The Impact of a Shopping Centre on the Value of Adjacent Residential Properties

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Abstract

One of the most significant changes in the South African retail landscape over the past few decades is the increase in the number and size of retail shopping centres situated in, or close to, residential areas. These shopping centres have the potential to generate both positive and negative externalities which may, in turn, be capitalised into adjacent residential property prices. However, policy makers are still unsure as to the effect of commercial land uses such as shopping centres on surrounding property prices. This study sheds light on this issue by considering the relationship between the Walmer Park Shopping Centre, situated in Nelson Mandela Bay, and surrounding residential property prices. The results of this study indicate that, in the case of the Walmer Park Shopping Centre, a statistically significant correlation between proximity to the mall and adjacent property values is present.

1 INTRODUCTION

One of the most significant changes in the South African retail landscape over the past few decades is the increase in the number and size of retail shopping centres situated in, or close to, residential areas. The city of Port Elizabeth, situated in Nelson Mandela Bay, South Africa, has also experienced growth in this area with approximately eight major shopping centres present, namely Greenacres, Metlife Plaza, Moffet on Main, Summerstrand Village, Sunridge Park, Walmer Park, 6^{th} Avenue Walmer, and Walker Drive (Port Elizabeth Shopping Malls, 2015). These shopping centres are all situated in close proximity to residential areas and have the potential to exert both positive and negative externalities (Colwell, Gujral and Coley, 1985; Des Rosiers, Lagana, Theriault and Beaudoin, 1996; Li, Prud'homme and Yu, 2006; Addae-Dapaah and Lan, 2010; Pope and Pope, 2012; Seago, 2013). These externalities may, in turn, be capitalised into adjacent house prices. However, although the effect of

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certain locational amenities such as schools, open spaces, and social housing on surrounding property prices is well documented in the international literature, policy makers are still unsure as to the effect of commercial land uses such as shopping centres (Seago, 2013). A deeper scientific understanding of how shopping centres affect residential property prices could lead to residential property owners and developers reaping substantial benefits (Des Rosiers *et al.*, 1996). In addition to this, commercial property valuators' predictive models could be improved with the inclusion of additional neighbourhood amenity variables (Des Rosiers *et al.*, 1996).

Positive externalities associated with shopping centres primarily take the form of increased convenience for nearby homeowners. Substantial time-savings can be enjoyed by being situated in close proximity to a shopping centre (Addae-Dapaah and Lan, 2010). However, shopping centres can also be the source of negative externalities, including noise pollution, increased traffic congestion, and increased localised pollution (Addae-Dapaah and Lan, 2010). The question thus arises: does the convenience of residing in close proximity to a shopping centre outweigh any potential negative externalities? In other words, do shopping centres exert a positive effect on adjacent residential house prices? This is an important policy question to consider since the majority of wealth that most working South Africans accumulate over their working lives comprises individual home ownership and retirement savings. Thus, factors such as the proximity to a shopping centre may have an effect on house prices and, in turn, individual wealth. With regard to the size of the South African residential property market, estimates vary from roughly R750 billion in 2002 rands to approximately R3 trillion in 2010 rands (Luus, 2003; Luiz and Stobie, 2010; New research values South Africa's property sector at R4.9 trillion, 2012). Based on the individual wealth contained in residential property, studies examining the effect of neighbourhood amenities on adjacent property prices could be of interest to residential homeowners, property developers, and policy makers. As previously mentioned, numerous studies have examined the effect of a wide range of local amenities on surrounding property prices. However, there is a dearth of South African studies examining the effect of shopping centres on adjacent property prices. The aim of this paper is to fill this gap. More specifically, the paper seeks to determine the relationship, if any, between the Walmer Park Shopping Centre, hereafter referred to as "Walmer Park" and property prices in an adjacent residential area, by applying the hedonic price model.

In what follows, Section 2 presents the literature review. The methodology employed in the study is discussed in Section 3. Section 4 describes the study site and the data used to estimate the hedonic price equations. Section 5 concludes the paper.

