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The cost to employers of limiting the catchment size from  
which they employ their staff.

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## **Abstract**

### **The cost to employers of limiting the catchment size from which they employ their staff**

Apartheid has left an urban legacy with excessive commuting distances for low income workers. Climate Change and Peak Oil will cause transport costs to rise. „Low carbon’ solutions are not viable in developing cities such as Cape Town, where most workers already use public transport and it is unlikely that governments will have the resources to further subsidise increasing transport costs. Consequently, a proposal to restructure the city to reduce travel distance between work, home and recreational activities will assist the poor but also mitigate climate change.

Cities in developing countries are expected to double in population over the next 25 years. This provides the opportunity to plan new settlements to reduce the dependency on motorised travel.

This study seeks to explore one specific dimension of the costs and benefits of city restructuring: the perceived costs and benefits to employers of reduced employee catchments and whether there is “a point where increasing the size of the catchment of employees does not produce additional benefits to the employer.”

Interviews were conducted with 47 managers of large Cape Town companies. A stated preference questionnaire was compiled to identify the trade-offs that employers make when faced with recruitment decisions. The costs were presented as a proportion of the company’s current recruitment pool, the average distance travelled by employees per day, the change in environmental impact (CO<sub>2</sub> emissions) of staff commuting and the financial cost of employee travel to the business (comprised of transport subsidies and carbon tax).

Employees were divided into two groups. “Level 1” were low to lower-middle income staff (earning R3 000 – R10 000 per month) and “Level 2” were middle income staff (earning R10 001 – R30 000 per month).

A Multinomial Logit (MNL) model was used to analyse the Level 1 and Level 2 data separately in terms of employers’ utility. Results showed that an inflection occurs in employers’ perceived value of catchment size and indicates a possible range at which this occurs. For employers recruiting Level 1, this inflection occurs at approximately 50% of the current recruitment pool and 15km radius. For Level 2 staff, this point of inflection would be approximately 55% of their current recruitment pool and 15km radius.

Employers also emphasised the importance of low cost public transport to their business. As travel costs inevitably rise, reducing travel distances may become the only viable and long term solution.

To become a viable solution, employers’ fears must be understood and overcome. Denser and more integrated settlements around business hubs need to be presented as a win-win for environmental, social and economic sustainability.

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## **Glossary of Terms**

### ***a priori* expectations**

Trends/results that were predicted before the actual results were analysed.

### **ArcGIS**

A geographic information system (GIS) developed by Esri for working with maps and geographic information

### **Basic Utility theory**

The choice between alternatives is assumed to be driven by the respondent's utility. The respondent's utility has two components. The first component is the deterministic component, which is a function of the observed attributes of alternatives, consumer characteristics and economic variables (such as income, price of goods, etc). The second component is the unobserved attribute.

### **Carbon Footprint**

The total amount of GHG emissions (set as an equivalent to carbon emissions) that a company (or organization) contributes to the atmosphere.

### **CBD**

The Central Business District is the economic centre of a city.

### **Choice overload**

The negative effects of regret or deferred choices that result from being given too many alternatives to choose from.

### **Climate Change**

The changes in temperature and rainfall patterns resulting from the increased infra-red radiation of global warming.

### **Choice modelling (CM) or Discrete Choice**

Respondents are asked to state their preference based on descriptions of the proposed changes. Each change is described in terms of characteristics (e.g. price, reliability, safety). The willingness to pay (WTP) is determined from this preference.

### **Conjoint analysis (CA)**

Respondents rate their preference of alternatives on a type of scale. This is a method of evaluation and does not require commitment to a specific option.

### **Contingent valuation method (CVM) or contingent valuation (CV)**

A survey-based, stated preference technique that places value on a good by asking respondents what they would do under hypothetical circumstances. There are two types of CVM: namely Open ended (which asks questions such as "how much would you pay for this product as described?") and Referendum or dichotomous (yes or no answers to a question) (Merino-Castello, 2003).

**Contingent rating**

A survey that involves evaluation of one scenario at a time.

**Contingent ranking**

Respondents are asked to rank alternatives in order of preference (from most preferred to least preferred).

**Delphi approach**

A method of study that involves 2-3 phases and a panel of experts. The first phase involves questions to a panel of experts; the second phase involves feedback with the initial results and then asks more qualifying questions about the initial research.

**Developing country**

A country with a low standard of living and less industrialized relative to other countries.

**Developed country**

A country with a highly developed economy and advanced technological infrastructure relative to other less-developed countries.

**Dummy variable**

A variable created for a level of an attribute when testing for non-linear effects in the levels of attributes.

**Flexitime**

The ability for staff to work non-conventional working hours that suit the employee's life style.

**Employer travel plans (ETP)**

Travel plans that are implemented by the employer to reduce both environmental and financial (to employer and employee) costs of commuting. It is the same as green commuter plans.

**Excess commuting**

Travel that is made unnecessarily in reaching chosen destinations.

**Global warming**

The gradual increasing temperature of the atmosphere leading to more extreme climatic conditions.

**Green Commuter plans (GCP)**

A package of practical measures drawn up by a business to reduce the environmental impact of their business and staff travel. It is the same as Employer travel plan.

**Greenhouse Gases GHGs**

Gases such as methane and carbon dioxide that contribute to Climate Change and Global Warming effects.

### **Green technologies**

Technologies that are less environmentally damaging than their predecessors, in terms of using renewable fuels or using non-renewable fuels more efficiently.

### **Hypothetical bias**

A bias that is introduced into the choice data due to pre-conceived ideas of the respondent or the researcher that are attached to the hypothetical situation presented.

### **Inter-suburb commuting**

People who live in one suburb and work in another suburb, thus commute between suburbs and not towards the CBD.

### **Job grade**

The way in which job positions are described within a company.

### **Labour broker**

Companies that use labour as their product – i.e. hire out staff for cleaning services etc.

### **Level 1 employees**

The term used in this study to define low to lower-middle income staff. In this study they were assumed to be earning between R3 000<sup>1</sup> – R10 000 per month and to use Public Transport.

### **Level 2 employees**

The term used in this study to define middle income staff. In this study they were assumed to be (earning between R10 001 – R30 000) and to use Private Transport.

### **Likert scales**

A measuring mechanism to provide information on attitudes and reactions of employers with numeric answers from a scale.

### **Limdep**

A program used to model the choice experiment data.

### **Linear regression**

A linear regression assumes that there is a constant ratio of increase between the variable X (the predictor) and the variable Y (the response) that are both continuous functions and linearly related.

### **Log likelihood**

Estimating the *likelihood* function and equating the first derivative of the *likelihood* function to zero to find the value of  $\beta$  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.

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<sup>1</sup> This is the minimum wage in South Africa, so only permanent employees are included and not temporary staff.

**Maximisers**

Persons who are determined to find „the best’ alternative that satisfies their criteria.

**Maximum likelihood theory**

The likelihood function expresses the probability of a choice. It forms the basis of the MNL model that gives the relationship between variables in terms of probabilities; i.e. for each unit of increase of variable X, the probability of an event (combination of variables) occurring increases/decreases.

**Mobility management**

Consciously controlling the way in which people travel – in this thesis it refers to the same thing as green commuter plans or employer travels plans which are interventions to encourage the commuting and business travel to reduce the environmental impact.

**Modal shift**

Changing the mode of transport that is dominantly used; for example, shifting people out of their private cars and onto public transport.

**Model fit**

The degree to which the model accurately explains the data and this is measured through rho-squared and probability tests.

**Multi-Attribute Valuation (MAV)**

Asks respondents what they would do under a hypothetical circumstance described with multiple attributes such as levels of service, of a good or service.

**Multinomial logit model (MNL)**

A discrete choice model based on the maximisation of utility theory to predict the decision-making behaviour of an individual (or a group of individuals).

**Non-motorised transport**

Transport such as walking and cycling.

**Paired comparison**

Respondents choose the preferred option from the comparison of two alternatives and then indicate the strength of their preference in the form of a scale.

**Peak Oil**

Peak oil is a concept that expresses the rate of production of oil from an oil field as reaching a peak and thereafter declining.

**Pilot survey**

An initial survey to test the questionnaire and gain feedback.

**Population growth**

The change in a population over time.

**Potential employees in flux**

People changing jobs.

**Probability**

The statistical likelihood of one alternative (described by a combination of variables) being preferred to the others that are offered.

**Recruitment scenarios**

A group/combination of factors involved in recruitment decisions; (e.g. in this study based on the number of potential employees to choose from, time period over which to find the person, the related CO<sub>2</sub> emissions and the financial cost to the business). The respondent was asked to choose the preferred scenario.

**Recruitment pool**

The proportion of the population from which potential employees are selected.

**Revealed preference**

A study where the data is based on actual observations of actual behaviour.

**Reverse-commuting**

When people live in the CBD and travel to the suburbs for work, i.e. commuting in the opposite direction to the dominant pattern from the suburbs towards the CBD.

