The impact of location choice factors on retail suburbanisation based on a stated preference model developed for Cape Town

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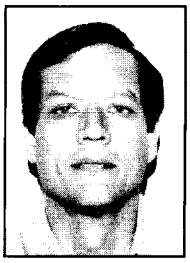
Suburbanisation, which involves the general shift in business activities from the central business district (CBD) of cities to the suburban areas, has lead to multi-dimensional and complex problems. Urban planners have proposed various urban densification strategies, such as corridor development, to address the structural problems of South African cities. To define the most effective policies to attract development to priority development corridors and nodes, metropolitan authorities need to understand the locational choice behaviour of the various urban activities and need to quantify the demand elasticities of the main factors driving locational choice.

The paper summarises research conducted for the purposes of the author's PhD thesis at the University of Stellenbosch. The main purpose of the research was to determine the locational choice behaviour of retail businesses in strategic spatial terms, in order to assist metropolitan authorities and planners to formulate effective urban densification strategies and to manage suburbanisation. The paper discusses the market research conducted among a sample of retail managers in Cape Town and the quantification of the relative importance and elasticities of locational choice factors derived from stated preference (SP) models that were calibrated on the survey data. The testing of decentralisation strategies with a retail location spreadsheet model based on the SP model results are discussed as well as policies to promote urban densification and to manage suburbanisation.



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Klaas specialises in integrated land use transportation planning. Career highlights are conducting stated preference studies to determine values of time for a number of major toll road feasibility studies in South Africa, and more recently for a toll road study in the state of Gujarat, India, and participating in the public transport restructuring projects in Durban and Cape Town which entailed developing SP mode choice models and evaluating public transport policies.

INTRODUCTION

Suburbanisation is a worldwide phenomenon, which involves the general shift in business activities from the central business districts (CBDs) of cities to the suburban areas. Various push and pull factors, such as traffic congestion and limited parking space, increased car ownership and urban sprawl, resulted in retail businesses following their markets to the outlying residential areas. Other businesses in the service sector followed retail development to be closer to their employees and the more attractive suburban environment.

Suburbanisation has lead to multi-dimensional and complex problems, which require comprehensive and integrated transport and land-use strategies. Mismatches between the supply and demand of office and retail space, and the negative impact of traffic in residential areas are some of the typical problems. Property analysts in South Africa expressed concerns about the local trend of developers providing shopping centres at a rate outstripping total demand (*Finansies & Tegniek*, 23 February 2001).

A national research study on the impact of suburbanisation on mobility indicated that suburbanisation together with the impact of the former Group Areas policies have reduced the accessibility of low-income public transport communities living on the edges of the urban areas to suburban employment and shopping opportunities (Cameron *et al* 1991).

Urban planners have proposed various urban densification strategies, such as corridor development, mixed land-uses, land infilling, and compact cities, to address the structural problems of South African cities (Naude & Green 2000; University of Pretoria 2001). A crucial problem facing metropolitan authorities is to define the most effective policies to attract development to priority development corridors and nodes. To achieve this, authorities need to understand the locational choice behaviour of the various urban activities and need to quantify the demand elasticities of the main factors driving locational choice.

Internationally and locally, planners have used aggregate land-use transport models to test the impact of urban densification policies on land-use and transport patterns. However, these models are based on coarse zoning systems, lack a behavioural basis explaining the numerous and complex choices of the urban land and transport users, and are sensitive to exogenous information that need to be supplied by the planner. The models are also data-hungry, time-consuming and costly to calibrate (Naude 1991; Crous 1989). Because of these problems, small-scale problem-specific techniques, such as discrete choice models, have become very popular among planners as they simulate choices of urban land and

transport users, are policy sensitive, flexible to include a large range of variables, and are less expensive (Meyer & Miller 1984).

During the last decade, large-scale integrated land-use transport models received renewed attention because of the progress made with activity-based surveys and models, and micro-simulation techniques. A few models are currently in the process of development (Waddel *et al* 2002; Timmermans *et al* 2002). These models have been motivated by the need for models with a behavioural basis and sensitivity to land-use and transport policies, and for the need to integrate land-use and transport decisions, instead of just interacting between conventional land-use and transport models. However, in view of the typical requirement of two-day activity-based surveys, and the extensive data requirements of these models, they would be less affordable for developing countries such as South Africa.

The approach of small-scale, problem-specific models, such as discrete choice models, is more appropriate and affordable for South Africa. Because of problems of calibrating discrete choice models on revealed, or observed preferences (RP), of users, stated preference (SP) survey techniques have become very popular. These involve describing alternative options in terms of combinations of the levels of the attributes of options and requesting respondents to rank the options or choose the preferred option.

For the purposes of strategic urban land-use and transport planning, the modelling of the discrete choices of businesses received very little attention. Such choices are mainly analysed from the business unit's perspective in terms of optimal site selection.

Determining the best location for its retail outlets is one of the most crucial decisions of any retail business, forming part of the overall retail marketing strategy (Mason & Mayer 1990). Location choice has a major impact on the profitability and market share of a retail business. The best location is the one that will maximise profit and market share, and build the image of the business. As such, the location needs to be conveniently located for the target market. Various sub-areas are evaluated by means of matching the target profile of consumers to the actual profile of each sub-area together with the location of competing businesses, using spatial analyses. Transport factors also play an important role in locational choice, such as the transport network, traffic volumes, traffic mix, and the road condition.

From a literature review it was concluded that a behavioural retail location model using stated preference techniques would be in support of various needs expressed by the international planning profession and would also be in line with modern planning and modelling trends. Research conducted for the purposes of the author's PhD thesis at the University of Stellenbosch has therefore aimed to address the understanding of the locational choice behaviour of retail businesses in strategic spatial terms, in order to assist metropolitan authorities and planners to formulate effective urban densification strategies and to manage suburbanisation. SP modelling was selected as the most appropriate method to determine the relative impact of locational choice factors of retail activities on suburbanisation. Retail development is one of the major forces driving suburbanisation and urban sprawl in South Africa, and it is also one of the main providers of job opportunities in the nine main economic sectors.

