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Are residential crimes the same? Evidence from the link between house prices and crime levels in South Africa

Omokolade Akinsomi, Kola Ijasan and Peterson Owusu Junior
School of Construction Economics and Management, The University of the Witwatersrand, Johannesburg, South Africa

Abstract

Purpose – One main result of residential crimes is the sub-optimal allocation of homeownership, as demand and price of residential property respond accordingly. Since crime is a neighbourhood phenomenon, this study aims to examine how different residential crime levels are associated with price of property in a densely populated municipality in South Africa.

Design/methodology/approach – The semi-log hedonic pricing model estimated with the least squares method was employed to test the difference between non-violent (burglary) and violent (robbery) crimes in their relationship with residential property prices. A combined total of 89,573 yearly property sales transactions and burglary and robbery at residential premises for five towns in the city of Johannesburg between 2010 and 2020 were used.

Findings – Burglary is strongly associated with house price compared to robbery. It is inversely related at about 0.85% in Randburg, 0.63% in Roodeport, 0.62% in Johannesburg, 0.61% in Soweto and 0.3% in Midrand. But robbery is positively associated with house prices. Despite differences in sample size and neighbourhood characteristics, the results do not corroborate for distinguishing among the towns as townships, urban and suburban areas on account of crime levels.

Practical implications – The findings are essential to inform policy development and planning in the housing market as well as security and criminal justice system. In so doing, the type of crime, combined crime and location of crime should be selectively dealt with.

Originality/value – This study is, to the best of the authors' knowledge, the first to examine, on a town-by-town basis, the link between residential-related crimes and residential property prices in the most densely populated province and municipality in South Africa.

Keywords Hedonic price, Crime rate, House price, Johannesburg, South Africa

Paper type Research paper

1. Introduction

The direct and indirect costs of crime to society can culminate in the sub-optimal allocation of homeownership. Historically, homeownership has been seen as a means to wealth building (Megbolugbe and Linneman, 1993; Tita *et al.*, 2006). Residential crime tends to limit neighbourhood desirability and suppress local house demand and prices. As a country known for high crime levels and also the largest real estate market in Africa, South Africa presents itself a unique case to examine the relationship between residential property prices

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and residential crimes. South Africa is among the five countries worldwide with the highest homicide (41.9 per 100,000 persons in 2021) (World Bank, 2023a) and crime rates [1] (75.5) following after Venezuela (82.1), Papua New Guinea (80.4), Afghanistan (78.4), and Haiti (78.3). Five years leading to the COVID-19 pandemic, the South African Police Service (SAPS) recorded 3,600 crimes per 100,000 persons per annum, on average. In 2023, South Africa ranked 70 out of 193 countries on the Global Initiative Against Transnational Organized Crime's (GI-TOC) Global Organized Crime Index, up from 19 in 2021 (GI-TOC 2023; GI-TOC 2021) [2].

The economic cost of crime comprises transfer, protection and opportunity cost, collectively estimated at 2% of gross domestic product (GDP) for households (World Bank, 2023a). Direct losses from robbery were estimated at 0.3% of GDP, crime prevention (security and insurance) at 1.3% of GDP (i.e. 4.7% of households' non-food expenditure) in 2007 (Alda and Cuesta, 2011). In translation, the average household in South Africa spent more on security than on education and health combined (about 4.3% of non-food budget), according to the Living Conditions Survey of South Africa (Stats SA, 2015). It is obvious that the total cost of crimes to households is much higher than that due to unquantifiable attributes (lost productivity and emotional harm) and lack of data (medical costs). Alda and Cuesta (2011) estimate that to be about 5% of GDP in 2007. One in five households were victims of crime in the 2014/15 fiscal year. Theft, housebreaking, robbery and home robbery are the main economic crimes in South Africa (Stats SA, 2015).

Households in urban areas are the more likely victims of economic crime (Chen *et al.*, 2024; Aliu, 2023). In the 2014/15 fiscal year, the share of households affected by economic crime was 24.6% and 17.9% for metro and non-metro areas, respectively, in South Africa. As confirmation, more crimes are reported in Johannesburg, Pretoria, Cape Town and Durban than all other areas. Further, more than 10% of all economic crimes are recorded in only 20 police stations which are mostly in major urban areas. Among these urban areas, the Gauteng Province has consistently topped the chart in all forms of crime. The impact of crime on households affects their quality of life (see, Ye *et al.*, 2024).

Businesses also face higher operating costs emanating from losses to crime, to security and insurance expenses. These costs hinder startup and growth of businesses, especially micro-, small- and medium-sized enterprises, and subsequently slow private sector efforts to drive economic growth. Following from that, the country has witnessed weak economic growth and job creation over a decade now (World Bank, 2023a). According to Statistics, South Africa housebreaking is still the number one crime in the country. Lightstone puts the Gauteng Province as the third most affected area for residential crime per 1,000 households. Over the past 14 years to 2020, residential robbery in Johannesburg has consistently been above the national average, as reported by SA Cities Network. In 2020/21, about 30% of households saw crime as their biggest problem, above unemployment, alcohol and drug abuse, lack of basic services and high cost of living.

Further, the City of Johannesburg indicated that as of June 2019, 49% of residents felt unsafe walking during daytime. About 84% of past resident crime victims felt very unsafe walking at nighttime. In 2020/21, 71% of residents in Gauteng felt unsafe at night, an increase from 60% in the 2013/14 fiscal year. These fears affect quality of life and well-being and induce behavioural changes to avoid crime. These include avoiding outdoor leisure activities, walking and/or using public transport (see Figure 1). Another avoidance mechanism is to relocate to low-crime neighbourhoods where these outdoor activities are possible. This leads to reduced demand for housing in high-crime areas and inversely increased demand in low-crime areas, both of which scenarios affect house prices. In addition to increased demand for housing in low-crime areas, operating costs for businesses

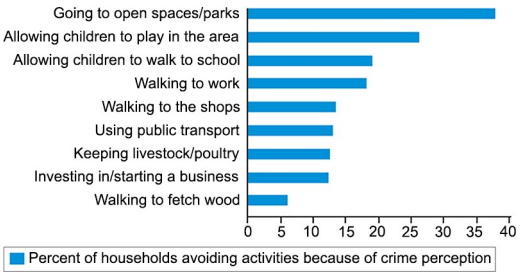


Figure 1. Percentage of household activities affected by crime perception
Source: World Bank (2023b)

and protection services cost to landlords for providing safety add to the high cost of housing. This is important because low-income households tend to have fewer resources available for protection against crimes so they will tend to choose neighbourhoods that are safe as a cost transfer mechanism. This situation adds the financial cost of crime to society as relocation can lead to sub-optimal allocation of homeownership. In furtherance, the historical premise of wealth building through homeownership is hampered by crime, as it limits neighbourhood desirability and suppresses local house prices (Megbolugbe and Linneman, 1993; Tita *et al.*, 2006).

