Albert Luthuli Ext 6	Ekurhuleni Metropolitan Municipality	5398
The Willows	City of Tshwane Metropolitan Municipality	10 977
Lady Selbourne	City of Tshwane Metropolitan Municipality	6000
Elandspoort / Danville	City of Tshwane Metropolitan Municipality	2 000
TOTAL		127267

Table 1: National Flagship Mixed Income Housing Developments

1.2 Problem Statement

There continues to be the same type of housing development occurring in South Africa: a mass roll-out of the freestanding RDP houses, Breaking New Ground (BNG) houses, and low-income bond houses (mortgage properties) on the periphery of cities (Tissington, 2012). The continuation of the roll out despite all captured findings of the negative impacts begs for an investigation into the alternatives. Mixed income housing

models and inclusionary housing policy are among the leading solutions used internationally to foster inclusion and achieve restructuring (Huang 2015; Tajani and Morano 2015; Klug et al, 2013; Onatu, 2010). The focus of this research is on mixed income housing developments as an alternative to the mass RDP roll out.

RDP housing is a subsidy programme that has provided the poor with housing but excluding them from the solution and implementation processes. Bradlow, Bolnick and Shearing (2011) highlights that the subsidy has been rather lucrative to private developers who have the responsible parties in constructing this housing with very little accountability, risk and reduction of the housing. The serviced top structure has been criticised for its poor quality and size; and spatial development, where houses are far removed from social and economic services (Bradlow et al., 2011).

The scale at which the mixed income development occurs is recognised as being varied. In context of the study the mixed income housing development to be analysed must also display medium to high density, a mix of households in different income bands- with the presence of low income earners being mandatory; and ownership and rental options are provided for. Low income earners are the priority in the delivery of Social Housing. By definition Social Housing is defined as housing for low income earners/households with an income of not more than R7 500 (Tissington, 2011). Sale (2013) highlights the income classifications and the respective subsidy types that exist within Social Housing; this is shown in Table 2 below.

Classification	**Income**	**Subsidy**
Middle-income	R3 500 – R7 500	Rental
Low-income	R1 500 – R3 500	Rental and partly subsidised ownership
Poor	<R1 500	Fully subsidised ownership
Destitute	0	Fully subsidised ownership

Table 2: Income classification and subsidy type

The introduction of low income housing and/or mixed income housing developments across the globe and in literature has cited experiencing “Not-In-My-Back-Yard (NIMBY)” resistance from local residents. The attitudes and perceptions of residents have been negative claiming that property values will decline as a result of the introduction of mixed income housing (or any housing that facilitates the introduction on low income households) (Scally and Tighe, 2015; Scally, 2013; Onatu, 2010; Tighe, 2010). The perception is that mixed income housing developments result in concentrations of multiple families on a single stand which is expected to negatively impact the property values of the single family occupied stand (Myerson, 2003). However, results U.S.A cities such as Boston, and Chinese cities found that property values did not decline (Pollakowski, Ritchay and Weinrobe, 2009; Nguyen, 2005). Other international studies found there to be a reduction while others reported an improvement (Sales, 2013). These results may point to the notion that the correlation has to be proved or disproved on a case by case basis.

Within the South African context, a study conducted in Port Elizabeth regarding the impact of low cost housing on surrounding property values proved that the low-cost housing development negatively impacted on the surrounding properties values (Sale, 2013). However the case study has different variables, namely it is a low cost housing development- not a mixed income housing development. The claims of property loss as a result of mixed income housing has not been proved as true nor disproved as false in South Africa, and particularly in the City of Johannesburg. Another paper written in the South African context is by Onatu (2010), where an investigation was conducted on a mixed income housing development; however the objective relates to racial and social integration- proving the wealthy and poor can thrive and interact in the same environment. This paper investigates the effects of mixed income housing developments on the property values of surrounding properties in response to the question do mixed income housing developments result in negative price impacts on nearby homes? To which no research has not been cited.

Literature argues that mixed income housing may be more effective than inclusionary housing in achieving restructuring and inclusion (Huang, 2015; Klug et al., 2013). Mixed income housing in the UK has been the basis from which countries, including the USA, Canada, New Zealand and South Africa have developed policy and strategy

(Landman, 2012). The Breaking New Ground (2004) housing policy highlights the importance of mixed developments in South Africa in restructuring cities and neighbourhoods (Landman, 2012). This is indicative of government's consideration of mixed income housing being a viable means for building inclusive neighbourhoods.

A number of mixed income housing have been developed since then with the introduction of the Breaking New Ground (BNG) policy in 2005, including Lufhereng in Johannesburg completed 2010 boosting 24 100 units; Thorntree View in Soshanguve, Pretoria with 11 700 units; Cosmo City, Lehae mixed income housing development project, Fleurhof mixed income housing and Pennyville mixed income in Johannesburg with 14 800, 5344, 9000 and 3200 respectively (Gauteng Partnership Fund, 2012). Contributing to the debate of mixed income housing developments negatively impacting surrounding properties becomes imperative as more and more mixed income housing developments are developed and planned for by municipalities.

Klug et al. (2013) highlights the issue of high income cliffs prevalent within the South African context that cannot be ignored in the implementation of housing projects. Income cliffs have been noted as a factor that influences the degree to which there is a negative impact on surrounding property values. The paper hypothesis that mixed income housing located within established middle-to-high income residential neighbourhoods does not negatively impact the surrounding property values of the single stand properties.

1.3 Research Aim

To analyse the impact of mixed income housing developments on surrounding single-stand residential property values in a City of Johannesburg case study.

1.4 Research Objectives

i. To analyse the impact of mixed income housing developments on surrounding single-stand residential property values using municipal valuations and purchase/sale price data
ii. Provide description of the specifications used for hedonic price modelling in recent South African studies

iii. Provide conclusions and recommendations based on the results of the analysis
iv. Contribute to the little knowledge on the impact of mixed income housing on surrounding neighbourhoods in South Africa

1.5 Research Question

Do mixed income housing developments have an impact on surrounding single-stand residential property values?

From the research objectives and the main research question four sub-questions are developed:

i. What are the hedonic model specifications used in determining property values?
ii. What are the determinants of property values?
iii. What are the challenges of mixed income housing developments?
iv. Are there benefits from mixed income housing developments?
v. Are there government policies on mixed income housing developments?

1.6 Justification of the research

The study is located within Johannesburg, the economic centre of the Gauteng Province and a magnetic pull for individuals seeking (increased) opportunities for employment and education. Migration into the city has become an inevitable outcome. It is forecasted that between 2010 and 2030 the City of Johannesburg population will grow from 3.7 million to 4.3 million and an additional 460,000 households (City of Johannesburg, 2012). The growth will result in increased pressure to provide access to social and economic facilities including housing. The City of Johannesburg developed the Sustainable Human Settlements Urbanisation Plan (SHSUP) in response to the rapid urbanisation and forecasted residential growth forecasted in collaboration with the Council for Scientific and Industrial Research (City of Johannesburg, 2012). As part of addressing the future housing concerns, interventions are proposed including emphasising mixed typology and mixed income housing as an alternative to RDP houses.

The research is an opportunity to understand the impact of mixed income housing on the housing market dominated by private developments for profit. In not investigating

the impact of mixed income housing on surrounding properties, developers base their decisions to proceed with developments on speculation and NIMBY attitudes. Results of the research may point government (City of Johannesburg Metropolitan Municipality) to investigate other types of developments as an alternative for sustainable integrated communities- should the results be negative.

The results will be beneficial to private developers who deter from residential developments with low income earners including mixed income developments based on a fear of facing resistance from the local community (Scally and Tighe, 2015; Scally, 2013). The research is aimed at assisting developers particularly in the Johannesburg housing market in their decision making process by answering the question of whether mixed income developments have a negative impact on the return and value of a developers property investment, thus dispelling myths from fact. In the instance where results indicate a negative correlation i.e. property values reduce, stakeholders should investigate the characteristics (as described in the hedonic modelling) that take away from the property value and minimise/remove them. If a positive correlation exists i.e. property values increase or remain unchanged, stakeholders can campaign and promote intensive roll out of these types of residential developments.

CHAPTER TWO: LITERATURE REVIEW

Chapter Two
Literature Review

2.1 Introduction

Literature on mixed income housing is limited within the African and South African context. Globally, the impact of Mixed Income Housing (MIH) on surrounding property values has been covered in literature, together with the negative attitudes of communities with the introduction of low income households into neighbourhoods, the importance of achieving a mix (that includes low income households) and profit is not compromised, the role of partnerships between private and public sector and the overall benefits of mixed income housing developments.

2.2 Determinants of Property Values

There has been no positive correlation that surrounding property values are negatively affected by the presence or development of affordable housing for low income earners (Nguyen, 2005). Factors such as the fit of the development within the neighbourhood, design of the development and units, the extent of the concentration of the affordable housing and management to a greater extent influence the property values (Nguyen, 2005). In a study of low income housing placed in high amenity areas this type of housing reduced the value of the land; however the value of the surrounding land was not investigated (Thorsnes, Alexander and Kidson, 2015). However, it is found with Sale (2013) that surrounding property values declined as a result of the development of low cost housing. The locations of the case studies vary indicating each case is different.

Property values of the “before” and “after” a development and introduction of social housing have not been compared (Nguyen, 2005). It is thought that the “before” picture has a trend and this trend would be central to the comparison. Moreover, the use of qualitative methods to understand changes in property values is an alternative not explored in literature. Race and ethnicity within social housing developments are flagged as possibly having an impact on surrounding property values (Onatu, 2010; Nguyen, 2005).

