Hedonic pricing in Windhoek townships

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ABSTRACT. This study applies the hedonic pricing model to property sales in the township areas in Windhoek, the capital city of Namibia, where municipal authorities have pursued a programme of selling plots of land to settlers in order to encourage them into a formalized economic situation. We find that, apart from house quality, access to the central business district, access to marketplaces and access to transportation, environmental quality also has a large impact on property prices. Properties located close to a garbage dump sell at considerable discounts, while properties located close to a combined conservation and recreation area sell at premium prices. The results thus suggest that the hedonic pricing method can be useful for studying townships in developing countries, and that this can help to clarify the importance of environmental factors which are otherwise frequently neglected in town planning for township settlements.

1. Introduction
The objective of this paper is to study whether property prices in the township areas in Windhoek, the capital city of Namibia, are influenced by attractive attributes in a similar fashion to prices in more developed property markets. This is analysed using the hedonic pricing method. This method has been applied in developing countries only rarely (see Malpezzi, 1999, for an overview), and hardly ever in township areas.

It might seem obvious that households living in townships will spend what little money they have on goods which are crucial for their short-term survival, and are unlikely to be willing to pay extra for a property with, for instance, a pleasing view. It might also seem obvious that even if township dwellers are in fact willing to pay premia for slightly more attractive dwellings, they are unlikely to have the necessary overview of the property market to know when attractive properties are available and be able to bid for them. However, if attributes such as environmental quality do affect property prices, even among extremely poor households, it is important to town planners to be aware of this, as these preferences should be reflected in policy decisions.

Only a few hedonic pricing studies have been carried out in Africa,[1] and these did not look at property markets in townships; in most of the informal and semi-formal settlements around large African cities the settlers do not have clear title to their land, and even when there are permanent or near-permanent property rights, trade in these properties is usually poorly documented.

In Windhoek, the municipality has pursued a policy of selling plots of land by instalments to low-income households and ultra low-income households – currently defined as households with monthly incomes of less than 1860 N\$ (160 US\$) and less than 500 N\$ (45 US\$), respectively – moving in from rural areas, in order to encourage them into a more formalized economic situation. Due to this policy, reliable information on property prices is more easily available for township areas in Windhoek than it is in most similar areas in developing countries. This means that Windhoek is one of the few places where the hedonic pricing method can be applied relatively easily to ultra low-income housing, in order to examine which factors are considered important by township inhabitants and what impact these factors have on property prices.

In the next section, the political and demographic background to the current township policies in Windhoek is presented. This is followed by a section which explains the theoretical framework for the study and discusses property attributes which might affect prices. The next section describes the econometric model and the data set used, followed by a section describing the results of the analysis. The concluding section discusses implications of the results.

2. The Windhoek townships

Windhoek lies in central Namibia. It was the colonial capital of what was then called South West Africa during the German colonial period, and subsequently during South African rule, which ended in 1990. The city is now the capital of independent Namibia and serves as the administrative, legislative, and judicial centre of the country.

The first of the present-day township areas in Windhoek was established during the South African apartheid system. Before the 1960s, the black population of Windhoek lived in the Old Location, a site west of the central business district. Residential blocks were rented from the municipality and

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[1] Asabere, 1981a, 1981b; Megbolugbe, 1989; Arimah, 1992; Akpom, 1996.

inhabitants built their own houses. During the late 1950s through to the 1970s, the expansion of the 'white section' of Windhoek towards the Old Location led to the forcible relocation of black residents to a site north-west of the city centre. The new site was called Katutura, which means 'the place where we do not stay' in one of the local languages.

The South African authorities adopted new housing policies as well, in order to minimize the construction of urban dwellings and to focus more on the provision of 'temporary' accommodation. Katutura initially consisted of 4,000 rental houses, a barrack-like single quarters area and a walled compound to accommodate migrant labour. The rental units were divided into ethnic group sections and were uniform in appearance, quality, and size. There were also general regulations to stem the influx of blacks into Windhoek (Pendleton, 1974).

The 1970s and 1980s witnessed a liberalization of the regulations governing black residents of Windhoek and other urban centres (Haines and Tapscott, 1991). From the 1980s, plots of land – called 'erven' in Namibia – and houses could be privately owned in Katutura. New areas west of the established townships were also opened for settlement (Pendleton, 1994).