By building on the fields of both housing market analysis and economics, the study adds to the literature by examining the relationship between residential crimes and local house pricing in the allocation of homeownership across neighbourhoods. Thus, in this study, it is expected that the levels of residential crime and house prices are inversely proportional to each other. It is also expected that, designated high-crime and low-crimes areas exhibit differences in magnitude in this relationship.

Crime, in general, also worsens inequality through other economic channels. The cost to households reduces their disposable income and hence affects their economic choices including housing (Ajzenman *et al.*, 2014).

The importance of the housing sector to South Africans cannot be understated, and it is well established in the literature. From the ongoing discourse, it is clear that both housing and crime levels play key roles in an economy due to their forward and backward feedback in the economic value chain (Gardner and Lockwood, 2019). Fluctuations in house prices and demand affect household spending and development at different geographic locations. Despite the depleting effect of crime on household wealth, well-being, safety, and community development in South Africa economy, the matter has not received the needed empirical attention. With declining urban security in several African countries, only Aliu (2023) has examined how neighbourhood security risk is associated with rental prices in Lagos. This study contributes to the dearth of knowledge gap by answering the question:

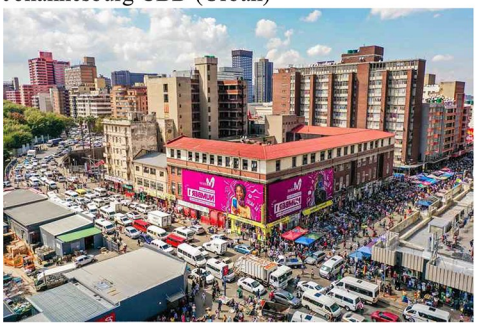
Q1. To what extent are residential crime levels associated with house prices for different South African towns?

The purpose of this study is to examine the association between residential crime rates and price of houses in South Africa's most densely populated and crime-prone metropolitan (Johannesburg – Gauteng). The study addressed important gaps to extend the crime–housing price literature in South Africa and beyond. First, while the Gauteng Province has received attention because of intensity of residential crime, it has focused on the City of Tswane to the

neglect of the Cities of Johannesburg and Ekurhuleni Metropolitan Municipalities. Breetzke (2010b, 2010a) and Cohn and Breetzke (2017) have shed light on the relationship between crime and housing and other socio-economic dimensions in South Africa. However, the City of Johannesburg has consistently ranked first in terms of crime (Coleman *et al.*, 2024) and specifically residential crimes (see Figure 4). It is also the smallest and most populated of the three metropolitan municipalities that make Gauteng. Hence, there is much to be learned from Johannesburg when it comes to residential crime, to inform policy development and planning in the housing market as well as security and criminal justice system.

Second, since housing and residential crimes are undeniably neighbourhood-specific phenomena (i.e. micro-level), the relationship is examined at the community level for more impactful policy responses. Plate 1 provides a snapshot of the different neighbourhoods in the City of Johannesburg Municipality, which can be characterised by disparity in homeownership, residential property demand and prices. Importantly, the selected towns in the snapshot are in the classification of the municipality into townships (Soweto), urban area (Johannesburg – Central Business District [CBD]) and suburban areas (Randburg, Midrand and Roodepoort). These categories are also described as high, moderate to high and moderate crime areas, respectively (Leonard and Dladla, 2015).

Johannesburg CBD (Urban)



Soweto (Township)

Midrand (Suburban)

Roodeport (Suburban)

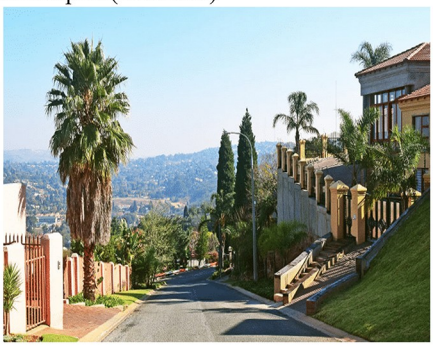


Plate 1. Snapshot of neighbourhoods in the City of Johannesburg Municipality

Source: https://propertywheel.co.za/2021/09/aucor-sells-four-mixed-use-multi-tenanted-properties-in-joburg-cbd/; https://images.app.goo.gl/rgUsbKa6qrLiJDyQu9; https://yourneighbourhood.co.za/midrand-2/; https://joburg.co.za/roodepoort-johannesburg/

Aggregated data analysis does not proffer the needed insights for community-specific actions in the housing market, security and criminal justice systems. Hence, the data is taken at the most granular level (i.e. towns) as far as available. Consequently, five out of the seven [3] towns of the City of Johannesburg Municipality are examined to determine the heterogeneity in the crime–housing price nexus since communities are fundamentally different. This affords the opportunity for a broader perspective by comparative analysis within metropolitan and municipality. Further, in addition to distinguishing between crimes as violent and non-violent (Tita *et al.*, 2006), we differentiate between violent residential crime (robbery) and non-violent residential crime (burglary). This is unlike Mulamba (2021) who used only burglary at residential premises and Manea *et al.* (2023) who used residential burglary and theft of vehicle as proxies for property-related crimes. Cheruiyot *et al.* (2024) also explored the relationship between residential property price and proximity to a cell tower base station in the City of Johannesburg, in which crime was included as a variable. In their study, an unbalanced panel data was used which does not help isolate the neighbourhood-specific nature of the relationship. The crime data used is also composite and does not delineate residential-specific crime to inform the needed direction for policy and homeownership allocation. The closest is Tita *et al.* (2006) who drilled down to census track level community characteristics (i.e. income, population density, demographic composition, etc.) as well as distinguished between crimes and their impact on house prices in Ohio. This is lacking for the City of Johannesburg and other parts of South Africa except for the City of Tswane.