In researching Integrated Housing and the possibility for a subsidised house to gain significant value so much so that households can benefit from this increased value Ruiter (2009) gave significant attention to Mixed Income Housing. Studies in cities of the USA analysing impact of property values surrounding mixed income developments found that property values either increased or remained unaffected (Ruiter, 2009). These have not been engaged with in South Africa.

There are a number of common themes discussed globally in literature around mixed income housing developments: benefits of mixed income housing, NIMBY attitudes, the role of Public-Private Partnerships (PPP's) in the implementation of mixed income housing, and the importance of achieving a social mix.

2.3 NIMBY attitudes and Social Housing

The perception by residents of declining property prices as a result mixed income housing developments has led to "Not-In-My-Backyard" (NIMBY) attitudes opposing these types of developments in numerous countries. Income cliffs have been cited as a component that has an effect on the resident interactions that take place within and around mixed income housing developments due to the perceptions of one income group over another. South Africa is a country with the greatest income inequalities in the world and it can be expected to experience NIMBY attitudes. NIMBY attitudes have created opposition to developments with a social housing component. There is great concern not addressed in literature regarding understanding who is the opposition and what informs those attitudes (Scally and Tighe, 2015).

The democratic process within planning such as public participation has given significant amount of decision making power to residents (Tighe, 2010). The perceptions, public opinion or personal bias of residents have caused this opposition (Scally, 2013; Tighe, 2010). However, these can positively be managed in the development process through sharing and disseminating accurate data and appropriate information relating to the development i.e. marketing, education and negotiation (Scally and Tighe, 2015; Scally, 2013; Onatu, 2010; Tighe, 2010).

The environment in which mixed income housing will succeed and become preferred in delivering housing for low income earners in South Africa lies in changing the

perceptions around these types of developments, in-depth understanding and analysis of different housing models and price ranges in a single development and achieve a sense of safety and security (Landman, 2012).

NIMBY attitudes, and the context in which they exist and are perpetuated, have not been fully understood. Scally (2013) and Tighe (2010) share concern that the link between increase in supply of affordable rental housing as a result of reducing these attitudes, through marketing campaigns that aimed to change the perceptions residents have about social housing, has not been investigated; Levy et al. (2013) flags that attention is required in understanding the influence of governance structures, management practices and resident participation as strategies to positively influence the level of interaction within (and around) mixed income housing developments; and Scally and Tighe (2015) noted that the impact and costs of participatory planning processes that result in decisions being made regarding the location of affordable housing is not known and this is an investigation that could assist developers of social housing in their decisions to continue with these types of housing developments or not.

2.4 Mixing incomes and policy

Profit orientated developments tend to be concentrated in areas where profit can be achieved, which further increases the value of land in those areas due to increased investment attracted. Social mix (a mix of different income groups and tenures) is a challenge in these conditions and therefore subsidies for low income housing is a tool to be used in policy for these areas (Dohnke, Heinrichs, Kabisch, Krellenberg and Welz, 2015). In South Africa, government policy needs to strengthen its position on mixed income housing (and inclusionary housing) (Onatu, 2010). It is noted that mixed income housing policy implemented has been positively associated with displacement and must be formulated to avoid this result (Hyra, 2013). Mixed income developments, which combine public and private initiatives, could be informative to inclusionary housing functioning and social mix. Policy (and the involvement) at both national and local level is key in the successful implementation of mixed income housing (Myerson, 2003).

There are assumptions made by government about social mix to make it the strategy that tackles social exclusion experienced by social housing i.e. social mix will overcome structurally induced barriers such as access to economic and social opportunities, as well as the lack of participation as citizens with power and responsibilities (Doney, McGuirk and Mee, 2013). Admittedly, the implementation of the social mix (which is a characteristic in mixed income housing) requires intervention from government (Korsu, 2015). However, the effectiveness of this strategy (and inclusionary policy) needs further investigation as implementation may lead to social fragmentation or integration of communities (Dohnke, 2015; Yuniati and Setiawan, 2013).

2.5 The role of Public Private Partnerships

Achieving the objectives of social mix would be by the efforts of the public and private sector. Public-Private Partnerships (PPP's) can play a significant role and is recommended in the delivery model for social housing, including in South Africa in the delivery of mixed income housing (NASHO, 2013; Onatu, 2010). Public sector will provide the land, subsidies/incentives and fast tract development processes which tend to deter developers and the private sector will provide the innovation, knowledge and technology (Dube, 2013; Onatu, 2010; Myerson, 2003). In South Africa (Johannesburg) PPP's are becoming common as a means to delivering housing developments that benefits low income groups (Dube, 2013). However, PPP's have failed in the past in countries such as Malaysia, and globally have not been interrogated in research about their successes and failures (Abdul-Aziz and Kassim, 2011).

Public Private Partnerships are used as a vehicle to implement projects that are both profitable while benefiting the public. The private entity is contracted to produce a public asset or service with the public entity having limited responsibility in the implementation.

An opportunity for research exists in examining the structuring and functioning of housing PPPs (including in South Africa) and understanding whether drawing on the experiences of mixed income housing developments would be beneficial for other housing types such as inclusionary housing (Dube, 2013; Klug et al., 2013; Abdul-Aziz

and Kassim, 2011). Nguyen (2005) furthermore put forward the concept that the manner in which affordable housing is implemented may have an impact on purchase prices of houses.

2.6 Benefits of Mixed Income Housing

The myths and facts on the benefits of mixed income housing developments are debated in literature. The benefits (or perceived benefits) of mixed developments include a positive social impact and addressing the culture of poverty, a concept that states a concentration of poor households further enable negative behaviour such as drug abuse and joblessness(Landman, 2012; Brophy and Smith, 1997). The benefits have yet to prove that in the South African context and unfortunately this can only be found over a period of time (Landman, 2012).

There are social and economic benefits to the development of mixed income housing with mixed tenure (Huang, 2015). There is an argument that the benefits for low income earners in mixed income developments have not been appropriately interrogated to make conclusions as it is found that economic desegregation and poverty alleviation were not achieved in these types of development (Levy et al., 2013). The extent of the benefits is questioned although it is acknowledged that employment rather than income improvement has been recorded. The social barriers still exist within mixed income developments with residents not engaging with those outside of their income group but can be encouraged through creation of common areas (Hyra, 2013; Levy et al., 2013).

In another school of thought, the benefits of mixed income housing are claimed and have not actualised and instead causes displacement due to escalation of rental and sale prices and seems to further benefit those already in a position of privilege (Levy et al., 2013; Hyra, 2013; Myerson, 2003).

The perceived benefits of mixed income housing are questioned in literature and therefore present an opportunity to investigate these alleged benefits including an improvement in the quality of life for the poor. Onatu (2010) summarises research opportunities with mixed income housing:

- The link of physical proximity of rich and poor households with the want/choice by the rich to willingly interact and understand the poor
- Even in a socially mixed housing environment whom do residents chose to interact with
- Most effective implementation
- Understanding mixed income developments within the South African context- a country with great income cliffs
- Critical challenges in financing these types of residential developments
- Preconditions for viability- also consideration of the impact of race and ethnicity
- The impact on middle- and upper income household property values

2.7 MIH Global

Mixed income housing (MIH) projects are being encouraged in a number of countries in Europe, North America and Asia through mandatory policy and regulation. Social housing in Europe are developed with both the low and middle income households in mind as one of the strategies to achieve a social mix. In France particularly, mixed income housing developments and/or the development of social housing in areas not synonymous with poverty (i.e. middle to upper income neighbourhoods) is being incentivised and encouraged by urban government to tackle the segregation of cities (Korsu, 2015). Albeit that the study by Korsu (2015) found that there was no impact or improvement in achieving a social mix with the introduction of social housing in cities in France, it is clear the focus on mixing incomes within housing developments is at the forefront of building inclusive cities.

Indonesia makes use of the residential ratio 1:3:6 regulation (Lingkungan Hunian Berimbang – LHB) whose main objectives is to develop affordable housing and to encourage mixed income housing developments. The ratio implies that 1 high-income, 3 middle-income and 6 low income units be built in all new residential developments. In 2011 the ratio was amended to 1:2:3, and unlike the 1:3:6 ratio the amended LHB ratio is enforceable only to a minimum 50 unit commercial housing units and is not mandatory to have units in adjacent locations. It is found that achieving spatial integration has been a challenge, for both the 1:3:6 and 1:2:3 ratio, due to location of

units seemingly still having room for negotiation with developers (Yuniati and Setiawan, 2013).

Conversion of public housing to mixed income housing is popular in USA cities and neighbourhoods. The development of the federal Housing Opportunities for People Everywhere (HOPE IV) Program in the United States has the aim of redeveloping, through the demolition and reconstruction or refurbishment, dilapidated public housing buildings into mixed income housing developments (Lucio, Hand and Marsiglia, 2014). HOPE IV has become a housing policy tool in the United States and was established in 1992 becoming one of the pivotal strategies in changing public housing (Lucio et al., 2014, Popkin, Rich, Hendey, Hayes, Parilla and Galster, 2012). There is concern that the HOPE IV Program displaces low income earners and has nationally reduced the number of available affordable housing which public housing developments provided (National Housing Law Project, 2002).

2.8 MIH in South Africa

Onatu (2010) investigated the possibility and benefit in developing informal settlement dwellings into formal dwellings through a mixed income housing strategy. The study found South Africa needs to strengthen mixed income housing in policy and have it form part of the Housing Code. The study does not focus on property values, but states that the impact of the mixed income housing developments on the middle to upper class household's property values is unknown in South Africa (Onatu, 2010).