As a result of the liberalized laws, urbanization increased dramatically. The population of Windhoek grew from approximately 100,000 in 1985 to approximately 145,000 at independence in 1990 (Windhoek City Council, 1996). Squatter settlements sprang up on the outskirts of Katutura and the other township areas.

Windhoek's population has continued growing after independence and is now believed to be roughly 250,000. Most of the urban expansion has taken place in the township areas to the north and north-west of Windhoek. Before the apartheid regulations were relaxed, the entire black settlement was limited to an area of about 400 hectares located between 4.5 and 7 km from the city centre; currently, the furthest township settlements are over 12 km from the city centre, and the entire township area covers well over 2,300 hectares.

The average monthly household income in the townships is estimated (Windhoek City Council, 1996) to be about N$850 (approximately 75US$). These very low incomes seriously limit the level of services that can be provided at cost to the inhabitants of these areas. Many city governments in Africa faced similar problems with low-income settlers in the 1960s and 1970s. These local governments often attempted to provide subsidized full-service housing for city residents who could not afford cost-recovery tariffs, and limit migration to the city in order to keep down the costs of subsidies to low-income areas. However, the result has frequently been that these cities have ended up both with costly subsidies to the formally recognized low-income areas, and also (since the city governments cannot afford to provide subsidized full-service housing for all settlers) with large informal settlements where residents have no access to any municipal services and no legal rights whatsoever. The uncertainty of tenure and constant threat of eviction in the informal settlements have led to low levels of community involvement; these settlements are often characterized by high crime rates and other problems.

The local government in Windhoek, which faced the problem of rapid urbanization later than local governments elsewhere in Africa, has attempted to learn from these experiences. The municipal township policies aim both towards being financially viable and towards integrating settlers in the formal economy.

Rather than provide subsidized full-service housing, the municipality permits settlers to lease or purchase unused municipal land. Land purchases can be paid either in cash or through loans from the municipality at market interest rates, with the purchased property as collateral. Once the municipality has sold a property there are no restrictions on the resale price, provided that any remaining debt to the municipality is paid in full. Municipal services, such as water and electricity, are optional, but are available at cost-recovery prices for those who choose to make use of them.

Refuse collection is the only municipal service which is compulsory for all erven; each erf has its own refuse bin which is emptied once a week either by municipal trucks (in the older townships) or by private contractors. Illegal garbage dumping in open areas was becoming a major problem throughout the city in the early 1990s, but after municipal authorities improved refuse collection, converting some of the illegal dumps into officially recognized dumping sites in the process, nearly all garbage is now collected and dumped in the officially recognized locations. Unlike many township areas in developing countries, Windhoek's townships therefore do not have any widespread sanitation problems related to uncollected refuse at present.

Several public sector agents have been involved in the provision of affordable housing in the township areas after independence. The government's Build Together Programme was designed shortly after independence to provide credit for building and building improvements to ultra low-income households. The programme also provided technical assistance to the program beneficiaries. Poor repayment levels, and high subsidies from government, characterized the programme. The state-owned National Housing Enterprise (NHE) was also set up in order to provide low-cost housing. However, due to profitability problems, the NHE moved away from catering for the ultra low-income groups and began targeting slightly higher-income groups. The NHE is currently reorganizing and plans to start building houses for the lowest-income categories once more, but at present most construction in the township areas is thus done either by residents or by other private agents.

There are few employment opportunities in the township areas; only about 10 per cent of the township population are estimated to work there. Those township residents who are formally employed primarily work in the central areas of the city in the central business district or in the nearby (no longer very aptly named) Windhoek North area, while unemployed gather in the open areas in the central parts of the city in the hope of being picked up by households or small businesses which need to hire labour for short-term jobs. Nearly all work-related travel in the township areas is therefore to and from the central business district, either on foot or by car. There is a considerable number of relatively cheap, privately operated taxis which carry large numbers of passengers at a time; rates are fixed by

a central association so that travellers from the townships pay the same rates for a specific destination regardless of where in the township areas they are picked up. In principle, these taxis are only permitted to pick up passengers at specially designated taxi ranks throughout the city, but this rule is only enforced intermittently; however, while taxis are permitted to drop off passengers anywhere, they charge less for delivering passengers to a designated taxi rank than they do for delivering passengers elsewhere. Since Windhoek is still a fairly small city, many people with steady jobs are picked up by their employers, while people without steady jobs may walk into town to search for employment (Windhoek City Council, 1996).