The foregoing discourse leads to the formulation of these null hypotheses:

H01. Residential crime levels are not associated with residential property prices for the selected towns in the City of Johannesburg.

H02. There is no difference between non-violent (burglary) and violent (robbery) crimes in their link with residential property prices in the City of Johannesburg.

2. Theoretical and empirical grounding

2.1 Hedonic pricing approach for residential properties

In this study, we employ the hedonic pricing model (HPM) (Rosen, 1974) to answer the research questions. Under the HPM, property features and other spatial demographics such as crime, quality of school and walkability are of importance to the price of houses (Owusu-Ansah *et al.*, 2023). The value of a property is largely equal to the sum of the price of the structure and the price of the land on which it is built. It is therefore argued that these are the two most important variables which should be included in the model, subject to data availability (Eurostat (European Commission), 2013). While property features are crucial, Fernández-Durán *et al.* (2011) argue that location may be the most important variable associated with house price since each location presents unique attributes that include residential crime levels. This is important because of the notable evidence that rampant crimes and concern over safety in neighbourhoods feed into the need for transportation and/or walking to and from home, school and work in Johannesburg. These are the drivers of quality of life and well-being of households, and they tend to affect behavioural changes and lifestyle choices. Chief among lifestyle choices is the selection of neighbourhood for residence. In Figure 2, it is argued that property values are associated with structural qualities and the neighbourhood- and location-specific factors such as accessibility, proximity to transport routes, schools, parks, etc. (Aliu, 2023) which together shape the state of the property market. While these proximity features are desired and together with property

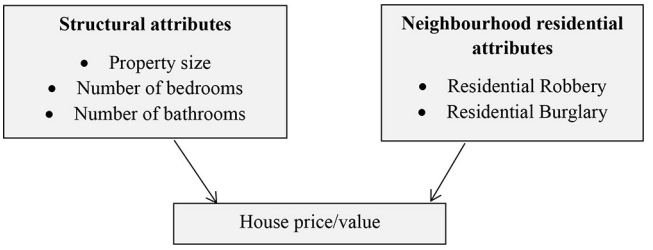


Figure 2. Residential property features and pricing link
Source: Authors' own creation

structural factors confer positive effects, not all proximities are positive for property valuation. For instance, the closer a residential property to a cell tower base station, the lower the sale price (see, Bond, 2007; Cheruiyot *et al.*, 2024). Residential crime rates have negative link with property values. Hence, we have limited the variables of interest both property characteristics and residential crime levels, mainly subject to the level of granularity of market data available. The nature of HPM elicits a multiple regression model (MRM) to account for a myriad of factors associated with the price of a property. Further, in economics sense of demand and supply, the value of a property is determined by the marginal contribution of its constituent features. In this study, MRM estimated through the least square approach is deemed appropriate for the HPM so that we can interpret estimated parameters as how much each feature is associated with the house prices in the selected towns.

3. Method and materials

The MRM of the HPM adopted for this is given in equation (1) under the axiom that the observed sales price (SP) of a property at location i at time t is a function of its structural attributes (S) and neighbourhood attributes (n). Neighbourhood attributes have been motivated so far as residential crime rates (CR):

$$SP_{i,t} = \beta_0 + \sum_{i=1}^{n} \beta S_{i,t} + \sum_{i=1}^{n} \gamma CR_{i,t} + \epsilon_{i,t} \quad (1)$$

3.1 Data

The HPM is adopted to examine the association between residential crimes and residential property prices of houses in the five selected towns in the City of Johannesburg Municipality in South Africa. Johannesburg is chosen because it is the most densely (2,364 persons per square kilometre) populated and largest (1,645 square kilometres) municipality. It is also the economic hub of the country and houses its rich history and diverse culture. The municipality derives its compact population from being situated in the smallest province – Gauteng [4] – measuring 18,178 km^2 as compared to the largest – Northern Cape – measuring 372,889 km^2. These attributes of the municipality pose social and economic concerns, chiefly among them are housing and crime. The population exerts pressure on demand for housing, thereby increasing prices. The compact density of the population and economic hardship fuelled by high levels of inequality tend to breed crime of various types and degrees (Ghani, 2017; Adam, 2021; Manea *et al.*, 2023; Wu, 2024). For instance, the Gauteng Province records the

highest crime rate [5] and has recorded the highest burglary and robbery rates at residential premises since 2006/07 reporting year to date [6] (see Figure 3).

The study also drilled down to extract the residential crime rate numbers for each of the towns to make a close relationship between house prices. The crime rate numbers are produced by the South African Police Service (SAPS) and sourced from Quantec. These are confined to only crimes reported to the SAPS. According to Item 24 of Schedule 6 of the Constitution of the Republic of South Africa, 1996 (Act No 108 of 1996), the police definition of crime is restricted to those infractions that require "the opening of case dockets and the registration thereof on the Crime Administration System (CAS)/Investigation Case Docket Management System (ICDMS)". Crime statistics are reported in ratios as:

$$Crime\ \ ratio = \frac{Crime\ \ figure}{Population\ \ size} * 100,000 \tag{2}$$

This is done so that equal proportion of the population for comparison across provinces, districts, municipalities, cities, towns and suburbs. We elected only robbery and burglary at residential properties to use for this study out of several categories. This accounts for both violent and non-violent crimes, while focusing on residential infractions. This is an attempt to ascertain the heterogeneous nexus between residential crime types and house prices in contrast to what several studies fail to do, as they assume crime and its link with house prices as homogeneous. While it may be a concern for the empirical exercise to suffer from selection