OBJECTIVES OF RESEARCH AND STRUCTURE OF PAPER

The following were the main objectives formulated for the research that are also presented in this paper:

- to determine the relative importance and impact of locational choice factors on retail suburbanisation by means of a sample survey among retail managers in Cape Town
- to test the performance of SP models to simulate the strategic locational choices of retail managers
- to formulate policies that would be most effective in promoting urban densification and managing suburbanisation

The paper discusses the market research conducted among retail managers in Cape Town and the quantification of the relative importance and elasticities of locational choice factors of the retail managers. The testing of decentralisation strategies with a retail location spreadsheet model based on the SP model results is also discussed, as well as policies to promote urban densification and manage suburbanisation.

PROFILE OF RETAIL BUSINESSES IN CAPE TOWN

Market research involving personal interviews of an area-stratified sample of 120 retail managers was conducted among CBD and suburban retail business managers. The sample design and sampling strategy were defined as follows:

- The CBD sample of 40 consisted of 19 street-front shops and 21 shops in shopping centres.
- The high-income sample of 40 was drawn from Bellville, Durbanville and Parow East, and consisted mostly of shops in shopping centres.
- The low-income sample of 40 was drawn from Nyanga, Langa, Kayelitsha, Gugulethu and Mitchell's Plain, and consisted mostly of shopping centres.
- To simplify the decision-making context, the sample focused on small to medium-sized shops with single owners. Large chain stores, where location decisions are made at corporate boardroom level, were excluded.
- The sample covered a wide range of merchandise, but services such as hair salons and cinemas were excluded.

The questionnaire, which was pilot-tested, consisted of the following three parts:

- background information characterising the shop in terms of size, ownership, rent, changes in location, and accessibility to transport
- importance ratings of locational choice factors
- SP experiment on preference for CBD and suburb location

The results indicated significant differences in the profile and attitudes of retail businesses in the CBD, low-income and high-income suburbs. The following are a few highlights of the survey results:

- The vast majority of retail accommodation is rented rather than owned, although a significant proportion of low-income suburb accommodation is owned. The average rent differs widely between the locations, with the high-income suburb businesses paying much higher rent than the CBD businesses, which in turn pay higher rent than the low-income suburb businesses.
- Retail businesses were found to be fairly immobile with only a small proportion having relocated recently. CBD businesses indicated a higher turnover than suburban businesses. The different locations displayed the same average age, with no significant interaction between the age of the business at the current location and the level of mobility of the business. Businesses relocated mostly within CBD locations or within suburb locations, with a small proportion relocating from the CBD to the suburbs. These results indicate that decentralisation is mostly driven by new businesses locating in the suburbs rather than existing CBD businesses relocating to the suburbs.
- The reasons for relocating were mostly related to improved market potential, characteristics of the location and access to customers. Accessibility to the market, therefore, played a major role.
- Reasons given in support of or against retail managers' current locations were related to business conditions, established customers and familiarity with the location, the nature of the location, access to clients and to transport, rent, cost of relocation and competition from other businesses. Poor business condi-

tions and access to customers and passers-by featured more prominently among CBD retail managers, while rent and cost factors featured more prominently among low-income suburb businesses.

- Access to the main road network was reported as better by low-income suburb retail managers, followed by the CBD, with high-income suburb retail managers reporting the poorest access. Access to train was reported as good and similar in all locations. Access to bus and taxi stops was reported as better by suburban retail managers than by CBD retail managers.

Empirical evidence from secondary data sources were summarised to contextualise the sample survey. Spatial retail data were found to be very limited showing the little attention that attractors of transport receive as opposed to the generators of transport. The integrated business database that Statistics SA (2001) is developing is an important step in addressing a proper sampling frame for surveys of economic activity.

The actual level of decentralisation of retail space in Cape Town was estimated to be in the order of 71 % to 79 %. Decentralisation is expected to increase in future as the future level of decentralisation in terms of the amount of retail space under construction or planned was much higher, that is, 87 %.

ATTITUDES OF RETAIL MANAGERS REGARDING THE IMPORTANT FACTORS AFFECTING LOCATIONAL CHOICE

The attitudinal section of the questionnaire requested importance ratings of factors that retail managers would consider when choosing the best location for their shop. The 15 factors described in table 1 were specified and respondents were requested to rate each factor on a five-point scale from 'not important' to 'extremely important'. The importance scale is also given in table 1. The keywords in the table are used as labels in the description of the results. The importance ratings were aggregated by means of categorical judgement analysis (CJA). CJA software was used to estimate an importance weight for each factor, between zero and one, assuming a normal distribution (Torgeson 1958). Importance intervals were also estimated.

Figure 1 gives the importance weights of each factor on an importance scale, sorted from most important to least important, for four sample groups, that is, the total sample, the CBD sample, the high-income suburb sample, and the low-income suburb sample.

The CBD, low-income and high-income samples indicated interesting sim-

Table 1 Description and keywords of locational factors and importance ratings

FACTORS	KEYWORDS
Degree of traffic congestion on surrounding road network	TRAFFIC CONGESTION
Monthly rental for premises	RENT
Parking fees for customers	PARKING FEE
Size of shopping complex where shop is located	SIZE OF CENTRE
Distance of shop from freeway	FREEWAY
Distance of shop from major road arterial	MAIN ROAD
Availability of parking close to shop	PARKING AVAILABILITY
Proximity of shop to train station	TRAIN
Proximity of shop to suppliers	SUPPLIERS
Proximity of shop to other businesses	OTHER BUSINESSES
Degree of safety from crime in the area	CRIME
Aesthetic appeal of natural and built environment	AESTHETICS
Number and variety of shops and businesses in area	SHOPPING MIX
Proximity of shop to residential areas	RESIDENTIAL
Proximity of shop to large employment centres	EMPLOYMENT CENTRES
IMPORTANCE RATING SCALE	**KEYWORD**
Not important at all	NOT
Of little importance	LITTLE
Important	IMPORTANT
Very important	VERY
Extremely important	EXTREMELY

