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Demographic and Economic Determinants of Housing Demand in the Johannesburg metro

A Thesis

Presented to

School of Construction, Economics and Management

In partial fulfilment of

the requirements for the

Master of Science in Property Development and Management

By

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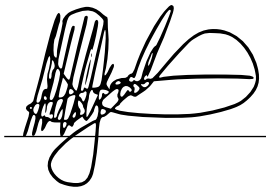
Declaration

I, **Nkgadi Frederick Sebogoane** declare that this research report is my own work. It is being submitted for the degree of Master of Science in Property Development and Management in the School of Construction, Economics and Management, faculty of the Built Environment and Engineering, at the University of Witwatersrand, Johannesburg. This report has not been submitted before for any degree or examination at this or any other University.



01/04/2019

Signature Date

Dedication

Firstly, I dedicate this report to my parents for ensuring that I got the education that I needed to succeed in life, without your hard work and sacrifices, none of this would be possible. Secondly, I want to thank my wife Refiloe and my son Phetolo, for affording me the time pursue this degree and always supporting me, even on days where I felt like giving up, thank you and I love you both very very much.

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They say God works in mysterious ways, and I could feel his hand at work in all that I did throughout my life, without him, nothing is possible.

A special thank you to Professor Samuel Azasu, a mentor, a friend, a spiritual leader and a pillar of strength for me throughout this process. It was definitely not easy and even when I was complaining you always helped see the bigger picture, I truly believe you were God sent, thank you and please continue helping others as you did me, you are changing lives and you don't even know it.

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Abstract

Housing forms a large part of household wealth and expenditure, it therefore follows that any change in housing markets, whether positive or negative, will have a direct impact on the wealth and expenditure of households. Numerous studies have researched housing demand for developed countries but applied research for developing countries is still relatively scarce, more so in South Africa. This study seeks to investigate the determinants of residential real estate demand in the Johannesburg metro. The research employs a mix of descriptive, correlation, and regression techniques, descriptive and correlation analyses are used to explore the basic features of the data that is used in the research. Regression techniques extend the descriptive and correlation analysis in estimating regression coefficients that measure how explanatory variables influencing housing demand, whether positively or negatively. The research found that, in the Johannesburg Metro context, after controlling for most of the variables in a housing model as we formulated and estimated, the effect of increasing the price at which exemption of transfer duty is applied is more effective in increasing housing demand in the low-income, middle- and high-income classes in that order.

Chapter 1 - Introduction

1.1 Introduction

Housing is for many households around the world both the largest expense and the most important asset (Bajari & Kahn, 2012). For all house-holds it is an important determinant of quality of life. For the majority in developed countries, and for some in emerging market economies, housing is adequate. But a significant proportion of the world's population does not have access to adequate and affordable housing (Warnock & Warnock 2008).

Mexico, like most developing countries, suffers a significant shortage of housing. The National Housing Commission (Conafovi) concluded in 2000 that Mexico required 1.8 million new housing units and major improvements in 2.5 million existing units given their severe level of deterioration (Fontenla & Gonzalez, 2009).

Housing accounts for a major fraction of consumer spending and wealth in the United States of America (Bajari & Kahn, 2012). Between 1935 and 1991 in the United States, shelter's budget share increased by 61%, while food's budget share fell by approximately 59% (Costa 1998). Housing equity represents the largest source of household wealth. Based on the 1998 Survey of Consumer Finances, the value of stocks owned by house- holds was $7.8 trillion, whereas the value of primary residences was $9.4 trillion (Bajari & Kahn, 2012).

With Housing forming a large part of household wealth and expenditure as stated above, it therefore follows that any change in housing markets, whether positive or negative, will have a direct impact on the wealth and expenditure of households.

In recent years, there have been few national housing markets in the world that have been more volatile and interesting than that in Britain. The fluctuations in house prices have

generated large changes in personal wealth, and focused attention on the structure of housing demand and supply (Chishire & Sheppard 1998).

Numerous studies have researched housing demand for developed countries (See Bajari & Kahn, 2012; Zabel 2004; T. Boehm & A. Schlottman 2014) but applied research for developing countries is still relatively scarce. Whilst housing market behaviour across countries has been similar, developing countries present important distortions in land and credit markets, urban infrastructure, regulation and law enforcement, among others (Fontenla & Gonzalez, 2009).

The literature on housing demand falls into four categories: (1) the demand for housing services, (2) the demand for individual housing attributes, (3) the demand for owner occupancy versus renting (tenure choice), and (4) the spatial allocation of households. Each of these categories requires very different modelling and estimation strategies (Zabel, 2004).

Recent developments in hedonic models of estimating have led to new approaches in estimating demand for housing. It allows the inclusion of variables ignored in previous studies (Chen, et al., 2011).

1.2 Problem Statement

Estimating demand for residential real estate has been researched extensively over the years, dating back to the mid to late 1900's. Historically, housing demand has also been the focus of much research (Zabel, 2004). However, no consensus has been reached as to what the correct model to use in estimating demand for residential real estate, nor has it been agreed what variables determine or influence demand for residential real estate and thus warrant inclusion in the different estimating models (Bajari & Kahn, 2012).

Furthermore, as noted above, numerous studies have researched housing demand for developed countries, but applied research for developing countries is still relatively scarce. Whilst housing market behaviour across countries has been similar, developing countries present important distortions in land and credit markets, urban infrastructure, regulation and law enforcement, among others (Fontenla & Gonzalez, 2009). There is therefore a compelling case to understand the determinants of residential real estate demand in the South African context.

1.3 Aims and objectives

1.3.1 To understand the determinants of residential real estate demand in the Johannesburg Metro.

1.3 Importance of the study

Housing is for many households around the world is both the largest expense and the most important asset (Bajari & Kahn, 2012). For all house-holds, it is an important determinant of quality of life. Therefore, understanding what factors drive demand and the barriers of entry will allow developers and policy makers alike to make sound decisions based on well researched ideas.

There are peculiar disparities in the South African property space because of the Apartheid spatial planning where populations were spatially segregated by race. It is unclear how these historical factors and or peculiarities affect or influence drivers of demand in the South African context. The influence of these factors on the city scape is clear, but not so on the demand drivers. There is thus a high probability that the drivers of demand observed in other markets will not be the same in the South African context.