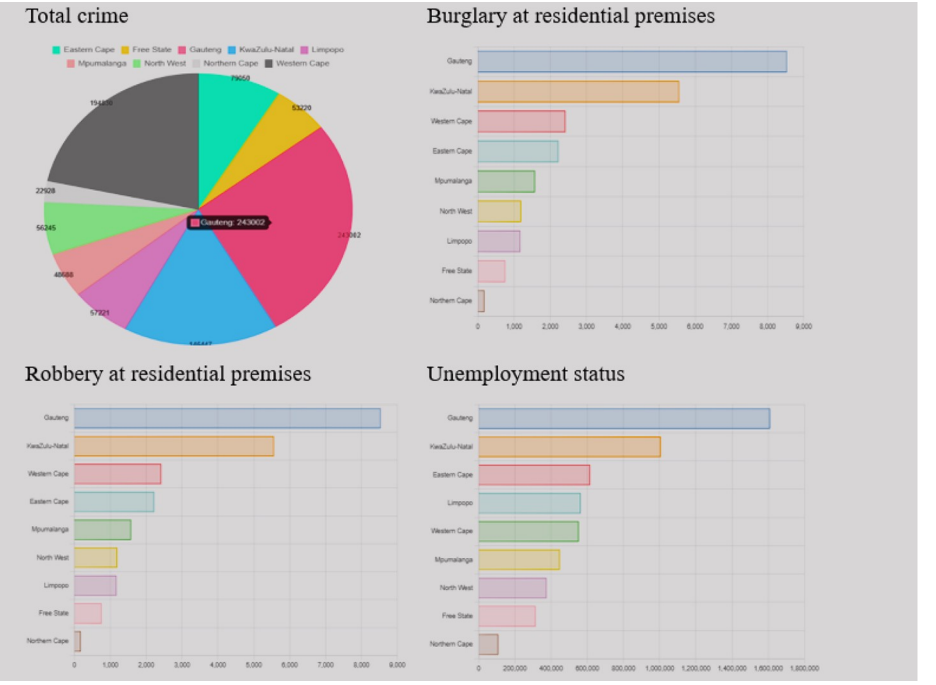


Figure 3. Crime rate categories and unemployment status per province in 2023 / 24 reporting year
Source: www.crimehub.org

bias in electing only residential burglary and robbery, there are valid reasons for this choice. The SAPS records seven main categories of crimes and 33 crime types under them. It is argued that other types of crimes close to the urban area may affect price transactions; however, this study covers townships, urban and suburban areas, which can be affected by all crime types. In the interest of staying true to the purpose of the study and divulging specific policy and housing demand and supply inferences, the property-related crime category was selected. We also note that, under this category, the only reported crimes related to residential property are the robbery and burglary at residential premises. Thus, we exhausted all the available options under crimes at residential premises.

For property data, a total of 89,573 property sales transactions covering, Johannesburg, Midrand, Randburg, Roodeport and Soweto towns between 2010 and 2020 were used. The data was sourced from Lightstone Property (Ltd.) based on records from the Deed's Registry. The original property data presents itself as a panel while the residential crime micro data set is a time series. To form the data set used for the analysis, we extract the house price transactions data for each town and match them with the corresponding residential crime data between 2010 and 2020 at yearly frequency. This process translates both data sets into a single time series data set per town without any loss of information, as used in equations (3) and (4).

However, the data varies for including number of bedrooms and number of bathrooms subject to availability. The structural attributes of the properties are included based on availability per town to isolate the impact of crime. For Johannesburg, Randburg and Roodeport, data points for number of bedrooms and number of bathrooms are inadequate for the HPM and, therefore, excluded. However, the data points for number of bedrooms and number of bathrooms are available and sufficient for Midrand and Soweto. We undertake the empirical estimation using the ordinary least squares (OLS) approach. Therefore, the Box–Cox transformation with lambda = 0 (same as logarithm transformation) was applied to all variables (except number of bedrooms and number of bathrooms) to reduce the levels of variance and meet the assumptions of linear regression via OLS. Further, there is empirical evidence that log form of the MRM for HPM performs well, especially when some property characteristics are not available.

Hence, double-log HPM:

$$lnSP_{i,t} = \beta_0 + \beta_1 lnPropertySize_t + \beta_2 lnRobbery_t + \beta_3 lnBurglary_t + \epsilon_t \quad (3)$$

was used each for Johannesburg, Randburg and Roodeport (in Table 2) and the semi-log HPM:

$$lnSP_{i,t} = \beta_0 + \beta_1 lnPropertySize_t + \beta_2 Bedrooms + \beta_3 Bathrooms + \beta_4 lnRobbery_t + \beta_5 lnBurglary_t + \epsilon_t \quad (4)$$

was used each for Midrand and Soweto (in Table 3).

4. Results and discussion

Both summary statistics and the HPM results for the property and residential crimes levels for the selected five towns in the City of Johannesburg metropolitan municipality are presented in this section.

4.1 Summary statistics

Table 1 shows the descriptive statistics for the variables per town. The minimum property price is ZAR 200,000 across board. The maximum property price is at least ZAR 600,000 to an excess of ZAR 200m for Soweto (township area). Randburg (suburban area), Johannesburg (urban area), Midrand and Roodeport (suburban areas) follow with about ZAR 90m, ZAR 30m and ZAR 20m, respectively. This is a wide range that feeds into the rest of the property characteristics of size and number of bedrooms and bathrooms. It also suggests the variety of residential properties sold across the city. Property size ranges from a minimum of 15 m^2 (Randburg) to 20 m^2 (Johannesburg). The biggest property in terms of size is about 3.9 million m^2 in Randburg, followed by 97,994 m^2 (Roodeport), 9,834 m^2 (Soweto), 9,148 m^2 (Johannesburg) and the rest.