**Rho-squared**

The result of the *log-likelihood* function. The rho-squared value shows how well the models fits the data.

**Rule-based decision theories**

Rule-based decision theories are non-algebraic methods based on Boolean approaches, where preferences and choices are modelled in terms of a set of logical conditions that need to be satisfied to generate a particular preference or choice. Examples of these approaches are decision trees (or decision nets) and decision tables.

**Satisficers**

Persons who will choose an alternative that at least satisfies their criteria.

**Stated preference**

A study where respondents are asked directly about their preferences. Stated preference techniques involve presenting respondents with one or more hypothetical scenarios and asking them to select their preferred option.

**Sustainability**

Development in such a way that the needs of current populations are met, without compromising the needs of future generations. This can be described in terms of environmental, financial, social and political aspects.

**P-value**

The p-value is from the probability test which checks whether beta (the coefficient) is equal to zero, which would mean that the variable has no relationship at all with the choice outcome. A p-value lower than 0.05 means that there is a 95% confidence that the coefficient of the variable does not equal zero and is thus statistically significant in employers decisions.

**Travel demand management (TDM)**

Strategies to reduce travel.

**Turnover rate**

The frequency that staff leave and/or are hired in the company over time.

**Urbanisation**

The physical growth of urban areas as a result of rural migration.

**Utility**

Benefit to an individual.

## **List of Abbreviations**

CA - Conjoint analysis

CBD – Central Business District

CM - Choice modelling

CVM - Contingent valuation method or

CV - Contingent valuation

ETP - Employer travel plans

GCP - Green Commuter plans

GHGs - Greenhouse Gases

IID - Independence and identically distributed error

MAV - Multi-Attribute Valuation

MNL - Multinomial logit model

TDM - Travel demand management

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# 1 Introduction

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

Transport costs are expected to rise significantly in the near future 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 minimise the need for motorised travel to places of work, education, retail, community services, recreation, etc. More generally, the world is becoming increasingly concerned with Climate Change and motorised transport has been identified as a major contributor with an estimated 23% of CO<sub>2</sub> emissions in 2007 and growing both in absolute terms and proportionally (World Conference on Transport Research Society (WCTRS), 2011).

Most 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 viable 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 of increasing transport costs.

Public transport and efficient „green’ technologies are important but insufficient or partial solutions to what is really a much more complex problem of dependence on non-renewable resources such as oil and population growth in current urban patterns. These are also less applicable in developing cities.

In addition, government and urban planners also need to consider long term solutions, such as redesigning cities. But this is extremely complex and if it is to succeed, deep research is needed into the preconditions for and implications of doing this.

Employers are one of the key stakeholders in this process and it is absolutely necessary to understand how they would see the issues of sustainably dealing with population growth and increasing oil price, their fears, their current perceptions and understanding of the problem as well as the solution. It will then be possible to consider how to get employers to engage as positive players in the city restructuring process.

This research begins to try and understand this in the context of Cape Town. It forms a small contribution to creating a real evidence base for decision-making.

This thesis seeks to provide specific evidence in support of a long term approach that would not only assist the poor but also mitigate climate change: *to restructure the city in such a way that the need for motorised travel is significantly reduced*. This chapter provides the background and motivation for this research.

## 1.1 International Context

### 1.1.1 Climate change

Climate change is a topic that is widely discussed and debated at present with a strong literature arguing that the emission of carbon dioxide and other greenhouse gases contributes to global warming and climate change.

Global warming refers to the gradual increasing temperature of the atmosphere leading to more extreme climatic conditions such as droughts, floods and melting ice caps (climate change). The South African government's National Planning Commission clearly anticipates serious socio-economic consequences including food shortages, famine, poverty and conflict over resources (National Planning Commission, 2011). It is expected that poorer countries are more vulnerable than developed countries with the financial resources to compete for the increasingly scarce energy and water resources (National Planning Commission, 2011).

Transport produces high volumes of CO<sub>2</sub> emissions - up to 23% of the CO<sub>2</sub> emissions in 2007 (WCTRS, 2011) which is expected to grow both in quantity and percentage. It is essential that changes are made to reduce the CO<sub>2</sub> emissions from transport. One way of doing this, in addition to cheaper public transport and more efficient engines, is to reduce the distances that people have to travel with motorised transport.

### 1.1.2 Peak oil

While resource scarcity is a concern for all sectors of industry and society, peak oil is of particular importance to the transport industry. Peak oil is a concept that expresses the rate of production of oil from an oil field as reaching a peak and thereafter declining (see Figure 1) (Hubbert, 1956). This concept has been extended to global oil supply and it has been estimated that globally world oil production may have reached its peak - though this is increasingly seen as more of a plateau (Cartwright, 2011). The discovery of new oil resources has decreased quite dramatically in recent years, and those that are discovered are found at greater depths and require expensive drilling and extraction procedures for smaller amounts of oil (Wakeford, 2011).

There are those who believe that technology will solve the problem and develop alternative energy sources that are sustainable (Del Mistro & Proctor, 2012).

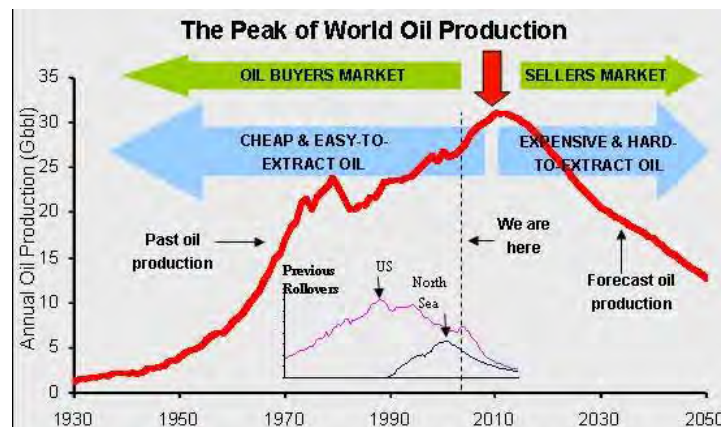


Figure 1 Peak Oil Concept (after Fishman & Robinson, 2006)

The larger body of informed opinion suggests that global oil consumption is currently increasing at unconstrained rates. Population growth, urbanisation, mechanisation, larger cities, more exporting and importing all rely on motorised transport and oil as an energy source, and many argue that the increasing demand for, and declining supply of oil will lead to a global shock (Wakeford, 2011).

*“..oil is an essential component of our modern life style (Schwartz, 2008b), peak oil will affect many aspects of society e.g. suburban living (Masson, 2008), availability and cost of food (Bériault,2007), medical care (Roth, 2006), the economy of a country (ITPOES,2010), etc.” (Del Mistro & Proctor, 2012)*

Transport costs are expected to rise significantly as a result of peak oil. It is unlikely that the poor will be able to absorb these increases; and a developing country like South Africa will also not be able to absorb them when one considers the extent to which oil-dependency permeates our economy (e.g. food production, manufacturing, medical care, etc.) (Del Mistro, 2011). This is expected to make it impossible for the low income and even some middle income population to commute.

It is imperative, therefore, that urban planners begin to consider all possible options – including restructuring our cities to minimise the need for motorised travel to places of work, education, retail and other services.

## **1.2 Sustainable transport systems for developing countries**

This thesis proceeds from the premise that current travel behaviour needs to change in a way that reduces the amount of motorised travel in order to reduce CO<sub>2</sub> emissions that cause climate change, and to help moderate the impacts of higher fuel prices on urban communities – especially the poorer sections of these communities.

One of the simplest and most frequently mentioned solution is to encourage a shift from private to public transport. If the effect of the higher oil price might not influence high income individuals to change their travel behaviour, perhaps their concern about the contribution of motorised transport to climate change might.

However, even this is unlikely to solve the problem completely, and the increased oil price will certainly induce medium income populations to change to lower cost public transport. However, many medium income households are located in the outer suburbs where house prices are lowest and are totally dependent on private transport because low urban density does not support public transport services. This leaves these populations vulnerable (Dodson & Sipe, 2005).

While the partial solution of modal shift to public transport may be applicable in cities of developed countries, in many developing countries commuters cannot afford the current fares of public transport and often the poor are located far from places of employment (e.g. the average commuting distance of low income workers using public transport in Cape Town is 16km) (Del Mistro & Proctor, 2012).

Low income workers already use public transport and many spend more than 20% of their income on fares (NDOT, 2003).

*“From the South Africa National Household Survey (NDOT, 2003) it can be estimated that 77% of households and 84% of low income households in South Africa used public transport*

*during the month under survey. ...Low income households account for 49% of the country's households and with some interpolation, it was estimated that 62% and 28% of the low income households spent more than 10% and 20% of household income on public transport respectively." (Del Mistro & Proctor, 2012)*

The expectation that governments will be able to increase subsidy payments might not materialise as they will face decreasing revenues as a result of declining economic activity caused by increased oil prices (Del Mistro & Proctor, 2012). The increasing fares due to increased oil prices will have significant social consequences, especially for the urban poor who cannot absorb the increased cost of travel or change to lower cost transport solutions.