Landman (2012) provided the challenges and concerns to be addressed in successfully implementing MIH in the South African context including changing perceptions, ensuring safety and security in high crime rate country and ensuring the viability of mixed incomes and therefore mixed prices of homes in a development. In 2014 the importance of shared outdoor spaces in a medium density mixed income development was investigated and found that it is critical to achieve the design of the spaces in order to promote the social acceptance and sense of community required to make MIH developments successful (Landman and du Toit, 2014). The study investigated issues of design. Landman (2010) also investigated the degree of importance and opinion on the location of MIH developments by residents of these

developments. The study confirmed location and proximity to economic and social opportunities to be an integral part on successful implementation.

The Council for Science and Industrial Research (CSIR) over a two year period investigated the benefits of medium density mixed income housing developments using case studies. The findings indicate developers and investors realise the financial gain in MIH's and are willing to engage in these developments, households have the willingness to move into these developments to be closer to economic and social opportunities, and there is great regeneration potential to the benefit of the poor and creating safer inclusive neighbourhoods (Osman and Herthogs; 2010).

There is limited research conducted on MIH developments and surrounding property values in South Africa.

2.9 Review of key points

Studies on mixed income housing developments are limited in South Africa. Globally, studies have covered investigating the effects on surrounding property values, the nature and role of NIMBY attitudes, the perceived and proved benefits of MIH developments as well as Public Private Partnerships in implementation of MIH developments. However, these have not been investigated in South Africa in particular reference to MIH developments. For this study, the impact of MIH developments on the surrounding property (residential) values is investigated.

A more recent South African study was completed by Sale (2013) in analysing impact of social housing on residential property values in the Nelson Mandela Bay area and found a negative impact on the surrounding residential properties. Sale has completed similar studies were applying case study, discrete choice analysis and spatial hedonic modelling was used in the investigation. Overall, studies on the impact of mixed income housing developments on property values could not be located during this research study.

The South African government's consideration of mixed income housing in housing policy such as Breaking New Ground (i.e. national level) is not entrenched and

regulated as compared to other countries such as Indonesia with its Lingkungan Hunian Berimbang – LHB ratio and a number of the first world countries.

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CHAPTER THREE: METHODOLOGY

Chapter Three
Research Methodology

3.1 Introduction

In assessing the impact of Mixed Income Housing (MIH) developments on surrounding property values the research undertakes a quantitative approach to the project. Existing literature and conducted research relating to determining the impact of mixed income housing (and/or even inclusionary housing, affordable housing or public housing) on surrounding house prices and property values stem from the use of quantitative methods and particularly hedonic modelling. Hedonic price modelling is the chosen research instrument and thus the basis of the research, data collection and treatment.

3.2 Research Design

A Case Study is selected as the preferred research design as it provides an opportunity for a detailed investigation in the here and now. The focus on a single MIH located in the City of Johannesburg gives the research and its findings defined strength. However, the disadvantage lies in the inability to apply findings across the various mixed income housing developments and neighbourhoods within South Africa.

The overall procedure in this research execution is the summarised six (6) step process below:

1. Identify the mixed income housing development and the impact area
2. Understanding the hedonic modelling principles and applicability to the Case Study application
3. Clarify the measuring instrument
4. Select the appropriate sample size
5. Data collection
6. Data analysis

3.3 Identification of a Mixed Income Housing (MIH) development and Impact Area

Pollakowski et al (2005) analysed seven (7) and used a criteria for the selection process. The MIH development had to comply with being: located in the Boston

metropolitan; fully developed within a determined period (to align with data available); focused on multi-family rentals and mixed income development; and a large project that contrasts the surrounding community (i.e. in size, bulk, form, and density). The selection was finalised with the use of Geo-Information Systems (GIS), aerial photographs and site visits to understand the location of the developments and their integration to communities.

Sturtevant and McClain (2010) provided simple criteria the mixed income developments must comply with in order to qualify for analysis. For this study the selected mixed income housing development is considered compliant with this criteria:

- Mix of housing types or have higher densities than the surrounding neighbourhood
- Located in close proximity to single-family homes/neighbourhoods
- Recently built (addressing concerns of the availability of data)
- Small in scale (within less than 1 km around the development should be other properties)

Once the MIH is determined the impact area (which is the surrounding properties to be assessed of the selected MIH) is selected. The impact area is smoothed by physical barriers, zonings, road networks, political boundaries and other specific characteristics of the study (Sturtevant and McClain, 2010; Pollakowski et al., 2005). The chosen properties are to comply with one or more of the following criteria:

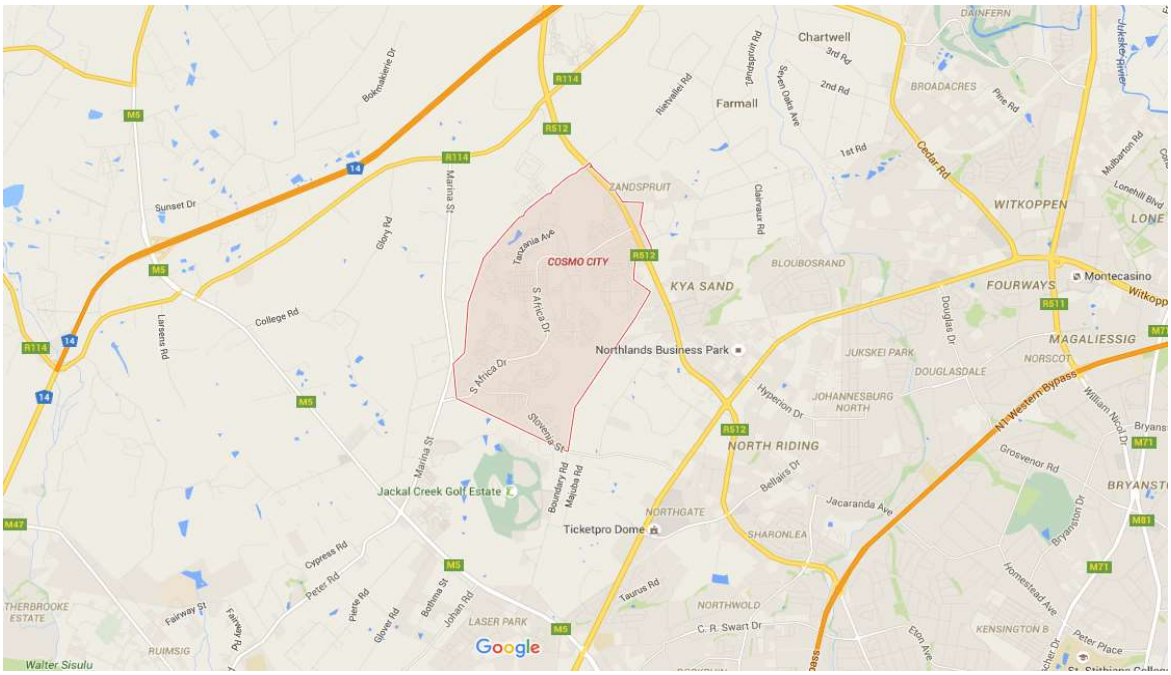
- Adjoining property to the site
- Visibility to the development site
- Adjacent to open space elements
- Adjoining property to the road network of primary and secondary streets that extend out from the site

3.3.1 Selected MIH: Cosmo City

Location

Cosmo City is located to the north west of the Johannesburg Central Business District (CDB). It is bounded by Slovenia Street to the South (also adjacent to Jackal Creek Gold Estate), Boundary Road to the East and is directly adjacent to Malibongwe Drive

(R512). Northumberland Avenue, a busy urban arterial which is in close proximity to Cosmo City connects a number of the northern suburbs. The closest suburbs from Cosmo City is Northriding, Jackal Creek with an informal settlement along Masina Street (alongside the western boundary of Cosmo City). Based upon the desktop land use survey of the surrounding area Cosmo City has largely factories and warehouses and vacant land with formal residential property a further distance away.



Source: Google Maps

Characteristics

Cosmo City is a mixed income, mixed use integrated residential development at a neighbourhood scale. The MIH has subsidised, affordable rental, partially subsidised, and bonded options, planned and allotted as follows (Palmer Development Group, 2011):

- 5 000 low-income Breaking New Ground (BNG) houses (R0 – R 3 500 p/m per household)
- 3 000 credit-linked FLISP (Finance- linked Institutional Subsidy Programme) houses (R3 500 – R16 000 p/m per household)
- 1 000 social rental units
- 3 300 bonded houses

Furthermore, schools and crèches; churches, clinics, parks and recreational facilities; and commercial and retail spaces are planned for.

Cosmo City exhibits a mix in housing options for a mix of household incomes. It is ideal for the assessment due to its location: adjacent to a primary road and within established northern Johannesburg suburb areas, properties having visibility to the MIH and Malibongwe Drive bordering the MIH. Cosmo City can be considered a well-established (in terms of its existence) MIH, with substantial subsidised, credit linked and bonded houses having been constructed in phases over a period 2006 to 2012 (Palmer Development Group, 2011).



Source: City of Johannesburg (Sustainable Human Settlements Urbanisation Plan)

3.4 Hedonic Modelling Principles

Results found in literature in determining the impact of mixed income housing and/or even inclusionary housing, affordable housing or public housing on house prices and property values stem from the use of quantitative methods, particularly Hedonic

Modelling. Monson et al (2009) has simplified the explanation of Hedonic Modelling, stating that buildings have characteristics (such as size, number of bathrooms), and these characteristics add to or take away from the transaction value (dependant variable). The model's main objective is to determine the statistical relationship between the characteristics of the property and its transaction value.