Midrand has the biggest range of robbery (480), Soweto has the smallest range (108) and the rest about 200 per 100,000 persons. Soweto has the minimum range for burglary of about 1,000, but Midrand has the biggest range of about 2,100 per 100,000 persons. These explain the large standard deviation values which make these residential crimes hard to deal with

Table 1. Summary statistics of property and crimes rates in Johannesburg towns

Town	Sales price	Property size	Robbery	Burglary	No. of bedrooms	No. of bathrooms
Midrand						
Min.	200,000	25	98.64	2,420.96	1	1
Max.	20,180,503	34,261	580.39	320.24	18	10
Mean	1,149,228.67	447.42	455.48	1,624.51	2.50	1.85
SD	941,047.90	1,685.89	748.86	2,716.99	0.95	0.84
Obs.	9,230	9,230	9,230	9,230	9,230	9,230
Soweto						
Min.	200,000	29	177.55	3,216.89	1	1
Max.	209,830,000	9,834	285.55	4,223.40	18	10
Mean	554,687.65	298.45	220.67	3,941.62	2.52	1.43
SD	4,925,835.73	424.37	30.97	220.13	0.77	0.70
Obs.	5,431	5,431	5,431	5,431	5,431	5,431
Johannesburg						
Min.	200,000	20	409.20	2,376.19		
Max.	3,000,000	9,148	658.27	3,706.85		
Mean	1,412,959.18	1,786.99	539.11	3,078.83		
SD	1,511,608.80	127,635.75	79.18	412.10		
Obs.	28,626	28,626	28626	28,626		
Randburg						
Min.	200,000	15	421.34	2,221.34		
Max.	91,350,000	3,940,000	670.97	3,804.94		
Mean	1,126,010.05	347.13	528.51	2,984.92		
SD	1,149,978.704	467.88	72.12	398.17		
Obs.	21,362	21,362	21362	21,362		
Roodeport						
Min.	200,000	20	534.72	3,227.90		
Max.	20,180,112	97,994	820.69	5,131.21		
Mean	911,953.39	352.40	691.65	4,501.29		
SD	734,709.59	770.08	93.69	535.59		
Obs.	24,924	24,924	24,924	24,924		

Source(s): Authors' own creation

because the averages could be misleading. Further, it is difficult to compare the values across the towns because of the differences in sample size as well as locational peculiarities. The log-transformation ensures that the data are centred and can be used in the least squares regression to allow for the easy interpretation of regression coefficients.

Table 2 presents the pairwise correlations between the variables in line with the specifications in equations (3) and (4) for each town. All correlations are significant at all conventional levels. The correlation between property price and robbery is positive, but the relationship between burglary and property price is negative for all towns. While this may be contrary to what is expected, it can be explained as it reflects in the regression results. In terms of the magnitude of correlations, most of them are below 90%. Tolerance and variance inflation factors were tested for each variable with the property price to check for multicollinearity. These are presented in the last row of Table 2. There is no evidence of multicollinearity among the model variables to hurt the least squares regression.

4.2 Hedonic analysis

The least squares regression results are presented in Tables 3 and 4 where each is given in three models. Model 1 estimates link between property price and only the property features (property size), Model 2 adds robbery and burglary at residential premises to ascertain how they associate with property prices. In Model 3, robbery and burglary are combined (TotalRes crime) to examine how they are linked to property prices. In Table 3, only property size is available and feasible for Johannesburg, Randburg, and Roodeport. But number of bedrooms and bathrooms are added for Midrand and Soweto (presented in Table 4). In both tables, the adjusted R^2 values are presented. But they are not relied upon for model fit adequacy due to its statistical weakness of monotonically increasing with the number of predictors. Focus is on the significance and magnitude of the estimated coefficients. First, in both Tables 3 and 4, we find that the intercept is statistically significant. This implies that house price could be associated with other factors independent of property size and residential crime levels. This could be attributed to the high demand for housing emanating from the overpopulation in the City of Johannesburg. This is confirmed by bigger coefficients of the intercept than both burglary and robbery, TotalRes crime and property size across all five towns.

From Table 3, property size (m^2) has the expected positive association with property price across all three models for Johannesburg, Randburg and Roodeport. For every percentage change in property size, there is an associated property price increase of about 0.28% (Johannesburg), 0.26% (Randburg) and 0.32% (Roodeport) for Model 1. In Model 2, all the variables are significant at all conventional levels. For the other three towns, robbery is positively associated with property price. This is a confirmation of the correlation in Table 2. However, burglary is significant and it is inversely associated with property prices for all the three towns – about 0.62% (Johannesburg), 0.85% (Randburg) and 0.63% (Roodeport). In all of these, the association property price with property size is negligible in terms of magnitude. In Model 3, where robbery and burglary are not differentiated (TotalRes crime), it is significant and has a positive association with property price (about 0.11%) for Johannesburg. But it is negatively associated with property price in Randburg (about 0.22%) and Roodeport (about 0.14%).

The disparity in the association of burglary and robbery at residential premises with property prices may not be too puzzling. On the one hand, they are distinct types of residential crime (i.e. non-violent and violent). On the other hand, they seem too close in terms of numbers in the past few years. They are around 85,000 per 100,000 persons (see Figure 3) in the 2023/24 reporting year in the Gauteng Province. However, burglary has been

Table 2. Pairwise correlations between of property features and crimes rates in Johannesburg towns

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Johannesburg						
(1) lnSalesPrice	1					
(2) lnPropertySize	0.41***	1				
(3) lnRobbery	0.1498***	−0.0303***	1			
(4) lnBurglary	−0.1549***	0.0303***	−0.6917***	1		
	Tolerance (VIF)	0.9989 (1.0011)	0.5215 (1.9177)	0.52147 (1.9177)		
Randburg						
(1) lnSalesPrice	1					
(2) lnPropertySize	0.4606***	1				
(3) lnRobbery	0.0847***	−0.0652***	1			
(4) lnBurglary	−0.1683***	0.0756***	−0.1681***	1		
	Tolerance (VIF)	0.9915 (1.0086)	0.9690 (1.032)	0.9675 (1.0336)		
Roodeport						
(1) lnSalesPrice	1					
(2) lnPropertySize	0.6212***	1				
(3) lnRobbery	0.0548***	−0.0499***	1			
(4) lnBurglary	−0.1366***	0.0178***	−0.3963***	1		
	Tolerance (VIF)	0.9975 (1.0025)	0.8411 (1.1889)	0.8429 (1.1863)		
Midrand						
(1) lnSalesPrice	1					
(2) lnPropertySize	0.5523***	1				
(3) lnRobbery	0.0819***	−0.063***	1			
(4) lnBurglary	−0.118***	0.0247***	−0.6603***	1		
(5) No. of Bedrooms	0.5149***	0.6147***	−0.0298***	−0.015***	1	
(6) No. of Bathrooms	0.5248***	0.4746***	−0.019***	−0.023***	0.6774***	1
	Tolerance (VIF)	0.6138 (1.6292)	0.5616 (1.7807)	0.5625 (1.7778)	0.5354 (1.8678)	0.4299 (2.360)

