THE COST TO EMPLOYERS OF LIMITING THE CATCHMENT SIZE FROM WHICH THEY EMPLOY THEIR STAFF

Authors

Viola Proctor, Post graduate student. Centre for Transport Studies, University of Cape Town. E-mail viola.proctor@uct.ac.za

Romano Del Mistro, Associate Professor. Centre for Transport Studies, University of Cape Town. Ph +27 21 650 2605 E-mail romano.delmistro@uct.ac.za

ABSTRACT

Cities in developing countries are expected to double in population over the next 25 years. The increasing cost of energy will have significant social consequences, especially for the urban poor who cannot absorb the increased cost of travel or access lower cost transport solutions. Transport contributed 23% of CO2 emissions in 2007 (WCTRS, 2011). These changes will affect business as the need to reduce CO2 emissions becomes more urgent. One important part of the solution will be to minimise travel between home and work. This can be achieved by shifts to greater use of public transport and also by reducing distances travelled.

Reducing travel distance implies reducing the number of trip end choices, the need to determine the "cost" of reducing these choices and even determining the amount of "sufficient" choice; beyond which additional choice only brings marginal benefits.

Information from the human resources department of major employers in Cape Town in 2012, illustrated the current situation where employee commuting costs are not borne by employers. Decision-makers in a number of large Cape Town companies completed a stated preference survey that investigated employer's decisions in a hypothetical context where employee commuting incurs costs (e.g. CO2 emissions and public transport fares) were also taken into account.

This paper describes the implications of reduced employee catchment size on employers. It explores the range of perspectives on this issue and discusses what scope there is for influencing urban planning and settlement policy so that travel distances are minimised while employers still have 'sufficient' choice, or employee selection opportunities, in the labour market.

Key words: Sufficient accessibility, urban structure, motorised travel, stated preference.

INTRODUCTION

In South Africa, Apartheid has left an urban legacy with excessive commuting distances for the low income classes. In Cape Town, low income commuters travel 16 km to work on average; and almost 20% spend more than 20 % of income on commuting (NDOT, 2003).

Transport costs are expected to rise significantly as a result of "Peak Oil". The poor will struggle to absorb these increased costs and it will become increasingly difficult for the low income and even middle income population to afford the cost of commuting. It is necessary therefore that an attempt be made to

restructure our cities to reduce / minimize the need for motorised travel to places of work, education, retail, community services, recreation, etc.

The world is becoming increasingly concerned with Climate Change and motorized transport has been identified as a major contributor (i.e. 23% of CO2 emissions in 2007, which is expected to grow still further in percentage and amount) (WCTRS, 2011).Literature on reducing the impact of motorised transport on climate change tends to focus on developing new technology (e.g. more efficient fuels and vehicles, green energy) and public transport solutions to attract car users (NDOT, 2003).

However, these 'low carbon' solutions are not appropriate in developing cities such as Cape Town, where the poor populations already use public transport and it is unlikely that governments will have the resources to pay additional subsidies to mitigate increasing transport costs.

Consequently a proposal to restructure the city where the need for motorized travel is significantly reduced will not only assist the poor but also mitigate climate change.

Cities in developing countries are expected to double in population over the next 25 years(Del Mistro, 2011).There is the potential to consciously locate the additional population, related work opportunities and land uses in such a way to reduce the dependency on motorised travel. The political will to implement a more appropriate city structure depends on the ability of the politicians and public to recognize the problem and that solutions exist to at least mitigate it. This requires an understanding of both the benefits and the costs implicit in any solution.

The benefits of shorter commuting distances, savings on cost of commuting and CO2 emissions are obvious. However, the reduction in the number of destinations that will be accessible to fulfil a trip's purpose will be seen to be a cost; because the purpose of urban transport has traditionally been to increase accessibility between urban areas.

This paper discusses research to understand one part of the costs and benefits of the concept of city restructuring; specifically the costs and benefits to employers of different employee catchments. The research investigated if there is "a point where increasing the size of the catchment of employees does not produce additional benefits to the employer."[1]

A REVIEW OF THE LITERATURE

Relationship between increased choice and benefit

As expected, no research could be found that discussed the benefits from reducing accessibility since the objective of transport has always been to increase accessibility. As a result, research on consumer preference was found in the fields of psychology, market research and economics was explored to give confidence to the possibility that the hypothesis might also apply to accessibility.

One clear pattern emerged from the studies reviewed: Increased choice can have a positive or negative effect on satisfaction depending on the context. There is no single formula that applies to all situations.

In the review of the literature, examples were found where increased choice (see Figure 1):

a) Produced increasing benefits. (Koelemeijijer & Oppewal, 1999, regarding the number of products offered by stores; Scheibehenne et al., 2010, in a meta-analysis of 50 "choice" studies)

[1]This research project forms part of a larger research project: Project 12; City Restructuring in which three other research projects are currently underway on excess commuting, the effect of informality on transport and the cost of reduced accessible work opportunities on employees. This research was funded by the Volvo Research and Education Foundation (VREF) through the African Center of Excellences for Studies in Public and Non motorized Transport (ACET).

b) Produced increased benefit but at a declining rate (Coombs and Avrunin, 1977, regarding consumer satisfaction).
c) Produced increasing benefits initially but declined after a certain point, producing an inverted U. This was reflected in a study of jams by Iyengar and Lepper (2000), store sales for Reutskaja and Hogarth(2009), varieties of Head & Shoulder brands (Goldstein, 2000) and many other studies (Oulasvirta, Hukkinen, & Schwartz, 2009; Reutskaja & Hogarth, 2009).

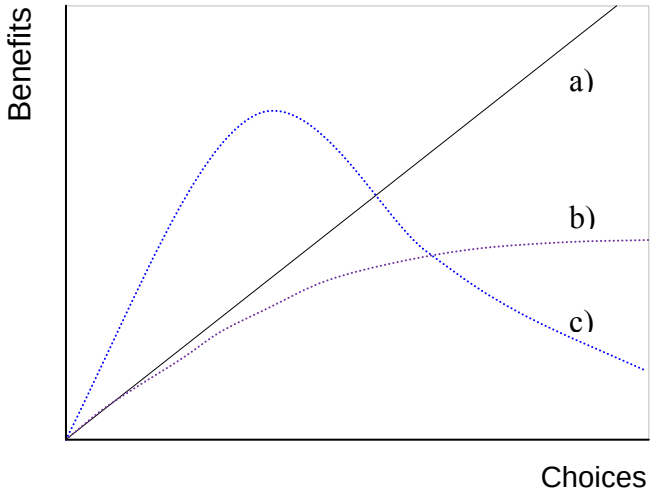

Figure 1 Three Relationships between Choice and Benefits

The effect of 'too much choice' for consumers of goods

A significant subset of the literature reviewed suggested that greater satisfaction results from choices made from a limited range of products.

It seems evident that there is an increased cost of choosing from more options; it takes longer for consumers to make a choice (Scheibehenne et al, 2009).This trend is also reflected in the declining quality of answers and confidence in making the correct choice also decreases as the number of options presented increases. This was shown in studies involving essay grades from increasing topics provided (Iyengar & Lepper, 2000)and answers given from a increasing numbers of search engine results (Oulasvirta et al., 2009).

In the literature, this situation is referred to as too-much-choice-effect, choice overload or hyper-choice (Botti & McGill, 2006; Bryant et al, 2007; Oulasvirta et al., 2009; Reutskaja & Hogarth, 2009; Scheibehenne et al., 2009; Schwartz, 2005 b).