2 LITERATURE REVIEW

Only a limited number of international studies have been conducted on the economic effect of shopping centres on surrounding house prices (Colwell *et* *al.*, 1985; Des Rosiers *et al.*, 1996; Li *et al.*, 2006; Addae-Dapaah and Lan, 2010; Seago, 2013). Colwell *et al.* (1985) investigated whether "neighbourhood shopping centres increase, decrease or both increase and decrease the value of proximate residential property" (Colwell *et al.*, 1985). In order to answer this question, the study analysed the effect of the Southgate Shopping Centre, a 23 400 square metre structure situated in Illinois, USA, on adjacent residential property prices. The study employed the hedonic price model and a total of 43 single family homes that were traded from 1976 – 1982 were analysed in terms of price and proximity to the shopping centre. The study concluded that the Southgate Mall exerted both positive and negative effects on surrounding property prices, depending on its proximity to residential housing. More specifically, the study found that houses situated within 500 metres were negatively affected (Colwell *et al.*, 1985). However, at distances greater than 500 metres, statistically significant positive effects on surrounding property prices were present. This finding suggests that there is an "optimal spatial frequency of these small shopping centres" (Colwell *et al.*, 1985).

Des Rosiers *et al.* (1996) also analysed the effect of shopping centres on surrounding house values, with the study focusing on both the proximity and size effects (Des Rosiers *et al.*, 1996). The study analysed the effect of 87 shopping centres of varying sizes on the prices of approximately 4000 residential houses traded between January 1990 and December 1991 in Quebec, Canada (Des Rosiers *et al.*, 1996). Hedonic price regressions were used to model the data and a variety of functional forms were employed (including the linear and semi-log functional forms). The study found a positive relationship between shopping centre size and residential house prices. In addition, the study concluded that the optimal distance to a neighbourhood shopping centre is approximately 215 metres (Des Rosiers *et al.*, 1996).

The study by Addae-Dapaah and Lan (2010) sought to provide clarity on the issue of whether or not shopping centres enhance adjacent residential property prices. In order to answer the research question, 8627 residential properties in Singapore were analysed using the hedonic price model. The following hypotheses were tested: flats situated in close proximity to shopping centres command a premium, and property values are inversely related to proximity to shopping centres (Addae-Dapaah and Lan, 2010). With regard to the first hypothesis, the study found that proximity to shopping centres enhances surrounding property prices, with houses commanding a premium of 4.7% for proximity to a shopping centre. However, the study found that this price premium decreases with an increase in distance from the shopping centre, thus confirming the second hypothesis (Addae-Dapaah and Lan, 2010).

Finally, Seago (2013) tested the effect of the Northgate Mall, situated in Montgomery County, USA and corroborated the findings of Colwell *et al.*, 1985. More specifically, the study applied the hedonic price model to 250 residential housing stands and found that houses situated within a radius of 800 metres were negatively affected by the presence of the Northgate Mall. However, houses that were situated outside of this band, but still within a 3200 metre radius experienced statistically significant price increases (Seago, 2013).

3 METHODOLOGY

The international literature reveals that the most commonly applied property value technique is the hedonic price model (Humavindu and Stage, 2003; Deaton and Hoehn, 2004; Palmquist, 2005; Anderson and West, 2006; Bayer, Keohane and Timmins, 2009; Walsh, Milon and Scrogin, 2011). The word "hedonic" stems from the Greek work "hedone" which means enjoyment (Picard, Antoniou and De Palma, 2010). This terminology was first used by Court (1939) who conducted an automobile study (Court, 1939; Palmquist, 2005). However, Lancaster's (1966) paper entitled "A new approach to consumer theory" provided the first reachable theory for hedonic price modelling. The essence of this approach is that the characteristics of consumption goods (not the goods themselves) provide utility to individuals. However, it is the goods (not the characteristics) that are traded in traditional markets. The attractiveness of the hedonic price model is that it allows for the recovery of implicit prices of the attributes (both market and non-market) inherent in consumption goods. Following the Lancaster (1966) study, Griliches (1971) performed a study on automobile demand and managed to popularise the technique (Griliches, 1971; Palmquist, 2005). Rosen's (1974) seminal paper entitled "Hedonic prices and implicit markets: product differentiation in pure competition" then paved the way for a plethora of hedonic price studies.