In addition, understanding the determinants of residential real estate demand will lead to a more informed decision processes for property developers and investors, in that the

decision on when to invest, where to invest and develop will now be rooted in carefull analysis rather than intuition and experience.

1.5 Research Question

What are the determinants of residential real estate demand in the Johannesburg Metro?

1.6 Scope and Limitations

The study seeks to understand the determinants of residential real estate demand in South Africa, specifically in the Johannesburg metro.

The study will focus on the Johannesburg Metro as the area of study. This is mainly because South African metros are very diverse and different variables are likely to affect the housing demand differently in each metro. This also implies that the estimated model might not be applicable to other metros in South Africa.

1.7 Structure of the research paper

The purpose of this research paper is to understand the determinants of residential real estate demand in the Johannesburg metro. The paper is divided into 5 Chapters, the first chapter introduces the reader to the topic by giving background and history of housing demand over the years, it also highlights the problem statement, the aims and objectives of the study, the significance of the paper and the research questions that need to be answered. This chapter then concludes by stating the scope and limitations of the paper.

The second chapter of the paper is the literature review, and this chapter assess prior research and use it to substantiate the research problem as well as the resultant research questions and hypotheses. The third chapter of this paper is research methodology and this section outlines the research methods that were employed in undertaking the study. It reviews research methods employed in previous studies and discusses the research paradigm

applicable to this specific study. Chapter 4, which is data description and analysis presents results and related discussions of estimation of determinant of housing sales using ordinary least square regression (OLS). The last chapter of this paper is the summary and conclusion and it will present the recommendations and conclusions of the research report.

Chapter 2 - Literature Review

2.1 Introduction

The purpose of the review is to assess prior research and use it to substantiate the research problem as well as the resultant research questions and hypotheses. The first section of the literature review will explain the different ways of visualising housing demand and what the different schools of thoughts are on the matter, including the literature on the four categories of demand. The second section will attempt to identify and explain the different variables that determine demand for the four categories of residential real estate. This is followed by a section on how housing demand is estimated, what methods are being employed and discusses the strengths and weaknesses of the different methods. The fourth section looks at what literature says about demand in emerging markets, what is known and unknown about these markets. The last section discusses what is known about housing demand in South Africa. The conclusion then summarises the facts about what is currently known about housing demand, and what is unknown and warrants further research thus leading us to the research question.

2.2 Different ways of visualising Housing demand

Housing accounts for a major fraction of consumer spending and wealth. Housing equity represents the largest source of household wealth. Based on the 1998 Survey of Consumer Finances, the value of stocks owned by households was $7.8 trillion, whereas the value of primary residences was $9.4 trillion. Shelter is the largest of the twelve categories that comprise the consumer price index (CPI) market basket (Bajari & Kahn, 2012).

It is viewed by many people that owning a house is the biggest investment that one can make. It is often a source of pride and sense of achievement for many families and households to own their own home. It is therefore important for scholars and

industry practitioners to formulate a view on the different types of housing demand that exist or could potentially exist. This will allow them to come up with solutions and developments that best speak to the needs and preferences of the consumers.

The literature on housing demand falls into four categories: (1) the demand for housing services, (2) the demand for individual housing attributes, (3) the demand for owner occupancy versus renting (tenure choice), and (4) the spatial allocation of households. Each of these categories requires very different modelling and estimation strategies (Zabel, 2004).

(Zabel, 2004) Continues to further say Category (1) is useful for estimating price and income elasticities of housing demand. Housing demand is modelled as a continuous quantity that represents the flow of housing services. Thus, it is similar to other continuous economic variables like money and electricity and it is generally modelled as a function of the price of housing, non-housing expenditures, and socioeconomic variables.

Category (2) is concerned with estimating the demand for specific structure characteristics such as Number of bathrooms, garages, etc. and neighbourhood characteristics such as availability of public transport, levels of crime and so forth (Rosen, 1974). Category (3) involves the estimation of a binary choice equation with rent/own as the two categories. And the final category (4) Spatial allocation of Households which focuses on neighbourhood.

With the demand for housing divided into the four categories above, it is important to take a closer look at the variables that constitute demand as defined in the different categories.

2.3 The determinants of housing demand

The demand for Housing has been divided into four categories and in each category different variables determine or influence the demand. It is therefore important to understand the nature of these variables in order to understand the various categories of demand.

Category 1(Housing Services)

Even after restricting the analysis to the demand for housing services, the concept of housing demand is still ambiguous. This is because what constitutes housing services is unclear. Invariably, it includes the services that result from the structure and the land on which it sits. Also, given that the location of the house is fixed, it is reasonable to include the services that arise from the local amenities. Together, stock plus amenities can be considered to provide housing services (Zabel, 2004).

Consider, for example, land use planning policies. These constrain the availability of land for development and the types of structures which are allowed to be built. The policies seem likely to be a significant factor in increasing both the amplitude of house price cycles and the level of house prices (Cheshire & Sheppard, 1998).

Land itself is not homogeneous. The price of land which is directly observable includes the capitalised value of neighbourhood characteristics, local amenities and public goods. To study the effects of land regulation would require separation of these values to focus on the price of space at each location, with associated accessibility to the employment centre (Cheshire & Sheppard, 1998).

Category 2 (demand for individual housing attributes)

Researchers have debated the validity of procedures for estimating the demand for specific structure characteristics (e.g., number of bedrooms) and neighbourhood attributes (e.g., air quality). Another literature concerns the estimation of the demand for public goods based on the median voter mode (Zabel, 2004).

The characteristics include not only physical characteristics and neighbourhood amenities, but also local public goods, including some outputs of the planning system, and land as pure space taking into account its location or accessibility. Physical location is important not only because it is a frequently neglected, but important, determinant of total structure price, but also because it plays a role in the answer we provide to an econometric critique which has been made of many studies of housing demand (Cheshire & Sheppard, 1998).

Category 3 (tenure choice)

Understanding the factors that influence households transitions into and out of homeownership, and thereby the likelihood that these households can sustain homeownership over time, is important for a number of reasons (Boehm & Schlottmann, 2014).