Evidence in the literature of the existence of "too much choice" in many disciplines provided the confidence to search for this to also exist in transport.

The effect of limiting choice on employers

Given that the employer is the focus of the study, this section briefly examines the factors that affect employer's decisions regarding the selection of an employee and business location and whether the travel requirements of the employee is one of these factors.

The importance of employee travel to employers

Minimising employee commuting does not seem to be an important factor when considering staff selection or business location. Currently, the literature suggests, employers make these decisions based on the principle of minimising the immediate financial cost and maximising short-term profit (Parr, 2002).

Different employers have different priorities depending on the type of business or industry, so it is difficult to generalise. Literature finds that proximity to a stable and reliable labour supply is a consideration for large, labour-intensive factories, but not for most commercial and smaller manufacturing enterprises (Okamoto, 2007; Sridhar & Wan, 2010).

The commuting patterns of staff do affect employers, although this may not be their top priority in recruitment or location decisions. Employers admit to experiencing the following costs of current commuting patterns: staff lateness and delays resulting from traffic congestion and/ public transport inefficiencies(Bristol University, 2007; Coleman, 2000); high parking costs (Bristol University, 2007; Coleman, 2000), as well as tiredness and reduced efficiency resulting from long commuting distances (Mawson et al., 2007).

The solution at the moment is to encourage cheaper and more environmentally friendly transport options. They do not confront the question of whether changing staff selection policies or the location of enterprises should be considered.

Internationally, employers are beginning to support sustainable commuting

There is a body of literature that describes examples of employers making commuting more sustainable by implementing measures such as flexitime, work from home, public transport incentives, etc.

The UK has implemented legislation for the introduction of Green Commuter Plans to force business to consider green commuting and the social, environmental and financial costs of current commuting patterns (Coleman, 2000). The majority of employers do not see themselves to be responsible for mitigating the environmental effects of employee commuting and are reluctant to implement a Green Commuter Plan - it is seen as unnecessary and costly (Rye, 2005).Employers demand viable public transport alternatives, central government legislation and tax and other incentives to be in place before implementing Green Commuter Plans(Coleman, 2000; Rye, 2005).

Despite this, there are many companies, mostly internationally, that have introduced measures to help their staff with the costs and modes of commuting.

Reducing CO2 emissions: There are many different company policies to encourage and incentivise the use of public transport (e.g. Aspen Valley Hospital, 2010; “Work, Job and Income,” 2010; Lawyers.com, 2010; United Nations, 2004), incentivise car pooling (Aspen Valley Hospital, 2010; Shoup, 1997; Lawyers.com, 2010), run awareness programmes for staff encouraging modal shift and reducing carbon emissions (United Nations, n.d.-c) and allow flexible working hours to reduce congestion and encourage working from home to reduce commuting (United Nations, n.d.-b)).

Subsidizing employee commuting costs: Some companies contribute to the costs of employee commuting in various ways that can overlap with the incentives to use public transport mentioned above(Aspen Valley Hospital, 2010; “Work, Job and Income,” 2010; Lawyers.com, 2010; United Nations, 2004). Some companies offer private mass transit services such as work busses (Lawyers.com, 2010; United Nations, 2004) and transport allowances separate from salary, to reduce the burden of travel on staff (South African Department of Labour, n.d.).

Measures to reduce travel: There are a few measures that attempt to reduce travel in itself. Companies decide to employ locally or incentivise workers to move nearer to where they work (City of Trenton, 2011; State of New Jersey Housing and Mortgage Finance Agency, 2011; United Nations, n.d.-a) and try to minimise business travel (International or Intercity) (United Nations, n.d.-a, n.d.-d, n.d.-e, n.d.-f).

While these companies do give some priority to employee commuting, the largest positive impact of all these measures lies in reduced emissions (from reduced motorcar usage), which is significantly lessened in SA and other developing countries where most working commuters do not have private motor vehicles and already use public transport. There are other costs of commuting that need to be considered before promoting a solution that is more suitable for developing cities.

The real costs of current travel patterns

The real cost of current commuting behaviour in Cape Town is carried by the employee and the environment.

The ***environmental costs*** of these patterns include high carbon dioxide emissions that aggravate Climate Change effects (National Planning Commission, 2011), air pollution and health issues (Bristol University, 2007). The spatial layout and limited public transport in Cape Town result in long travel distances by car (African Centre for Cities, 2011; National Planning Commission, 2011) resulting in injuries and deaths from road accidents (National Planning Commission, 2011).

The ***social costs*** of these travel patterns are mainly carried by the workers themselves and their families. Long travel distances and long travel times have negative effects on the quality of life and work of the commuter (National Planning Commission, 2011). Low income workers carry the larger proportion of the impacts of travelling times and distances (Aguiléra, Wenglenski, & Proulhac, 2009). As a result, tiredness and low energy affects both employee work performance and family life (Mawson et al., 2007).

Employees experience a reduction in quality of life. Their disposable income decreases as travel costs increase from either increased travel distance or increasing cost of travel (increasing oil price or a carbon emissions tax for example) (Del Mistro & Proctor, 2012).

Employees are forced to make a difficult trade-off with regard to high land costs with shorter travel distances (close to jobs) versus longer distances with more affordable land (Okamoto, 2007). The incongruence between residence and work location is disturbing, especially for low income workers who have limited choices in residential locations that they can afford (National Planning Commission, 2011).

Low income workers have few alternative options to mitigate costs: they cannot afford to switch jobs or move closer to work when travel costs increase (Okamoto, 2007). This is a crucial point of this study.

Although employers are directly and indirectly affected by these social and environmental costs, they do not see the costs as high enough to make them change their current hiring and location practices. The majority of employers do not see themselves as having a role in changing employee travel behaviour (Coleman, 2000). Cape Town employers are likely to react with the same scepticism to policies encouraging the management of staff mobility.

In the past the environmental costs of car dependency, residential dispersions and long commuting distances have been ignored and not accounted for. Economists and the government are beginning to incorporate these environmental costs into the price of travel. This is in the form of CO2 taxes, Green “tolls”, taxes for driving into the city centre, etc. (Cartwright, 2011; National Planning Commission, 2011). Business and society will soon be forced to pay for their carbon footprints.

RESEARCH METHOD

Survey Design

Experiment design

Currently, the cost of employee travel does not affect the cost of employment to the employer, so it makes sense that a firm would like to be able to select the best employees from a wide selection. But as the cost of recruiting labour from long distances increases, it is expected that the benefits of unlimited choice will reduce. To investigate the value that employers place on having access to more employees is difficult. In this way, the costs of excessive employee commuting need to be made obvious to the employer and imposed upon them as a direct cost by means of a hypothetical situation. One way to elicit this value is to identify the trade-offs that employers make when faced with recruitment decisions. As a result, a stated preference survey was developed.