Global attention on reducing the impact of motorised transport on climate change by developing new technology (e.g. more efficient fuels and vehicle engines, green energy) (Del Mistro, 2011) is another important but only partial solution because they tend to focus on reducing carbon emissions of motorised transport, and ignore the important issue of financial sustainability for poorer populations faced with increasing costs of transport.

As discussed these solutions can only partially benefit the poor in Apartheid cities (or cities of developing countries) because the poor already use public transport, which many cannot afford and it is unlikely that governments will have the resources to pay additional subsidies.

The three main strategies of the Cape Town Spatial Development Framework (City of Cape Town, 2012) are to:

- 1) Plan for employment and improve access to opportunities;
- 2) Manage urban growth, and
- 3) to build an inclusive, integrated, vibrant city.

These strategies call for development to reduce the distance between where people live and work, encourage higher density settlement with mixed income and mixed land use neighbourhoods. This study speaks to each of these strategic principles (City of Cape Town, 2012).

The proposal to restructure the city to reduce the need for motorised travel, it is argued here, will not only align with strategic objectives of local, provincial and national government in South Africa, mitigate climate change and assist the poor, but could also improve competitiveness of the city by reducing the cost of labour.

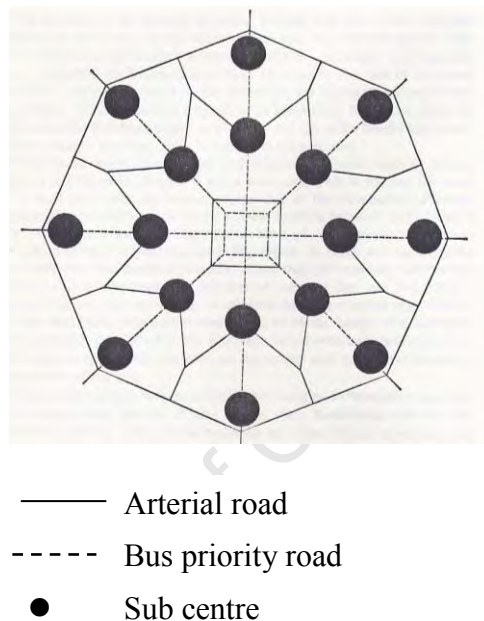
### **1.3 Transforming the urban structure to reduce motorised travel**

This approach is complex and involves consciously re-organising land use and transport infrastructure to reduce the amount of motorised travel.

Motorised travel can initially be reduced in existing situations through the elimination of excess travel/commuting, which is "*travel that is made unnecessarily in reaching chosen destinations*" (Del Mistro & Proctor, 2012: 6). A study by Tabane (2005) found excess travel in Cape Town to be 16% and 6% among the non-poor and the poor respectively. This does not offer a lot of scope for improvement.

It is imperative therefore that an attempt be made to restructure our cities to reduce / minimise the need for motorised travel to places of work, education, retail, community services, recreation, etc. The unavoidable conclusion is that it will be necessary to concentrate people and activities.

This is not a completely new idea. The idea that is closest to this concept was developed by J Michael Thompson (1977) in his book, *Great Cities and their Traffic*, where he discussed an archetype for developing cities which he called the **low cost strategy**. This was his solution for cities, typically in developing countries, where resources are not available for major radial rail systems to the city centre and an underground rail system to allow for large-scale growth of the city. Instead the radial routes are served by buses or trams and centres are developed along these radials to reduce the number of commuters travelling to the city centre. The strategy is shown diagrammatically in Figure 2.



**Figure 2 The Low Cost Strategy for Developing Countries. Source: Thompson (1977)**

Thompson proposed a system of eight corridors radiating from a CBD that each carried 20 000 commuters per hour (320 000 people in a two hour period) using road based transport to the CBD, with an additional 20 000 jobs (“*not more than 30 000 [jobs]*” (Thompson, 1977:227)) provided by the nodes on each corridor.

The concept underlying this research is the possibility that the city be divided into sub-areas each offering 500 000 jobs (200 000 within walking distance and 300 000 accessed through public transport) serving a population of about a million inhabitants in the sub-area; e.g. “*a city of 5 million inhabitants could be divided into 5 or more sub-areas each with its own sub-city centre*” (Del Mistro and Proctor, 2012). Achieving this approach requires new transport strategies to be implemented that discourage travel and commuting between sub-areas in order to achieve the objective of minimising motorised travel. This approach would limit the choice of trip ends to those within the sub-area.

This quantum was also developed by Hall (2010: 35) who proposed new towns located “*...outside the commuter belt ... 200 000 or even 250 000 inhabitants so that they could support all the jobs and service required ...as many as 1/3 of the inhabitants would find jobs in the place where they lived*”.

## **1.4 Understanding the preconditions for, and implications of, Urban restructuring**

This approach implies an urban structure without a central core with all sub-cities being equally significant in size, with very good internal links and large enough to be self contained; and purposely not highly connected.

Implementing such an approach must be done with great care and must be based on sound research into every possible aspect of the process.

The first question that arises is whether it is possible to change the structure of a city. The opportunity to do so exists in cities of developing countries which are expected to double in size in the next 25 to 30 years (Del Mistro, 2011). The additional population will require places to live, work, play, etc. that do not exist at present; and can be located to reduce the dependency on motorised travel. The second question is whether the political will exists to implement a more appropriate city structure. This can only be achieved if politicians and the public recognize the problem and that solutions exist to at least mitigate the problem.

To recognise this as a solution requires an understanding of both the benefits and the costs implicit in any solution. The solution proposed motivating this study is to restructure developing cities in a way that reduces / minimises the need for motorised travel.

The benefits are obvious. However, by attempting to reduce the need for motorised travel, there is a reduction in the number of destinations that will be accessible to fulfil a trip's purpose. As such, there is a need to understand the consequences of reducing choice of origin-destination pairs.

Transportation strategies have in the past always attempted to improve accessibility; i.e. increase the choices available. The intention to limit choices in the strategy described would only make sense if this was beneficial. This research attempts to demonstrate a level of accessibility beyond which the benefits are marginal or negative. No literature related specifically to transport choices could be found and therefore it was necessary to turn to other disciplines for examples where greater choice is not always beneficial.

The next chapter (Chapter 2) presents a review of the literature in three main topic areas that concern this study:

- The effect of reducing the number of choices available for general retail consumers of goods and services,
- The costs specifically to employers of long staff commuting distances – and how they balance these against their other priorities in running a successful business enterprise (as well as understanding the costs of commuting to communities and the environment).
- The literature on modelling different kinds of decision-making processes.

Chapter 3 explains the process of developing the method and the details of the final method used in this study to model the implications to employers of reducing travel distance and thus employee catchment sizes.

The analysis process and results are presented in Chapter 4, followed by a detailed discussion of the results. The discussion explains what the data reveals of employers' opinions of the costs to their business of limiting their employee catchment size, it also discusses the implication of this finding in the light of city restructuring. Lastly, the Chapter five discusses the challenges and limitations involved in this study.

The final chapter (Chapter 6) consists of the conclusions from this study for employers in Cape Town and the concept of City Restructuring. It will also present recommendations for further research to strengthen the findings and application of this study.

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## 2 Review of the literature

The hypothesis of this research is “that there is a point where increasing the size of the catchment of employees does not produce additional benefits to the employer.”<sup>2</sup>

This review of the literature was required to support the research proposal and to develop the research method; and covers the following three areas:

1. **Benefits from Choice.** Since the objective of transport has always been to increase accessibility, as expected, no research could be found that discussed the cost or benefits from reducing / limiting accessibility. Fortunately, research on consumer preference was found in the fields of psychology, market research and economics and also in regard to decisions by retailers, manufacturers and a few others. These are discussed in some detail to give confidence to the possibility that the hypothesis might also apply to accessibility; provide a review of measures of “benefits” in the choice and in the choice making process; and to identify choice situations that might have some similarity to choice making of employers.
2. **Employee selection.** Since the focus of the study is on the employer, this area examines the factors that affect the selection of an employee and business location, whether the travel requirements of the employee is one of these factors considered and the degree to which this influences the selection or location. International literature shows businesses are beginning to pay attention to the problems associated with employee commuting and are moving to incentivise car pooling and use of public transport or non-motorised forms of transport. Some have developed Employee Transport Plans. It then proceeds to look at the current travel conditions of employees in Cape Town to provide a context for the data collection.
3. **Modelling decision making:** While reducing commuting distance has significant benefits for the employee and society, it is essential to be able to estimate the actual and perceived benefit (or costs) to employers of a reduced catchment of employees, which can be used to estimate a value for “sufficient” catchment. To this end, the third part of the literature review will discuss alternative theories of choice making, and related survey methods, statistical models and data analysis techniques that can be used to estimate the value of the factors affecting employee selection, including factors such as the size of the employee catchment and related cost of travel.