Dietz & Haurin, (2003) evidence of the impact of a household achieving homeownership from household wealth and portfolio choice, mobility, labour force participation, urban structure and segregation, home maintenance, political and social activities, physical and mental health, demographics, and outcomes for children.

Category 4 (Spatial allocation of Households)

The classical economically rational consumer will choose a residential location by weighing the attributes of each available alternative, accessibility of workplace, shopping, schools, quality of neighbourhood life, the availability of public services, costs such as taxes, dwelling characteristics and so forth (Malpezzi, 1999).

(Malpezzi, 1999) goes to further state that in reality, consumers vary substantially in their tastes for housing, and may also display bounded rationality, with he result that a distribution of responses would result from presentation of the same apparent alternatives to each consumer population.

2.4 How is housing demand estimated

The issue of estimating demand for residential Real Estate has been researched extensively over the years, dating back to the mid to late 1900's. Historically, housing demand has been the focus of much research (Zabel, 2004). However, no consensus has been reached as to what the correct model to use is in estimating demand for residential real estate as (Bajari & Kahn, 2012) states that because the methods that we use are somewhat unique, it is useful to review the methods that have been used to estimate the demand for housing attributes and the demand for differentiated products more generally.

First, the recent literature on estimating discrete choice models has emphasised that price elasticities tend to be biased toward 0 if the economist fails to account for ξj, product characteristics observed by the consumer but not by the economist. This problem is ignored in most previous studies of housing demand with the exception of the study of Bayer et al. (2002). It is expected that this problem will be especially important in housing research

based on standard Census data, where researchers commonly find that the observed covariates explain only one-half or less of the variation in prices.

In painting a clearer picture of the deficiencies in previous demand estimating models and how the models can be improved (Bajari & Kahn, 2012) further states: our model allows for a flexible specification of the joint distribution of tastes and demographic characteristics. In our model we estimate the distribution of eight random coefficients (seven for the observed product characteristics and one for the unobserved product characteristic) as a function of eight demographic variables. Parametric assumptions about the distribution of random coefficients are not imposed during estimation. In most previous work that estimated discrete choice models, the random coefficients are typically assumed to be independently and normally distributed, conditional on demographics. Given that these models are computationally intensive, such parsimonious parametric specifications are required to make the problem computationally feasible. In contrast, our procedure is easy to compute and can be quickly estimated using standard statistical packages (Bajari & Kahn, 2012).

However, the above model is not without drawbacks and the author admits this by saying the analyst does face a couple of trade-offs, however, in using this approach as compared with the random coefficient logit model estimated by Berry et al. (1995) or the random coefficient probit estimated by McCulloch et al. (2000). The first such trade-off is that in characteristic models such as this, not all products are strong gross substitutes(Bajari & Kahn, 2012). Interestingly, (Chen, et al., 2011) have an interesting view on the development of the hedonic estimating models and how they have evolved over the years to accommodate variables that were not taken into consideration before. He says that it is well established that monopolistic competition implies that firms obtain a mark-up over the marginal cost of production and that the mark-up decreases with the absolute value of the price elasticity of

demand. Recent literature has extended this result to hedonic equilibrium. Moreover, the hedonic model has been extended to allow different pairings between supply and demand at each of several discrete points along the hedonic function. These developments allow modelling of disparate demand and supply equilibria with a single hedonic function in a single submarket (Chen, et al., 2011).

2.5 What do we know about housing demand in emerging markets?

Previous studies on housing demand and the methods used were mainly to cater for developed economies and very little has been done to understand the emerging economies and their unique characteristics, their land issues and under developed credit markets, urban developments and law enforcement (Fontenla & Gonzalez 2009). The bulk of the research, documents that housing market behaviour is remarkably similar from place to place. Institutions and constraints, particularly the amount of income available for housing and other goods and services certainly do vary dramatically from place to place. And at a different level it could be argued that the stakes of how well housing markets work vary from place to place. But these differences in institutions and constraints should not obscure regularities in behaviour (Malpezzi, 1999).

Interestingly, some developing countries and transitional economies have used housing demand as a way to stimulate economic growth, as is acknowledged by (Cheng, et al., 2014) who state that it is the expressed intention of the government to use the housing market as an engine to promote industrial and economic growth. On the other hand, there is the danger associated with the overheating of housing markets. There appears to be a growing awareness of the role housing prices play in the health of the whole economy. However, most countries, especially the developing and transitional economies, are fully aware of the dangers posed by overheating housing markets, especially on the evidence of what happened

to the economies of developed nations like The United States of America during the economic crisis. As a result, transitional and developing economies like China have put in regulatory policies to guard against this, as noted by (Cheng, et al., 2014) that the Shanghai Government has been actively adjusting the taxation relating to housing trading and interest rates of mortgage loans with the intent of constraining demand. In 2005, a 'transaction tax' for previously-owned dwellings was introduced to replace the 'capital gains tax'. The transaction tax equals 5% of the total sale price of a dwelling whereas the previous capital gains tax only applied to a net gain over the original purchase price (Cheng, et al., 2014).

2.6 What do we know about housing demand in South Africa?

Over the last two decades, the South African property market in general has become very sophisticated and requires a new level of understanding and approach if one is to succeed. The integration of South Africa back into the international markets after the end of apartheid has seen a flock of investors coming to South Africa looking for investment opportunities and using it as a gateway into the rest of Africa. This will further fuel the need to critically analyse and research the South African Property market to generate a different perspective. Also, important contributions can be made to these theoretical perspectives from the South African property experience, while also ensuring an integration of local scholars into the international property space.

The issue of estimating demand for residential Real Estate has been researched extensively over the years, dating back to the mid 1900's. However, no consensus has been reached as to what the correct model to use in estimating demand for Residential Real Estate, nor has it been agreed what variables determine or influence demand for residential Real Estate and thus warrant inclusion in the different estimating models. This has potential to be researched further and generate a different perspective. Also, important contributions can be made to

these theoretical perspectives from the South African property experience, while also ensuring an integration of local scholars into the international property space. Further research of the potential gap areas mentioned above could go a long way towards achieving that goal.