The building characteristics each have a significance level representative of the extent the characteristic affects (adds or subtracts) to the building value i.e. indicates the correlation. Characteristics range from structural characteristics and other characteristics such as year sold to represent the time value of money/sales prices and proximity to mixed income development (Sale, 2013; Sturtevant and McClain, 2010; Monson et al., 2009; Pollawoski et al., 2005) .These are inevitably used to build a hedonic price model. The impressive benefit of the hedonic model is its predictive nature of building purchase prices.

Hedonic price modelling hasn't always been used in studies investigating impact on property values due to the unavailability of large data of sale/house prices. Earlier studies (during the 1990's) made use of the Test versus Control Area Methodology which was highly criticised for its lack of exploration and depth (Nguyen, 2005). The method entailed: identifying a neighbourhood with affordable housing (termed the Test Area) and a neighbourhood without affordable housing but has similar characteristics (termed the Control Area); then property values of homes for both the Test Area and Control Area were obtained and compared.

Results of all those studies either found no difference in property values between the two (2) groups or the presence of affordable housing has a positive impact on the surrounding property values. The criticism of the method further brought criticism about the results. Given this criticism, recent studies (during the 2000's) turned to Multiple Regression techniques (and Hedonic Price Models) in order to control individual factors that can have an impact on the property values (Nguyen, 2005).

This study proceeds upon this understanding of the accuracy and validity of hedonic price modelling.

3.5 Hedonic Modelling for the Case Study

Hedonic modelling in South Africa has been used in analysing impact of low cost housing on property values, analysis of structural characteristics of residential property, and influence of transport development on property values to name a few; however hedonic modelling on mixed income housing developments is limited if at all existent in current literature. This represents an opportunity within South Africa in mixed income housing developments and hedonic modelling.

However, Sale (2013) explored three models in investigating the impact on property values due to the presence of social housing in the Nelson Mandela Metropolitan Municipality, South Africa. All models tested for multicollinearity and heteroscedasticity. Model 1 made use of three variables: actual sale, municipal value and distance of the property from the social housing development. Models 2 and 3 make use of twelve (12) variables. Model 2 has the municipal value as the dependent variable and the eleven (11) various housing characteristics such as number of bedrooms, presence of a swimming pool, number of bathrooms etc. as the independent variables. Model 3 has the actual price sale as the dependent variable and the independent variables as those of Model 2.

Model 1 uses municipal values as a proxy for the individual housing characteristics. This has been criticised on account of the accepted rule that the use of housing characteristics as explanatory variables is imperative to estimating the value of the property (Sale, 2013; Nguyen, 2005; Pollakowski et al., 2005). Model 1 should theoretically be eliminated as the preferred method for the study. However, the lack of data on housing characteristics from the City of Johannesburg make it difficult to eliminate this model outright.

As with the case Model 3, most studies make use of the actual sale price as the dependent variable to the hedonic price modelling (Cotteleer and van Kooten, 2012). The easy accessibility of municipal assessed values as compared to actual sale prices has led to a number of studies making use of the municipal assessed values as the dependent variable. The findings in studies indicate that the impact on property values does indeed vary between using the actual sale price or assessed values as the

dependent variable. As a result it is better to make use of actual sales because studies can draw accurate conclusions on the impact of property values, (Cotteleer and van Kooten, 2012). For this study the dependent variable (actual sales) data is available and obtainable from various sources. Model 2 cannot be used for this research on account of the assessed municipal value used as a dependent variable.

However, it is noted in a study to investigate the impact of open spaces on property values, Cotteleer and van Kooten (2012) found that the hedonic price model using either actual sales or assessed values as the dependent variable can result in very close coefficient estimates. A 0.79 correlation coefficient (i.e. positive relationship) between the two dependent variables was found when testing the statistical differences (Sale, 2013). This indicates that although actual sales are preferred, municipal assessed values have a degree of accuracy although to a lesser extent. Pollakoswki et al (2005) indicates that the actual sales prices must be accompanied by house characteristics.

Model 3 is therefore theoretically the best method to be employed for this research. However, the City of Johannesburg (CoJ) valuation process does not allow for the capturing of housing characteristics unless in the case of a property owner objecting to the estimated municipal valuation captured in the Municipal Valuation Roll. As a practical implication, Model 1 is used for this research. The research is conducted as follows (Sale, 2013):

- Purchase/obtain actual sales data
- Obtain municipal assessed values
- Adjust all values using Housing Price Index (HPI)
- Input the data and ran linear, semi-log and/or a double-log regression models to test for multicollinearity and heteroscedasticity

However, the municipal assessed value is adjusted to account for issues of accuracy, as discussed further below.

3.6 Measuring Instrument for the Case Study

The use of municipal assessed values is discouraged in literature, with many studies finding that the impact on property values does indeed vary if a researcher uses the

actual sale price versus the use of assessed values as the dependent variable in hedonic price modelling (Cotteleer and van Kooten, 2012) (Sale, 2013). Cotteleer and van Kooten (2012) and Sale (2013) in reporting on the impact on property values given proximity to open space and low income housing, from their respective studies was upon the basis of sale transactions/actual sales. Pollakowski et al (2005) and Sale (2013) made use of the actual sales data of surrounding property values (over a 14 and 20 year period respectively) and the structural characteristics arguing that structural characteristics of a house have a distinct and strong influence on the estimated sales price. It is clear that the use of actual sales data and housing characteristics in a hedonic price model will prove the validity in the results of this study.

In the study by Pollakowski et al (2005), as a different approach to Sale (2013), determined an impact area (with the MIH) and control area (the remaining extent of the neighbourhood) which were then compared to investigate the influence of a mixed income development on surrounding property values. The independent variables were selected after examination of the sample's descriptive statistics, namely: house size and lot size (as continuous variables), number of bathrooms and number of bedrooms are entered as dummy variables, year built and year sold which account for changes over time. The assumption is that individuals place a monetary value on the various characteristics of the house (Sale, 2013; Pollakowski, 2005; Nguyen, 2005). The year built (is divided into quintiles reflecting the housing eras) is entered as a dummy variable as well, similarly is the date sold which is divided in two year intervals. Sale (2013) specifically investigates an impact area, which is preferred for this study.

Based on the above, this study should make use of actual sales data and housing characteristics in the hedonic price model to give validity to the results i.e. use Model 3 (Sale, 2013) However, it should be noted that the specification of the hedonic price model is informed by data availability. The City of Johannesburg valuation process makes it so that housing characteristics are not be so easily available- if at all. Hence Model 1 is opted for, in which the municipal value is used as a proxy for the housing characteristics.

The selected measuring instrument is selected in view of investigating the methodology and measuring instrument used in a similar study which analysed the impact a low income housing development has on the surrounding property values. The study by Sale (2013) ran a linear, semi-log and double log regression and compared those results. One of the objectives of the research is to delve into the hedonic price model used in recent studies in South Africa.

Semi-log and double log regression refers to the log transformation of variables. Semi-log transforms only one variable (i.e. the outcome/dependent variable) and double log is the transformation of all variables usually to correct non linearity.

3.6.1 Municipal assessed values as a proxy for housing characteristics

The City of Johannesburg conducts Mass Valuations. The method has comparable properties grouped and common attributes identified in each group, thereafter a valuation model using the software Computer Assisted Mass Appraisal (CAMA) is used to estimate values applicable to the group (Douw, 2014). Mass valuations uses data, including sales and construction costs, from a common area to determine patterns for these groups of properties (Ramakhula, 2010).

The Land Information System (LIS), which adds structural characteristics such as number of rooms and construction materials (assumed by the municipality), is used together with the Geographic Information Systems (GIS), which adds the non-structural characteristics such as zoning, size and location to derive estimated values of properties captured in the General Valuation Roll (Ramakhula, 2010). However, there is concern regarding the accuracy of the estimated values because of the inputs of either the LIS or GIS or both. GIS may not accurately capture data or update data thus affecting the estimated values.

Douw (2014) finds that the method used by larger municipalities does not capture the true value of properties released in the General Valuation Rolls. Municipal valuers make use of the “global score”. The method allocates points to the various characteristics (contributing to the value) of a property. Each property has different value contributing characteristics and those are identified and allocated the relevant

points. The sum of the points (quantified) is referred to as the global score. However, this method of scoring a characteristic (i.e. a variable) overlooks the differences within the variable which can be scored differently. This introduces Multiple Regression Analysis (MRA) in determining the value of a property using a more reliable method (Douw, 2014).

General Valuation Rolls using the global score results in a reduced value. It is found that the General Valuation Rolls are reduced by at least 4.68% of the base (Douw, 2014). The accuracy of the value of the property is taken to be 95% and as a result the obtained values from the General Valuation Roll is adjusted by a multiplier of 1.05. Thereafter these values are adjusted using the Housing Price Index (HPI) to reflect estimated values in 2016 which takes into consideration the time value of money and economic fluctuations (see formula below).

$$\text{Value (2016)} = \text{Value (2008)} * \frac{\text{HPI (2016)}}{\text{HPI (2008)}}$$

Note:

1. *Both the actual sale value and municipal value will be adjusted using the HPI*
2. *2008 represents the year 2008 actual sale value or municipal value as captured in Deeds Registry or South African Property Transfer Guide; or the City of Johannesburg respectively*

The adjustment of the municipal assessed value reduces concerns around accuracy and minimises errors. Therefore, this independent variable (i.e. the municipal value) can now be used in the hedonic model. This is an improvement on the Model 1 as discussed by Sale (2013).