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<sup>2</sup> 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.

## **2.1 A review of the literature on the effects of limiting consumer choice and its applicability to choice limitations facing employers**

Since the objective of transport has always been to increase accessibility, this literature review was unable to find significant research that reflected any benefits or costs from transport options that limited accessibility. The only research on the effects of limiting consumer choice comes from the fields of psychology, market research regarding consumer satisfaction and choice in the general retail and industrial sector. These are discussed in some detail to explore the possibility that some of the hypotheses regarding limiting consumer choice might also apply to employer and worker perceptions regarding accessibility of employment opportunities. This section also includes a review of the measure of “benefits” in the choice outcome and in the choice making process.

### **2.1.1 Relationship between increased choice and benefit**

A review of the general literature on consumer choice revealed that there were three broad categories of findings regarding maximising consumer choice in general retail environments:

1. Some studies concluded that the results of greater choice were seen only as beneficial.
2. Other studies showed that as choice increased, the extent to which it was seen as beneficial decreases.
3. Some studies concluded that while choice was seen as beneficial at first, it turned negative at a certain point producing an inverted U.

The literature shall be discussed under these headings.

#### ***2.1.1.1 Studies in which increased consumer choice is seen as explicitly beneficial***

Evidence from a wide range of studies show that in general consumers enjoy being able to choose from a wide range of products. On this basis, many argue that stores that offer a larger assortment of products have a competitive advantage (Koelemeijer & Oppewal; 1999, Chernev, 2003). The proven hypothesis in these studies is that larger assortments increase the likelihood of consumers matching their preference (Lancaster, 1990).

It is often assumed that increasing choices increases perceived freedom and that this increases satisfaction (Reibstein, Youngblood, & Fromkin, 1975). Reibstein et al. (1975) found that perceived freedom to decide and consumption levels were considerably greater for those selecting from four rather than two flavours of cooldrink. In another study, Kahn & Wansink (2004) found that given a wider assortment of candies, both children and adults eat more candies than if they were given a smaller selection.

However, a number of recent studies seem to have concluded that the picture is not so simple, and that „too much choice’ can affect consumers negatively and have a correspondingly negative impact on sales.

### ***2.1.1.2 Studies in which perceived benefits of choice increase at a decreasing rate***

Coombs & Avrunin (1977) claim that perceived benefits for consumers increase at a decreasing rate. As a result, the satisfaction curve flattens after a certain point.

### ***2.1.1.3 Studies in which increased consumer choice starts to decrease beyond a certain point producing an inverted U-Shape***

The ‚inverted U’ image describes the main hypothesis for this thesis and is mirrored through the many consumer studies reviewed here (e.g. Oulasvirta, Hukkinen, & Schwartz, 2009; Reutskaja & Hogarth, 2009; Shah & Wolford, 2007).

In a study on exotic jams, Iyengar & Lepper (2000) found that consumers were more likely to buy products from a display of fewer products than a display of large amounts. Interestingly, while more people were initially attracted to the display of 24 jam flavours, more people bought jams from the display with only six. In a second study they also found greater satisfaction among those offered six flavours of chocolate compared to those given only one chocolate (thus ‚no choice’) and to those who were offered 30 different flavours (Iyengar & Lepper, 2000).

Reutskaja & Hogarth (2009) describe an example of the German retail chain, ALDI, that sells 35 times fewer products than its rival counterpart, but sells more of each item. Procter & Gamble noticed a 10% increase in sales of its Head & Shoulders brand after they reduced the number of varieties from 22 to 15 (Goldstein, 2001).

This literature confirms the possible negative effects of too much choice and thus the implied benefits of certain restrictions on choice. Speaking in Ted Talks, Dr Schwartz claimed: *“There’s no question that some choice is better than none, but it doesn’t follow that more choice is better than some”* (Schwartz, 2005b). Increasing numbers of studies challenge the “dogma” that increased choice leads to more freedom and therefore, increased choice equals increased well-being (Schwartz, 2005b).

### ***2.1.1.4 The effect of ‘too much choice’ for consumers of goods***

A significant subset of the studies discussed above suggested that greater satisfaction results from choices made from a limited range of products.

This body of literature suggests that there is increasing dissatisfaction and decreased motivation to choose as the number of options per choice set are increased above a certain point. Another study found that the more alternatives participants could choose from for a retirement plan, the longer they deferred their choice, essentially going without substantial financial benefits (Iyengar, Jiang & Huberman, 2004). Shah & Wolford (2007) found the percentage of students buying black pens decreased from 70% to 33% when presented with a larger display of 16 to 20 black pens versus 8 to 14 black pens.

It becomes evident that there is an increased cost of choosing from more options. Scheibehenne et al., (2009) found that 79% of respondents in Germany (and 77% in USA) took longer to choose from the large assortment of classical music CDs, compared to the small assortment.

Consumer choice studies of students found that the relevance of answers and confidence in making the correct choice also decreases as the number of options presented to them increases (Iyengar & Lepper, 2000; Oulasvirta et al., 2009). For example, one study found that more students completed and achieved higher marks when choosing from a list of six essay topics than those choosing from a list of 30 topics (Iyengar & Lepper, 2000). Another study investigated the effect of the quality of the choices and satisfaction of Finnish university students when using search engines that displayed either six or 24 results per search (Oulasvirta et al., 2009). They found that when six results were displayed by a search engine the students experienced higher subjective satisfaction and greater confidence in the correctness of their choice (Oulasvirta et al., 2009). These effects have been documented in psychological research as fatigue and fluctuating relevance (Clancy & Wachslar, 1971).

However Schwartz (2008a) goes further to explain why satisfaction decreases with increasing choice set:

- People regret the many other alternatives that they did not choose (also Scheibehenne et al., 2009).
- People will dwell on the opportunity costs of „what could have happened if they had chosen the other option’.
- Thirdly, people experience an „escalation of expectations’ that one of these is „perfect „when presented with the freedom of a vast number of alternatives.
- When a choice is finally made, the reality of imperfection will induce self blame onto the chooser who made the wrong decision when faced with so many options (Botti & McGill, 2006).

All these factors contribute to the decreasing satisfaction, and declining well being, of individuals faced with too many choices (Schwartz, 2008).

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

#### **2.1.1.5 Lack of consensus in the literature**

From the discussion of the literature it is clear that studies agree that some choice is better than none, but that is where the results from different studies diverge. This inconsistency in the literature is not helped by the fact that Scheibehenne, Greifeneder, & Todd (2010) find that the studies for choice overload are not replicable – the same results cannot be achieved when an experiment is repeated. They conducted a meta-analysis of 50 „choice’ studies. Their results of statistical analysis find that the negative effects due to choice overload are not robust and that “more choice is better” (Scheibehenne, Greifeneder, & Todd, 2010: 421).

A commentary paper by Chernev, Bockenholt, & Goodman (2010) on Scheibehenne et al., (2010)’s meta-analysis of the choice experiments produces the following key findings:

1. *“The mean effect size of choice overload is “virtually zero”.*
2. *Several preconditions but no “sufficient conditions” for choice overload can be identified.*

3. *No significant monotonically increasing relationship between assortment size and choice overload was observed.*”(Chernev et al., 2010)

Scheibehenne et al., (2010) explained the inconsistency and replication problems by identifying preconditions for choice overload that must occur in some combination to cause the effect of choice overload and identifying key moderators that could have affected the experimental studies they examined.

The commentary from Chernev et al. (2010) accused Scheibehenne et al., (2010) of neglecting a bias that is introduced by assuming that different choice experiments had the same purpose.

### 2.1.1.6 Preconditions for choice overload

Preconditions for choice overload are nonetheless interesting to look at in an attempt to understand the disagreement in the literature and are shown in Table 1.