2.7 Subsidised housing: An overview

At the start of the millennium, more than one billion people lived in inadequate housing and that number has been growing rapidly, particularly in poor countries (Gilbert, 2014).It has never proved easy to help the poor through housing subsidies, particularly in poorer countries. While there have certainly been positive experiences, there is a very long list of failures particularly in the field of public housing (Gilbert, 2004).

Influenced by their reading of this experience, the major development institutions of United States of America have long preached that providing subsidies to the poor through public housing has rarely been successful. Justified in their belief or not, the multilateral development institutions have long been highly critical of the public housing record (Gilbert, 2004). Historically, public provision and mass production of social housing, mainly in OECD countries, have left a mixed legacy. In some cases, such as in New York, the housing produced was of higher quality, a result of well-designed policies; in other instances, public housing has left a grim heritage (Buckley, et al.,2016).

Over the past decade there has been a sudden, extraordinarily large, and simultaneous expansion of multi-billion dollar housing subsidy programs in many developing and emerging economies (Buckley, et al.,2016).Social housing has been an important part in Europe's housing provision for many decades both in terms of investment in new build and

regeneration but also in providing adequate affordable housing for a wide range of European citizens (Scanlon, et al., 2015).

In Western Europe, middle-income groups are finding it increasingly difficult to buy houses, middle-income households in the Netherlands are ‘falling between two stools’.This housing market problem is not specifically Dutch – it is evident in many Western European countries (Hoekstra & Boelhouwer, 2016).

All of the so-called BRICS; Brazil, Russia India, China, and South Africa as well as Angola, Argentina, the Democratic Republic of Congo, Ethiopia, Rwanda, Mexico, Indonesia, and Sri Lanka, have initiated new large-scale housing programs (Buckley, et al., 2016). In South African cities, millions of men and women living informally are being rehoused through the state-directed provision of formal houses to poor beneficiaries (Meth & Charlton 2017).Since 1994, the South African government has embarked on one of the largest low-income housing programmes in the world, constructing approximately 3.3 million new housing units to date (Cloete & Marais, 2014).

Studying these programs in this particular moment in time is crucial for several reasons. Firstly, due to the long-term effects of housing policies for the cities' development and secondly, due to the importance that housing holds in shaping what is referred to as a ten-generation urbanisation project (Buckley, et al., 2016).A variety of methods have been implemented around the globe to tackle the issues around subsidised housing, to varying degrees of success, and as a result, many countries have attempted to develop what they believe are working models specific to their countries’ needs and unique circumstances.

2.8 Subsidised Housing Ownership: Policy Overview

In order to decipher the reasons behind the sudden shift in housing policy, one has to look at both larger contextual reasons, and, particular motivations within different countries. These motivations vary across time and space (Buckley, et al., 2016). Housing problems for middle-income groups usually stem from the high entry costs of the home ownership sector. The mortgage for which a middle-income household is eligible is often insufficient to purchase the house that this household aspires to (Hoekstra & Boelhouwer, 2016). This creates what is sometimes referred to as "the missing middle", that it, those that earn too much to qualify for a subsidy and too little to qualify for a mortgage. During the 1960s and early 1970s, housing policies in Argentina, Brazil, Chile and Colombia were fashioned to meet the demand of those in formal employment. As a consequence, most authors agree that these housing policies failed to target the unemployed and those working in informal or casual jobs (Murray & Clapham, 2015).

Affordable home ownership products are designed to bridge the gap between the purchase price of the house and the financial capacity of the household. This can be done in two ways: by reducing the former or increasing the latter (Hoekstra & Boelhouwer, 2016).

(Hoekstra & Boelhouwer 2014) further notes that reducing the purchase price usually involves some reductions in the property rights. Since the middle 1980s, the major development banks and the United Nations have been preaching that major public projects should be removed from the housing agenda and replaced by new forms of intervention. Particularly popular has been the idea of providing subsidies to poor families to allow them to buy homes produced by the private sector. The up-front capital subsidy pioneered by the Chileans in 1977 has been an exemplar of this new housing approach (Gilbert, 2004).

In the United Kingdom, in the main there are two types of owners of social rented housing: companies in municipal ownership or municipalities themselves (in the UK the term 'council housing' was long synonymous with social housing), and non-profit organisations usually known as housing associations (Scanlon, et al., 2015).

Over the past two decades, much attention has been paid—in policy terms—to housing lower-income households. At the bottom end of the South African housing market, the South African Housing Subsidy Programme (a capital subsidy) has provided housing and ownership to roughly three million low-income households. This subsidy is available to households with a household income below R3500 a month. In practice, the subsidy is paid to a developer or contractor who constructs a small housing unit for the household (Hoekstra & Boelhouwer 2016).

Originally, the subsidy amounts were scaled - the bigger the income, the smaller the subsidy . This scaling was intended to link the smaller subsidies to mortgage finance, but it did not prove effective. A mere 120,000 subsidised housing units had been linked to mortgage finance in 2009. This figure represented only 4 % of the total subsidised housing opportunities created between 1994 and 2009. The scaling of the subsidy for households earning less than R3500 was therefore abandoned in the mid-2000s (Hoekstra & Marias 2016).

Shared ownership (part buy, part rent) schemes in the UK are provided through housing associations. They are designed particularly for households with a moderate income who have no or only limited access to the social rental sector but cannot afford home ownership on the free market. Shared ownership requires less subsidy than ordinary social rental

housing because only the rental component of the house is subsidised while the home ownership component is sold at market value (Hoekstra & Boelhouwer 2016).

Some of the current policy efforts in subsidised housing were designed to serve as counter-cyclical programs, others to address the problems posed by rapid urbanisation, still others deal with the legacy of an urbanisation process that has left many under-provided or without any access to formal housing and basic services. Even if the links between urbanisation and economic growth are known, one should not forget that urbanisation is also a disruptive process that has been often accompanied by slum formation (Buckley, et al., 2016).

2.9 Conclusion

From the literature it can be concluded that there are four categories to estimating the demand for housing, namely: (1) the demand for housing services, (2) the demand for individual housing attributes, (3) the demand for owner occupancy versus renting (tenure choice), and (4) the spatial allocation of households and each of these categories require very different modelling and estimation strategies with very careful consideration for the variables that go into the different models.