The hedonic price model relies on the systematic variation in house prices due to differing attribute combinations to impute the willingness to pay for the attributes (Epple, 1987; Haab and McConnell, 2002; Sirmans, Macpherson and Zietz, 2005). Typically, the estimation of a hedonic price model entails two distinct stages. However, most researchers have abandoned the second stage due to the identification problem[1] (Haab and McConnell, 2002). Focusing on the first stage, a hedonic price function is estimated by means of regression analysis. The hedonic price function can be specified as:

$$P = f(S, L, M) \tag{1}$$

where: P represents the sales price of a property, S represents the on-site characteristics of the property, L represents the location and surrounding neighbourhood characteristics, and M represents the market characteristics. The first-stage hedonic price estimates can be used to calculate the implicit prices of housing attributes. For example, the implicit price of attribute L in Equation (1) can be estimated by the following equation:

$$\partial P/\partial L = \partial P(S, L, M)/\partial L \tag{2}$$

In terms of functional form selection, traditional economic theory provides very little guidance (Cropper, Deck and McConnell, 1988). Initial hedonic price

[1] One of the main shortcomings of the hedonic pricing model is the estimation of the demand function. This is because the second stage may not reveal any new information and, thus, the estimated demand equation simply mirrors the results of the first-stage regression (Brown and Rosen, 1982). This is often referred to as the identification problem (Brasington and Hite, 2005).

studies employed the standard functional forms (linear, semi-log, and double-log) and generally made use of goodness-of-fit criteria when selecting an appropriate form (Cropper *et al.*, 1988). However, Goodman (1978) suggested the use of flexible functional forms, with the flexibility coming primarily from the transformation of the dependent variable (Goodman, 1978). Box-Cox transformations are now relatively common in hedonic price studies (Williams, 2008). Four commonly applied transformations are the left-hand Box-Cox transformation (lhBC), the right-hand Box-Cox transformation (rhBC), the restricted Box-Cox transformation (rBC), and the unrestricted Box-Cox transformation (rBC) (Williams, 2008). The lhBC transforms only the dependent variable, the rhBC transforms only the continuous independent variables, the rBC trasforms both sides of the hedonic equation by the same parameter, and the uBC transforms both sides of the hedonic equation using different parameters (Williams, 2008). In all cases, an iterative process is used to select the parameter values that result in the best fit, based on maximum likelihood estimation (Williams, 2008). The use of the Box-Cox regression output is twofold. Firstly, the regression output can be used as a functional form selection test. Secondly, the Box-Cox output can be used as a functional form itself, should the selection test reject the standard functional forms (Williams, 2008).

4 STUDY SITE INFORMATION AND THE DATA

The suburb of Walmer, Nelson Mandela Bay was the residential area considered for this study. The Walmer neighbourhood offers a wide variety of residential housing options, including free standing homes, townhouse complexes and security complexes. In order to estimate the hedonic price equation, historical sales price data for free standing, residential properties in the neighbourhood of Walmer that were traded at least once during the period 1995 to 2009 were obtained.[2] Sales prices were then adjusted to constant 2009 rands in order to control for market fluctuations. Data obtained from ABSA house price index (Port Elizabeth and Uitenhage) were used in this regard. Adjusting sales prices to control for house price inflation is a relatively common approach when the data originate from different years (Cummings and Landis, 1993; Carroll and Clauretie, 1999; Leggett and Bockstael, 2000; Cho, Bowker and Park, 2006; Cotteleer and van Kooten, 2012).

The Walmer neighbourhood has a total of 2 625 residential properties and a total of 1 326 transactions took place from 1995 to 2009 (excluding repeat sales) (South African Property Transfer Guide, 2011). The population in this study was, thus, limited to the 1 326 transactions that took place over the study period. Of these transactions, a simple random sample of 170 was drawn.[3]

[2] All transactions that were not arms-length ones were excluded from the analysis.