**Table 1 Literature Summary of the Preconditions for Choice Overload**

Preconditions for Choice Overload		Citation
Pre-defined preference	The lack of pre-defined preference can lead to choice overload. If a consumer or respondent has a predefined preference, studies show decisions are easier to make, the respondent simplifies the choice him/herself (by reducing their consideration set of alternatives).	(Mogilner, Rudnick, & Iyengar, 2008; Scheibehenne et al., 2009, 2010)
Multidimensional choices	“ <i>The user can be overwhelmed with a comparison of only two items, if the number of relevant choice dimensions is large</i> ” (Oulasvirta et al., 2009: 518). For example, when buying a car or a computer which has so many attributes to compare before making a decision.	(Oulasvirta et al., 2009)
Knowledge about assortment	Little knowledge of the assortment increases choice overload. Better knowledge of the assortment makes it easier to process and makes choice overload less likely.	(Scheibehenne et al., 2009)
Assortment Structure	Confusing categories, too much or too little information describing the options lead to effects of choice overload.	(Scheibehenne et al., 2010)
Perceptions of variety	Perceptions of variety, not the actual number of options, determines the quantity consumed (Kahn & Wansink, 2004). However results from a study on restaurants in Berlin found that perception of variety did not affect an individual’s choice behaviour (Scheibehenne et al., 2009).	(Kahn & Wansink, 2004) (Scheibehenne et al., 2009)
Maximisers vs Satisficers	Maximizers will experience higher satisfaction from smaller assortments (of vinegrettes, chocolates or ice creams examples from the study) and stronger dissatisfaction with their choices from larger assortments of products. Satisficers tend to feel a lower level of satisfaction, although they still prefer to chose from a smaller assortment of vinaigrettes, chocolates or ice creams than larger assortments (even though they are less dissatisfied than maximizers) (Dar-Nimrod, Rawn, Lehman, & Schwartz, 2009). Maximisers will sacrifice time and energy to experience larger assortments, looking for the „best’ product (Dar-Nimrod et al., 2009). Satisficers did not experience the negative effects of choice overload described in the literature.	(Dar-Nimrod et al., 2009)

### 2.1.1.7 Managing choice overload

There are also strategies or techniques that people use to minimise the effect of choice overload. These can be seen as “managing choice overload”. Table 2 summarises the literature findings on these strategies. The preconditions for choice overload when reversed can minimise the effects or help to prevent choice overload.

**Table 2 Literature Summary of Managing Choice Overload**

Managing Choice Overload		Citation
Explanations	People are more satisfied with explained options. In the health sector where patients are required to make more and more choices, a study found that patients are less satisfied and experience more regret over decisions made without reasoning.	(Bryant et al., 2007)
Heuristics	Heuristics are “cognitive shortcuts that reduce thinking effort so that everyday decisions can be made more efficiently” (Bryant et al., 2007). These reduce the effects of choice overload.	(Bryant et al., 2007)
Decision Strategies	Participants considered fewer options in the large set, shielding themselves from the excessive choices. People explored only 50% of the options for the large assortment of classical music CDs, compared to 84% in the small assortment.	(Scheibehenne et al., 2009: 243)
The presence of alternatives/ comparison	Simply being associated with choice can make alternatives more attractive. For example, people are more likely to agree to join a particular plan and willing to pay more for it when it is offered alongside another plan (or choice set), than if it is offered alone.	(Bryant et al., 2007)
The way options are phrased: Eg. Local vs exotic options	When considering the choice of a local hospital (phrased as a default choice) versus the choice from several hospitals somewhere else. The more exotic alternative is not always the best. This paper is a warning to health professionals to phrase choices carefully. The way alternatives are framed influences people’s preferences.	(Bryant et al., 2007)
Shared decision making	Shared decision-making (e.g. between professionals and patients) has been described as the best way to manage the effect of choice overload.	(Bryant et al., 2007)
Assortment Structure	Dividing the choice set into labelled categories (shown in an experiment with magazines and coffees) can minimise the effect of choice overload.	(Mogilner et al., 2008)
Justification	Whether choosers had to justify their choices or not was found to be the only effective moderator (and not set sizes or the comparative attractiveness of options) (Scheibehenne et al., 2009). Another study (Sela, Berger, & Liu, 2009) describes how when people are faced with a larger choice set, people are more likely to select options that are easier to justify.	(Scheibehenne et al., 2009) (Sela et al., 2009)

Authors, such as Schwartz (2004) and Hill (2008), describe the enormous complexities involved in choices by individuals. Hill (2008) emphasises the role of preference construction in this complex choice process. The process of choice is too complex to simply make a general conclusion from all these specific studies that more choice is better or worse (Hill, 2008).

### **2.1.1.8 Implications of ‘too much choice’**

The concept of reducing benefits with increasing choice serves to provide confidence towards the proposal of reducing travel within cities. There have been authors who have acknowledged the implications of this concept in other fields such as marketing, retail, healthcare and social implications.

This behavioural trend can have implications for marketing and retail centres. Alexander Chernev (2005) approaches the question of too much choice from a marketing economics perspective. He found in a study of toothpaste, that one brand offering too many new products can cause consumers to hesitate. In this moment, usually loyal customers are destabilised and may choose another brand (Chernev, 2005). He describes it as risky adding too much complexity (Chernev, 2005).

What emerges from the literature is the suggestion that consumers are more satisfied if they feel they have made a choice (and not deprived of choice) (Botti & McGill, 2006; Mogilner et al., 2008). Having options to choose from is often seen as an important precondition of personal freedom, democracy and access (Schwartz, 2004; Schwartz, 2005a).

However, Schwartz (2005a, 2005b) argues that as the number of alternatives increases, well-being actually decreases. The ever increasing choices offered by privatisation and neoliberalism actually have the opposite effect from the assumed effect of increasing welfare. He describes the ‘decline of happiness’ by increasing divorces, eating disorders and depression (Schwartz, 2004). “People want choice within limits” (Schwartz, 2005a: 53).

*“This leads to the question of whether more options benefit all sectors of society, whether they benefit equally, or whether the more disadvantaged sectors actually benefit less since providing more options has cost implications on all options even the ones that the disadvantaged can access.”* (Del Mistro & Proctor, 2012).

### **2.1.2 A review of the measures of “benefit”**

Reutskaja & Hogarth (2009: 199) describe satisfaction as the difference between perceived benefits and costs of choice. They describe costs as *“anxiety about uncertain preferences, ... incorrect decisions and trade-offs”* and benefits are observed as *“greater perceived decision freedom, feelings of autonomy, self-control, and intrinsic motivation”*.

Satisfaction and costs can be measured both with the output of the choices and with the choice process itself. Most studies measure a combination of the two.

#### *a) Some studies measure only the satisfaction on the choice output*

Studies used a questionnaire asking respondents to rate (on a point scale) how satisfied they were with their choice of gift box (Reutskaja & Hogarth, 2009), coffee (Botti & McGill, 2006; Mogilner et al., 2008) and how good the coffee tasted (Mogilner et al., 2008). Similar questions were used by Iyengar & Lepper, (2000) and Dar-Nimrod et al., (2009) to gauge the level of satisfaction with the outcome of the choice. Respondents in another study were asked to estimate their confidence in the correctness of their answers and the suitability and satisfaction regarding the search engine they had used (Oulasvirta et al., 2009).

Some studies measured the ownership of the choice and the resulting credit or blame the respondents place on themselves (Botti & McGill, 2006) or the regret they feel from the outcome of their choice (Iyengar & Lepper, 2000).

*b) Some measure the costs and satisfaction with the process of choosing*

In most studies respondents are asked to indicate the level of enjoyment with the process of choosing (Dar-Nimrod et al., 2009; Iyengar & Lepper, 2000; Reutskaja & Hogarth, 2009). Iyengar & Lepper (2000) also asked respondents how difficult they felt it was to pick an option and the level of frustration they felt. Their questionnaire also measured the confidence of the respondent that their choice would satisfy them before tasting the chocolate, for example, and whether the respondent felt that they were able to make well informed decisions on the chocolate they had picked. Respondents were asked to indicate the carefulness involved in selecting their answers with different numbers of sites displayed by the search engines (Oulasvirta et al., 2009).

These are measured in a number of different ways/techniques.

*i. Likert scales*

Almost all of the consumer choice studies use point scales to measure the degree of satisfaction or regret of the respondents (Iyengar & Lepper, 2000; Mogilner et al., 2008; Reutskaja & Hogarth, 2009).

*ii. Revealed preference*

This is measured in a number of different ways in the different studies:

- Whether respondents make a decision (Schwartz 2005b):
  - Bought the item or not: pens (Shah & Wolford, 2007), jams (Iyengar & Lepper, 2000), groceries (Borle, Boatwright, Kadane, Nunes, & Schmueli, 2005).
  - Wrote the voluntary essay (Iyengar & Lepper, 2000).
- The time taken to make a choice (Scheibehenne & Todd, 2009).
- Quality of performance:
  - Relevant answers to the questions using different search engine layouts (Oulasvirta et al., 2009)
  - Essay mark (Iyengar & Lepper, 2000)

*iii. Stated preference questionnaire*

Consumer choice studies focus on eliciting the consumer's preference, however, the literature examined here tends not to use methods of stated preference because it is simpler and more cost effective to use revealed preference and Likert scale methods. Section 2.3 discusses residential and business location choice and has examples on this method of eliciting preference.

*iv. Combination of methods*

Many of the studies use a combination of Likert scales and revealed preference methods. For example, (Iyengar & Lepper, 2000) record how many people are initially attracted to the display of exotic jams, how many people taste jams, how many people buy jams and then those buyers are asked about the satisfaction of their choice and choice process.

### **2.1.3 Unanswered questions in the literature**

This section will discuss the difficulties found in the literature relating to its application for this study.

#### **2.1.3.1 When is too much?**

There is a gap in the literature where studies have looked at two points on the continuum of what might be a U shaped curve but few have investigated the number of choices (of a product) that would provide the optimum point or region of satisfaction for the consumer. Literature struggles to show when is too much. Only one study has attempted to do this where participants described the option of 30 chocolates was “too much choice” (Iyengar & Lepper, 2000).