The hypothetical situation converted the costs of recruiting from far (expressed in terms of employee commuting costs) into direct costs to the employer. From literature and conversations with employers, the following variables, that influence employment decisions, were identified:

1. **The number of employees to choose from**. The recruitment pool from which employers could recruit from was varied among scenarios; i.e. the number of persons available to recruit from (i.e. potential employees changing jobs per month) was calculated within each increasing radial area. This was calculated using the Census 2001 (Statistics South Africa, 2001) population per suburb, of each applicable income level[2], and the average turnover rate of the company. Four radial catchment sizes (10km, 15km, 25km, 40km) were used in this study[3], with the firm's location as the centre point.
2. **Transport subsidy**. This is the difference between 8%[4] of an employee's salary and the transportation costs of commuting (based on the mode and distance they travel). Employees travelling by car, were not calculated to receive transport subsidies because they were more likely to have the option to shift to cheaper modes, move to residences or change jobs so that they were closer to each other.
3. **CO2 emissions.** The emissions from employee commuting add context to the recruitment decision and contribute to the carbon footprint of the firm itself. Nedbank found commuting contributes to approximately 20% of their total carbon footprint (Nedbank, 2011). Emission factors from 2011 DEFRA, combined with calculations to include the CO_2 from the production of petrol/diesel, were used to calculate CO_2 emissions per employee with distance (Sasol, 2011)[5].
4. **CO2 tax.** Companies will pay a "green tax" for their carbon emissions, a part of which are made up from commuting. These emissions are converted into a financial cost to the company in the form of a tax. The value of R120 ($15) per ton CO_2equivalent was used (DNA Economics & IMBEWU Sustainability Legal Specialists, 2012).

Sample population

Large companies[6] situated on a single site were randomly contacted. Construction companies, for example, could not be considered because they already transport their employees to various sites. Of the 20 companies approached, five companies agreed to participate in this study and satisfied the requirements. These companies span across the service sector (hospital), retail sector, public institution, academic institution[7] and consulting firm.

[2] Population figures were left the same as 2001, but income boundaries were adjusted to 2012 values using 5% inflation per annum.

[3] Four catchment sizes were used to prevent restriction of the relationship of distance (catchment size) with benefit/choice; i.e. this allows for parabolic, cubic and linear relationships between the variables.

[4] It was hypothesised that employees could not spend more than 8% of their income on commuting; and that employers would have to pay the difference. This was calculated from a study on affordability in Cape Town.

[5] 0,54 kgCO_2e/passenger km (car) and 0,1 kgCO_2e /passenger km (bus) were used in the model.

[6]Companies with more than 150 employees, taken from the Chamber of commerce website.

[7] Only non-academic staff were considered from this company. Academic staff are too specialized and often recruited at a national and international level.

Questionnaire design

This research was concerned with employees who have limited travel choices, i.e. the lower to middle income population who are vulnerable to fluctuations in transport costs. A number of assumptions were made to simplify the categorisation of employee income brackets. They were divided into two groups (levels); namely:

1) The first one relating to low to lower-middle income staff (earning between R3 000[8] – R10 000 per month) who were assumed to use Public Transport. Referred to as "Level 1 staff" in this paper.
2) The second involving middle income staff (earning between R10 001 – R30 000[9]) who were assumed to use Private Transport. Referred to as "Level 2 staff" in this paper.

The questionnaire consisted of three sections: a general introductory section, the stated preference questionnaire containing pairs of recruitment scenarios and the last section which collects general information on business location choice.

The questionnaire introduced the background to the study and the hypothetical scenario where this study assumed that employers will, pay for employees' "excessive" transport costs in a competitive market as part of the Total Cost of Employment. It explained that the interview was investigating the implications to their business if it were no longer practical to hire staff from the whole metropolitan area; but only from areas closer to their company.

A question followed this explanation that encouraged the employer to consider the costs and benefits of this hypothetical situation where the company would no longer have access to employees beyond a certain distance (or would pay highly for it).

Figures illustrating each company's current employee commuting profile (status quo) were used to provide context for the questionnaire and the recruitment choices that would be relevant to the employer. This status quo presented the company's current recruitment area (40km radius), the number of people (per income level) changing jobs per month[10], the weighted average distance of commuting and the corresponding average CO_2 emissions for each income level. These would serve as the baseline figures for the recruitment scenarios in the stated preference questions that followed.

The next four questions described two scenarios of the consequences of recruiting (regarding low to lower-middle income staff) and respondents selected their preferred scenario in each case. This was repeated with appropriate values for middle income employees.

Recruitment decisions were presented to the employers which included the following consequences (variables):

- The proportion of the company's current recruitment pool available to recruit from.
- The average distance travelled by the staff of the company per day.
- The change in the environmental impact (of CO_2 emissions) of staff commuting (in relation to the current emissions of the company).
- The financial cost of employee travel to the company. This cost is comprised of a transport subsidy to the employee and carbon tax to the government.

[8] This is the minimum wage in South Africa, so only permanent employees are included and not temporary staff.

[9] This was the value chosen because jobs above this income level have the tendency to be advertised on a national and even international level.

[10] Based on the company's average turnover rate and Census 2001 figures.

The last section gathered information on the advantages and disadvantages of the firm's current location and the importance of different factors affecting location of businesses.

Data collection

There were two phases to the data collection process. This initial phase involved the Human Resources department within the company providing the initial information[11]so that the values used in the stated questionnaire in second phase of face-to-face interviews with the managers involved in recruitment were realistic.

The Modelling Approach

The model results were obtained from a Multinomial Logit Model (MNL) which is based on the maximisation of utility theory.

Basic Utility Theory

Basic utility theory states that the choice between alternatives is assumed to be driven by the respondent's utility.

The respondent's utility is broken down into two components:- a deterministic component, which is a function of the observed attributes of alternatives, respondent characteristics and economic variables (such as income, price of goods, etc.); and an error term, which is a function of unobserved characteristics that may influence the respondent's choice. Formally this is represented as

$$Uit = Vit + \varepsilon it \qquad (1)$$

where *Uit* is the total utility of choosing alternative *i* to the decision maker *t*,

Vit is the observable (deterministic) portion of the utility which is estimated by the analyst, and

εit is the error component representing the influences that are unobservable by the researcher, but known to the individual.

The deterministic component V_{it} corresponds to influences that can be observed by the researcher, such as characteristics of the individual or observed attributes of alternative outcomes and descriptions of the choice context (Del Mistro & Hensher, 2009). The functional form of V_i can be expressed as linear, logarithmic or quadratic as illustrated below (Koppelman & Bhat, 2006; Hensher, Rose and Greene, 2005).

$$V_i=\beta_{0i} + \beta_{1i}f(X_{1i}) + \beta_{2i}f(X_{2i}) + \beta_{3i}f(X_{3i}) +...+ \beta_{ki}f(X_{ki})$$

Where *f* is the generalised notation for the functional form (these can be different for each attribute).

$\beta_{1i}$is the weight (or parameter)associated with attribute X_1 and alternative *I*

β_{0i} is parameter not associated with any of the observed and measured attributes, called the *alternative-specific constant*, which represents on average the role of all the unobserved sources of utility of the specific alternative.

[11]This information included the income bracket and the residential suburb of each employee in two salary brackets (namely R3000- R10000 and R10001 to R30 000 per month) and the date at which they joined the firm. Names, addresses or salaries of employees were not requested.

The underlying assumption is that individuals will try to choose an alternative that awards them the highest utility (Koppelman & Bhat, 2006). In other words, *"alternative 'i' is chosen amongst a set of alternatives, if and only if the utility of alternative 'i', is greater than or equal to the utility of all alternatives, 'j' in the choice set, C."*(Koppelman & Bhat, 2006).