3.7 Sample size

Pollakowski et al (2005) had a range of 70-176 observations within the impact areas of the study. Sale (2013) used a sample size of 170 for hedonic modelling with Model 2 and Model 3, however the study emphasises that these sample sizes are greatly affected by availability of information (Sale, 2013; Monson, 2009). Model 1 had a simple random sample of 289 properties using an equation of the population and a level of precision (Sale, 2013). The chosen sample size is guided by these studies conducted in the literature. As a result a sample size of 103 is selected.

3.8 Data collection

Data collection of actual sale values is obtained through the existing public systems of the Deeds Registries and a private entity - the South African Property Transfer Guide (SAPTG). Actual sales values are within a 16 year period between the years 2000 to 2016.

For the municipal values, the City of Johannesburg has Electronic Services that can be accessed online via their website. The online tool provides the most recent municipal values of properties. The 2013 General Valuation (GV) Roll is the current and valid GV. In instances where there is missing data, the City's Valuation unit, located at the Municipal Offices in Braamfontein, Johannesburg (154 Loveday Street), can provide these valuations. The Municipality will be informed of the purpose of the information requested.

3.9 Data analysis

SPSS Statistics software is used for all analysis and regressions. The basis of the analysis is Hedonic Price Modelling with housing characteristics using standard linear functional form as applied in the Walmer Township, Nelson Mandela Metropolitan Municipality case (Sale, 2013). The actual sale values is the dependent variable, while the assessed municipal value and distance from the MIH are the two independent variables identified.

Table *3* below summarises the independent variables, description, unit of measurement and the expected impact on the actual sale value.

Variable	Description	Unit of Measurement	Expected impact	Type of variable
Dependent				
Actual Sales	Adjusted Sale Price	Constant 2013 rands		Numeric
Independent				
Assessed value	Municipal valuation	Constant 2013 rands	+	Numeric
Distance from MIH	Distance of the house from the MIH	Metres	+	Numeric

Table 3: Variables for the linear regression analysis

Distance from MIH is a non-structural characteristics measured in metres. The further away a house is from an MIH the higher the property value is expected to be, oppositely the further away a property is from a school the lower the property value is expected to be. All structural characteristics are expected to add to the value of the property. The results from running the linear regression determines the symbol (either negative or positive) of the independent variable coefficients, including of particular interest the “Distance from MIH” variable.

The inherent risk of missing data and the introduction of that bias in the interpretation of distributions is noted. With consideration of this approach the sample size of the properties reduces to a number that may reduce the study’s ability to generalise findings for the area.

3.9.1 Limitations

Hedonic modelling used in similar studies makes it clear that property prices are determined by various factors (Sale, 2013; Sturtevant and McClain, 2010; Monson et al., 2009; Pollakowski et al., 2005). The model considers only one non-

structural/neighbourhood/external variables (i.e. the distance of the property from the MIH) neglecting all other possible external variables. In addition, it is reiterated that the findings in the case study cannot be generalised and applied in different locations.

The importance of housing characteristics in hedonic price modelling cannot be understated. The use of municipal values as a proxy for housing characteristics, due to the lack of data from the municipality, is a criticism to the accuracy of the findings. The adjustment of municipal values seeks to mitigate this.

3.10 Review of key points

The employment of hedonic modelling in a mixed income housing project has not been tested and improved in South Africa. Hedonic modelling seeks to determine the relationship between the characteristics of the property and its transaction value. The municipal assessed value acts as a proxy for those characteristics which isn't necessarily the best choice for the model.

The model uses an outcome/dependent variable and two independent variables. One of the independent variables- municipal assessed value- must be criticised for its accuracy. The municipal assessed values is determined using mass valuation instead of the consideration of the specific housing characteristics is a concern. The outcomes and conclusions that result from this are cautioned to be swayed.

Data will come from thre (3) sources: the City of Johannesburg Electronic Services for the municipal assessed values, the South African Property Transfer Guide for the purchase prices and online navigation for the distance of the property to Cosmo City.

CHAPTER FOUR: RESEARCH ANALYSIS AND FINDINGS

Chapter Four
Research Analysis and Results

4.1 Introduction

In analysing the data, the process of linking a purchase prices with the correct property was not a complex challenge. However, in many instances data required cross referencing between the two sources of information: City of Johannesburg Electronic Services (for the municipal assessed values) and the South African Transfer Property Guide (SATPG) for the purchase prices. At times the initial randomly selected property had to be replaced with another due to unavailable information.

The selection of properties to form part of the analysis was undertaken first by narrowing down the areas of analysis. These are suburbs or residential complexes that, without conducting a more in depth investigation, seem to fit the set criteria. All properties (including the replacement properties) came from these areas.

The data contains twelve (12) outliers which were removed thus reducing the sample from 103 to 91. A regression model was produced with this reduced sample. The findings/results from the scatterplot, normal probability plot, Variance Inflation Factor (VIF), p values and R-squared were compared with the findings of the model that included outliers.

4.2 Procedure

Properties for the analysis are identified on the basis of the road network and a desktop land use survey. The adjacent properties are of vacant land parcels, industrial use such as large factories, offices and residential blocks/buildings. In analysing the road network and typical traffic pattern in and around Cosmo City six (6) roads are identified as being significant to the immediate network for individuals living within and around Cosmo City. The major internal roads within the MIH is the South Africa Drive which connects to Malibongwe Drive, Aureole Avenue and Northumberland Avenue/Witkoppen, Marina Street. The road network isolated general area/suburbs and identified Zandspruit, Northgate and Northwold as areas to be included in the analysis as indicated in Figure 1.

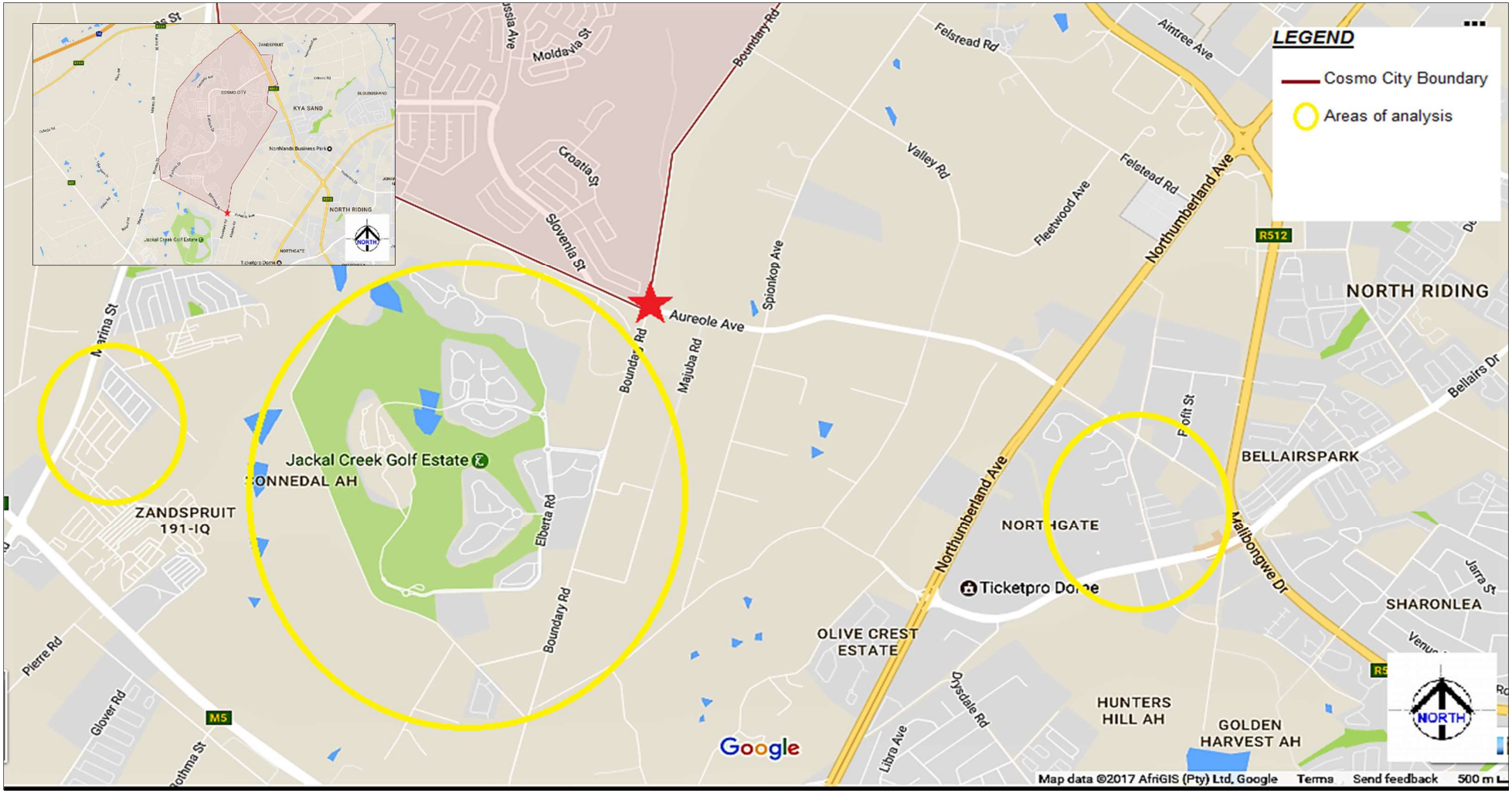


Figure 1: Areas of interest for the selection of properties

Using the City of Johannesburg Metropolitan Municipality (CoJ) Geographic Information Systems (GIS) the municipal valuation (General Valuation 2013), legal property descriptions, zoning, ownership and street addresses were obtained for random properties in the isolated suburbs/areas.