#### **2.1.3.2 Dealing with sensitivities in the study**

Many studies have shown that increased choices can be seen to have a positive or negative effect on satisfaction depending on the context. The difficulty is finding the point where the positive effects of increased choice end and the negative effects ‘too much choice’ begin (the turning point of the inverted U shape).

##### **2.1.3.2.1 Depends on items**

This point or region is also different for different items (Shah & Wolford, 2007). From the results of various studies it can be seen that 24 jams, 30 essay topics, 30 chocolates (Iyengar & Lepper, 2000), 24 search engine results (Oulasvirta et al., 2009), 50 coffee flavours (Mogilner et al., 2008) and 30 gift box options (Reutskaja & Hogarth, 2009) are too many choices. However, four coldrink flavours are too few (Reibstein et al., 1975).

One very significant finding from the studies of consumer choice is related to the frequency the product is bought. It was found that consumers prefer more options to choose from when selecting products that are bought less frequently (Borle et al., 2005). This would suggest consumers rely on habit when buying products that are bought more frequently and fewer choices are ‘sufficient’ to provide satisfaction. A store that reduced varieties of staple products such as milk, bread, cereal, etc., retained customers, even increased sales. However, customers stopped shopping at the store when items bought less frequently, such as aluminium foil, frozen bakery goods, frozen potatoes and onions rings, etc. were reduced in combination with other more frequently bought items (Borle et al., 2005).

#### *2.1.3.2.2 Depends on scale*

Oulasvirta et al. (2009) and Reutskaja & Hogarth (2009) have described the relationship between (perceived) satisfaction and size of the choice set as an inverted U curve: a continuum where initially increasing options increase satisfaction, until there passes some „optimum’ point or region from where the costs of making the choices increase at a faster rate than the benefit (Reutskaja & Hogarth, 2009).

But it is this continuum that causes problems of what portion of the x-axis a study occupies. This could explain why some studies find a negative effect of increased choices and others do not.

#### *2.1.3.3 Holistic considerations*

While it is clear that a number of choices provide benefits, only the benefits (satisfaction), as well as the costs, of the consumer or decision-maker are measured. There seems to be little consideration or discussion so far on the external costs/benefits that are incurred to produce or supply such variety.

Initially on a consumer level, this may not affect choices. But at an employer (or strategic decision-making levels) these external costs may need to be considered. The benefits and costs of these decisions would possibly need to be more inclusive in my study than it is in consumer choice literature. For this reason, this section will now discuss briefly some costs of supplying variety and trade-offs involved in decisions that weigh up the costs and benefits of providing variety.

#### *2.1.3.4 Costs of providing increased choice*

There are different costs for different decision-makers in any choice process. The costs of providing increased choices are very different in different contexts and are illustrated in this section in terms of retail managers stocking large assortments for consumers and manufacturing studies on the costs of producing a variety of goods.

##### *2.1.3.4.1 In a Retail Context*

In the retail sector this has been done in terms of storage costs of a retailer holding a larger variety of products. Large supermarkets are able to offer customers a wide variety of products for each brand and a number of different brands for every product. Smaller retailers struggle to compete with the large retailers like Wal-Mart (Borle et al., 2005). As a result there have been a number of studies carried out to investigate the effect of cutting stock and comparing this with the savings in storage space, etc. (Borle et al., 2005; Sloot, Fok, & Verhoef, 2006). There are mixed conclusions from different studies.

Sloot et al. (2006) did an investigation for a store to determine the effect of reducing their product variety by 25% of the least purchased detergents, enough to close one whole warehouse while maintaining the same display space on the shelves (Sloot et al., 2006).

The study found that while there was an adverse effect on sales of detergents in the short-term, in the long term there was an increase in „new buyers’ which partly offset the sales losses among previous buyers (Sloot et al., 2006). After receiving the feedback from the study, the store proceeded to cut their stock nationwide by 32 out of the original 37 detergents listed as part of the experiment. The assortment reduction did not significantly affect detergent sales (as a percentage of total store sales) in the long run. From these results, the retailer continued to reduce assortments of products in other categories where consumers might find too many options to choose from (Sloot et al., 2006).

One study analysed the online sales of a grocery store over a year where for the first six months all products were available and for the second six months both the number of products available within product categories, as well as the number of categories offered by the grocery store were reduced. The results from this study show that limiting the range of choice led to a decline in the frequency of sales, as well as a decline in overall store sales (Borle et al., 2005).

Borle et al. (2005) argues that previous studies found no change (Boatwright & Nunes, 2001) or even increases in sales with decreasing product selection (Drèze et al., 1994) because they had included only a few items that were mostly frequently bought, items such as milk and eggs, which would not experience a change in behaviour if options were reduced. However, Borle’s study (2005) showed that products that are bought less frequently were the most adversely affected by the reduction in product choice. Thus, a more representative picture is created by including a wide range of goods, and their study concludes that cutting options will reduce the overall income of the store. However, Borle et al. (2005) does not present the entire picture as they ignore benefits such as savings from storage space.

This has been explained by (1) the different types of products investigated (Borle et al., 2005), (2) the difference between short-term and long-term effects (Sloot et al., 2006) and (3) consideration of the positive and negative effects that offset each other (Sloot et al., 2006).

#### *2.1.3.4.2 In a Manufacturing Context*

The costs of providing variety can be looked at in the manufacturing sector literature. A few studies done in an industrial situation have found negative effects of increasing product variety to inventory costs (Benjaafar, Kim, & Vishwanadham, 2004), and manufacturing performance (in terms of labour productivity and consumer-perceived product quality) (MacDuffiel, Sethuraman, & Fisher, 1996). This has been described as the trade-offs between product variety and supply-chain performance (Thonemann & Bradley, 2002).

Inventory costs of manufacturers increase with variety. This was demonstrated in a study on a hypothetical multi-item production-inventory system (Benjaafar et al., 2004) which found that inventory costs of a finite production system<sup>3</sup> increase almost linearly with the number of products. They advocate the importance of understanding the value and effects of variety-reducing strategies (product consolidation for example) for managers of the production line (Benjaafar et al., 2004).

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<sup>3</sup> A finite production system is one where products are made to store and share the same manufacturing facility. It has a finite production rate and stochastic production times, and incurs setup time when switching from producing one product to another (Benjaafar et al., 2004).

Increasing product variety is also seen to have a negative effect on labour performance. The degree to which variety affects manufacturing and labour performance differs widely between industries. One study looked at the effects of product variety on manufacturing performance of 70 motor vehicle assembly plants worldwide in terms of labour productivity and consumer-perceived product quality (MacDuffiel et al., 1996). They found the effect of variety on performance to differ but to be lower than is “conventionally believed” (MacDuffiel et al., 1996: 350). Despite this, varying parts complexity has a consistently negative effect on performance (MacDuffiel et al., 1996).

Some forms of industry find that producing a larger variety of products works in their favour. For example, a study of steel mills finds that a higher profit margin can be generated from producing custom products from rare (“exotic”) steel grades. This only applies when there is less competition in this market (Denton, Gupta, & Jawahir, 2003).

However, the actual costs to efficiencies of the production line have vastly increased to produce these specialised products. As a result, these factories have suffered a lack of capacity and storage of semi-finished goods. Yet, these costs are still offset by the increased profits and less competition in the market for custom made products of special steel grades.

The steel mill case has little relevance to this thesis, except to illustrate the trade-offs of costs and benefits of producing a larger variety of products. In the case of employers, previously the costs of labour mobility have been ignored or invisible, thus the trade-offs are unrepresentative. By drawing attention to the real costs of labour mobility, to the environment, social situation and employers, one hopes to allow employers to re-examine the trade-offs and decisions.

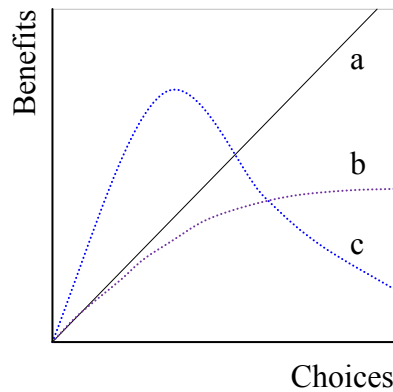
#### **2.1.4 Conclusions**

Since no studies could be found on the effects and costs to employers of increased employee catchments or limiting access, the investigation into the costs and benefits of increasing choices was found to come mainly from the studies on consumer choice.

The studies reviewed reveal one clear pattern: increased choice can be seen to have a positive and negative effect on satisfaction depending on the context. There is no simple formula that applies to all situations.

In summary of the review of the consumer choice literature, it was found that (see Figure 3):

- a) Some studies concluded that the results of greater choice were seen only as beneficial.
- b) Other studies showed that as choice increased, the extent to which it was seen as beneficial decreases.
- c) Some studies concluded that while choice was seen as beneficial at first, it turned negative at a certain point producing an inverted U.