[3] The sample size was determined by employing the following equation:

$$n = N/(1 - Ne^2) \tag{3}$$

Walmer Park is situated within the suburb of Walmer and is considered to be one of Port Elizabeth's most popular retail outlets. The Centre officially opened in 1998 and has since expanded by approximately 31 000 square metres to its current size of 42 000 square metres (Walmer Park: About Us, 2015). Walmer Park comprises a vast array of national and international clothing retail shops, restaurants, service related businesses, and movie cinemas. The Centre also provides ample fee outside parking for shoppers and paid underground parking (Walmer Park: About Us, 2015).

With regard to the structural and neighbourhood variables thought to influence house prices in Walmer, previous research conducted by Sirmans *et al.* (2005) was consulted. Information on the following characteristics was collected: erf size, number of stories, presence of a swimming pool, presence of an electric fence, presence of a garage, presence of air-conditioning, age of the house, number of bathrooms, number of bedrooms and distance of the property from Walmer Park. The distance from the subject property to Walmer Park was measured using Google Maps. The closest and furthest distance to Walmer Park was 400m and 5300m, respectively.

5 RESULTS

The estimation of all models in the study was done using Stata Version 11.0. A complete model was estimated first, which included all variables thought to have an influence on the value of a property.[4] Following this, a reduced model, including only the coefficients of variables that were significant at the 10% level, was estimated. Table 1 provides a description of the variables used to estimate the reduced model, along with the hypothesised signs.

In terms of structural characteristics, erf size, the number of stories, the presence of a swimming pool, and the presence of an electric fence, were all expected to have positive impacts on the sales price. With regard to the neighbourhood characteristic (distance to Walmer Park), the hypothesised sign was indeterminate.

Table 2 provides a summary of the descriptive statistics of the variables used to estimate the reduced model.

The average house in the sample has 1.18 stories, an erf size of 1 776 square metres, is situated 2 508 metres from Walmer Park, and is valued at R1 626 395. The majority of houses in the sample have a swimming pool, although less than

where: n = sample size
N = population size
e = level of precision
The sample size was determined with a level of precision of 7.2 percent. According to Fink (2003), the generally accepted level of precision for representative samples is 10% or less (Fink, 2003).

[4] The full model was tested for multicollinearity. More specifically, VIF values for each independent variable were estimated. None of these estimates exceeded the threshold value of 5, indicating that there was no severe multicollearity present in the full model. In the interest of parsimony, only the results of the reduced hedonic models are presented in this paper.

half the houses in the sample have an electric fence

Seven functional forms were employed for the estimation of the reduced hedonic model – linear, semi-log, double-log and four Box-Cox transformations. The results of these models are presented in Table 3.

The results of the hedonic regressions generally conform to *a priori* expectations. More specifically, the presence of a swimming pool and an electric fence contribute positively to property prices in the Walmer Neighbourhood. The size of the erf and the number of stories are also positively correlated with sales prices. In terms of the key variable used in this study (proximity to Walmer Park) the sign of the coefficient is negative and statistically significant (in all seven models). This implies that proximity to Walmer Park and adjacent property values are statistically significantly correlated.[5] Importantly, the statistical significance of the key variable allows for the estimation of implicit prices.

The implicit price of distance to Walmer Park (in all seven models) can be calculated by taking the partial derivative of the price, Y, in respect of distance, X:

$$\frac{\partial Y}{\partial X} = \beta z X z^{\theta-1} \gamma^{1-\lambda} \tag{4}$$

Applying Equation 4, the mean implicit price calculated in this study varied between R106.58 and R116.60 (see Table 4). In other words, distance to Walmer Park is valued at between R106.58 and R116.60 per metre, depending on the functional form employed.[6]

In order to determine the accuracy of the implicit prices generated by employing equation 4, the regression results were subjected to functional form selection tests, using the Box-Cox transformations. Table 5 displays the results of the Box-Cox transformation hypothesis tests and reveals that the standard functional forms (linear, semi-log, and double-log) were rejected.