Although there are few employment opportunities in the township areas, there is a great deal of other activity going on. Schools are available throughout the area. The municipality has also established a number of market places, where commodities are traded and where cultural activities take place. A large area around the Goreangab dam, where water is stored for the dry season, was set aside as a combined conservation and recreation area in the late 1960s. Although the townships have since expanded and now almost surround it, the area has been preserved and is one of the largest open areas in Windhoek. It has considerable scenic appeal and is used for activities such as barbecues, hiking, boating, and picnicking.

3. Hedonic pricing
Real estate characteristics such as the area of the plot or the distance to the nearest school are not themselves traded in any markets; they are tied to the individual property being sold and are only traded as parts of the bundle of characteristics constituting that particular property. However, by examining the prices paid for different bundles of characteristics, it is possible to estimate the value attached to a specific characteristic. This is the basis for the hedonic pricing model (Rosen, 1974; Sheppard, 1999).

A property is characterized by a vector of attributes, $H = h_1, h_2, ..., h_k$, and the hedonic pricing method attempts to establish the relationship between housing expenditure $P(H)$ and the levels of the various attributes, $P(H) = f(h_1, h_2, ..., h_k)$. If the price relationship is correctly specified, and if property markets are functioning efficiently, it becomes possible to determine households' implicit marginal valuation of each attribute, $P_i = \partial P(H)/\partial h_i$. Attributes which have been studied in hedonic studies fall into two major groups; structural attributes of the property, such as the plot size, the size of the house, the number of rooms, and the building materials used; and location-specific property attributes, such as the distance to the city centre, access to transport, and environmental and socio-economic characteristics of the neighbourhood.

The few empirical studies which have been made of housing markets in African countries have all indicated that access variables are important in determining property prices. Asabere (1981a, 1981b) found that nearness to the city centre and quality of nearby roads had an impact on property prices in two Ghanaian cities. Megbolugbe (1989), Arimah (1992), and Akpom (1996), in their studies of different Nigerian cities, similarly found that a number of variables, measuring access to labour markets and/or

access to services, were important. The coverage of structural attributes in these analyses varied considerably, from studies which only looked at the sizes of the traded plots to studies which had access to detailed information on building materials as well as on the number and type of rooms of each house. Most studies, however, ignored the issue of environmental quality. The two studies by Asabere did include variables measuring environmental bads (and found these to have significant impacts on property prices in the two cities studied), but the later studies did not take such factors into account.

There are generally two stages to a hedonic pricing study; the first stage is the estimation of implicit prices for various attributes, while the second stage is the estimation of the implicit demand functions determining these prices. The implicit prices of different attributes in a property market, which reflect the marginal valuation of these attributes, can be estimated using sales prices of properties and data on the attributes involved. However, these implicit prices are in turn determined by the equilibria of implicit supply and demand functions, which are affected by a large number of factors. The market clearing implicit prices will be set through a bargaining process between the agents in the property market and will be affected by factors specific to the households buying and selling properties – household sizes, income levels, income distribution, and so on.

It is only possible to estimate the underlying implicit demand functions for different attributes by including data, not only on the traded properties, but also on the households involved in the property market at hand. Of the African studies cited above, only Arimah (1992) had this type of household information and was able to proceed beyond estimating implicit prices to estimating the implicit demand functions. In Windhoek's township areas, there is no detailed household-level information available on variables, such as income, employment, or household size. At the moment, there are in fact not even reliable figures available on the total number of inhabitants in the different township areas, let alone inhabitants in individual households, and the only data on income levels are estimated average figures which are not sufficient for any detailed analysis. This analysis is therefore limited to estimating the implicit prices, rather than the implicit demand functions, for different property attributes.