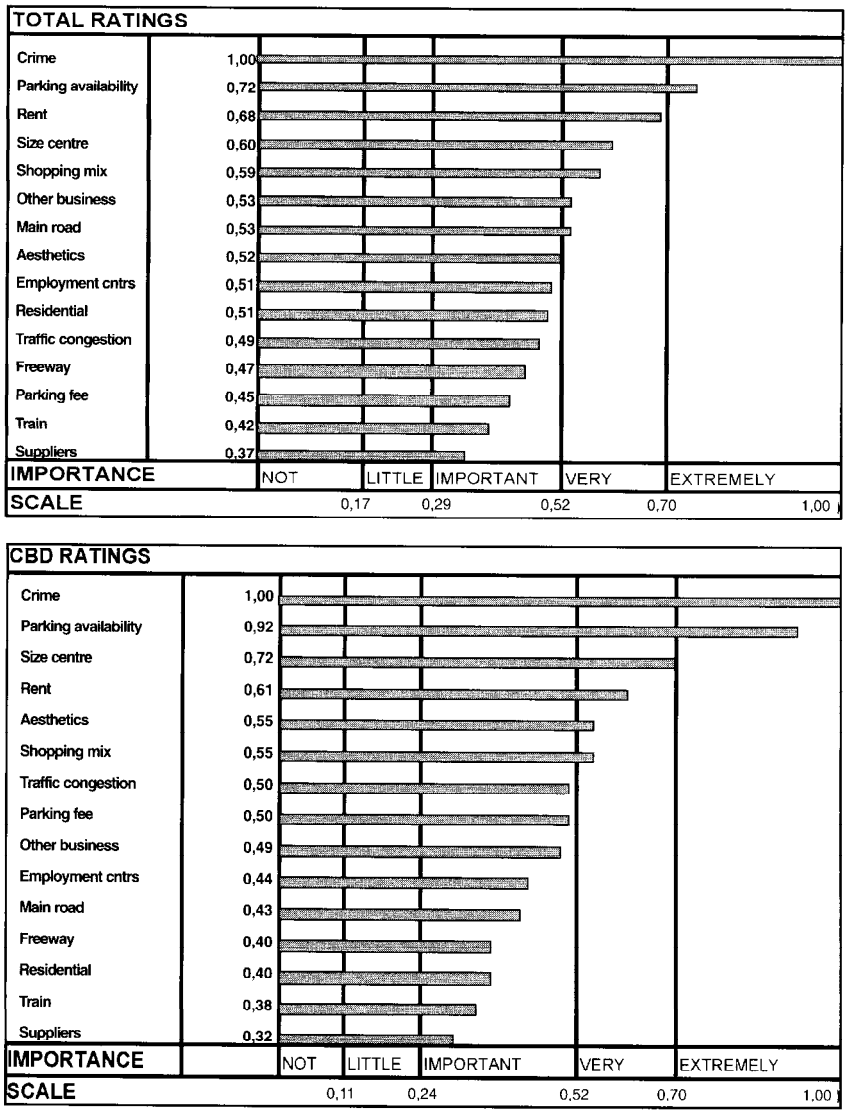
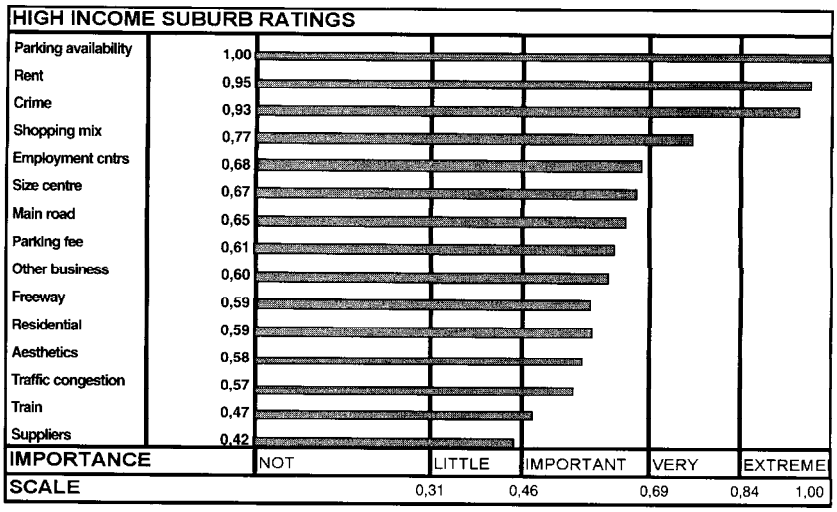


Figure 1 Importance weights and ratings of locational factors for various market segments *(continued on page 12)*



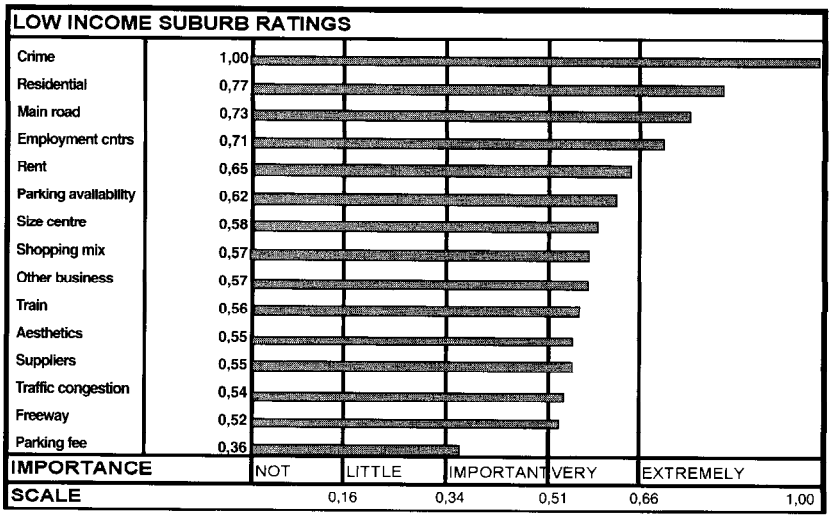


Figure 1 Importance weights and ratings of locational factors for various market segments (continued from page 11)

ilarities and differences. Fourteen of the 15 factors were rated as important to varying degrees, from important to extremely important, while only ' suppliers' was rated as of little importance in high-income suburbs.