Over the years researchers have made advancements on the methods used to estimate demand for housing, with variables that were thought to be less significant now being included in estimating models. However, as noted by (Fontenla & Gonzalez, 2009) Previous studies on housing demand and the methods used were mainly to cater for developed economies and very little has been done to understand the emerging economies and their unique characteristics, their land issues and under developed credit markets, urban developments and law enforcement among other things. South Africa is considered an emerging economy and as far as we know, there are no studies done on estimating housing

demand in the country and particularly the City of Johannesburg and thus the question of the determinants of residential real estate demand remains unanswered.

Chapter 3 - Research Methodology

3.1 Introduction

This chapter outlines the research methods that were employed in undertaking the study. It reviews research methods employed in previous studies and discusses the research paradigm applicable to this specific study. It will also discuss the limitations of the study and describe fully the area of study and the demographics of the area of study. The chapter ends by outlining the intended contribution of the study to the body of knowledge.

3.2 Review of previous studies

The issue of estimating demand for residential Real Estate has been researched extensively over the years, dating back to the mid to late 1900's (Zabel, 2004). However, no consensus has been reached as to what the correct model to use in estimating demand for Residential Real Estate, nor has it been agreed what variables determine or influence demand for residential Real Estate and thus warrant inclusion in the different estimating models (Bajari & Kahn, 2012).

TABLE 1: SUMMARY OF VARIABLES USED IN PREVIOUS STUDIES:

Author	How Dependant Variable was measured	Explanatory Variable	Sign (+-)	Technique Used
Developed Countries				
T. Boehm & A. Schlottman (2014)	Likelyhood and timing of tenure choice dynamics	House Prices	_	Cross sectional
P. Cheshire & S. Sheppard (1998)	The fluctuations in house prices by estimating demand for housing, land and neighbourhood characteristics	House Prices, Income levels, Population, Transport costs, Local amenities, Public goods	_ _ + _ + +	Hedonic Model

R. Palmquist (1984)	Estimating demand for housing characteristics	Area of house, Number of bathrooms, year of construction, general condition of house	+ + _ _	Hedonic Model
J. Zabel (2004)	The demand for housing services	House Prices and Income elasticity	_ _	Log linear
Developing Countries				
W. Wu et al. (2013)	Measure the relative impact of location characteristics versus individual characteristics in determining the residential location choices of households	Location Characteristics (Public goods accessibility), Individual characteristics (Income, educational attainment, ownership status)	+ _	Survey
M. Fontenla & F. Gonzalez (2009)	Analyse the components of housing demand in mexico in the context of developing and developed nations	Housing units, Other goods consumed, demographic characteristics and vector A (gender, education, Age)	+ _ _	Hedonic Model
Y. Chen, J. Clapp & D Tirtiroglu (2011)	Hedonic estimation of housing demand elasticity with a markup over marginal costs	Unit Size, Costs of construction	+ _	Hedonic Model
Y. Cheng, J. Dagsvik, H. Han (2014)	Examine the impact of four housing market-related policies	Income, Demographic characteristics of households, housing attributes (Price, location & sizes of dwellings)	_ + + _	Mixed multinomial logit model

Informed by a review of the above previous studies, the following estimation equation was used to estimate housing demand in the City of Johannesburg metropolitan municipality.

Y (Number of sales) = $\mathbf{b_0}$ + $\mathbf{b_1}$ (Median house prices) + $\mathbf{b_2}$ (Population or Number of households) + $\mathbf{b_4}$ (Interest rate) + $\mathbf{b_4}$ (Inflation rate) + $\mathbf{b_5}$ (Disposable Income) + $\mathbf{b_6}$ (percent below) + **e**

where $\mathbf{b_0}$ **is the constant,** $\mathbf{b_1}$ **to** $\mathbf{b_6}$ are regression coefficients to be estimated, and **e** is the residuals.

3.3 Research Techniques

The research employs a mix of descriptive, correlation, and regression techniques. Descriptive and correlation analyses are used to explore the basic features of the data that is used in the research. Regression techniques extend the descriptive and correlation analysis in estimating regression coefficients that measure how explanatory variables influencing housing demand, whether positively or negatively.

This research used secondary data obtained from various sources. These data covering 1993 to 2010 included the following:

- Median house price (in Rands) – this was calculated from average transfer house prices per year obtained from Lightstone, a real estate company in South Africa.
- Population size (numerical value) – this was obtained from Quantec EasyData.
- Number of households (numerical value) – this was obtained from Quantec EasyData.
- Disposable income (in Rands) – this was obtained from Quantec EasyData.
- Interest rates (%) – this was obtained from South African Reserve Bank.
- Inflation rate (%) – this was obtained from South African Reserve Bank.
- Percent below (%) – this represented the proportion of house sales in a given year that had prices equal or below the statutory house price value (as declared by the Minister of Finance) under which buyers are exempted from paying transfer duty.

3.4 Delineation and Limitations of the Study

The results from the analysis apply to City of Johannesburg metropolitan municipality in South Africa. There is need to replicate the research in other metropolitan municipalities in Gauteng and South Africa as a whole. These proposed studies either may confirm results in this study or may shad more insights to the determinants of housing demand in these other metropolitan municipalities. The City of Johannesburg metropolitan

municipality is situated in Gauteng Province and covers an estimated area of 1,645 km^2. Johannesburg is the largest city by population in South Africa, and the commercial capital of Gauteng Province. According to the EasyData (2018), the city contributes about 37% (5,163,522 people) to Gauteng provincial population of 14,192,002 people.

3.5 Ethical Consideration

The study will make use of secondary data that is already in the public domain, and therefore there are no ethical considerations in collecting the data, carrying out the study and safe keeping of the data at the conclusion of this study.