(*continued*)

Table 2. Continued

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Soweto						
(1) lnSalesPrice	1					
(2) lnPropertySize	0.0897***	1				
(3) lnRobbery	0.1241***	0.0767***	1			
(4) lnBurglary	−0.1162***	0.0214***	−0.1661***	1		
(5) No. of Bedrooms	0.1383***	0.1792***	0.0251***	0.012***	1	
(6) No. of Bathrooms	0.1424***	0.1388***	0.1447***	−0.0972***	0.4503***	1
	Tolerance (VIF)	0.9583 (1.0435)	0.9499 (1.0528)	0.9624 (1.0389)	0.7701 (1.2986)	0.7791 (1.2836)

Note(s): ***, *** and *indicate 1, 5 and 10% significance levels, respectively
Source(s): Authors' own creation

Table 3. HPM for properties and crime rates for selected towns in Johannesburg

Town/Model	Variable	Estimate	*t*-Value	*p*-Value	Adj. R^2
Johannesburg (Obs. = 28,626)					
Model 1	Intercept	12.2489*** (0.0211)	580.81	0.000	
	lnProperty size	0.2843** (0.0037)	76.04	0.000	
					0.168
Model 2	Intercept	14.2273*** (0.5377)	26.46	0.000	
	lnProperty size	0.2883*** (0.0037)	78.63	0.000	
	lnRobbery	0.4677*** (0.0384)	12.19	0.000	
	lnBurglary	−0.6154*** (0.0426)	−14.45	0.000	
					0.2001
Model 3	Intercept	10.7229*** (0.5381)	19.929	0.000	
	lnProperty size	0.2843** (0.0037)	76.062	0.000	
	lnTotalRes crime	0.1067* (0.0376)	2.838	0.0045	
					0.1682
Randburg (Obs. = 21,362)					
Model 1	Intercept	12.4030*** (0.0181)	683.98	0.000	
	lnProperty size	0.2582*** (0.0034)	75.83	000	
					0.2121
Model 2	Intercept	16.8168*** (0.2911)	57.77	0.000	
	lnProperty size	0.2693*** (0.0033)	81.29	0.000	
	lnRobbery	0.3716*** (0.0264)	14.05	0.000	
	lnBurglary	−0.8506*** (0.0267)	−31.84	0.000	
					0.2603
Model 3	Intercept	15.7078*** (0.2979)	52.73	0.000	
	lnProperty size	0.2585*** (0.0034)	76.13	0.000	
	lnTotalRes crime	−0.2320*** (0.0209)	−11.12	0.000	
					0.2166
Roodeport (Obs. = 24,924)					
Model 1	Intercept	11.8716*** (0.0136)	875.1	0.000	
	lnProperty size	0.3244*** (0.0026)	125.2	0.000	
					0.3859
Model 2	Intercept	16.2447*** (0.2991)	54.304	0.000	
	lnProperty size	0.3265*** (0.0025)	128.192	0.000	
	lnRobbery	0.1382*** (0.0225)	6.142	0.000	
	lnBurglary	−0.6290*** (0.0248)	−25.396	0.000	
					0.4086
Model 3	Intercept	14.6346*** (0.2992)	48.916	0.000	
	lnProperty size	0.3236*** (0.0026)	125.003	0.000	
	lnTotalRes crime	−0.1847*** (0.0199)	−9.245	0.000	
					0.388

Note(s): Number of bedroom and bathrooms are excluded because there was not enough variability in them to fit the model. ***, *** and *indicate 1, 5 and 10% significance levels, respectively. S.E. are in parenthesis. TotalRes crime is the sum of robbery and burglary at residential premises
Source(s): Authors' own creation

on a general declining path since the 2005/06 (about 25,000 per 100,000 persons) to 2023/24 (about 11,000 per 100,000 persons) reporting years. The lowest recorded was approximately 10,000 per 100,000 persons in the 2020/21 reporting year. This number is understandable given the COVID-19 pandemic and associated lockdown (see Figure 4). While residential robbery is generally lower than residential burglary, it has not seen the same level of decline

Table 4. HPM for properties and crime rates for selected towns in Johannesburg

Town/Model	Variable	Estimate	*t*-Value	*p*-Value	Adj. R^2
Midrand (obs. = 9,230)					
Model 1	Intercept	12.314*** (0.0219)	561.94	0.000	
	lnProperty size	0.1845*** (0.0054)	34.23	0.000	
	No. of bedrooms	0.0628*** (0.0074)	8.44	0.000	
	No. of bathrooms	0.1962*** (0.0075)	26.05	0.000	
					0.3985
Model 2	Intercept	13.3044*** (0.5092)	26.129	0.000	
	lnProperty size	0.1891*** (0.0053)	35.516	0.000	
	No. of bedrooms	0.0611*** (0.0073)	8.318	0.000	
	No. of bathrooms	0.1942*** (0.0074)	26.123	0.000	
	lnRobbery	0.2141*** (0.0372)	5.755	0.000	
	lnBurglary	−0.304*** (0.0411)	−7.395	0.000	
					0.4146
Model 3	Intercept	11.8855*** (0.508)	23.387	0.000	
	lnProperty size	0.1846*** (0.0054)	34.237	0.000	
	No. of bedrooms	0.0629*** (0.0075)	8.452	0.000	
	No. of bathrooms	0.1936*** (0.0075)	26.056	0.000	
	lnTotalRes crime	0.0303*** (0.0359)	0.844	0.399	
					0.3985
Soweto (Obs. = 5,431)					
Model 1	Intercept	12.5399*** (0.0486)	258.187	0.000	
	lnProperty size	0.0395*** (0.0088)	4.505	0.000	
	No. of bedrooms	0.0403*** (0.0072)	5.567	0.000	
	No. of bathrooms	0.0507*** (0.0079)	6.6401	0.000	
					0.3026
Model 2	Intercept	16.299*** (0.7606)	21.430	0.000	
	lnProperty size	0.0375*** (0.0087)	4.299	0.000	
	No. of bedrooms	0.046*** (0.0072)	6.399	0.000	
	No. of bathrooms	0.0362*** (0.008)	4.546	0.000	
	lnRobbery	0.2459*** (0.0366)	6.725	0.000	
	lnBurglary	−0.612*** (0.0853)	−7.176	0.000	
					0.04992
Model 3	Intercept	10.51*** (0.484)	21.716	0.000	
	lnProperty size	0.0368*** (0.0088)	4.186	0.000	
	No. of bedrooms	0.0412*** (0.0072)	5.690	0.000	
	No. of bathrooms	0.0476*** (0.0079)	5.988	0.000	
	lnTotalRes crime	0.1498*** (0.0355)	4.215	0.000	
					0.03325

Note(s): ***, *** and *indicate 1, 5 and 10% significance levels, respectively. S.E. are in parenthesis. TotalRes crime is the sum of robbery and burglary at residential premises
Source(s): Authors' own creation

as residential burglary. Comparatively, residential robbery has cumulatively trended upwards except for the decline which coincides with COVID-19 pandemic and associated lockdown.