Adapted from Koppelman & Bhat (2006), an individual *t* will choose alternative 'i' instead of alternative 'j' if $U_{it} > U_{jt}$ where $V_{it} + \varepsilon_{it} > V_{jt} + \varepsilon_{jt}$. Rearranging to place the observable and unobservable attributes together gives:

$$V_{it} - V_{jt} > \varepsilon_{jt} - \varepsilon_{it} \tag{2}$$

where $\varepsilon_{jt} - \varepsilon_{it}$ is unobservable and cannot be said for sure to be less than $V_{it} - V_{jt}$.

Thus the choice outcomes can therefore only be explained using probabilities (P) of occurrence; the probability that $\varepsilon_{jt} - \varepsilon_{it}$ will be less than $V_{it} - V_{jt}$:

$$P_i = P\left[\left\{\varepsilon(S, X_j) - \varepsilon(S, X_{i)}\right\} < \left\{V(S, X_{i)}) - V(S, X_j)\right\}\right] \tag{3}$$

where X_i, X_j are vectors of attributes describing alternatives i and j, respectively.

S_t is a vector to describe individual t in terms of the characteristics that influence his /her preferences among alternatives (Koppelman & Bhat, 2006).

It is assumed that when an individual makes a choice, the deterministic components of the alternatives are weighed up against one another and the probability of choosing alternative i is given as:

$$P_i = \frac{\exp(V_i)}{\sum_{j=1}^{J} \exp(V_j)} \tag{4}$$

which illustrates the probability of a decision-maker choosing alternative *i* when considering the systematic component (V_j) of the utility of all the alternatives *j*.

The MNL model assumes the error term to be defined by a Gumbel Distribution. The assumption of a normal distribution of error is theoretically more accurate in statistical literature, but is very complicated to compute (Koppelman & Bhat, 2006). The use of the Gumbel function to define the unobserved error gives the probabilistic choice model (probability density function) a closed form (defined boundaries) and closely approximates the normal distribution (Koppelman & Bhat, 2006).

The MNL model is based on the difference between the systematic characteristics of the utilities of the alternatives and not their actual values (Koppelman & Bhat, 2006).

The theory of maximum likelihood

The MNL model uses the theory of Maximum Likelihood (a likelihood function) to estimate the value of the parameters that will link the utility function to the choice data likelihood function and indicate the probability of choice (Koppelman & Bhat, 2006).

This involves estimating the *likelihood* function and equating the first derivative ie. the *log-likelihood* function to zero to find the value of β that maximises the equation. The *log-likelihood* function is used because it is easier to differentiate and yields the same value. This is usually done through a computer programme (Koppelman & Bhat, 2006).

The expected results

Consumer choice literature on "too much choice" serves as the basis for the expectation that there will be increasing satisfaction with increasing choices, until a point beyond which the satisfaction will increase at a slower rate or decline. As such, it is expected that total utility will be initially positive with increasing catchment size, but after a certain catchment size utility will begin to decrease as catchments sizes increase. Coefficients of the variables for distance, CO2 emissions and financial cost (transport subsidy and carbon tax) were expected to have a negative impact on utilities.

FINDINGS

Description overview of data

The choice of companies to interview

The responding companies span across the following sectors; service (hospital), retail sector, public institution, academic institution12 and engineering (consulting).Some of the larger companies were split into separate companies; so that five companies became nine companies. Further characteristics of these companies are described in Table 1.

The major difference between the respondent companies was related to the staff skills profile (i.e. L1/L2 ratio the number of Level 1 staff divided by the number of Level 2 staff).

The average daily commuting distance was calculated from the weighted average of the current staff travel distances for each company.

Table 1 Summary characteristics of the companies participating in this study (Source: Proctor , 2013)

	Total staff	L1/L2 ratio*	Turnover rate (employees/ month)	Average daily commute distance	
				Level 1	Level 2
Company 1	129	0.72	0.01	34	26
Company 2	287	0.50	0.001	30	25
Company 3	639	0.07	0.002	36	30
Company 4	315	0.07	0.002	33	29
Company 5	413	0.69	0.004	28	30
Company 6	442	18.22	0.002	17	18
Company 7	279	17.60	0.002	27	28
Company 8	199	2.26	0.002	37	39
Company 9	127	1.23	0.002	47	45

*L1/L2 ratio = Level 1 (low to lower-middle income) employees / Level 2 (middle income) employees

Respondents

A total of 47 interviews were conducted with managers involved in recruitment from 'nine' companies.

[12] Only non-academic staff were considered from this company. Academic staff are too specialized and often advertised for at a national and international level.

Results

Modelling techniques

The aim of this study was to investigate a non-linear relationship between utility and employee catchment size which is why a MNL model was used to analyse the data. The MNL models tested the influence of all the variables on the employers' preferred recruitment scenario for level 1 and 2 employees. These variables were:

1) Employee catchment size.
2) Staff commuting distance.
3) CO_2 emissions from staff commuting.
4) Financial cost to the employer made up of a transport subsidy to the employee and carbon tax to the government.

The models were also run incorporating dummy variables for different aspects of the decision making process. The following dummy variables were introduced:

1) A variable for Level 1 and Level 2 employees.
2) A variable for the urgency of the recruitment decisions to be made over 1 month or 3 months.
3) The different catchment sizes1, 2, 3, and 4 that represent the different percentages of potential employees available to recruit from.
4) A separation of highly skilled companies or companies of lower skilled staff. Where companies 1,2,3,4,5,8,9 were grouped and companies 6, 7 were grouped.

The two aspects of the MNL model, used to select the model that best describes the data were goodness of fit and the estimated parameters of the model.

Multinomial Logit Model (MNL)

The results of the MNL model are given in terms of the probability of an event occurring. The relationship between the variables is described in term probabilities; i.e. "for each unit of increase of variable X, the probability of an event (combination of variables) occurring increases or decreases" (Proctor, 2013: 80).

The following aspects are investigated to identify the best model to describe the data.

a) Model Fit

The following options are used to analyse the goodness of fit:

i. The difference between the log likelihood base value (estimated with no explanatory variables in the model)and the log likelihood value of the model (calculated using the coefficients estimated by the model). The closer the difference is to zero, the better the model explains the data.

ii. The adjusted rho-squared (adjusted ρ^2) be between 0.2-0.4 (Hensher et al., 2009) for a good fitting MNL model.

b) Estimated parameters

i. The probability test (p-value) is a statistical estimate of the probability that the variable is being included when it is not relevant to the model. The inclusion of eh attribute is acceptable when the P-value is less than 0.05.

ii. The signs of the coefficients for each variable need to be logical.

Analysis of the data

Level 1 and level 2 staff were analysed separately because models of analyses of the combined data performed poorly.

Table 2 shows the performance and coefficients of eh best models produced by the analysis

Analysis of the low to lower-middle income (Level 1) employee data

The log likelihood function value in the model improved from -130.31(no coefficients) to -97.30 (with coefficients estimated by the model). The adjusted ρ2value of 0.24 is within the acceptable range of 0.2 – 0.4 (Hensher et al, 2005). The p-value shows each variable is statistically significant (< 0.05) in the model.

The magnitude and size of the variable's coefficients were also significant. The magnitude showed the contribution of each variable to the total utility (part-worth utility) and the sign indicated whether there was a positive or negative effect on utility. Thus employers had a positive value towards increasing employee catchment sizes but CO2 emissions were experienced as negative factors in recruitment decisions of level 1 staff.