In terms of the most appropriate Box-Cox transformation, AIC and BIC values revealed that the unrestricted Box-Cox transformation provided the best

[5] An anonymous referee felt that caution should be exercised when interpreting the distance coefficient in terms of correlation and causation. More specifically, one should not conclude with certainty that proximity to Walmer Park causes property prices to rise.

[6] The price-distance relationship was tested for linearity by adding a quadratic distance term to the simple linear model. The estimated quadratic hedonic price function is as follows:

$$\begin{aligned} P &= 414934 + 565 erf\_size + 306652 stories + 326676 swim + 278869 elec\_fence \\ &\quad -317 Dshop + 0.04 Dshop^2 \end{aligned}$$

Equation 5 implies that the incremental reduction in house price (with each additional metre increase in distance) diminishes by R0.04 per additional metre in distance (Coulson, 2008). However, the coefficient of the quadratic term was insignificant (P = 0.167). Therefore, it cannot be concluded that the price distance relationship is non-linear. For interests' sake, the implicit price of distance to Walmer Park was estimated by taking the partial derivative of Dshop with respect to P:

$$\begin{aligned} \partial P / \partial Dshop &= -317 + 0.08 Dshop \\ &= -116.36 \end{aligned} \tag{5}$$

Equation 6 implies that proximity to Walmer Park is valued at R116.36 per metre, which is very similar to the results obtained by applying Equation 4.

fit.[7] The unrestricted Box-Cox transformation thus produced the most accurate implicit price (R112.68 per metre).

6 CONCLUSION

This study finds that a statistically significant correlation is present between proximity to Walmer Park and adjacent property prices in the neighbourhood of Walmer, Port Elizabeth. More specifically, the study finds that proximity to Walmer Park is valued at R112.68 per metre. In this localised case, the convenience of being situated in close proximity to a shopping centre outweighs the potential disamenities of increased traffic, noise, and localised pollution. Beyond the theoretical findings of this study, the practical implications are clear – residential homeowners and property developers could reap substantial rewards by gaining a deeper understanding of how amenities such as shopping centres affect adjacent residential property prices. In addition to this, commercial valuators' models could also be improved, in terms of predictive accuracy, with the inclusion of additional neighbourhood variables. The findings of this study are, however, subject to two important qualifications. Firstly, the study has only considered one neighbourhood, which limits the extent to which the results can be interpreted on a broader scale. Secondly, a fairly small dataset was employed in the study.

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[7] See Table 6 below. As is evident in Table 6, the lhBC reported the lowest AIC and BIC values, suggesting that it is the most appropriate model. However, according the Williams (2008) it is preferable to transform both sides of the hedonic equation. The uBC model was thus considered to be the most appropriate model for this study as it had lower AIC and BIC values than the rBC.

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Table 1: Variable mnemonics and definitions of the variables used in the regression analysis

Variable	Description	Unit of measurement	Expected sign
Dependent variable			
Sales price	Actual market price	2009 rands	
Independent variables			
Erf_Size	Size of the erf	Square metres	+
DShop	Distance of house to the shopping centre	Metres	+/-
Stories	Number of stories	Number of	+
Swim	Presence of a swimming pool	Yes = 1 No = 0	+
Elec_fence	Presence of an electric fence	Yes = 1 No = 0	+

Table 2: Summary statistics

Variable	Min	Max	Mean	Standard deviation
Sales Price	193 600	4 926 800	1 626 395	774 758
Erf_Size	38	4 600	1776	629
DShop	400	5 300	2508	1183
Stories	1	2	1.18	0.39
Swim	0	1	0.8	0.4
Elec_fence	0	1	0.26	0.44