In addition to declining crime levels (residential included) coinciding with the COVID-19 pandemic and lockdown, there have been intentional governmental interventions for crime prevention over the years beginning in 1996 with the National Crime Prevention Strategy (NCPS). The NCPS [7] is built on four pillars, namely, effective and efficient criminal justice system, crime reduction through environmental design, public values education and trans-national preventive measures. For instance, the 2023 State of the Nation Address (SONA)

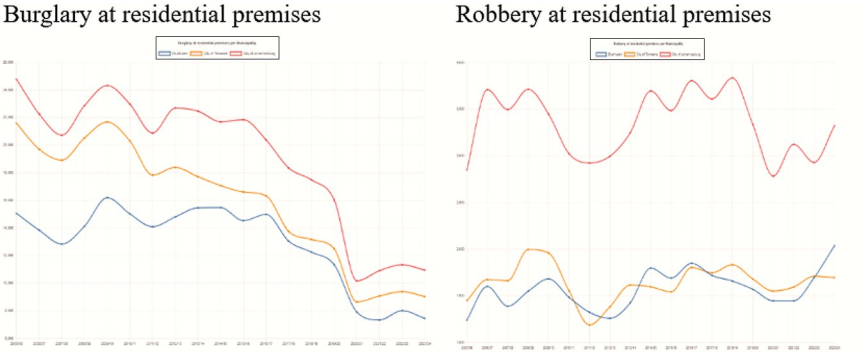


Figure 4. Residential crime rates for the three metropolitan municipalities in Gauteng
Source: www.crimehub.org

emphasised improving the capacity of the National Prosecuting Authority to ensure justice in line with Pillar 1 to fight against crime and violence. Further, the president indicated strengthening the SAPS by putting more police on the streets and setting up specialised teams to focus on different crime types. In this regard, 10,000 out of 12,000 recruits graduated from police academies in 2022 [8]. These efforts can be viewed as delivering on the promises made the 2019 SONA. The president indicated that the government will continue to work to improve success rates in investigating and prosecuting crimes and to ensure better training and professionalisation throughout the criminal justice system. Further, the country was assured violent crimes will be halved, if not eliminated [9]. With funding from the government, the SAPS Crime Intelligence and Information Management fosters crime intelligence patterns to facilitate crime detection, support prevention and investigation (SAPS, 2024). Crime data analysis by third parties have also been available freely online that helps crime mapping for law enforcement to identify hotspots and target resources efficiently (Obagbuwa and Abidoye, 2021). Improved economic conditions through increase employment and shrinking income inequality (Demombynes and Özler, 2005) have also acted as catalysts for crime reduction.

Further, the magnitude of burglary far exceeds that of robbery at residential premises. For instance, the peak of burglary and robbery is about 24,000 (2009/10):3800 (2019/20). The trough is also 10,000 (2020/21):2,500 (2020/21) for burglary and robbery, respectively. The frequency of burglary can also be driven by its simplicity. It does not involve arms which may be difficult to acquire as compared to break-in items for burglary. While violent and traumatising, the generally low levels of robbery compared to burglary may be perceived as isolated rather and systemic. Nonetheless, the positive association between robbery and residential property prices is not surprising. It can be inferred that robbery is associated with high property prices (in other words, larger houses) because they are suggestive of more wealth to be taken as reward. This is confirmed by Demombynes and Özler (2005), for South Africa, as they find that crime rates are 25–43% higher in police precincts that are the wealthiest compared to other neighbourhoods.

Nonetheless, it is clear that all crimes are not the same in terms of their association with residential property prices in these towns. Violent crimes (robbery) have a positive association with residential property prices but non-violent crimes (burglary) have a negative

association with residential property prices. This corroborates Tita *et al.*'s (2006) study results in Columbus, Ohio, and that of Breetzke's (2010b, 2010a) in the City of Tswane. The differences in the magnitude and direction of relationship also confirm the uniqueness of neighbourhoods in respect of crimes, despite the variations in sample size.

The number of bedrooms and bathrooms given for Midrand (suburban) and Soweto (townships) are presented in Table 4. Property size, number of bedrooms and bathrooms exhibit their expected directions with residential property prices, where they are statistically significant. In Soweto (also known as South Western Townships), with a sample of 5,431, structural property features are significantly associated with property prices but not as strong as those in Midrand. In Midrand, the number of bathrooms has the strongest link to property price, followed by property size, then bedrooms. Nonetheless, robbery and non-differentiated crimes (TotalRes crime) are significant but have a positive nexus with residential property prices in both Midrand and Soweto. In both Midrand and Soweto, burglary does not markedly reduce the magnitude of the association between property size and number of bedrooms and bathrooms and property price. For every percentage increase in burglary, there is a corresponding reduction in property price by about 0.3% (Midrand) and 0.61% (Soweto) and vice versa, *ceteris paribus*. Explanation for the divergence in the relationship between robbery and burglary and residential property prices is the same discussed for the results in Table 3. Again, the message is clear that all residential crimes are not the same and they also differ across neighbourhoods. Summary of findings are presented in Table 5.