Chapter 4 - Data Description and Analysis

4.1 Introduction

This chapter presents results and related discussions of estimation of determinant of housing sales using ordinary least square regression (OLS). Preliminary analysis implemented through descriptive statistics and correlation analyses are covered in the first section. Correlation analysis was necessary to find out if multicollinearity problem was likely to be encountered. Parameter estimation, first, focuses on the 'global model', where all sales are combined regardless of income class, and second, focus shifts to disaggregated three income classes, that is, low-, medium- and high-income classes as earlier pointed out in Chapter 3. In each of the preceding regressions two set of results are reported; first, is where population is used a regressor, and second, is when the number of households is used. The alternative use of population size and the number of households was necessary since the two regressors not only appear to proxy the same effects on the dependent variable, but that both are included in estimation, they caused severe multicollinearity. Discussion of results is covered here as well.

Diagnosis analysis is presented to establish any distortion of OLS assumptions. Panel data estimation could not be performed because of size of data. The data available is for 16 years only and the variable used are median price, population, households, disposable income, interest rate, inflation, and percent below.

4.2 Descriptive Statistics

Table 2 shows the number of observation for each of the variable used in the analysis. Due to missing data, the number of observations is not the same. Both median price and percent below have 54 observations, while the number of observations for population size, number of households, disposable income, and interest rate is 48. The number of observation for inflation is equal to 51.

Table 2: Number of observation for each variable

Variables	N	Mean	Standard Deviation	Minimum	Maximum
Median Price	54	298,214	214,750	109,833	660,000
Population size	48	3,401,187	444,145	2,655,870	4,103,406
Households	48	1,061,701	171,386	749,079	1,290,921
Disposable Income	48	114,473	29,937	74,452	163,970
Interest rates	48	11.18	2801	6905	16.53
Inflation rate	51	6119	2773	-692	10.06
Percent below	54	372	0.0811	191	504

Source: Author's calculations

4.3 Correlation Matrix

Table 3 shows correlation matrix of model variables. The table shows that there is positive correlation between median price, population size, number of households and disposable income, while median price is negatively related to interest rate and inflation. The relationship between median price and inflation is unexpected, since prices and inflation are expected to move in the same direction. Several correlation coefficients are more than 0.6, that is, median price and population (0.87), median price and disposable income (0.97), median price and number of household (0.82), median price and interest rate (-0.72), populations and number of households (0.99), disposable income and number of households (0.94), and population and interest rates (0.61). "Percent below" variable is positively correlated with median price, population size, number of

households, disposable income, but negatively correlated with interest and inflation rates. These results suggest possible collinearity problem during estimations.

Table 3: Correlation matrix

	Median price	Population	Households	Disposable income	Interest rates	Inflation rate	Percent below
Median price	1						
Population	0,877	1					
Households	0,819	0,992	1				
Disposable income	0,957	0,975	0,945	1			
Interest rates	-0,717	-0,614	-0,597	-0,696	1		
Percent below	0,399	0,605	0,666	0,506	-0,311	-0,298	1

Source: Author's calculations

4.4 Regression estimates

4.3.1 Regression results for the global model whole data set

Using the data for the 16 years from 1993 to 2010, ordinary least square estimation was performed using sales as a dependent variables and median price, disposable income, population, inflation, interest rate, households and percent below as regressors. The estimation procedures started with a global data set, where the dependent variables included the number of house sales regardless of income groups. Because of multicollinearity, estimation was conducted twice; first, with population size as one of the regressors, and second, with the number of households as the regressor. Note also that disposable income was not included in both estimations, since including it in both cases, resulted in severe multicollinearity.

Table 3 shows that when population is used as a regressor, instead of household, only median price and percent below are statistically significant. These results show that with a one-rand increase in the median price, housing demand decreases by 0.032 units. The results also show that for every one-percentage increase in percent below, housing demand increases by 77,534 units, which is also significant at a 1% level of significant. All other variables are insignificant. When the estimations was performed using the number of households as a regressor, instead of the population, the results do not change much. Table 3 shows that only median price and percent below remain the only statistically significant regressors explaining housing demand. In OLS (1) and OLS (2), the adjust R^2 for both cases are 0.783 and 0.785, respectively – meaning that the models explained 78% and 79% of housing demand.

Table 4: Estimation results using population size and number of households

Variables	OLS (1)	OLS (2)
Median Price	-0.032* (1.487e-02)	-0.033** (1.220e-02)
Population size	-0.004 (8.011e-03)	
Interest rates	69.408 (5.903e+02)	37.401 (5.836e+02)
Inflation rates	26.416 (4.483e+02)	-7.748 (4.604e+02)
Percent below	77,534*** (2.279e+04)	79,686*** (2.375e+04)
Households		-0.011 (1.852e-02)
Constant	16,819 (2.084e+04)	14,649 (1.617e+04)
Observations	16	16
R^2	855	857
F	11.84	11.96
Adj R^2	783	785

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1, OLS (1) indicates that population was used as one of the regressors; and OLS (2) indicates that the number of households was used as one of the regressors.

4.3.2 Regression results per income classes, with population size as one of the regressors (instead of number of households)

Table 4 presents three regression outputs related to three income classes. In each of the models, the Adjusted R^2, which explains the proportion of housing demand that is explained by model variables, were high (above 85%) in all models. The estimation for high-income buyers (OLS (1a)) and OLS (1b) reveals that median price, interest rate, inflation rate, and percent below are all statistically significant in explaining housing demand in the City of Johannesburg. Generally, results do not vary much. For instance, for both OLS (1a) and OLS (1b) results show that for every one-rand increase in median

price, the housing demand decrease by 0.004 units. In OLS (1a), one-percentage increase in interest rate and inflation rate lead to 53.2 units and 55.7 unit decrease in housing demand, respectively. In OLS (1b), one-percentage increase in interest rate and inflation rate lead to 58.02 units and 57.7 unit decrease in housing demand, respectively. For percent below, results show that one-percentage increase in percent below in OLS (1a) lead to 2,484 units increase in housing demand, whereas the same one-percentage point lead to 2,518 units increase in housing demand in OLS (1b).