Four factors were rated in all areas as either very or extremely important, namely 'crime', 'parking availability', 'rent' and 'shopping mix'. These factors should therefore be given special attention in any land-use transport policies regardless of whether it relates to the CBD or the suburbs.

In view of the seven most important factors, the factors that need most attention in land-use transport policies for each area are the following:

- *CBD*: 'Aesthetics', 'size of centre', 'traffic congestion' and 'parking fee'.
- *High-income suburbs*: 'Employment centres', 'size of centre' and 'main road'.
- *Low-income suburbs*: 'Main road', 'residential', 'employment centres' and 'size of centre'.

Low-income suburbs have an overall lack of infrastructure and economic base, and all aspects need special attention to meet the needs of retail managers and their customers, who have limited mobility.

In terms of the role of transport, provision of parking plays the dominant role for understandable reasons, while traffic congestion and parking fees in the CBD, and access to main roads in the suburbs also play a significant role.

The low importance of rail access implies that rail development, as a policy to attract businesses, will not be successful. This supports the international experience that rail projects are generally not successful to promote densification, unless coupled with strong land-use control.

CALIBRATION OF RETAIL LOCATIONAL CHOICE MODELS AND DEVELOPMENT OF A SPREADSHEET MODEL

Discrete locational choice models were calibrated, based on the stated preference responses and background data obtained as part of the retail survey conducted in Cape Town. The well-known ALOGIT calibration software was used to calibrate *binary logit models simulating retail* managers' choice between the CBD and the suburbs. The best model for the purpose of policy testing was subsequently used to develop a spreadsheet model in Excel format.

Issues relating to the application of discrete choice models to spatial decisions

A number of issues that need to be considered in the application of discrete choice models to spatial decisions have been identified from the literature review. These include the larger number of choice sets, the larger number of locational choice factors, the larger number of market segments, and the rarely revealed infrequent choices. The literature also identified the need to model both mobility choices, that is, the decision to relocate, and location choices. Because of the advantages of SP techniques to overcome the limitations of RP techniques, especially to address the rarely revealed spatial choices, they became popular in spatial and geographical contexts as well. The limited number of alternatives and attributes that can be incorporated in SP experiments to obtain reliable results, is an issue that needs to be addressed in the SP design in view of the need to address a large number of alternatives and attributes.

Table 2 SP variables and levels defined for SP experiment

SP variable	CBD levels	Suburban levels
1 Rent per square metre per month	R10 less or R10 more than now	R10 less or R10 more than now
2 Walking time from parking or public transport	2 to 7 minutes	2 to 7 minutes
3 Number of shops in shopping centre	Not applicable	40 to 120
4 Shop on major or minor road	Not applicable	Minor or major road
5 Low-income or high-income suburb	Not applicable	Low-income or high-income

In view of the more complex nature of spatial choices, some planners hypothesised that spatial choices follow non-compensatory behaviour. However, a few studies indicated that utility maximisation (compensatory) models provided similar good fits to the locational choice behaviour of managers compared to non-compensatory models (Miller & Lerman 1981). In view of the fact that the main objectives of the private sector is to maximise profits and market share, and to optimise business location, utility maximisation theory would be more appropriate.

Design of the SP experiment

In view of the complexities to model locational choices and the results of the pilot test of the initial SP design, it was decided to adopt a very simple design. This also supported the main objective to estimate the elasticities of choice factors rather than building complex choice models. The market research among Cape Town retail managers indicated that only a small percentage of businesses relocated (11 %). Mobility choice therefore does not play a significant role and was also not the focus of the research. To address the large number of choice factors it was decided to support the SP modelling with the attitudinal analyses of importance ratings, which was discussed in the previous section.

The most important factors influencing retail location choice were identified from international and local literature. In the pilot survey, importance ratings were obtained on each factor in order to define the most important factors for the SP experiment.

The main design features were as follows:

- Respondents were offered a simple binary choice between locating their business in the CBD or in the suburbs. A plausible reason for such a choice context was provided, that is, the respondent had to assume that he needed to expand his business and therefore had to look for alternative premises. Specific examples of possible CBD and suburban locations were given.
- Seven SP variables with two levels each were tested. These are described in table 2.
- The seven variables, each with two levels, yielded 128 choices for a full factorial design, that is, all possible combinations (number of choices = 27). The pilot test indicated that a partial factorial design of 16 choices per person introduced fatigue, and it was therefore decided to opt for a two-block design of 16 choices in total with 8 choices per respondent. This is a Resolution IV design, which means that only main effects can be estimated, but independently from two-way interactions. All interactions were assumed to be negligible.

An experimental design software package, DESIGN-EASE, was used to generate orthogonal designs. (Software supplied by Stat-Ease Corporation, USA.)

Calibration results of SP models

A wide range of models was calibrated to determine differences between market segments and to test the inclusion of various dummy RP variables. Table 3 gives the calibration statistics of some of the main models tested. The table gives the coefficient of each variable in the utility function used in the logit model and its t-value. The Rho-square value indicating the overall fit of the model is also given. Each row in the table gives information in a specific model. The column headings in the table give the variable names, whether the variable was included in the utility function of the CBD or the suburbs, as well as the measurement unit of the variables.

Some of the variables are indicated as dummy variables in table 3. These variables were all specified as having a value of either one or zero. For example, 'Centre location' assumes the value of one if the respondent is located in a shopping centre, and zero if he is not located in a centre. RP variables were entered in either the CBD's utility function or the suburbs' utility function.