Further, the results do not align with the classification of the five towns into townships (Soweto), urban area (Johannesburg – Central Business District [CBD]) and suburban areas (Randburg, Midrand and Roodepoort) on account of crime. The three areas are also described as high, moderate to high and moderate crime areas, respectively (Leonard and Dladla, 2015). The results also corroborate Chen *et al.*'s (2024) assertion that the relationship between urban form is both linear and non-linear in the housing market dynamics. Burglary has the stronger association house price compared to robbery – about 0.85% (Randburg), 0.63% (Roodeport), 0.62% (Johannesburg), 0.61% (Soweto) and 0.3% (Midrand) (from Model 2). What is clear is that the association between burglary and residential property prices is both most and least in suburban areas and moderately to highly in urban and township areas. Nonetheless, the differences in magnitude are not big which also suggests similarities among the towns. This can confirm Mulamba's (2021) finding that property-related crimes in South Africa are spatially autocorrelated (see also, McIlhatton *et al.*, 2016). This is also the case given that the five towns are contiguously neighbouring. Based on the findings from these analyses, we reject or fail to accept the null hypotheses that residential crime levels are not associated with residential property prices and that there is no difference

Table 5. Summary of findings from HPM

Town	Area class	Robbery	Burglary	Stronger link	Rank of town
Johannesburg	*Urban*	*Positive*	*Negative*	*Burglary*	*Third*
Randburg	*Suburban*	*Positive*	*Negative*	*Burglary*	*First*
Roodeport	*Suburban*	*Positive*	*Negative*	*Burglary*	*Second*
Midrand	*Suburban*	*Positive*	*Negative*	*Burglary*	*Fifth*
Soweto	*Township*	*Positive*	*Negative*	*Burglary*	*Fourth*

Source(s): Authors' own creation

between non-violent (burglary) and violent (robbery) crimes in their link with residential property prices in the selected towns in the City of Johannesburg.

5. Conclusions and recommendations

This study investigated the association between residential property prices and robbery and burglary at residential premises covering Johannesburg, Midrand, Randburg, Roodeport and Soweto towns in the City of Johannesburg between 2010 and 2020. The City of Johannesburg is selected because it is the most densely populated province, consistently records the highest crime rates in all categories across the country and has the highest demand for housing in South Africa. We focus on residential crimes and differentiate violent (robbery) and non-violent (burglary) crimes.

Since crime is largely a neighbourhood phenomenon (He *et al.*, 2024), households bear the brunt of the effects of crime in diverse ways, especially in economic terms. For instance, it is estimated that the average household in South Africa spends more on security than on education and health combined (about 4.3% of non-food budget). Of the types of crimes, according to Statistics South Africa, housebreaking is still the number one crime in the country. Over the past 14 years to 2020, residential robbery in Johannesburg has consistently been above the national average, as reported by SA Cities Network. Residential crimes affect the quality of life and well-being and induce behavioural changes such as avoiding outdoor leisure activities, walking and use of public transport. These may lead to relocation to low-crime neighbourhoods. Among other things, there are effects on wealth-building, well-being, safety and community development, as well as sub-optimal allocation of homeownership.

The HPM employed reveals several interesting findings. First, robbery has a direct relationship with residential property prices but the opposite in the case for burglary. Both scenarios have reasonable explanations. The frequency and magnitude of burglary for the unwealthy put financial pressure on homeowners who may relocate from crime-prone neighbourhoods. Potential homeowners will also find their areas unattractive and hence the reduction in demand can drive prices down. For the direct link with robbery, it is surmised that larger houses may be suggestive of high rewards for robbers who take more risks than burglars. Second, burglary has the stronger link with house price compared to robbery in all the five towns. Third, despite differences in sample size and neighbourhood characteristics, the results do point to distinguishing among the towns as townships, urban and suburban areas. There are additional neighbourhood features such as walkability which feed into the housing market and pricing dynamics. Theoretically, it does appear that the HPM is able to capture, to a large extent, the logical relationship between house prices, crime levels, structural property qualities across the five towns in the City of Johannesburg.

5.1 Recommendations

These findings proffer a re-think on the general narrative about the generalised expected relationship between location-dependent crime levels and housing demand and prices. The results are essential to inform policy development and planning in the housing market as well security and criminal justice system. In so doing, the type of crime, combined crime and location of crime should be selectively dealt with. Nonetheless, it is possible to apply similar policy on neighbourhood house planning and criminal justice system. However, the historical and economic inequality among the towns should be a more paramount informant.

In making a choice of where to purchase a house, it is important to distinguish between the specific residential crime albeit factoring structural attributes of the house. It is obvious that all residential crimes do not have the same effect on property prices. Implications of this study can stimulate research for other populated parts of South Africa and beyond.

The study was constrained by the availability of more data on property characteristics for some towns (especially the townships) and the time period on only 10 years (2010–2020). It is noted that two townships (i.e. Alexandra and Orange Farm) were excluded from the study solely on the grounds of small sample size. Unequal length of property data downplays reliable comparison among the towns. This does not also foster equitable housing and urban development and criminal justice policy interventions. The granularity of both property and crime data is lacking. The data could also drill down to police stations and locational addresses to properties provided so that closer relationships could be established between crimes and house prices in those proximities. The findings are limited to only crimes that are reported to SAPS, which are lower than the actual crimes committed in the municipality. Reported crimes do not reflect the total situation, especially fewer people report residential-related (54.5% of robbery and 52% break-in) crimes to the police as per Stats SA's (2020, 2016) National Victims of Crime Survey [10].

In future studies, the use of geospatial data can establish stronger and more revealing relationship between crime levels and house prices in South Africa. It will also be ideal to examine all three metropolitan municipalities of the Gauteng Province together to foster a healthy comparison.

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Notes

[1.] https://worldpopulationreview.com/country-rankings/crime-rate-by-country

[2.] https://globalinitiative.net/analysis/ocindex-2023/

[3.] Alexandra and Orange Farm are excluded for lack of data.

[4.] https://southafrica-info.com/land/nine-provinces-south-africa/

[5.] www.crimestatssa.com/index.php#!/statistics/

[6.] https://crimehub.org/map

[7.] https://shorturl.at/90T3k

[8.] https://shorturl.at/ZPChO

[9.] www.gov.za/news/speeches/president-cyril-ramaphosa-state-nation-address-2019-20-jun-2019

[10.] https://crimehub.org/faqs

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Corresponding author
Omokolade Akinsomi can be contacted at: kola.akinsomi@wits.ac.za