Although formal segregation has been abolished for over a decade, it is still unthinkable for white or coloured households in Windhoek to move into the township areas in the northern and north-western parts of town, regardless of household income or house price. Likewise, although the former white neighbourhoods have seen an influx of black families in the past years, there is still considerable reluctance on the part of white homeowners to sell their houses to blacks. This means that there are, effectively, two separate housing markets in Windhoek, making it problematic to apply one single hedonic model for the entire area.

Frequently, hedonic studies have attempted to capture market segmentation between different areas by using switching regressions; the area being studied is divided into discrete segments, the model is estimated for each segment separately, and the results for different segments are then compared to see whether the differences are significant. However, there

are problems with using this approach on spatial data such as property prices, since the delineation of the areas becomes crucial for the results. Variation within the studied areas will produce misleading results, and where there are significant differences between different market segments the model will predict unrealistically large price differences between neighbouring plots at the borders between those segments (Can, 1992). The same problems occur when dummy variables are used for different market segments, an approach used in many hedonic pricing studies (including several of the African applications discussed earlier). In this study, rather than attempting to model the precise relationships between pricing of attributes in different sections of the city, we have chosen to limit the analysis to the township area. Moreover, since the township areas are all located in close proximity to each other rather than spread around the city – the latter frequently being the case with townships in other cities – we have also chosen not to subdivide the area by introducing neighbourhood dummies, in order to avoid the delineation problems noted above.

For the individual properties being traded, information on the sizes of the relevant erven is readily available. Unfortunately, detailed information on the structural attributes of individual houses, which could also be expected to affect prices, is not. However, when a house has been built, the municipality makes a valuation of the replacement cost of that house. Any changes made to the house have to be reported to the municipality, which then makes a new valuation. This means that the municipal replacement cost valuation can be used as a measure of overall house quality. Still, experiences from other hedonic pricing studies indicate that factors such as house size, number of rooms and building materials are very important in determining property prices, and, although a measure of plot size and a proxy measure of overall house quality are considerably better than nothing, it would definitely have been preferable to have more specific information on the buildings.

A number of access variables might be expected to be of importance in determining property prices in townships. Namibian roads are of high quality compared to those in other African countries and, unlike several of the studies cited earlier, we have therefore not included any measure of road quality. However, other access variables which are more likely to play a role in determining property prices are the distances to the central business district and to the nearest major market. Factors such as the access to taxi ranks, and the walking distance to the nearest school, might also play an important role in determining real estate prices in townships, where few households own their own car (Blaauw *et al.*, 1998).

While economic valuation of public goods has not been a major part of urban planning in Windhoek or elsewhere in Namibia, a recent survey (Humavindu and Masirembu, 2001) indicated that the Goreangab dam recreation area was perceived as important by township inhabitants and that they wished to have it preserved. It is of interest to see whether this stated preference for the site is also reflected in actual market behaviour, in which case properties with easy access to the area should be regarded as attractive and might be expected to sell at premium prices. Alternatively, the municipal garbage dumps which are located throughout the city are

probably not appreciated by their neighbours. If this lack of appreciation for the dumps is reflected in property prices, one would expect a downward pressure on property prices in the vicinity of a dump.

4. Econometric specification and data

Economic theory provides no *a priori* reason to prefer one functional form for the hedonic price function over others, and hedonic pricing studies have frequently used Box–Cox transformations to find the functional form that fits the data best. However, several authors (Cassel and Mendelsohn, 1985; Cropper, Deck, and McConnell, 1988; Sheppard, 1999) have argued that it is problematic to use Box–Cox transformations in hedonic pricing studies, both because the resulting parameter estimates tend to be highly sensitive to small variations in the data and also because those parameter estimates are frequently difficult to interpret. These authors have suggested using simpler functional forms which produce more stable parameter estimates.

The use of a simple functional form is especially recommended in situations such as the one studied here, where some potentially important attributes (such as house size or number of rooms) are not included due to limitations in the data set. Rather than using polynomial expressions or Box–Cox transformations, we have therefore chosen to test the following, quite simple, model for the price of property i

$$P_i = \alpha + \beta_1 Size_i + \beta_2 RCH_i + \beta_3 dCBD_i + \beta_4 dMarket_i + \beta_5 dSchoool_i + \beta_6 dRank_i + \beta_7 Garbage_i + \beta_8 Gorean_i + \beta_9 dGor_i + \varepsilon_i$$

Size is erf size in square meters and *RCH* is the official municipal valuation in N\$ of the replacement cost of the house. *dCBD* is the distance to the central business district where most of the township inhabitants find employment (if any), *dMarket* is the distance to the nearest major marketplace where they are likely to make most of their purchases, *dSchool* is the distance to the nearest school, and *dRank* is the distance to the nearest taxi rank; all these distances are measured in meters. It is assumed here that the Euclidean distance is a reasonable approximation of the actual travel distance, which is usually the case for dense road networks (Puu, 1997) such as those in Windhoek's township areas.