Basic models

Models 1 and 2 test the difference in specifying the size of the shop in terms of square metres or in terms of total employment. Both the models yielded acceptable Rho-square values of 0,16 to 0,17, relative to a model including only alternative specific constants. According to Toner and Wardman (2000) a Rho-square value of between 0,2 and 0,4 indicates a good fit for binary choices, while values of less than 0,1 may also be acceptable in certain contexts.

All the SP variables are significant except for the walk time in the suburb. A t-value of greater than +1,96 for positive coefficients (or less than –1,96 for negative coefficients) indicates that the coefficient is significantly different to zero at a 95 % confidence level. The rent, suburb income (high- vs low-income suburb) and the existing location are highly significant with t-values between 7 and 8. The size of the shop in terms of employment is significant, while the physical size is less significant, that is, somewhat below 95 % confidence level.

The coefficients of models 1 and 2 have plausible signs with rent, walk time and size of shop regarded as impacting negatively on the share of the location, while road access (major versus minor road), size of the shopping centre and income of the suburb are regarded as positive. The existing location is positive and highly significant, showing the high inertia of retail managers to relocate.

The alternative specific constant (ASC) in models 1 and 2, which was attached to the suburb's utility function, is not significant, but the small positive value indicates some inherent preference for the suburb.

Access to parking and public transport is more of a problem in the CBD and this explains the significance of walk time in the CBD and its insignificance in the suburbs.

The shop size variable yielded a negative coefficient when specified as part of the CBD utility. It means that the retail managers of larger shops would prefer the suburb above the CBD probably due to physical constraints playing a role in the CBD, as well as transport problems of employees.

Significance of shopping centre versus street-front shops

In model 3 the better of the previous two models was used and a dummy variable added, indicating whether the shop is located in a shopping centre or whether it is a street-front shop. The shopping centre location variable is highly significant, and the overall performance of the model is increased – the Rho-square value increased from 0,17 to 0,20. The chi-square test was applied to the differences in the log-likelihood between the models. The test indicated that the addition of the centre location improved the model fit significantly in explaining location choice at a 95 % level of confidence.

Effects of product category

The inclusion of various product categories as RP dummy variables was also tested. The main difference between the product categories with regard to locational choice is whether they can be classified in terms of comparative or convenience shopping. A dummy variable indicating whether a shop sells comparative products or not was therefore created and included in the model. Model 4 in table 3 indicates that the comparative product category is significant and negative, indicating a preference of these retail managers for the suburbs. This is contrary to the conventional assumption of the strong market position of the CBD for comparative shopping, which indicates that suburban shopping centres are taking over this role from the CBD.

Monetary values of choice factors

The monetary value of the independent variables is calculated by taking the ratio of the coefficient of the relevant variable (utility per unit of variable) to the coefficient of the rent variable, which is expressed in utility per rands per square

Table 3 Retail location model calibration results: models calibrated on total sample (number of records = 978; significant coefficients are in bold)

	Rent (R/square metre per month)	Walk time CBD (mins)	Walk time Suburb (mins)	Road access Suburb (dummy-major/minor)	Size of centre Suburb (no of shops)	Income of area Suburb (dummy-high vs low)	Existing location CBD (dummy
Model 1							
Coefficient	-0,0126	-0,062	-0,027	0,314	0,004	1,179	1,099
t-values	-8,1	-2,1	-0,9	2,1	2,1	7,9	7,1
Model 2							
Coefficient	-0,013	-0,062	-0,027	0,314	0,004	1,183	1,120
t-values	-8,2	-2,1	-0,9	2,1	2,2	7,9	7,2
Model 3							
Coefficient	-0,018	-0,064	-0,029	0,329	0,004	1,235	0,665
t-values	-9,70	-2,10	-1,00	2,20	2,20	8,00	3,90
Model 4							
Coefficient	-0,013	-0,062	-0,027	0,316	0,004	1,187	0,691
t-values	-8,3	-2,1	-0,9	2,1	2,2	7,9	2,6

metre per month. The monetary values of variables are therefore expressed in terms of rands per square metre per month, and they provide a very useful way of interpreting the relative impacts of variables by regarding the values as the equivalent rent per month.

The following ranges in monetary values (equivalent monthly rental per square metre per month) were found among different market segments:

- The value of walk time to parking and transport facilities in the CBD: R3 per minute (suburbs) to R8 per minute (CBD).
- Location of the shop on a major road compared to minor road: R25 (shopping centres) to R58 (CBD).
- A large centre of 120 shops compared to a small centre of 40 shops: R17 (suburbs) to R25 (shopping centres).
- High-income versus low-income suburb: R49 (suburbs) to R172 (CBD).
- Location in a shopping centre versus street-front: R61 (suburbs) to R93 (CBD).

Calibration results of models including importance ratings

Research conducted by Del Mistro and Arentze (2002), which was also supported by empirical results of user preference studies in Durban and Cape Town (Van Zyl *et al* 2001; TRC Africa and Stewart Scott 2001), indicated that respondents' existing situation and perceptions of the alternatives currently available to them influenced their choices in the SP experiment. It seemed that they found it difficult to relate to a hypothetical choice situation and therefore tended to make choices according to their current perceptions of alternatives especially if the SP levels seemed unrealistic.

In order to test to what extent respondents' inherent attitudes towards different factors influenced their choices in the SP experiment, the importance ratings of the various choice factors collected in the survey were included as RP variables in the main SP model. The rating on each factor, on the five-point scale, was duplicated for each SP choice for a particular respondent, similar to the process followed for other RP variables.

The ratings were arbitrarily specified as part of the CBD utility function. The model shows an almost 50 % higher Rho-square value, in the order of 0,26, than model 2 in table 3. In terms of the Chi-square test, the importance ratings had a significant impact on the explanation of respondents' choices.

Most of the factors were significant in the model, that is, 11 of the 15 factors. The four factors that were not significant were 'parking fee', 'train access', 'main road access', and 'proximity to other businesses'. For two of these factors their low importance ratings correlated with their low significance in the model. The other two factors had average rankings, but were regarded as very important, which did not correlate well with the modelled results.