The purchase prices and year of purchase was then obtained from the South African Property Transfer Guide (SAPTG). The information received from SAPTG had missing identification elements such as the street address and legal property description. As a result, the owners names from the CoJ GIS was cross referenced with those received from SAPTG in order to identify the related purchase price.

With the identification of these properties, the ABSA monthly Housing Price Index (HPI) from 1966 to 2016 were obtained. These were averaged to calculate the yearly HPI. All purchase prices from the identified properties were brought to 2013 constant rands using the corresponding year's HPI. The selection of the year 2013 is dictated by the latest available municipal valuation roll.

Lastly, the variable of interest being the distance from the MIH was measured to the nearest meter using Google Maps. A network distance measure was employed rather than the linear measure and all measurement was taken from the centre point of Cosmo City, at 39 Abuja Cres (Sale, 2013).

With all variables obtained, a multi-linear regression was employed using IBM's SPSS Statistics 24. The findings are discussed below.

4.3 Findings

The average purchase price in the sample is R751 829.38 and the average municipal assessed value is R921 981.55. The average house is located 6 618.45 metres away from the mixed income housing development, Cosmo City. The houses are located within distances ranging between 5400- 7300 metres. Table 4 below summarises the key descriptive statistics of the model variables.

VARIABLE	MIN	MAX	MEAN	STANDARD DEVIATION
Purchase Price (ZAR)	11 277.3	2 286 901.1	751 829.38	583 950.64
Municipal Assessed Value (ZAR)	63 000.0	2 040 150.0	921 981.55	493 120.49
Distance from MIH (m)	5400	7300	6618.45	455.84

Table 4: Descriptive statistics of model variables (n=103)

At the fundamental level of running a multiple linear regression lies four (4) assumptions which must be present:

1. A linear relationship between the outcome/dependent variable and the independent variables. A scatterplot of the standardized residuals plotted on the y-axis against the predicted Y' values plotted on the x-axis indicate whether a linear relationship exists.
2. Normality- assumes that the error term (ui) of the regression is normally distributed. Since we do not directly observe the true errors (ui) the residuals (ei), act as proxies for ui. A normal probability plot (P-P Plot) of residuals and histogram are used to determine whether normality exists.
3. No Multicollinearity- assumes that the independent variables are not highly correlated with each other.
4. Homoscedasticity- assumes the variance of error terms are similar across the independent variables.

Assumption 1 can be interpreted in two ways. First, *linearity of variables* where the mean of Y' (dependent variable) remains constant at all values of X (i.e. independent variables) which is indicated through the scatterplot. Second is the *linearity of parameters* where the mean of Y' is a function of the Betas (i.e. b1 and b2). The Beta coefficients are the estimated model parameters, which minimises the samples sum of squared errors or in this case the residuals (i.e. the deviations of the predicted values from the actual empirical values). The model $Y'_i = b_0 + b_1X_{1i} + b_2X_{2i}$ (untransformed model) indicates b_1 and b_2 are to the power of 1 only (and not 2) thus making the model linear in parameters.

It is generally accepted that models are concerned with the *linearity in parameters* and not *linearity of variables*. However, intuitively and through literature the relationship between the dependent variable (Purchase Price) and the independent variables (whether the Municipal Assessed Value or Distance from MIH) must be linear. It isn't expected that an increase in the municipal assessed value will not produce a corresponding change in sale price of a property. Equally, the closer (in terms of distance) a property is to a desirable or non-desirable neighbourhood variable (such as a hospital or dumping site) is expected to produce a corresponding change in the sale price due to desirability or non-desireability. As a result the *linearity of variables* assumption cannot be ignored in the study.

The scatterplot shows that generally the residuals (y-axis) do not remain close to the best fit line (i.e. 0). It is also evident that there are outliers (see Figure 2 below). This indicates no linear relationship between the outcome/dependent variable and the independent variables. As a result, the outcome/dependent variable will be transformed.

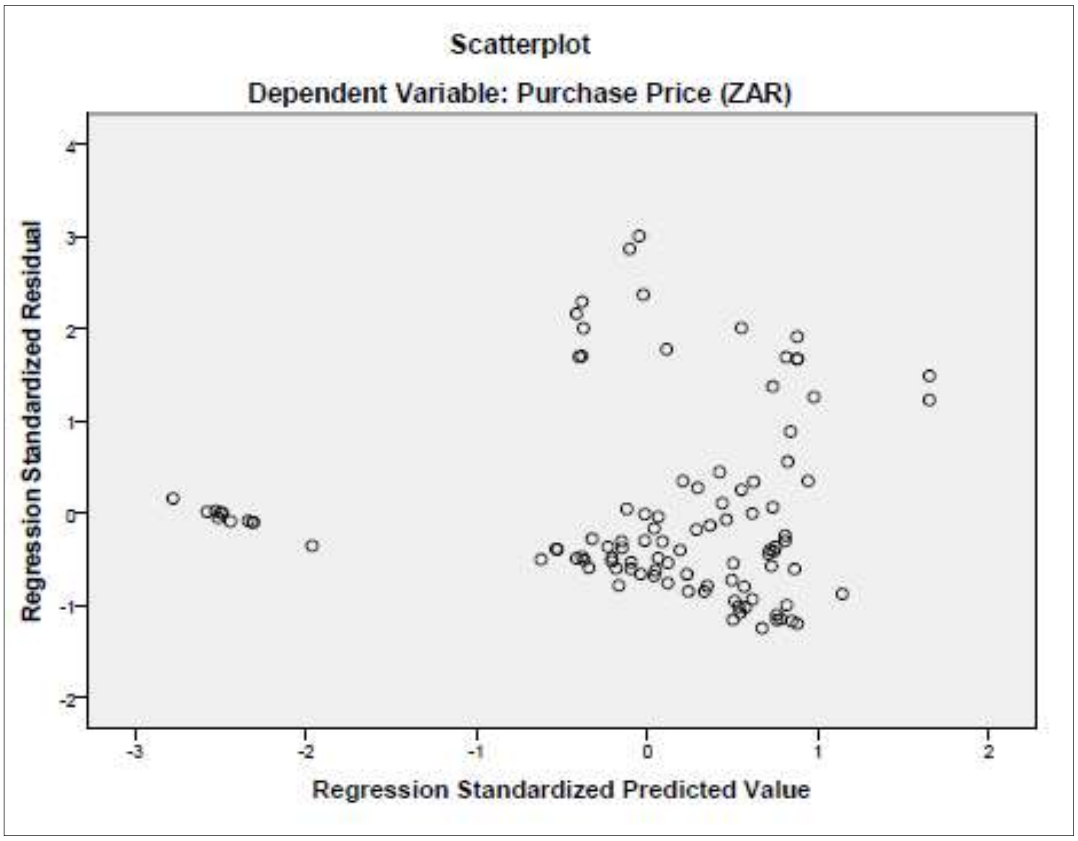


Figure 2: Scatterplot indicating residuals against predicted values

Regarding Assumption 2, the normal probability plot (P-P Plot) of residuals in Figure 3 below suggests a violation of normality. A P-P plot compares the empirical data set with the theoretical data set- this is what is expected of the data. Unlike the histogram the P-P plot has the ability to pick out a single observed data point and analyse its deviation from normality.

The deviation of the observed data from the theoretical is what determines the normality or skewness of the distribution. There is clear deviation and therefore the outcome/dependent variable, Purchase Price, requires remedial action through log transformation. The P-P plot shows data that is skewed to the left.

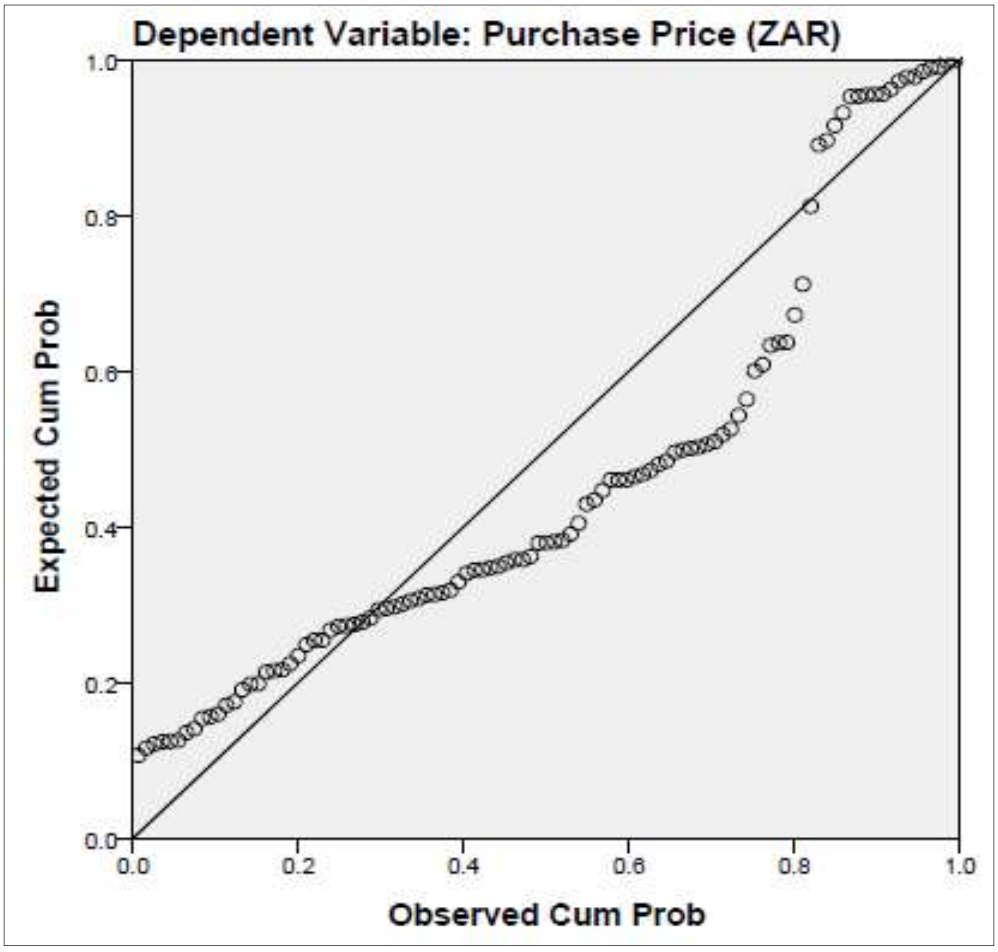


Figure 3: Normal probability plot of the outcome variable

Furthermore, the histogram below indicates that the outcome/dependent variable is not normally distributed (see Figure 4). The dependent variable is found to be skewed to the right- indicating the mean is to the right of the median (the middle value in the data).