For middle-income class (OLS (2a) and OLS (2b)) estimation of housing demand returned median price, interest rate, inflation rate, and percent below as statistically significant regressors. The results show that for every one-rand increase in median price, housing demand increase by 0.006 units and 0.005 units for OLS (2a) and (OLS (2b), respectively. Similarly, each one-percentage increase in interest rate results in a 259 units (OLS (2a)) and 269 units (OLS (2b)) decrease in housing demand. Similarly, a one-percentage increase in inflation rate lead to a 249 units (in both OLS 2(a) and OLS 2(b)) decrease in housing demand. Percent below also explains housing demand in the middle-income category – one-percentage increase in percent below will lead to 7,124 units (OLS (2a)) and 6,900 (OLS (2b)) increase in housing demand.

Table 4 further shows that estimation for low-income buyers (OLS (3a)) and (OLS (3b)) returned median price, and percent below as statistically significant variables that explain housing demand. Thus, for every one-rand increase in median price, the housing demand decreases by 0.042 units in both models. With percent below that is statistically significant at 5%, results show that one-percentage increase in percent below will lead to 67,926 units (OLS (3a) and 6,900 units (OLS (3b)) increase in housing demand.

Table 5: Regression results for different income classes

Variables	OLS (1a)	OLS (1b)	OLS (2a)	OLS (2b)	OLS (3a)	OLS (3b)
Median price	0.004*** (6.061e-04)	0.004*** (5.086e-04)	0.006*** (1.437e-03)	0.005*** (1.226e-03)	-0.042** (1.462e-02)	0.005*** (1.226e-03)
Population size	-0.001 (3.266e-04)		-0.001 (7.743e-04)		-0.002 (7.879e-03)	
Households		-0.001 (7.718e-04)		-0.002 (1.860e-03)		-0.002 (1.860e-03)
Interest rates	-53.214* (2.407e+01)	-58.015** (2.432e+01)	-259.392*** (5.705e+01)	-269.013*** (5.863e+01)	382.014 (5.806e+02)	-269.013*** (5.863e+01)
Inflation rates	-55.664** (1.828e+01)	-57.691** (1.919e+01)	-249.061*** (4.333e+01)	-249.989*** (4.626e+01)	331.141 (4.409e+02)	-249.989*** (4.626e+01)
Percent below	2,483.907** (9.291e+02)	2,518.383** (9.896e+02)	7,123.554*** (2.203e+03)	6,900.932** (2.386e+03)	67,926.027** (2.241e+04)	6,900.932** (2.386e+03)
Constant	1,475.057 (8.496e+02)	979.562 (6.737e+02)	5,732.683** (2.014e+03)	4,567.871** (1.624e+03)	9,611.670 (2.050e+04)	4,567.871** (1.624e+03)
Observations	16	16	16	16	16	16
R^2	974	974	967	965	900	965
F	76.20	73.50	58.46	54.45	18.09	54.45
Adj. R^2	962	960	950	947	851	947

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; OLS (1a) and OLS (1b) relates to high-income category, with population and number of households, used as regressors (in turn), respectively. OLS (2a) and OLS (2b) relates to middle-income category, with population and number of households, used as regressors (in turn), respectively. OLS (3a) and OLS (3b) relates to low-income category, with population and number of households, used as regressors (in turn), respectively.

4.5 Diagnostic Analysis

In this section, various diagnostic tests are performed to test the robustness, including meeting OLS assumptions, of the results obtained above. These tests include multicollinearity test, serial correlation test, heteroscedasticity test, and stationarity test. Results related to these tests are reported in Tables 5-7. Table 5 shows that all variables had variance inflation factors (VIFs) less than 5, with exception of the population and number of households. However, population and number of households' VIFs were less than 10, leading us to conclude that multicollinearity was not a problem in model estimation.

Table 6. Multicollinearity tests

Variable	Median price	HHs	Interest rates	Percent below	Population	inflation
VIF	5.93	8.33	2.21	2.65	10.38	1.34

Table 6 shows very small and insignificant Chi-square value, meaning, we fail to reject the null hypothesis of no serial correlation of residuals at lag 1. Table 7 shows that we fail to reject the null hypothesis of constant variance.

Table 7. Serial Correlation test

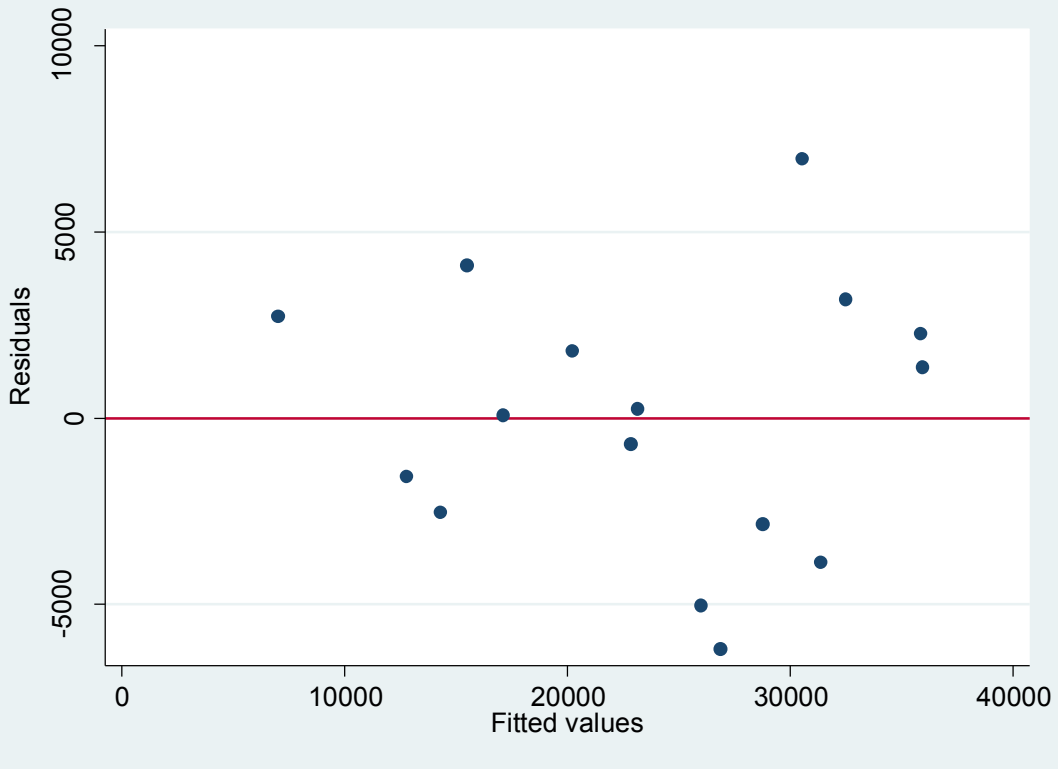
Breusch-Godfrey LM test for autocorrelation		
H_0: No serial correlation	When one of the regressor is population	When one of the regressor is the number of households
Chi-square	824	1028
p-value	0.3641	0.3106