**Figure 3 Three Relationships between Choice and Benefits**

Even within studies, the difficulty is finding the point where the positive effects of increased choice ends and „too much choice’ begins (the turning point of the inverted U shape). Literature struggles to show when choice is too much.

The effects of increased variety of options in the manufacturing situation is also not directly relevant to this study but it does show trade-offs and considerations of costs and benefits of producing variety. In retail the costs of providing increased variety are increased storage costs.

The objective of this section is not to show that choice for consumers or manufacturers in the literature discussed is similar or comparable to employer choice, rather to show that there are well documented cases in many different contexts where increased choices result in decreased or negligible additional benefit and to reflect that increased choice may be accompanied by increased cost.

## **2.2 The effect of limiting choice on employers**

### **2.2.1 Introduction**

This section investigates the degree to which employers currently consider employee travel when making decisions about employment of staff and business location. It proceeds to consider the available literature that addresses the issue of employer’s current awareness and understanding of the social and environmental effects of employee commuting and their limited response to this.

Despite an intensive search, there seem only to be a small number of studies that address these issues, and most of these focus on ways of reducing emissions and making current commuting patterns more sustainable. Few, if any, actually consider the option of reducing the distances travelled by employees through locating plants or offices closer to where people live and/or policies that might incentivise or compel the recruitment of staff that live closer and need to commute less.

International literature from the United Kingdom (UK) and the Netherlands suggests that in some countries there is a degree of awareness of problems associated with employee commuting such as lateness of staff due to congestion (Coleman, 2000; Rye, 2005). This literature suggests that a small number of employers are beginning to pay attention to these problems and have devised ways of incentivising car pooling and use of public transport or non-motorised forms of transport (Aspen Valley Hospital, 2010; Shoup, 1997; United Nations, 2004). Some have developed Employer Transport Plans (Rye, 2005).

These studies provide background information on international policies and actions where employers are being encouraged to assume a role in changing the current travel behaviour of their employees (Rye, 2005). These travel plans, however, focus on converting motorised trips to public transport or non-motorised transport. These measures are not suitable in developing cities such as Cape Town with its poor public transport system that is already the only option available to lower paid workers.

An investigation of current mobility patterns in Cape Town sets the context for the research to follow this review. The costs of current commuting patterns have become unsustainable. These costs are not only measured in CO<sub>2</sub> emissions and increasing commuting costs as oil prices rise. But, as this study will show, there are additional environmental and social costs that directly affect employers as well.

## **2.2.2 Employer's priorities**

Currently, the literature suggests, employers make most decisions about staffing and the location of their businesses based overwhelmingly on the principle of minimising the immediate financial cost and maximising short-term profit (Parr, 2002). This review will explore a range of other factors that increasingly confront employers, and offer a deeper understanding of the impacts of different employment policies and practices.

### ***2.2.2.1 Factors that currently affect selection of staff***

#### ***Criteria for employee selection***

Employers currently consider a number of factors when assessing a potential employee. These include skills levels appropriate for the type of position, experience in similar work, education and personal qualities<sup>4</sup> (Grove, 1981) that will best benefit the employer in terms of efficient work practises and lower management costs; thus factors essential to maximise profit (Barron, Bishop, & Dunkelberg, n d).

#### ***Effort in selecting employees***

The hiring process is a trade-off between the costs of searching for appropriate candidates (marketing, time for the interview process) and the „best' candidate to fill the position.

It is believed that the more time and effort is spent seeking the best person for the job and the more interviewees to choose from, the greater the likelihood of finding the most suitable person for the job (Barron et al., n.d.).

Other characteristics found to influence employment decisions are the characteristics of the employer and the nature of the labour market (Barron et al., n.d.). The larger firms seem to spend more money in the hiring process (advertising and interviewing) to make sure they find a capable and reliable employee because the costs and difficulties of monitoring worker performance in a large firm are higher. In smaller firms where the monitoring of workers is easier, there is often seen to be a less rigorous hiring process (Barron et al., n.d.).

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<sup>4</sup> A study by Grove (1981) tested a model for hiring staff for a soap and detergent factory and identified five key factors that these employers were looking for (and value most) in a potential factory employee: “stamina and agility, willingness to work hard, working well with others, learning the work and initiative” (Grove, 1981: 58)

If the market is flooded with unemployed workers or workers of a particular skill, this affects the trade-offs in the hiring process: companies spend less money on searching for employees to fill a position often for a lower wage. If the skill required is scarce, the costs are higher to find these skills and higher wages are expected. It also appears that the more rigorous the hiring process, the higher the potential employees envisage their wages (Barron et al., n.d.).

It is clear that the hiring and layoff of staff incurs costs to the employer. These costs were represented in Van de Panne and Bosje (1962) in the investigation of the optimum number of employees in relation to production output for a paint factory. The hiring and layoff costs were expressed by the following equation, where  $w_t$  is the workforce in the month  $t$  with coefficients<sup>5</sup>  $c_2$  and  $c_{11}$ :

$$c_2 (w_t - w_{t-1} - c_{11})^2$$

The results found that the estimated values of the coefficient  $c_2$  was overestimated and that there was not a very strong relationship between workforce and production. It would require a 78% overestimation in the coefficient to results in \$100 loss per month (Van de Panne & Bosje, 1962).

From the limited literature under review, the proximity of employee residence does not seem to feature as a factor worth consideration by employers.

#### **2.2.2.2 Factors that affect business location**

Minimising employee commuting has seldom, if ever, been an important factor when considering business location. One aim of this study is to determine what factors might prompt employers to consciously include the costs of commuting into their employment and business location decisions.

It is difficult to generalise because different employers have different priorities depending on the type of business or industry. But despite this complexity, the study will seek to establish any patterns that might exist.

The generation of technologies that enable many employees to work from home has stimulated investigations into changes that have occurred in the workplace and business locations (Moos & Skabuski, 2010; Towers, Duxbury, Higgins, & Thomas, 2006). This changing work environment helps a specific sector of the work force to reduce the amount and distance they travel (Aguilera, Wenglenski, & Proulhac, 2009). However, it is usually low income workers who travel the furthest to work (Day & Cervero, 2010) and generally they do not have either the skills or equipment and resources to work from home.

This also resulted in increasing attention to reverse-commuting and inter-suburb commuting that is said to be a result of many reasons including the flexible working conditions that no longer require business to take place in the centre of a town or city (Aguilera et al, 2009; Okamoto, 2007).

Table 3 summarises the factors affecting locations of businesses found in the literature explored.

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<sup>5</sup> Where  $c_2$  was estimated to be 64,3 and  $c_{11}$  was estimated to be zero (Van de Panne & Bosje, 1962).

**Table 3 Summary of literature describes factors affecting the location of business**

Topics	Main priorities influencing location	Author
1 Firms locate to maximise profits; one aspect is to minimise wages	Firms locate to maximise profit.	(Parr, 2002) (Sridhar & Wan, 2010)
	Labour intensive firms tend to locate in small cities, avoiding the higher wages (because employees are more aware of their rights), training costs and attrition rates in large-medium sized cities.	(Sridhar & Wan, 2010)
	Firms consider the economic trade-off between the land rent and wages costs.	(Okamoto, 2007)
	Firms choice is modelled by minimum wage cost function. The wage of local workers decrease and the wage of „cross-border’ workers (workers that travel between suburbs) increase, as business move towards the suburbs.	
2 Supply of labour	Firms in India tend to follow a large supply of labour.	(Sridhar & Wan, 2010)
	Exporting firms and large businesses are expected to locate in large cities; attracted to the large labour pool and variety of skills availability.	
	More local workers are employed as a result of this increasing wage difference between workers (substitution among types of workers). Thus firms with high labour intensities are expected to locate further from the CBD to take advantage of the low wage level of local workers.	(Okamoto, 2007)
3 Government policy	Areas with greater restrictions on labour hiring and firing, the less likely firms will locate there.	(Sridhar & Wan, 2010)
4 Economic Geographic factors	Economic geographical factors (such as the location of inputs, industrial diversity, labour supply) play an important role in firm location in India, Brazil and China.	(Sridhar & Wan, 2010)
	Businesses consider market size, agglomeration, local economy (Krugman, 1995) and policy related forces (Markusen, 1999) when locating.	(Markusen, 1999) (Krugman, 1995) (Sridhar & Wan, 2010)
	Firms in smaller cities face limited markets and higher mean transportation costs.	(Sridhar & Wan, 2010)
5 Accessibility by train	The possibility of being reachable by train seemed to be more important to a firm than the expectation of staff actually using the train for commuting.	(Willigers, Floor, & van Wee, 2007)
	The trade-offs of increased prices and reduced travel time of high-speed rail affect different types of users. Commuters have a higher value on time than business travellers. However, potential accessibility is so highly valued by Dutch firms that high-speed rail will have a large effect on business location decisions.	
6 High income workers closer to CBD and using PT	The relationship between employment suburbanisation and growth of reverse commuting and changes in weekly travel patterns in Paris.	(Aguilera et al., 2009)
	Reverse commuters were found to be mainly high-income professionals who work near the city in business districts. These areas are served by public transport. Resulting in lower travel distances and lower car use in Paris.	