Analysis of the middle (Level 2) employee data

The model that best explains the data regarding Level 2 employee data can be seen in Table 2includes cost and dummy variables for catchment 1, 2, 3 and 4. However, this was still rather weak - with an adjustedρ2 of 0.077 (not between 0.2 - 0.4). The log likelihood function value improves from -130.31 (with no coefficients) to -115.01 (with coefficients estimated by the model). The t-stat results also indicate the variables are highly significant with values significantly below 0.05.

As expected, the coefficients for catchment sizes are positive, thus having a positive effect on utility, whereas cost has a negative effect on utility.

The weak fit of the model is due to a number of different reasons:

- Hypothetical bias - The rigid racial and social profiles of the current residential suburbs in Cape Town may have affected employers' decisions. They could have made decisions of the size of catchment they require to find a suitable employee in the mindset that there are no low income suburbs near their business for example.
- The financial cost may not have been high enough to cause a real trade off with environmental or employee lifestyle costs and having more employees to choose from.
- There may have been other factors that employers consider when employing level 2 staff that are different to those included in the questionnaire and for level 1 staff.

Table 2 The parameters produced by the MNL model for level 2 employees (adapted from Proctor, 2013).

	Level 1		Level 2	
Log likelihood Base	-130.31		-130.31	
Log likelihood Model	-97.36		-115.00	
Δ log likelihood	32.95		15.3	
ρ2 adj	0.24		0.10	
Observations	376		376	
Utility Equation	Coefficient	P-value	Coefficient	P-value
CO2	-6.46	0.01		
Cost			-0.05	0.02
Catchment 1	-9.51		-8.50	
Catchment 2	+1.49	0.02	+2.38	0.00
Catchment 3	+3.91	0.01	+2.74	0.00
Catchment 4	+5.12	0.05	+4.38	0.01

Results from the qualitative semi-structured interview

A series of open questions on the advantages and disadvantages of the current firm's location were included in the questionnaire. The main advantages (and disadvantages) were related to the proximity of the firm to public transport (or lack thereof). Congestion and parking problems and long travel distances for staffer were the next most common disadvantages of business locations.

Figure 2 shows the relative importance to employers of aspects related to the location of their businesses. From this it can be seen that access and employee commuting were very important to employers.

Figure 2 Importance of different factors affecting business location (Proctor, 2013)

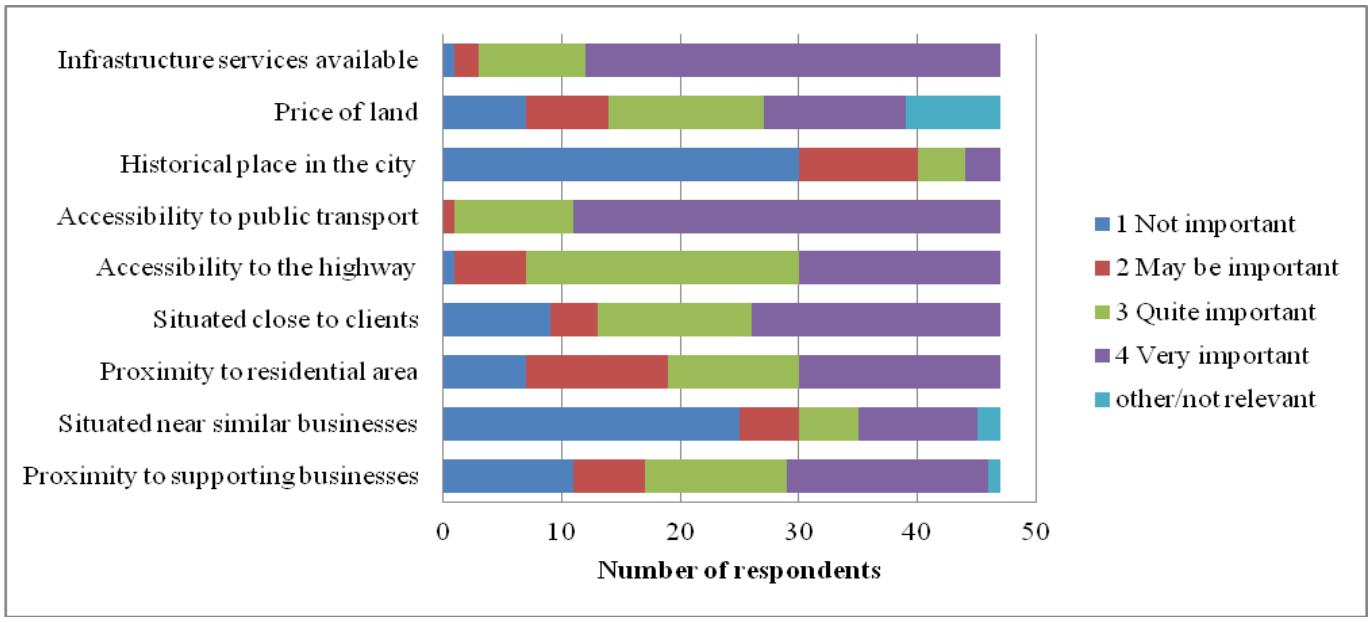

Table 3 shows the potential advantages and disadvantages mentioned by respondents when considering a workforce that lived closer to the company.

Table 3 The potential advantages and disadvantages of hypothetical reduced catchment pool to recruit from

Advantages	Disadvantages
• Reduced lateness and absenteeism. • Reduced travel time, better quality of life for employees, saves them money. • Happier and more productive workforce. • Employees would be more willing to come in after hours for training or overtime. • Environmental advantages. • Reduced costs of company transport. • Easier to collect staff if there is a transport strike. • No advantages.	• Limited skills pool to draw from. • May not have the right class of people living there or not suitable people in the area. • Low skilled and low income staff live far and can't afford the land closer to company. So would increase business costs to pay subsidy etc. • It would be difficult to comply with employment equity ratios if only employ from closer areas. • Unfair to not allow people to make their own choices and possibly exclude people of the certain demographics. • No disadvantages.

Employers acknowledge many benefits of staff living closer to the company, but also express serious concerns over the difficulty in finding the correct skills and person for the job in a limited recruitment pool.

GENERAL DISCUSSION

The effect of limiting employee choice for employers

Employers are one of the key stakeholders in the process of redesigning cities to reduce motorised travel and shift our dependence on non-renewable resources. It is important to understand employers' current perceptions, fears and their understanding of the problem as well as solutions. It will then be possible to try to get employers to actively participate in the restructuring process.

This exploratory study showed that employers do value the impact of commuting distance on the affordability commuting to lower income employees and to carbon emissions. At the same time they value the size of catchment from which they can draw their employees. The study also showed that the benefits of increasing catchment are not incrementally positive.

The value of catchment sizes to Cape Town employers

Two discontinuous functions that meet at the point of inflection for the data were fitted to the utility equations 5 and 6. This can be seen in Figures 3 and 4 for Level 1 staff and Figures 5 and 6 for Level 2 staff. The combinations of two linear functions fit the data more closely and the inflection points can be described as follows:

- For Level 1 data this point is between 25% and 50% of the current catchment size (Figure 3) and a catchment radius between 10 and 15km (Figure 4). After this point utility decreases with increasing catchment size.
- For Level 2 data inflection occurs between 30% and 60% of the current catchment size (Figure 5) and a radial distance between 10 and 15km (Figure 6). Beyond this point utility continues to increase but at a lower rate.

At this stage, these findings serve as evidence that inflection occurs and provides the possible range in which it might occur. However, further research into this range would be needed produce a more

accurate value of the point of inflection or perhaps provide evidence that this point might vary for different employers.