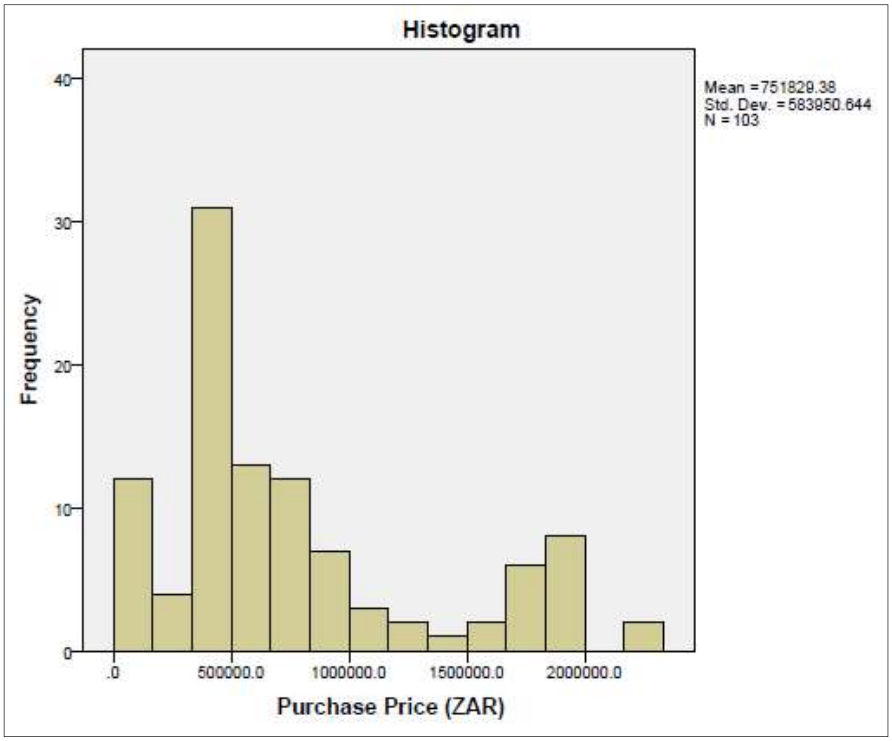


Figure 4: Normal distribution of the dependent variable (purchase price)

It is generally accepted that it is in actual fact the error terms (or residual when dealing with a sample) that should be of normal distribution, not particularly the dependent variable in order to estimate for accurate values. The residual (or error terms referring to population) measures the difference between the observed value and estimated/predicted value. Residual and probability plots were appropriately applied to test for normality (see Figure 3 above). The horizontal axis, (X-axis) plots values of the variable of interest (i.e. the residuals, ei), and the vertical axis (Y-axis), plots the expected values of this variable to determine if its distribution is normal. It is observed that the normality assumption is violated and thus data must be transformed.

Assumption 3, is tested using the Variance Inflation Factor (VIF) statistic.

Assumption 4, the standardized residuals plotted against the predicted Y' values (as with Assumption 1) can indicate whether points are equally distributed across all

values of the independent variables or not. From observation the residuals were not randomly scattered but rather with most residuals clustering at the lower end of the plot. This indicates that the error variance is not constant with the varying values of the predicted values.

Heteroscedasticity is detected in the interpretation of the scatterplot shown in Figure 5. Explained differently, there is high variability in the Purchase Price and the variance of Purchase Prices does not remain the same at all points of the predicted values i.e. there in unequal/non constant variance- this is heteroscedasticity. Homoscedasticity exists where there is equal or constant variance.

Furthermore, the normal probability plot shows significant deviation from the best fit line. Thus transformation of the dependent variable will rectify the presence of heteroscedasticity.

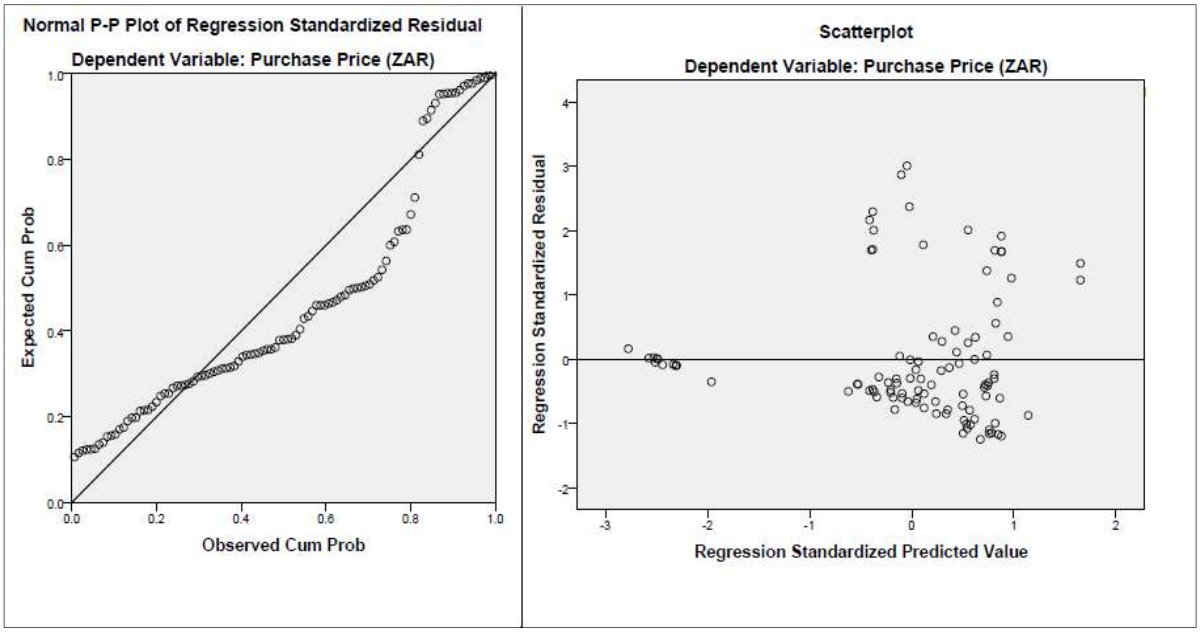


Figure 5: Deviation from normality representations

4.3.1 Natural Log Transformation

The transformation of the outcome/dependent variable impacts the findings of the model. In comparing the accuracy of the model with a non-transformed outcome/dependent variable versus the model with the transformed outcome/dependent variable the R-squared is used. The R-squared indicates a

model's goodness of fit by looking at the distance or rather closeness of data to the fitted regression line.

The model of the untransformed variables measured an R-squared of 0.237 indicating that only 23.7% of the variation in the Purchase Price can be explained by the independent variables. This indicates a poor model fit. With the model of the transformed outcome/dependent variable an R-squared of 0.693 was measured. This indicates a good model fit as 69.3% of the variation in the log transformed Purchase Price is explained by the independent variables.

Following the transformation of the dependent variable, Purchase Price, the Assumptions 1 to 4 must still be present. The residual scatterplot in Graph A in Figure 6 shows outliers to the left and the rest of the plots remaining close to 0 indicating a flat pattern and constant/equal variance. The outliers were removed, in Graph B, and an undeniable consistency in the errors can be seen with no distinct pattern - indicating homoscedasticity.

The outliers are related to Zandspruit Extension 9. This area is a township with the highest purchase price being R40 000 and a municipal value of R450 000 as compared to the mean of R751 829.38 and R921 981.55 respectively.