Table 8: Heteroscedasticity test

Breusch-Pagan/Cook Weisberg test		
H0: constant variance	When one of the regressor is population	When one of the regressor is number of household
Chi- square	0.71	0.68
p-value	0.4003	0.4112

Figure 1, where we plot the residuals of our estimation against fitted values, show that there is no relationship (see the horizontal line implying correlation coefficient of zero) between the residuals and fitted values. These results confirm the residuals are homoscedastic.

Figure 1: Scatterplot of residuals and fitted values



Further, Table 8 shows results for stationarity test. From the table we observe that tests for stationary for all the models variables are generated by a stationary process.

Table 9: Stationarity test

ADF: 3 lags	H_0: the variable contains a unit root	H_1: The variable is generated by a stationary process		
Variable	**Test statistic**	**1% Critical Value**	**5% Critical Value**	**10% Critical Value**
Number of sales	-1410	-4380	-3600	-3240
Median price	-3436	-4380	-3600	-3240
Population size	-3359	-4380	-3600	-3240
Interest rate	-1932	-4380	-3600	-3240
Inflation	-2907	-4380	-3600	-3240
Per Below	-947	-4380	-3600	-3240
Number of households	-2111	-4380	-3600	-3240

4.6 Conclusion

From the estimation, starting from use of combine or aggregate data, only median price and percent below are significant in explaining housing demand. However, when we disaggregated data into low-, medium-, and high-income categories the data is more informative. In other words, more regressors become statistically significant in explaining housing demand. Across all models, while the role of median price in explaining housing demand is statistically evident, its role nonetheless is small. Neither population size nor the number of households was statistically significant in explain housing demand in all the models.

Notwithstanding the magnitude, the effects of interest and inflation rates was negative across all models. More informative was the role of percent below. The results suggest that as the percent below increases the effect is become more evident or increases as one moves from high- to middle- and finally to low-income categories. Essentially, after controlling for most of the variables in a housing model as we formulated and estimated, the results suggest that the effect of increasing the price at which exemption of transfer duty is applied is more effective in increasing housing demand in the low-income, middle- and high-income classes in that order. The estimation for high-income buyers (OLS (1a)) and OLS (1b) reveals that median price, interest rate, inflation rate, and percent below are all statistically significant in explaining housing demand in the City of Johannesburg.

Chapter 5 - Summary and Conclusions

5.1 Introduction

This chapter will present the recommendations and conclusions of the research report.

5.2 Summary of findings

The results indicate that when population is used as a regressor, instead of household, only median price and percent below are statistically significant. The results also show that for every one percentage increase in percent below, housing demand increases by 77,534 units, which is also significant at a 1% level of significant and all other variables are insignificant, and the results are not different when households is used as a regressor.

The research findings for the disaggregate model with three regression outputs related to three income classes (low, medium and high income classes) in each of the models, the Adjusted R^2, which explains the proportion of housing demand that is explained by model variables, were high (above 85%) in all models. Generally, results do not vary much.

5.3 Conclusions

In this study, we applied Ordinary Least Squares (OLS) to estimate determinants of housing sales in the Johannesburg Metro, using secondary data from various sources ranging from 1993 to 2010. To the best of our knowledge, this study is the first of its kind in the City of Johannesburg using regression to estimate determinants of housing sales and thus estimating drivers of demand for housing in the metro.

The research findings are divided into two major sections, namely the “global model” where all sales are combined regardless of income class and the disaggregated model, and the disaggregated model has further three subsections, namely, low, medium and high income classes. Using the data for the 16 years from 1993 to 2010, ordinary least square estimation

was performed using sales as a dependent variable and median price, disposable income, population, inflation, interest rate, households and percent below as regressors, because of multicollinearity, estimation was conducted twice; first, with population size as one of the regressors, and second, with the number of households as the regressor. When population is used as a regressor, instead of household, only median price and percent below are statistically significant. These results show that with a one-rand increase in the median price, housing demand decreases by 0.032 units. The results also show that for every one-percentage increase in percent below, housing demand increases by 77,534 units, which is also significant at a 1% level of significant and all other variables are insignificant, and the results are not different when households is used as a regressor.

The research findings for the disaggregate model with three regression outputs related to three income classes (low, medium and high income classes) in each of the models, the Adjusted R^2, which explains the proportion of housing demand that is explained by model variables, were high (above 85%) in all models. Generally, results do not vary much. For both OLS (1a) and OLS (1b) results show that for every one-rand increase in median price, the housing demand decrease by 0.004 units.Estimation for low-income buyers (OLS (3a)) and (OLS (3b)) returned median price, and percent below as statistically significant variables that explain housing demand. Thus, for every one-rand increase in median price, the housing demand decreases by 0.042 units in both models. With percent below that is statistically significant at 5%, results show that one-percentage increase in percent below will lead to 67,926 units (OLS (3a) and 6,900 units (OLS (3b)) increase in housing demand.

The results above suggest that, in the Johannesburg Metro context, after controlling for most of the variables in a housing model as we formulated and estimated, the effect of increasing

the price at which exemption of transfer duty is applied is more effective in increasing housing demand in the low-income, middle- and high-income classes in that order.

5.4 Recommendations

There are peculiar disparities in the South African property space because of the Apartheid spatial planning where populations were spatially segregated by race. It is unclear how these historical factors and or peculiarities affect or influence drivers of demand in the South African context. It is therefore our recommendation that this study be carried out for all other major metros in South Africa to fully understand factors influencing demand in this metros as they are likely to differ across the different metros in the country.

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