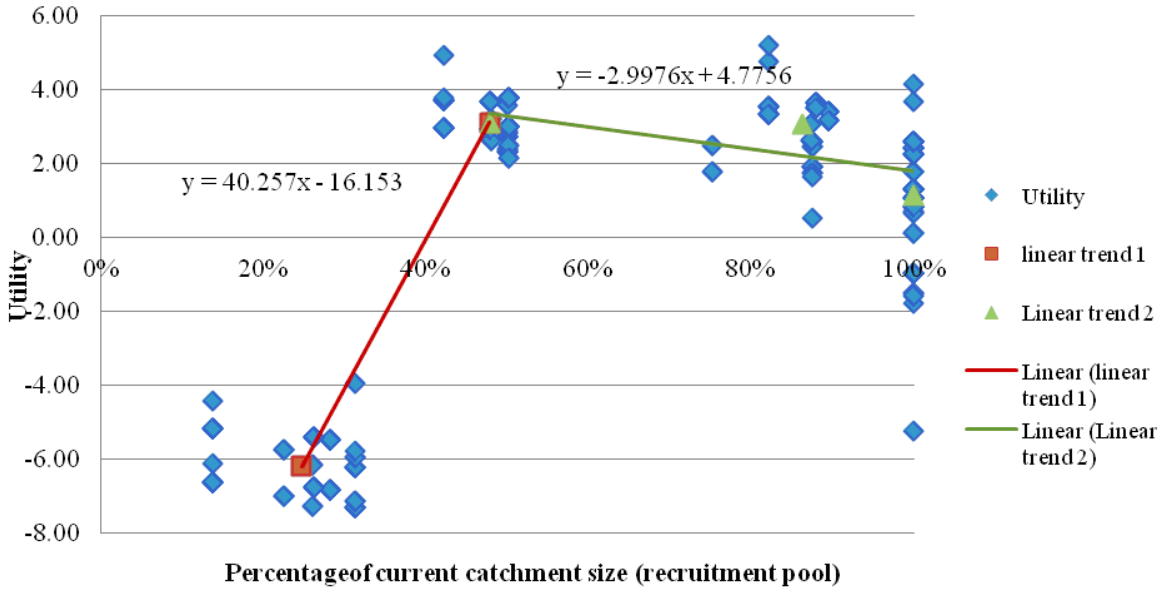

Figure 3 The effect of percentage of current catchment size of Level 1 staff on utility perceived by employers and the approximate point of inflection (Source: Proctor, 2013)

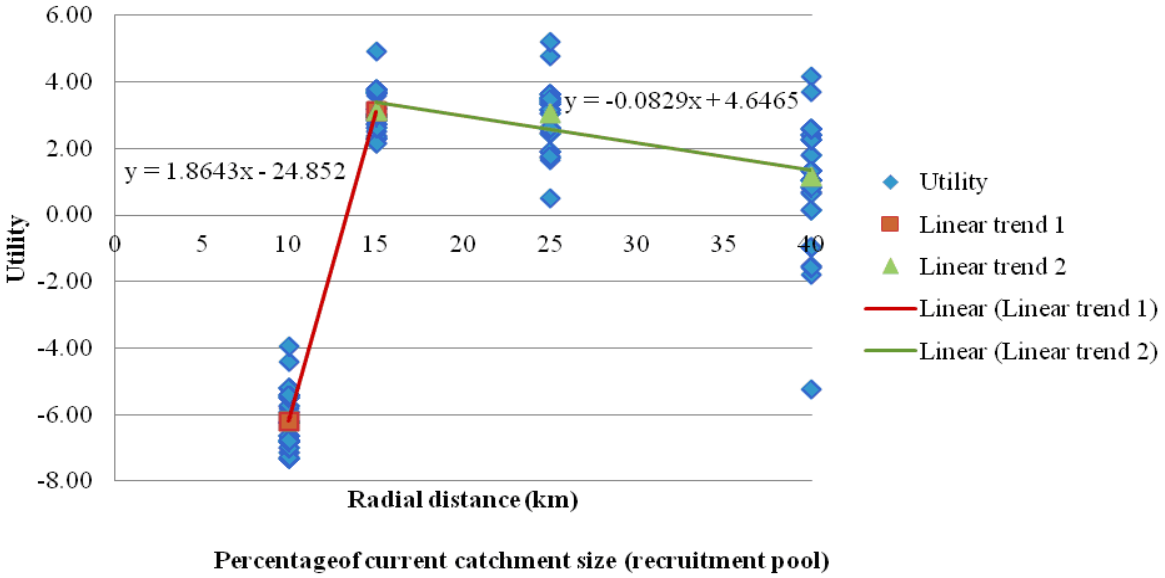

Figure 4 The effect of the radius of the catchment of Level 1 staff on utility perceived by employers and the approximate point of inflection (Source: Proctor, 2013)

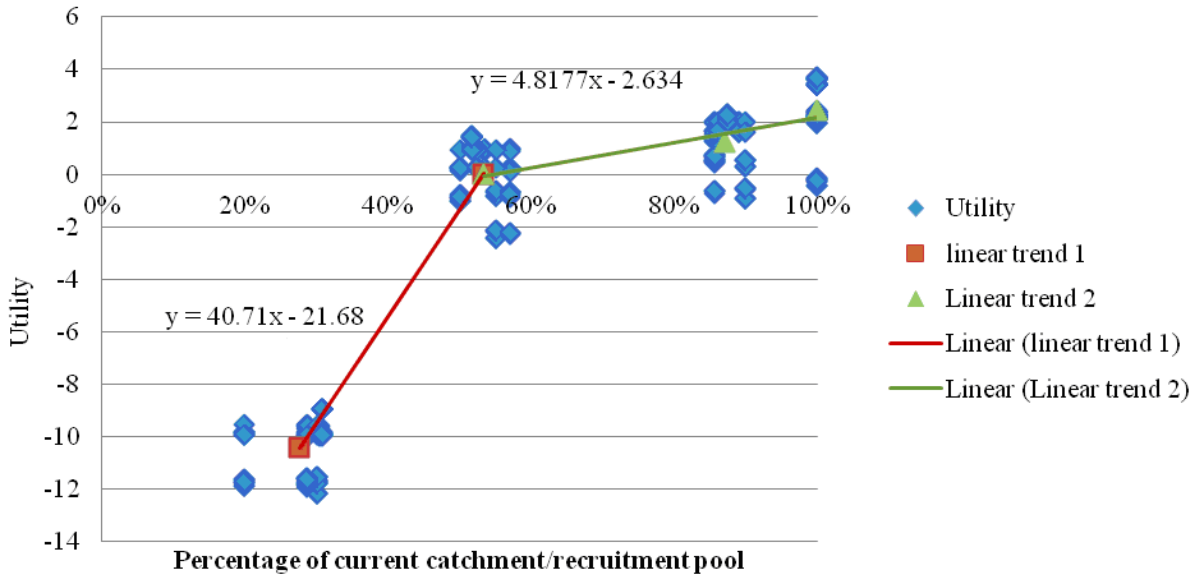

Figure 5 The effect of percentage of current catchment size of Level 2 staff on utility perceived by employers and the approximate point of inflection (Source: Proctor, 2013)