Of the seven factors ranked the lowest and rated as only 'important', only two were not significant in the model. Of the eight factors rated as 'very' to 'extremely important', all were significant, except two that were marginally significant.

Apart from a few outliers, there does seem to be a behavioural relationship between the importance ratings of factors and their significance in explaining the SP choices. Plausible conclusions are that retail managers who regard the following factors as very important would tend to prefer the CBD:

- access to high-order road network
- access to suppliers
- conglomeration benefits resulting from close proximity to other businesses and shops

Retail managers who regard the following factors as important would tend to prefer the suburbs:

- rent of retail space
- size of shopping centre
- safety from crime
- aesthetically pleasing environment
- proximity to residential areas

The fact that respondents' inherent attitudes also affected their SP choices is jeopardising the main objective of the SP

Size of shop CBD	Centre location Suburb (dummy)	Comparative products CBD (dummy)	ASC suburb	Log likelihood	Rho Sq (cons)
GLA sq m -0,0002 -1,7			0,402 1,40	-552	0,16
No of employees -0,011 -2,3			0,360 1,3	-551	0,17
No of employees -0,011 -2,40	1,28 6,1		-0,43 -1,40	-531	0,20
No of employees -0,021 -2,6		-0,515 -2,0	-0,039 -0,1	-548	0,17

technique, that is, to conduct a controlled experiment in order to test respondents' preferences in view of the specified SP variables. Further research is needed in this regard, but attitudinal ratings as part of a more comprehensive pilot test and as part of the SP survey would seem to be very beneficial in assisting the interpretation of the SP results.

Development of spreadsheet model

A spreadsheet is the ideal tool for quick, easy and transparent application of discrete choice models. A spreadsheet model was therefore developed to facilitate easy testing of suburbanisation policies and scenarios.

The most reliable type of application of the logit model on the input data is the technique of sample enumeration. This means that the model is applied to each record or interview conducted during the sample survey. The model output, in the form of the probability of choosing each alternative, is calculated for each respondent and then these are aggregated over the whole sample or segments of the sample. The survey data was used to estimate realistic values for the various attributes of the CBD and suburb location for each retail manager represented in the database. The logit model was subse-

Table 4 Summary of elasticities and importance ratings of choice factors impacting on the market share of various retail locations

	CBC		High-income suburb		Low-income suburb	
FACTORS	Elasticity	Importance	Elasticity	Importance	Elasticity	Importance
Crime		EXT		EXT		EXT
Parking availability		EXT		EXT		VERY
Size of centre suburb	0,32 HIGH	VERY	0,17 MED	IMP	0,32 HIGH	VERY
Rent	0,4 HIGH	VERY	0,41 HIGH	EXT	0,84 HIGH	VERY
Aesthetics		VERY		IMP		VERY
Shopping mix		VERY		VERY		VERY
Traffic congestion		IMP		IMP		VERY
Parking fee CBD	0,14 MED	IMP	0,05 LOW	IMP	0,07 LOW	IMP
Proximity other businesses		IMP		IMP		VERY
Employment centres		IMP		IMP		EXT
Main road access suburb	0,04 LOW	IMP	0,01 LOW	IMP	0,01 LOW	EXT
Freeway access		IMP		IMP		VERY
Proximity residential		IMP		IMP		EXT
Train access		IMP		IMP		VERY
Proximity suppliers		IMP		LIT		VERY
Income suburb	0,32 HIGH		0,17 MED		0,28 MED	
Walk time CBD	0,19 MED		0,07 LOW		0,09 LOW	
Walk time suburb	0,08 LOW		0,04 LOW		0,08 LOW	
Size of shop CBD	0,03 LOW		0,01 LOW		0,02 LOW	
Centre location	0,17 MED		0,46 HIGH		0,19 MED	
Comparative products	0,12 MED		0,09 LOW		0,09 LOW	

quently applied to these attributes.

Although the calibrated model contained only a binary choice between the CBD and suburb locations, it was decided to apply the model for three locational choices to improve the policy testing capabilities of the model. The suburb alternative was therefore divided into low-income and high-income suburbs.

The spreadsheet model also adjusts the constants of the alternative locations so that the modelled market shares are equal to the observed market shares entered by the user.

ELASTICITIES OF LOCATIONAL CHOICE FACTORS

The elasticity of the dependent variable in any model with respect to a change in a specific independent variable is typically defined as the percentage change in the dependent variable as a result of a 1 % change in the independent variable. Elasticities were calculated in two ways: by applying the calibrated models on the SP values using the ALOGIT software, and by using the spreadsheet retail location model, described in the previous section.

In general terms, if the elasticity of a factor is in the order of 1 or higher the factor is regarded as elastic, while values below one is regarded as relatively inelastic. However, in terms of locational choices, changes take place slowly over time as a result of a large number of complex factors that determine natural growth in development and relocation of businesses. In view of the fact that various economic and commercial factors act as constraints to the growth in the number of retail outlets and relocation of businesses, the demand for CBD versus suburb locations estimated by the SP model must be regarded as latent demand. The actual choices to relocate or open up new outlets would therefore lag behind the latent demand as indicated by the SP model.

The following more appropriate guideline has therefore been used to classify choice factors in terms of the degree of elasticity:

- elasticities above 0,3 – high
- elasticities between 0,1 and 0,3 – medium
- elasticities below 0,1 – low

A comparison of the elasticities between those provided by the ALOGIT software and those provided by the spreadsheet model indicated fairly similar values within the above classification. Table 4 summarises the elasticities of choice factors impacting on the market share of various retail locations from the spreadsheet model, supplemented by those obtained from the ALOGIT software. The highest value of the direct elasticity and the cross elasticity of a factor was used as the criterion. The table also indicates the importance ratings of choice factors obtained from the Categorical Judgement Analysis. Empty cells indicate that the elasticity or importance rating is not available.

The suburbanisation impact matrix in table 4 can be used as a sketch-planning tool to get an initial idea of the most effective policy factors to control suburbanisation, revitalise the CBD, or attract retail businesses to a priority corridor or node.