In order to study whether environmental quality has an impact on property prices, two dummy variables and one continuous variable are used. *Garbage* is a dummy variable for proximity to garbage dumps, which takes the value 1 for plots which are less than 250 m from a garbage dump and 0 for plots which are not. The reason for using a dummy rather than the continuous Euclidean distance is that the perceived aesthetic difference between a plot adjacent to a garbage dump and one 500 m away is likely to be considerably greater than the perceived aesthetic difference between a plot 1 km away from a dump and one 1.5 km away. While this type of consideration might alternatively have been captured by using both linear and quadratic forms of the distances, this would have increased the risk discussed earlier of making the estimates highly sensitive to small variations in the data and estimating parameters incorrectly, because of the missing variable problem caused by the lack of structural information on houses.

The reason for choosing 250 m as a cutoff distance is that this captures properties in housing blocks adjacent to a garbage dump, while excluding properties located in housing blocks further off. Similarly, *Gorean* is a dummy variable which takes the value 1 for plots which are less than 250 m from the Goreangab dam recreational area and 0 for plots which are not; this variable is intended to capture the value of living directly adjacent to the recreational area, with an attractive view and extreme ease of access to the area. *dGor*, finally, is the distance to the recreational area, and is intended to capture the ease of access to the area for those plots which are located further off.[2]

Windhoek municipality registers sales prices, official property valuation, and erf area when individual erven are traded, and also if the property is being sold by the municipality or by a close relative of the buyer. The full data set (Windhoek City Council, 2001) consisted of 551 recorded sales of residential erven in the northern and north-western suburbs (Goreangab, Hakahana, Katutura, Okuryangava, and Wanaheda) during 1999. Of these, 72 were sales either by the municipality or by a close relative of the buyer and were excluded from the sample, leaving a total of 479 sales in the reduced data set. Combining detailed maps of Windhoek (Windhoek City Council, 2001) with GIS software, it has been possible to calculate the distances from the centre point of each traded erf to the centre points of, respectively, the central business district, the nearest major marketplace, the nearest school, and the nearest taxi rank, as well as to the nearest garbage dump and to the Goreangab dam recreation area.

It deserves to be noted (table 1) that the average valuation of building investments in the traded properties is close to 47,000 N$, so many households clearly spend large amounts of time and/or money improving their dwellings once they have bought them. One of the goals of the settlement formalization programme has, of course, been to encourage people in the township areas to take greater responsibility for their surroundings, so this effect was to be expected, but similar behaviour has been observed in township areas in other developing countries where households only have semi-permanent squatter rights and do not actually own their properties (Jimenez, 1982). However, for some of the traded properties (28 of the properties which remained in the reduced data set) the official valuation of the replacement cost is zero, i.e. any existing structures are of such poor quality that the municipality believes that, if destroyed, they could be rebuilt at negligible cost. This means that the sample includes houses ranging from the extreme lower end of the market to fairly high-quality dwellings.

One may also note the considerable variation in the size of plots. Until 1997, the smallest erf size permitted by the Ministry of Regional and Local Government and Housing was, in principle, 300 m², a minimum which has since been lowered to 200 m², and well over half of the traded plots have sizes between 200 m² and 400 m². However, some plots have sizes which

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[2] An earlier version of this paper used only the dummy variable; we thank a referee for pointing out that this would only capture the 'view' aspect of the Goreangab area.