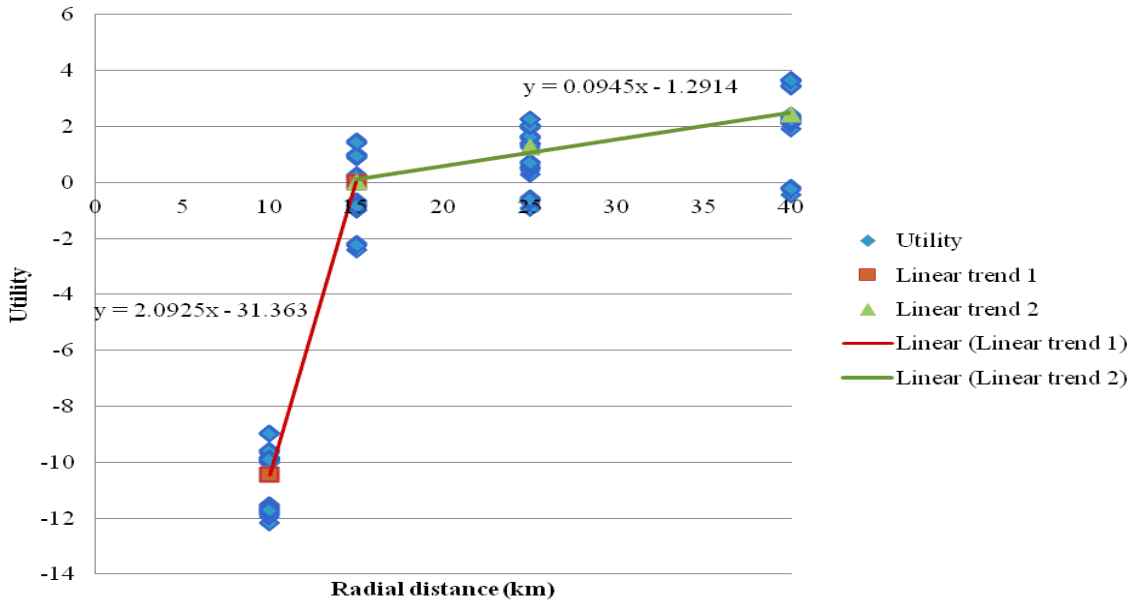

Figure 6 The effect of the radius of the catchment of Level 2 staff on utility perceived by employers and the approximate point of inflection (Source: Proctor, 2013)

Implications for city restructuring

These findings hold considerable implications for city restricting.

Some employers already acknowledge the benefits of employing staff that live closer to the business which is most commonly recognised to improve employee quality of life with reduced travel time and more money and energy for quality time with families.

However, employers also articulated concerns that a limited recruitment pool would result in serious difficulties when searching for the correct skills and person for the job. This would be especially difficult because often housing near business location was expensive and many people cannot afford to live

there. There were concerns that this would further disadvantage certain people that live far from the city and are usually poor.

Thus, densification and proactive location of the population growth over the next 25 years are crucial to overcome these concerns.

Challenges and difficulties

Some of the main challenges were:

- Respondents found it conceptually difficult to understand population densities and employee catchment sizes.
- Rigid existing urban structures and demographics (racial and social profiles) of the suburbs in Cape Town may have affected the answers provided by respondents.
- Sources of error introduced in the data collected, model calculations for the questionnaire and the MNL model programme.
- It was difficult, in the time available, to get enough interviews to add weight to the conclusions in this study.

CONCLUSIONS AND RECOMMENDATIONS

This paper has focussed on the effect of reduced employee catchment size on employers. As employee commuting costs are not borne by employers, this paper presented the response from decision-makers in a number of large Cape Town companies when encountered with a hypothetical context where employee commuting incurs costs (e.g. CO_2 emissions and public transport fares).

The results from this study clearly show that there is an inflection that occurs in the employers' perceived value (benefit) of employee catchment size. The results also indicate a possible range at which this inflection occurs. Employers recruiting staff earning between R3 000 – R10 000 per month, experience this point of inflection somewhere between 25% and 50% of their current recruitment pool and a radial distance between 10km and 15km. Employers recruiting staff earning from R10 001 – R30 000 per month, inflection occurs between 30% and 60% of their current recruitment pool and in the catchment radial range between 10 and 15km from the firms location.

Understanding the fears and current perceptions of employers makes it possible to consider how to get employers to be involved as positive players in the city restructuring process.

Public transport was seen as very important to employers, which can currently be equated to cheap access to staff. As travel costs rise, reduced travel distances will be the only way to maintain manageable travel costs.

Employers agree on the benefits of happier and more productive workforce when staff live closer to the company, but are concerned of having a limited recruitment pool.

Thus for city restructuring to work as a sustainable solution, employers' fears must be understood and overcome. In a context of denser and more integrated settlements around business hubs, limiting employee catchment size will be a win-win for environmental, social and economic sustainability.

Recommendations

The statistical significance of this study could be improved with more studies with larger samples. Further work is also necessary to better define the range over which the inflection in the utility occurs as a result of increasing worker catchment.

REFERENCE LIST

African Centre for Cities. (2011). Counter-Currents Experiments in Sustainability in the Cape Town region. Jacana.

Aguiléra, A., Wenglenski, S., & Proulhac, L. (2009). Employment suburbanisation, reverse commuting and travel behaviour by residents of the central city in the Paris metropolitan area. *Transportation Research Part A*, 43, 685-691. Elsevier Ltd. doi:10.1016/j.tra.2009.06.004

Aspen Valley Hospital. (2010). Aspen Valley Hospital: Benefits Enrolment Guide. Retrieved November 23, 2011, from http://www.aspenvalleyhospital.org/documents/job_opportunities/Summary_of_Benefits_Booklet.pdf

Botti, S., & McGill, A. L. (2006). When Choosing Is Not Deciding : The Effect of Perceived Responsibility on Choice Outcome Satisfaction. Journal of Consumer Research, 33, 211-219.

Bristol University. (2007). No Title. Retrieved from http://www.bris.ac.uk/transportplan/plan/appendixd.html

Bryant, L. D., Bown, N., Bekker, H. L., & House, A. (2007). The lure of " patient choice ." British Journal of General Practice, (October), 822-826.

Cartwright, A. (2011). Economics of Sustainable Urban Development. Lectures for Sustainable Urban transitions (p. 9 march 2011).

City of Trenton. (2011). Live Where You Work Trenton. Retrieved November 18, 2011, from http://www.trentonnj.org/cit-e-access/webpage.cfm?TID=55&TPID=8138

Coleman, C. (2000). Green commuter plans and the small employer : an investigation into the attitudes and policy of the small employer towards staff travel and green commuter plans. *Transport Policy*, 7(2), 139-148. doi:10.1016/S0967-070X(00)00003-2

Coombs,C. H.,& Avrunin,G. S. (1977). Single-peaked functions and the theory of preference. *Psychological Review*,84,216–230. Cited in Reutskaja, E., & Hogarth, R. M. (2009). Satisfaction in Choice as a Function of the Number of Alternatives : When " Goods Satiate ." *Psychology & Marketing*, 26(3), 197-203. doi:10.1002/mar

Del Mistro, R. (2011). The socio - economic impact of Peak Oil : Working paper, (ACET Working paper 12-01 Draft), 1-48.

Del Mistro, R., & Hensher, D. (2009). Upgrading Informal Settlements in South Africa: Policy, Rhetoric and what Residents really Value. *Housing Studies*, 24(3), 333-354.