The results in table 4 indicate that there is a strong relationship between the elasticities and the importance ratings. Land-use and economic factors such as rent, size of shopping centres, location of shops in shopping centres as opposed to street front, and market potential (income) of the suburbs have the highest elasticities. Although transport-related factors such as parking fees and access to parking and transport facilities in the CBD have elasticities in the medium range, they would in combination have a higher impact. The choice factors that have medium to high elasticities, or importance ratings of very to extremely important, need to receive the highest priority in policies aimed at managing suburbanisation.

TESTING OF DECENTRALISATION SCENARIOS

The spreadsheet model discussed in the previous section was applied to test various decentralisation scenarios.

A trend scenario was formulated to determine the impact on decentralisation if locational forces are allowed to follow past trends. To determine how effective a combination of various interventions would be to reduce the trend in decentralisation, a managed decentralisation scenario was also formulated and tested.

Values of the independent variables, or locational choice factors, were estimated for both the trend scenario and the managed decentralisation scenario from various data sources. Planning reports of the Cape Town Metropolitan Council (CMC), bulletins of Statistics SA, and Rode's retail reports were used for this purpose (CMC 1998; Rode & Rode 1990).

A time horizon of ten years was used. The percentage change in the value of each locational choice factor over a ten-year period was used as the multiplier factor defined in the spreadsheet.

In view of the lack of trend data and the potential significant impact of the large regional Canal Walk shopping centre recently developed in Cape Town, it was decided to formulate two trend scenarios – with and without the Canal Walk centre. Canal Walk is part of a larger development, Century City, some ten minutes' drive from the CBD along the N1 freeway. It is a typical suburban shopping centre aimed at the higher-income car owner and easily accessible from the freeway from a dedicated interchange.

The managed decentralisation scenario assumed that

- a levy would be charged on the suburban properties to reduce the rela-

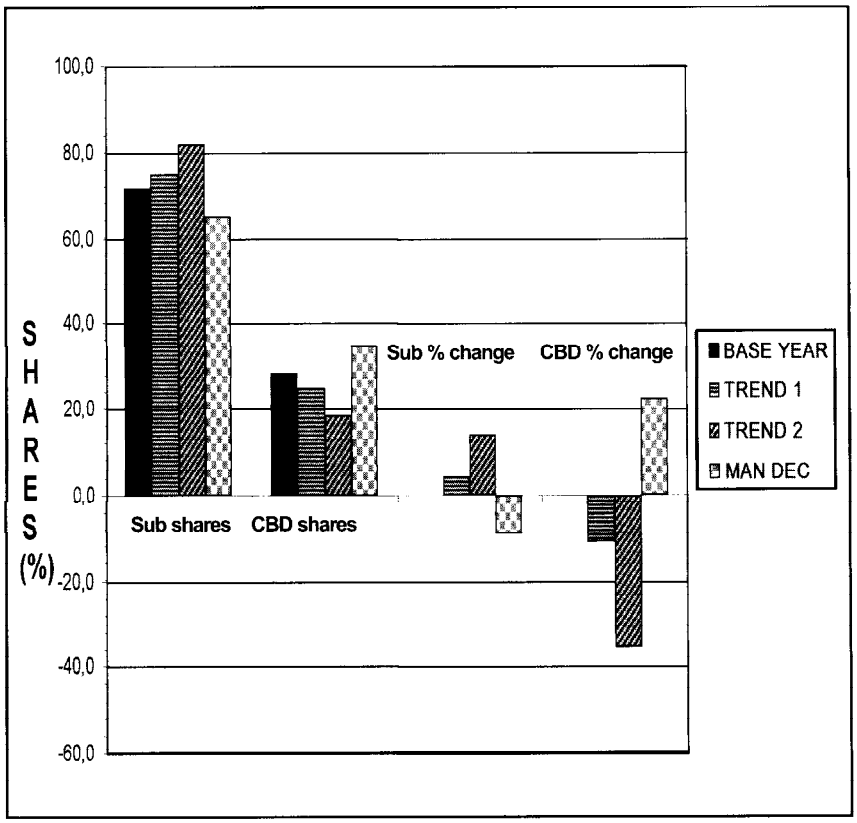


Figure 2 Graphical illustration of impact of decentralisation scenarios on CBD and suburb shares (%)

tive growth in rent between the CBD and the suburbs
- the relative growth in parking fees of the CBD compared to the suburbs would decline as a result of a parking fee policy that would favour shoppers in the CBD
- the growth in walk access time would be reduced by reducing traffic congestion in the CBD and making more short-term parking space available for shoppers by means of an appropriate parking policy
- relative growth in the supply of shopping centres between the CBD and the suburbs through supply management in line with demand would occur.

Impact of retail decentralisation trend and management scenarios

Figure 2 illustrates the percentage change in the shares of the CBD and the suburbs for each of the scenarios.

The trend scenario, excluding the impact of the Canal Walk centre, reduces the share of the CBD with 11 % over ten years, and increases the share of the suburbs with 4,4 %. The Canal Walk centre has a major impact on decentralisation – the share of the CBD reduces with 35 % and increases the share of the suburbs with 14 %.

In contrast, the managed decentralisation scenario indicates that a combination of strategies to attract retail businesses to the CBD would have a significant and positive impact on the share of the CBD, in the order of a 23 % increase in share.

In terms of the typical changes in the locational factors over a ten-year period, the accessibility to the suburb market and the relative changes in rent between the CBD and the suburbs have the highest individual impact. The results demonstrate that despite the positive impact of the lower growth in rent in the CBD compared to the suburbs, negative factors impacting on the CBD outweigh this positive impact.

The typical changes in the accessibility and parking fees of the CBD also have significant impacts, followed by the size of shopping centres in the suburbs. The change in road access of suburban centres has a limited impact.

POLICY GUIDELINES FOR METROPOLITAN AUTHORITIES TO MANAGE URBAN DECENTRALISATION

From the identification of the significant choice factors impacting on the locational choices of retail managers, policies and strategies can be formulated to manage suburbanisation. A brief summary is given here of the main policies and strategies that would be effective to manage suburbanisation.