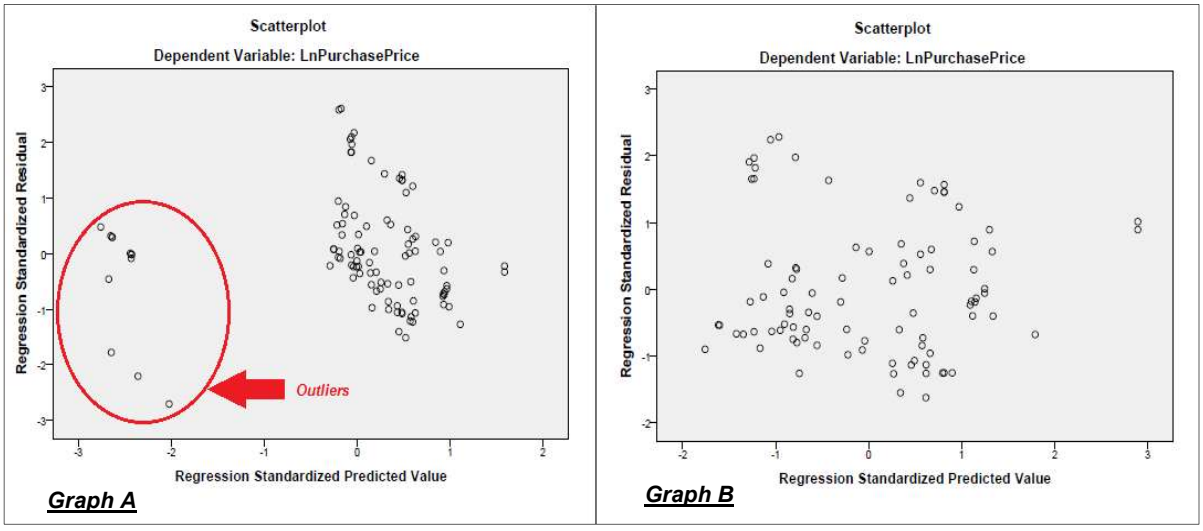


Figure 6: Observed residuals normality distribution (transformed dependent variable)

Furthermore, Figure 7 below indicates the normality probability plots of the regression model with the outliers (Graph C) and the model without outliers (Graph D). Both plots

show less deviation from the best fit line indicating improved normality in the distribution of residuals as compared to the untransformed outcome variable as discussed in Figure 2). However, the P-P plot with the outliers appears to have less skewness with less individual data points deviating from normality as compared to the P-P plot that excluded the outliers.

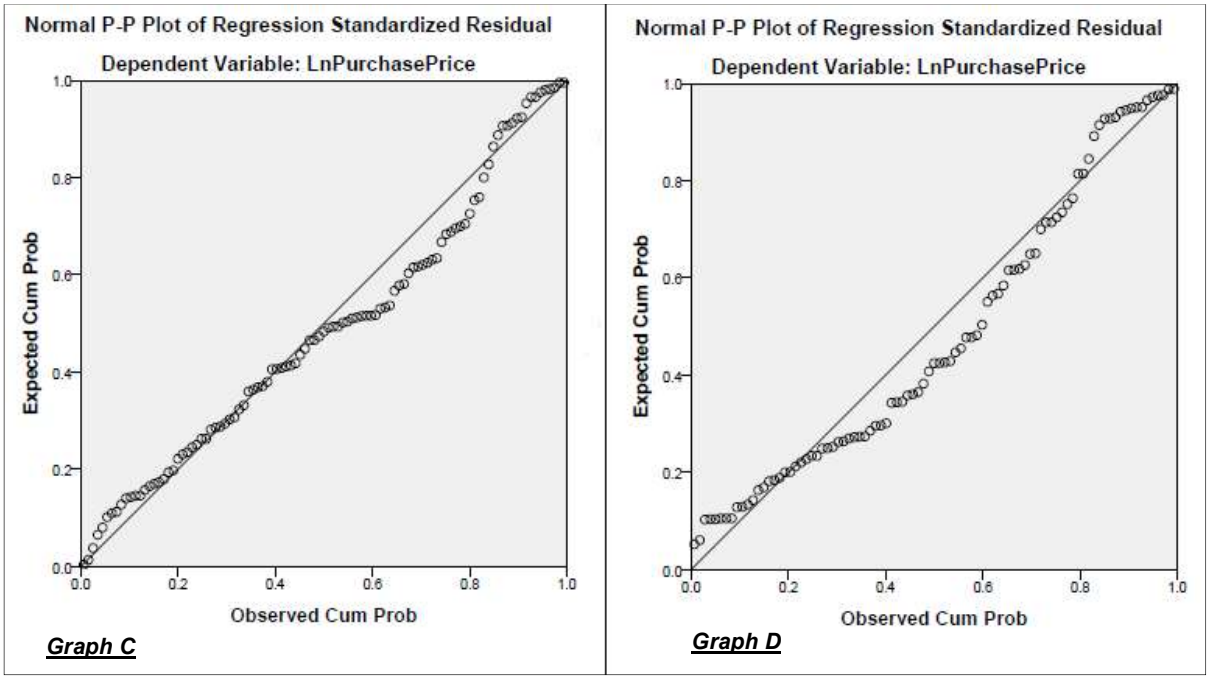


Figure 7: Normal probability plot (transformed dependent variable)

4.4 Results

The estimation results from the model (with the log transformed outcome variable, Purchase Price) indicate the independent variable Distance from MIH is statistically significant (with a p value of 2.974 E-23 which is below the 0.05 significance level) and confirms the expected positive sign. There is a strong linear relationship between variables Distance from MIH and Purchase Price, measuring the highest strength of correlation at 0.823. Thus it can be stated that the farther the distance a property is located from Cosmo City, the higher the purchase price (i.e. property value/price in the market). The null hypothesis is therefore rejected.

The second and final independent variable, Municipal Assessed Value, is statistically significant with a p value of 0.026. The expected positive sign confirms that the higher the municipal assessed value the higher the purchase price.

The R-squared was found at 0.693, indicating that almost 70% of the variation in Purchase Price (i.e. property value in the market) is explained by the independent variables. This indicates a good model fit.

With the exclusion of the outliers, the independent variables: Distance from MIH is found to be significant with a p value of 0.042 and the Municipal Assessed Value insignificant with a p value of 0.140. No strong correlation is found between any of the variables, with the highest strength of correlation being 0.210 between Distance from MIH and the Purchase Price.

The R-squared was measured at 0.068, indicating that only 6.8% of the variation in Purchase Price (i.e. property value in the market) is explained by the independent variables. This indicates a poor model fit.

Multicollinearity was tested and in both models (where outliers are included and excluded) and the Variance Inflation Factor (VIF) was >=1, indicating no multicollinearity between the independent variables.

4.5 Closing remarks

From the findings above, both independent variables are part of the predictive model for purchase price. There is no scientific reason for excluding outliers other than their influence of the significance of the coefficients of the independent variables. The farther away a property is from the MIH the higher the purchase price (i.e. property value); and a greater municipal assessed value gives a greater purchase price. The values of Y (the dependent variable) can be predicted using the following linear transformation:

$$Y'_i = b_0 + b_1X_{1i} + b_2X_{2i}$$

$$\text{Log } (Y'_{1i}) = -0.188 + 0.0000001398\ X_{1i} + 0.001\ X_{2i}$$

where, X_1= Municipal Assessed Value and X_2= Distance from MIH

For every 1 unit increase of the Municipal Assessed Value (X1) the purchase price increases by 0.00001398% (i.e. 0.0000001398 *100); and for every 1 unit increase of Distance from MIH the purchase price increases by 0.1% (i.e. 0.001 * 100).

CHAPTER FIVE: CONCLUSION

Chapter Five
Conclusion

5.1 Introduction

Mixed income housing has become a focus for South Africa and the development of policy and strategy with the Breaking New Ground (2004) housing policy highlighting its importance in restructuring cities and neighbourhoods (Landman, 2012). This research report investigated whether the presence of mixed income housing projects, such as Cosmo City had an impact on residential property values (i.e. property purchase prices) of the surrounding properties.

The research question posed, do mixed income housing developments have an impact on surrounding single-stand residential property values, is responded to that indeed Cosmo City impacts the property values and it does so in a negative way. Furthermore, the research report has fulfilled its set out objectives. The impact of mixed income housing developments on surrounding single-stand residential property has been found- and results and recommendations captured, hedonic price modelling in recent studies in South Africa was engaged and the model discussions in the Sale (2013) study was used as the basis for this study. Overall, the findings have contributed to the knowledge of mixed income housing projects in South Africa.

5.2 Key conclusions

The results of this study confirms the hypothesis, revealing that the presence of the Cosmo City has a negative effect on surrounding residential property values. However, the model does not reveal the reasons for this reduction. The results of the model should be applied with critical thinking for a number of reasons discussed further.

The model, although found to be a good fit, used the monthly Absa Housing Price Index (HPI) for a typical middle class house (141- 220 metres squared in size) in the northern Johannesburg area. The applied HPI was an average of the monthly HPI's for the given year. The HPI for the related suburbs, Zandspruit, Northgate and Northwold could not be obtained. The model assumes the property trends of the northern Johannesburg applies specifically to the individual suburb trends.

The inaccuracy of the municipal assessed value included in the model is a cause for concern. The municipal valuation was adjusted by a 5% to cover for the noted reduced

values. Lastly, the consideration of more than one MIH being included in the analyses would give stronger argument to the results.

The 15.3% variation, as inferred by the part coefficients, not explained by the model suggests other variables impact surrounding property values and that must be investigated.

5.3 Recommendations

In order to support mixed income housing developments such as Cosmo City, the government particularly at a municipal level (where projects are implemented) must engage and campaign the surrounding community and residents on the benefits and myths beginning from the initial stages through to the implementation of the MIH projects. The importance of MIH projects outweighs that of reducing property values. Therefore the local government must mitigate any negative impacts for the surrounding property owners through reducing taxes and providing discounts of municipal services accounts.

Mass Valuations, particularly in large metros with a high economic contribution such as the City of Johannesburg, should be discontinued and apply an alternative approach to the valuation of residential properties which considers the specific characteristics of a property. An attribute-based hedonic price model for the purposes of municipal property valuations must be applied (Sale, 2013).

There are other influences that impact the surrounding property values of a MIH project. These must be debated and investigated within a South African context. This research should begin by considering the location and property market within that location.

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