Del Mistro, R., & Proctor, V. (2012). How much accessibility do cities in developing countries need or should provide? *SIG10 Conference 14-16 April*. Vienna.

Department for Environment Food and Rural Affairs (DEFRA), & Department of Energy and Climate Change (DECC). (2011). 2011 Guidelines to DEFRA/DECC's GHG Conversion Factors for Company Reporting.

DNA Economics, & IMBEWU Sustainability Legal Specialists. (2012). Carbon Tax Discussion Forum (pp. 1-28).

Goldstein, N. (2001). Inside influence report: Is your company offering too much? When more is less. In C. Cibbarelli & B. Gordon (Eds.), Influence at work. Retrieved July 18, 2005, from www.insideinfluence.com/year03/08/MoreisLess. Cited in Shah, A. M.,& Wolford,G. (2007). Buying behaviour as a function of parametric variation of number of choices. *Psychological Science*,18,369–370.

Hensher, D. A., Rose, J. M., & Greene, W. H. (2009). *Applied Choice Analysis. A Primer* (pp. 1-742). New York: Cambridge University Press.

Iyengar, S. S., & Lepper, M. R. (2000). When Choice is Demotivating : Can One Desire Too Much of a Good Thing? *Journal of Personality*, 79(6), 995-1006.

Koelemeijer, K., & Oppewal, H. (1999). Assessing the Effects of Assortment and Ambience: A Choice Experimental Approach. *Journal of Retailing*, 75(3), 319-345.

Koppelman, F. S., & Bhat, C. (2006). *A Self Instructing Course in Mode Choice Modelling : Multinomial and Nested Logit Models*.

Lawyers.com. (2010). Taxes & Qualified Transportation Fringe Benefits. Retrieved November 18, 2011, from http://employee-benefits.lawyers.com/Employee-Benefits/Taxes-and-Qualified-Transportation-Fringe-Benefits.html

Mawson, E. J., Turok, I., Bishop, K. D., Phillips, A. A. C., Warren, L. M., Minns, R., Tomaney, J., et al. (2007). Policy Review Section. *Regional Studies*, (July 2007), 37-41

National Planning Commission. (2011). *National Development Plan: Vision for 2030*.

NDOT 2003. National Household Travel Survey 2003:Technicl Report. NDOT, Pretoria

Nedbank integrated report 2011. Retrieved 20 July 2012, from http://www.nedbankgroup.co.za/financial/Nedbank_ar2011/operational/environmental.asp

Okamoto, R. (2007). Location choices of firms and workers in an urban model with heterogeneities in skills and preferences. Regional Science and Urban Economics, 37, 670 - 687. doi:10.1016/j.regsciurbeco.2007.08.001

Oulasvirta, A., Hukkinen, J. P., & Schwartz, B. (2009). When More Is Less : The Paradox of Choice in Search Engine Use. Finance, 516-523.

Parr, J. B. (2002). The location of economic activity: Central place theory and the wider urban system. In P. McCann (Ed.), Industrial location economics. Cheltenham, UK & Northampton, MA, USA: Edward Elgar. Cited in Sridhar, K. S., & Wan, G. (2010). Firm location choice in cities : Evidence from China , India , and Brazil. China Economic Review, 21(1), 113-122. doi:10.1016/j.chieco.2009.11.003

Proctor, V. (2013). The cost to employers of limiting the catchment size from which they employ their staff. Unpublished BSc (Eng) thesis, Department of Civil Engineering, University of Cape Town.

Reutskaja, E., & Hogarth, R. M. (2009). Satisfaction in Choice as a Function of the Number of Alternatives : When " Goods Satiate ." Psychology & Marketing, 26(3), 197-203. doi:10.1002/mar

Rye, T. (2005). Employer Management at the employer level. Workshop on Implementing Sustainable Urban travel Policies in Japan and other Asia-Pacific countries (pp. 1-9). Tokyo.

Sasol Integrated Report (2011) Retrieved on June 2012, from http://www.sasol.com/sasolinternet/downloads/Sasol_IR_2011_1328013405316.pdf

Scheibehenne, B., Greifeneder, R., & Todd, P. M. (2009). What Moderates the Too-Much-Choice Effect ? Psychology & Marketing, 26(3), 229-253. doi:10.1002/mar

Scheibehenne, B., Greifeneder, R., & Todd, P. M. (2010). Can There Ever Be Too Many Options ? A Meta-Analytic Review of Choice Overload. October, 37(October). doi:10.1086/651235

Schwartz, B. 2005a. Freedom, Choice, Wealth and Welfare, Finance & Bien Commun, 2 No 22, p. 47-53

Schwartz, B. 2005b. Barry Schwartz: The Paradox of Choice [Video file]. Retrieved from http://www.ted.com/talks/

Shoup, D. C. (1997). Evaluating the effects of cashing out employer-paid parking : Eight case studies. Science, 4(4), 201-216.

Sridhar, K. S., & Wan, G. (2010). Firm location choice in cities : Evidence from China, India, and Brazil. *China Economic Review*, 21(1), 113-122. doi:10.1016/j.chieco.2009.11.003

South African Department of Labour. (n.d.). Sample - Domestic worker employment contract. Retrieved November 18, 2011, from http://www.google.co.za/url?sa=t&rct=j&q=employers pay for workers transport&source=web&cd=7&sqi=2&ved=0CFIQFjAG&url=http://www.labour.gov.za/downloads/documents/forms/Basic%20Conditions%20of%20Employment/Sample%20-%20Domestic%20worker%20employment%20contract.doc&ei=ySDGTo-BKMOemQXO3_wv&usg=AFQjCNFHRO6diuXHdgJjj_gGptC1bT34rA&sig2=DqfSTQBNxF_jDalPoi7f_w

State of New Jersey Housing and Mortgage Finance Agency. (2011). *Live Where You Work Home Buyer Program (fact sheet).* Retrieved November 18, 2011, from http://www.state.nj.us/dca/hmfa/consu/buyers/close/pdf/lwyw_factsheet.pdf

Statistics South Africa (2001) South African National Census 2001.

United Nations. (2004). Step-by-step Transport assessment. Assessment (pp. 1-13).

United Nations. (n.d.-a). IOM: Cutting Costs and Emissions. Retrieved d from http://www.greeningtheblue.org/case-study/iom-cutting-costs-and-emissions

United Nations. (n.d.-b). UNEP: Distance Working. Retrieved e from http://www.greeningtheblue.org/case-study/unep-distance-working

United Nations. (n.d.-c). Greening the Blue: Our Approach. Retrieved October 22, 2011, f from http://www.greeningtheblue.org/our-approach

United Nations. (n.d.-d). Directors Leading From The Top. Retrieved g from http://www.greeningtheblue.org/case-study/unido-directors-leading-top

United Nations. (n.d.-e). Travel Policy at UPU. Retrieved i from http://www.greeningtheblue.org/case-study/travel-policy-upu

United Nations. (n.d.-f). UNFPA: Reducing the Climate Footprint of Travel. Retrieved j from http://www.greeningtheblue.org/case-study/unfpa-reducing-climate-footprint-travel

WCTRS. (2011) *Putting Transport into Climate Change Agenda- Recommendations from WCTRS to COP*. 17 December 2011.

Work, Job and Income. (2010). Retrieved November 18, 2011, from http://www.brasil.gov.br/para/worker/work-job-and-income/public-transport-subsidy-vale-transporte/br_model1?set_language=en