- Policies can be classified into those improving the attractiveness of the CBD and those addressing the suburban areas. To have any impact, policies must address both categories comprehensively. Such a strategy calls for a comprehensive and integrated approach. Authorities must address management and institutional issues at the highest level to ensure that all role players support and actively pursue identified strategies. The creation of transport authorities provided by the National Land Transport Transition Act (Act 22 of 2000) is important to integrate policies as it will put all the transport factors under the control of a single authority.
- The increasingly high intensity of media reports on the rapid decay of CBDs in South Africa indicates that this matter must be treated with the utmost urgency by metropolitan authorities. The big cities have already started with programmes such as business improvement districts to address the basic factors such as crime, hawking and the quality of the environment. The results of the Cape Town's research showed that before even trying to address the higher-level land-use and transport factors impacting on the CBD's livelihood, the serious impact of rising crime and uncontrolled hawking must first be addressed. This was seen as the most important factor by CBD and suburban retail managers.
- When formulating incentives and disincentives, authorities should consider the importance weights and choice elasticities of business managers. The weights and elasticities identified for Cape Town's retail managers can be used as a point of departure. The elasticities and weights give a good indication of the likely impact of the various incentives and disincentives of various measures.
- Financial measures will have the highest impact as indicated by the high elasticity of the rent variable. Levies charged to businesses and developers in undesirable areas can be used to provide tax incentives to those locating to priority areas. Cape Town's experience indicated that businesses are willing to pay an extra levy in exchange for the council guaranteeing improved services and increased security (*Die Burger*, 10 July 2001).
- The characteristics of the shopping node, such as the number and mix of shops, and size of the centre have a significant impact on the attractiveness of the node, as indicated by the elasticities and importance ratings of these factors. Economic considerations such as the market potential of the suburb also have a significant impact. These factors may also be used by authorities to attract business back to the CBD or areas close to the CBD, as indicated by the Waterfront development in Cape Town and the Foreshore Conference Centre. Convenient, high-frequency distribution services between the node and the CBD will ensure that the CBD will also reap the benefits of the development.
- Although authorities do not have a direct influence on the nature of the development and economic market forces, they can use the elasticities of choice factors to determine the impact of new developments on the likely shifts in demand from existing to new developments. To protect the CBD and other existing business nodes, some overseas countries, such as the Netherlands, require developers to conduct an impact study to show that there is sufficient overall demand and that their development will not impact negatively on established nodes (Van der Schuren & Van Maarseveen 2001).
- Promoting residential activities in the CBD is another strategy to exploit the high importance of accessibility to residential areas. Although this strategy can have a positive impact on the livelihood of the CBD, the security situation and management of sectional-title deed properties must first be addressed for banks to be persuaded to withdraw their moratorium on loans in the CBDs of some South African cities (*Finansies & Tegniek*, 5 October 2001).
- Transport access, especially by car to the CBD, also has significant impacts on suburbanisation and these factors are under the direct control of the authorities. Authorities must give new attention to parking supply and pricing policies. Care must be taken not to chase car users away as the attractiveness of the CBD is very sensitive to car access. However, carefully designed policies can make more short-term parking available to shoppers, promote public transport and reduce congestion. Clark quantified the huge parking subsidies paid by employers to their car-owning employees in Cape Town CBD (Clark & Crous 2000). They indicated that an extra levy on long-term parking will be affordable and that these funds can be used to promote public transport access to the CBD.
- Large-scale new rail projects are not appropriate solutions for managing suburbanisation as indicated by mostly negative international experience, supported by the low importance ratings of rail access as a locational choice factor by Cape Town retail managers. Upgrading of existing rail infrastructure and services, together

with proactive land development around stations, would have the best chance of success.

- The high importance rating of most choice factors by retail managers in low-income suburbs is indicative of the overall lack of infrastructure and economic base of these areas. All aspects need special attention to meet the needs of these retail managers and their customers who have limited mobility.
- Strategies to promote the densification of priority corridors and nodes will also have to address the transport needs of public transport captive users. The user preference studies in Durban and Cape Town indicated the mode choice factors that are important to captive public transport users (Van Zyl *et al* 2001; TRC Africa and Stewart Scott 2001). These factors, such as fare, door-to-door travel time, transfers and security, should be addressed together with any urban densification strategies to be of any benefit to public transport users. Properly designed integrated rail services can attract significant additional demand from bus and taxi users, but any such rail-based policy should first address the security and image of train to be successful.

CONCLUSIONS AND RECOMMENDATIONS

The main objective of the research to determine the relative impact of various retail locational choice factors on suburbanisation was achieved. It was demonstrated that SP modelling techniques could be successfully applied to retail locational choice, despite the complexities of estimating SP models on long-term locational choice. However, a number of problems were identified and the lessons learned would be able to assist future applications and guide research.

A significant finding was the strong subjective influence of respondents' attitudes on their stated preferences. Increased sample size, more attention to focus groups and the collection of attitudinal information to support the SP modelling, are important considerations. Development of survey techniques to calibrate RP locational choice models, the investigation of non-compensatory models, and the incorporation of important qualitative variables in the SP experiment, are important research needs.

Elasticities were estimated for all the factors in the locational choice model and for various retail segments. The elasticities were used to identify the most effective policies to manage suburbanisation. The calibrated models performed sufficiently well to be applied for policy testing purposes.

It is recommended that metropolitan authorities and urban planners in South Africa can fruitfully use the results of this research in the following ways:

- using the elasticities and importance weights of retail locational factors quantified by this research as a sketch-planning tool to devise incentive and disincentive measures to manage suburbanisation and to promote corridor and nodal development
- applying the retail locational spreadsheet model using local data to test and formulate appropriate policies to manage urban decentralisation
- following the guidelines of this research to conduct market research of business location choices and attitudes and to develop SP locational choice models to test suburbanisation and urban densification policies. These techniques could be easily interfaced with the existing strategic transport models of authorities.

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