Table 3: Regression results

Variable	Model						
	Linear	**Semi-log**	**Double-log**	**lhBC model**	**rhBC model**	**rBC model**	**uBC model**
Constant	228141.4 (257558.7)[C]	13.34 (0.157)	12.68 (0.63)[c]	112.14	642496.2	251.4	116.88
Structural Characteristics							
Erf_Size	556.83[a] (75.6)[c]	0.00029[a] (0.000046)[c]	0.3169[a] (0.059)[c]	0.0117[a] (42.08) [d]	129.34[a] (48.92) [d]	4.91[a] (37.63) [d]	0.0177[a] (42.079) [d]
Stories	300196.7[b] (116819.8)[c]	0.2009[a] (0.0710)[c]	0.2044[a] (0.0738)[c]	7.49[a] (8.21) [d]	283120[a] (6.904) [d]	34.08[a] (7.586) [d]	7.45[a] (8.115) [d]
Swim	332107.8[a] (116461)[c]	0.295[a] (0.070)[c]	0.3328[a] (0.0731)[c]	10.201[a] (14.799) [d]	330516[a] (8.164) [d]	38.58[a] (15.24) [d]	9.99[a] (14.832) [d]
Elec_fence	281172.3[a] (102978.6)c	0.14[b] (0.063)[c]	0.15996[b] (0.0653)[c]	5.78[b] (6.297) [d]	278608.2[a] (7.435) [d]	23.17[a] (7.33) [d]	5.67[b] (6.326) [d]
Neighbourhood Characteristics							
DShop	-114.15[a] (41.02)[c]	-0.00007[a] (0.000025)[c]	-0.1798[a] (0.498)[c]	-0.0027[a] (8.601)[d]	-24.51[a] (7.204) [d]	-1.718[a] (11.84) [d]	-0.00419[a] (8.531) [d]
R-squared	0.46	0.46	0.42				
F-statistic	28.25	27.85	23.36				
Transformation Parameters							
λ				0.26 (0.102) [b]	---	0.35[a] (0.097) [b]	0.254[a] (0.102) [b]
θ				---	1.19 (0.35)[b]	0.35[a] (0.097) [b]	0.94[a] (0.312) [b]
Log likelihood				-2470	-2492	-2473	-2470

Notes: [a]Significant at the 1% level
[b]significant at the 5% level
[c]Standard errors in parentheses
[d]Chi – square values in parenthesis[1]

[1] The Box-Cox produced probability values for the coefficients on the basis of chi – square tests (as the use of ordinary least squares estimates of variance may produce inaccurate measures of significance when used with Box-Cox transformations) (Williams, 2008).

Table 4: Implicit prices

Model	**Coefficient, $\boldsymbol{\beta}$**	**Implicit price**
Linear ($\lambda = \theta = 1$)	-114.15	114.15
Semi-log ($\lambda = 0, \theta = 1$)	-0.00007	113.85
Double-log ($\lambda = \theta = 0$)	-0.1798	116.60
lhBC ($\lambda = 0.26, \theta = 1$)	-0.0027	106.58
rhBC ($\lambda = 1, \theta = 1.19$)	-24.51	108.44
rBC ($\lambda = \theta = 0.35$)	-1.718	115.55
uBC ($\lambda = 0.254, \theta = 0.94$)	-0.00419	112.68

Table 5: Box-Cox transformation hypothesis tests

Transformation	$\boldsymbol{\lambda}$	$\boldsymbol{\theta}$	**Ho Equation**	**Chi² statistic for rejecting Ho when X =**			**Standard functional forms rejected**
				1	**0**	**-1**	
lhBC	0.26		λ=X	46.17	6.67	193.43	Semi-log and linear
rhBC		1.19	θ=X	0.34	22.71	56.44	Semi-log and reciprocal
rBC	0.35	0.35	θ=λ=X	39.44	13.03	199.52	Linear and log-log
uBC	0.245	0.94	θ=λ=X	46.20	19.79	206.28	Linear and log-log

Table 6: AIC and BIC values

Model	**AIC**	**BIC**
lhBC	4942	4945
rhBC	4988	4991
rBC	4949	4952
uBC	4944	4950