Table 1. *The data set*

	Unit	Average	Minimum	Maximum
Price	N$	60,192	2,060	220,000
Size	m²	337	131	1,191
RCH	N$	46,737	0	266,300
dCBD	m	6,862	4,587	9,323
dMarket	m	870	103	2,763
dSchool	m	435	57	1,468
dRank	m	344	41	2,223
Garbage	Dummy	0.06	0	1
Gorean	Dummy	0.01	0	1
dGor	m	2,661	118	4,955
N = 479				

Notes: Price is the sales price of each property; *Size* is the plot size; *RCH* is the municipal valuation of the replacement cost of the house on the property; *dCBD, dMarket, dSchool,* and *dRank* are the Euclidean distances to the central business district, the nearest market, the nearest school, and the nearest taxi rank, respectively; *Garbage* is a dummy variable which is 1 for plots which are less than 250 m from a garbage dump and 0 for plots which are not, while *Gorean* is a dummy variable which is 1 for plots which are less than 250 m from the Goreangab dam recreation area and 0 for plots which are not; finally, *dGor* measures the Euclidean distance to the Goreangab dam recreation area.

are less than the official minimum, while a few plots are far greater than the official minimum size.

The distance to the city centre varies by almost 5 km for the traded properties. As noted earlier the townships currently extend to a distance of approximately 12 km from the city centre, but many of the outermost settlements have been established relatively recently and the properties there have not yet been resold. Most properties are located relatively close to a school and a taxi rank, but the average distance to the nearest major market is considerably greater. The distance to the Goreangab reserve, finally, varies from dwellings located in blocks directly adjacent to it to dwellings located almost 5 km away.

5. Results

The model presented above was estimated using an ordinary least squares regression. As a White test indicated the presence of heteroscedasticity, the standard errors in the regression were corrected for heteroscedasticity using a White estimator (White, 1980). The results are presented in table 2. Results using semi-log and log formulations[3] are shown for comparison in tables 3 and 4; the results in terms of significant variables are largely similar, but the linear form has greater explanatory power.

Some attributes which could potentially be important, such as individual attributes of houses, were not included in the available data,

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[3] In the log formulation, we used zero rather than ln(*RCH*) for those properties where the replacement cost was valued at 0.

Table 2. *Estimation results for the linear form*

	Coefficient	Robust SE	t-value
Size	5.13	19.94	0.26
RCH	0.72	0.07	10.47
dCBD	−6.64	2.10	−3.16
dMarket	−9.88	3.57	−2.77
dSchool	6.42	8.42	0.76
dRank	−16.18	6.92	−2.34
Garbage	−34706.26	4086.45	−8.49
Gorean	21801.38	8032.49	2.71
dGor	−3.32	1.82	−1.82
Constant	92367.02	19553.41	4.72
$R^2 = 0.4520$			
$F(9, 469) = 42.28$			

Notes: See table 1.

Table 3. *Estimation results for the semi-log form*

	Coefficient	Robust SE	t-value
Size	0.000339	0.000379	0.895
RCH	0.000011	1.59E-06	6.936
dCBD	−0.000211	0.0000532	−3.971
dMarket	−0.000344	0.0000963	−3.575
dSchool	0.0000875	0.000209	0.42
dRank	−0.000582	0.000186	−3.125
Garbage	−0.769	0.149	−5.149
Gorean	0.740	0.286	2.588
dGor	−0.000051	0.000046	−1.109
Constant	12.060	0.451	26.723
$R^2 = 0.3720$			
$F(9, 469) = 34.77$			

Notes: See table 1. The regression used the logarithm of the dependent price variable.

Table 4. *Estimation results for the log form*

	Coefficient	Robust SE	t-value
Size	0.728	0.120	6.044
RCH	0.125	0.019	6.72
dCBD	−0.904	0.385	−2.351
dMarket	−0.226	0.077	−2.951
dSchool	−0.011	0.087	−0.123
dRank	−0.172	0.081	−2.117
Garbage	−0.886	0.144	−6.153
Gorean	0.794	0.213	3.736
dGor	−0.033	0.102	−0.321
Constant	15.961	4.150	3.846
$R^2 = 0.3477$			
$F(9, 469) = 67.27$			

Notes: See table 1. The regression used the logarithms of all variables except the two dummy variables; for the variable RCH, the value 0 rather than ln(RCH) was used in the 28 cases when RCH took zero values.)

leading to a relatively low R^2 of 0.45 (the R^2s for the other specifications were even lower). Even so, at a 5 per cent significance level the results support the hypothesis that several other attributes of the traded properties have an effect on property prices in the township areas. The R^2 is not much lower than those in several of the other hedonic pricing studies cited earlier, and the F statistic for the entire regression is 42.28, which is also significant at the 5 per cent level.

Erf size does not appear to have a significant impact on property prices, while housing quality and nearness to the city centre do have significant impacts. This suggests that the recent decrease in the statutory minimum erf size can potentially be welfare enhancing because it means that the municipality can open up for further densification of the older township areas, making it possible for people in recently established townships further out to move closer to the city centre. (Incidentally, the marginal valuation of an additional N$'s worth of building investments is lower than 1, which means that there are no arbitrage gains to be made by sellers through making additional investments before selling.)

Proximity to a school has no significant effect on property prices – the point estimate of the parameter even has the 'wrong' sign. This is presumably due to the fact that the distance to a school is fairly short for most properties in any case, so that an additional meter is not perceived as particularly important. Despite the limited enforcement of the rank system (which should mean that many commuters are able to catch a taxi wherever they want to anyway) the distance to the nearest taxi rank has a significant impact on property prices. Many people use commuter taxis to travel into town and back, and it appears that they attach considerable importance to having easy access to taxi transport. This indicates that the municipal policy of establishing taxi ranks and taxi services quickly in newly settled areas is likely to be appreciated by inhabitants and may play an important role for the municipality's success in integrating new settlers into the local economy.

The distance to the nearest major market has a significant effect on property prices (the marginal valuation of an additional meter is actually higher for the distance to the nearest market than it is for the distance to the city centre), indicating that households attach considerable importance to having access to major marketplaces. Although one cannot say anything with confidence without having estimates of the underlying implicit demand functions as well, it is possible that the cost of establishing additional market places might be more than offset by the resulting increase in social welfare. This is, at any rate, something that deserves to be studied more closely.

The two dummy variables for environmental quality both had significant impacts on property prices. Proximity to a garbage dump is clearly viewed as unattractive; the mean effect is to reduce the value of a property by almost 35,000 N$. Close proximity to the Goreangab dam recreation area, on the other hand, raises the value of a property by almost 22,000 N$. The distance to the Goreangab area, on the other hand, does not appear to have a significant impact on property prices. Thus, having a pleasant view is valued highly while the ease of access does not have an impact on prices

for plots further away.[4] This finding is in line with an earlier study (Humavindu and Masirembu, 2001) which indicated that travel distance to Goreangab did not affect how frequently people living in the township areas visited the site. One possible explanation for this might be that many people go to Goreangab by taxi and thus pay a fixed rate regardless of where in the township area they start.

6. Conclusions
This paper has shown that property prices in Windhoek's townships reflect attractive and unattractive location-specific characteristics, including proximity to environmental goods and bads. Public policy determines many of these location-specific attributes, and the results indicate that the hedonic pricing method can be useful for evaluating public policy not only in affluent neighbourhoods but also in townships. Keeping track of property sales in townships, in the way that municipal authorities have done in Windhoek, can thus provide urban authorities responsible for administering townships with a powerful additional tool for policy analysis.

Lack of reliable detailed information on household characteristics is likely to be a problem for township studies in other cities as well. The usefulness of the method could nonetheless be increased further by at least recording household characteristics at the time of sale/purchase of a property, even if it is likely be difficult for many municipal authorities to update this household-level information on a regular basis. Property market segmentation, and the welfare effects of this, also warrants further exploration, as this is likely to be a complicating factor in the analysis of property markets in many developing country cities.

An important finding in this study is the high value that inhabitants in the township areas clearly attach to environmental quality. Proximity to a conservation area or to garbage dumps have remarkably large impacts on property prices. Townships in other developing country cities have often been allowed to expand under less organized circumstances than in Windhoek, and the issues of maintaining refuse disposal and secluding garbage dumps from residential areas, as well as maintaining open spaces in township areas have frequently been neglected by urban authorities. Our results indicate that where this neglect has occurred it may have been a very serious omission.

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[4] Dropping one of the two 'Goreangab' variables does not affect the result for the other one, so it would appear that the two different aspects of the Goreangab area studied here are not closely related.

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