	The smallest travel distances are observed for high earners who live and work in the inner city.	
	This study observes a trend where low income residents of the central city replaced by high income residents due to the high price of land in the city centre.	
	Trends of commuter modes have shown higher income workers reducing car usages and higher public transport users.	
7 Low income workers further from CBD and using cars	A trend of increasing home-work travel distances especially for low-income city residents who cannot afford to move. The car use for labourers has doubled.	(Aguilera et al., 2009)
	Low- wage workers cannot switch jobs when commuting costs increase.	(Okamoto, 2007)
	Workers choices are modelled to maximise the utility of their “net income function” (total minus commuting costs).	
8 Persons with similar skills, incomes and preferences for amenities choose to locate together in residential areas i.e. homogenous residential areas	A correlation between skills level and preference of workers. Workers of a similar skills level tend to live in the same area near the amenities and land rent that they can afford (preference).	(Okamoto, 2007)
	A firm needs to employ workers of different skills levels and thus workers from all different areas of a city. As a result, commuting costs are high. If workers of different skills levels live in the same area, then the commuting costs could be zero.	
	However, there are losses of utility resulting from the different amenity preferences of each worker – i.e. workers of different skills levels have different preferred levels of amenities and if workers of different skills are to settle in one place, each skills level will suffer a decrease in utility (well-being) resulting from the compromise in amenities that may not be their preference.	
9 Firms require heterogeneous workers	A firm in CBD can employ all types of staff at mean wage level.	(Okamoto, 2007)
	The heterogeneity of workers and amenities are used to explain „excess commuting’, also described in this study as a form of „cross-border’ commuting.	
	Division of labour development, relaxation of immigration controls and fiscal decentralisation were found to cause a trend of production activities to the CBD.	
10 Government can have more social goals in choosing location	Government owned businesses have the ability (and preference) to locate in “hostile business environment” (eg. restrictive labour laws) and “adverse geography” (eg. far from inputs). Government businesses can locate where land is cheaper.	(Sridhar & Wan, 2010)

### 2.2.3 How important is employee travel to employers

#### 2.2.3.1 In staff selection and business location

Proximity to a stable and reliable labour supply has long been a consideration for large, labour-intensive factories (Okamoto, 2007; Sridhar & Wan, 2010). But the available literature suggests that for most commercial and smaller manufacturing enterprises, this is not a factor.

### **2.2.3.2 Making existing travel patterns more sustainable**

However, there is a body of literature that certain (a few) employers are beginning to implement measures (such as flexitime, work from home, public transport incentives, etc.) to make commuting more sustainable. These studies suggest an increasing awareness of the costs of current commuting patterns that include:

- Staff lateness and delays of employees travelling on business, resulting from traffic congestion (Bristol University, 2007; Coleman, 2000).
- Company car travel costs for business (Coleman, 2000).
- High parking costs (of employer's accommodating staff and customers who commute in private vehicles) (Bristol University, 2007; Coleman, 2000).

This literature also refers to the issues of staff lateness resulting from public transport inefficiencies (Coleman, 2000) and tiredness and reduced efficiency resulting from long commuting distances (Mawson et al., 2007).

However, the solution is at present seen simply as selecting cheaper and less environmentally damaging forms of transport. Employers do not confront the question of whether changing staff selection policies or the location of enterprises should be considered.

### **2.2.3.3 Employer Travel Plans/Green Commuter Plans**

The United Kingdom (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). This is a way of compelling business to take responsibility for reducing CO<sub>2</sub> emissions from commuting.

A Green Commuter Plan or travel plan is defined as “*a package of practical measures, tailored for any given business, which ease the problems and costs, and reduce the environmental impact of travel. A plan will include a range of those actions most suitable to that site or business, and most likely to be feasible and attractive to employees*” (Environmental Information Exchange (EiE), n.d.).

These are based on the principles of Travel Demand Management (TDM). Travel plans are designed to reduce both environmental and financial (to employer and employee) costs of commuting – that is to reduce the impact of travel, not reduce travel itself (Coleman, 2000; Rye, 1999).

### **2.2.3.4 Employer Travel Plans (ETPs) in practise**

In the UK, employers are encouraged to develop comprehensive ‘employee travel plans’ (green commuter plans) to reduce car-based travel to work and promote more sustainable alternatives (Coleman, 2000) but very few really engage actively with the idea.

A study in Oxford found that only 19% of 67 employers that responded to the survey were aware of the term “Green Commuter Plans” and of those 64% had no concept of what the term meant (Coleman, 2000).

The majority of employers do not see themselves as playing a responsible role in mitigating the environmental effects of employee commuting. A Green Commuter Plan is low on most employers' priorities: they feel that "*businesses should be given priority and support, not penalised*" (Coleman, 2000:12). Many companies said they would struggle to implement such a plan due to resource constraints and organizational structure. Only 4% of the responding businesses (81% of the original sample did not respond to the questionnaire) indicated that they would be willing to implement a green commuter plan and 38% said "yes, maybe" (Coleman, 2000: 13).

90% of responding businesses in Oxford (and 62% outside Oxford) stated they are situated within walking distance (10 minutes) of a bus stop and 59% of Oxford residents claimed to stay within 10 minutes of a bus stop or park and ride (Coleman, 2000). Yet businesses gave numerous reasons explaining the difficulties of reducing motorised transport:

1. Employers claimed that unpredictable working hours, such as shift work and anti-social hours, make using transport modes other than the car impractical (Coleman, 2000).
2. Some types of work require a car (such as an estate agent or construction manager moving between sites). Employers suggested these should be exempt from green commuter plans (Coleman, 2000).
3. The location of staff and business are dispersed (and particularly if employees or business are located in rural areas) and the only "convenient access" is by car (Coleman, 2000).
4. The distribution of staff home location and different working hours make lift sharing difficult (Coleman, 2000).
5. Skilled labour needs to be recruited from a larger area and thus requires the use of a car. (Thirty-four percent of responding businesses employ staff that travel over 26 miles from their work place (Coleman, 2000)).
6. There are no tax or other incentives to implementing Green Commuter Plans (Rye, 2005).

A study on mobility management at the employer level (Rye, 2005) found that large businesses (greater than 500 employees) with particular problems, such as parking or accessibility difficulties, or planning conditions/regulations related to site expansion are more likely to implement travel plans. Very few employers will voluntarily implement a Green Commuter Plan for environmental reasons alone. They see it as unnecessary and costly. Employers want the government to pay for and implement sustainable commuting plans (Rye, 2005).

Research carried out in the UK (DfT, 2004) found that travel plans cost businesses £47/US\$80/€62 (approximately R560) on average per employee per year (Rye, 2005). This is not a huge amount of money compared to parking costs. However, parking bays are reserved for the high income and skilled professionals.

The three most commonly stated requirements of employers before green commuter plans could be implemented were: viable public transport alternatives exist, central government legislation, tax and other incentives (Coleman, 2000; Rye, 2005).

#### 2.2.3.4.1 *Support for commuting staff*

There are many companies, mostly international, that have introduced measures to help their staff with the costs and modes of commuting. These are not necessarily part of any formal Green Commuter Plans but they involve employee travel. These measures have been grouped here into three main sections. Firstly, those that are concerned with Climate Change and reduction of CO<sub>2</sub> emissions through encouraging use of public transport and sustainable commuting, secondly those measures that help employees with the financial burden of commuting and, lastly, those that attempt to reduce travel in itself.

##### **(1) *Reducing CO<sub>2</sub> emissions***

There are many different company policies to encourage and incentivise the use of public transport. These are:

- Provide discounted fares or subsidise public transport passes. (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).
- Reimbursing parking costs for those who park and then take public transport and subsidising park and ride systems (Shoup, 1997; Lawyers.com, 2010).
- Encouraging cycling to work (Shoup, 1997; Lawyers.com, 2010; United Nations, n.d.-a).
- Encourage the use of public transport for business trips (United Nations, 2004; United Nations, n.d.-a, n.d.-b).
- Locate business near public transport systems to encourage and facilitate modal shift (United Nations, 2004; United Nations, n.d.-a, n.d.-b).
- Allow flexible working hours to reduce congestion and encourage working from home to reduce commuting (United Nations, n.d.-d).
- Running awareness programmes for staff encouraging modal shift and reducing carbon emissions (United Nations, n.d.-e).
- Pledging to reduce a company’s carbon footprint (United Nations, n.d.-e, n.d.-f).
- Minimising business travel (International or Intercity) (United Nations, n.d.-c, n.d.-f, n.d.-g, n.d.-h).

##### **(2) *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. These might make it easier for workers to travel, but they have minimal environmental impact.

Some companies:

- Provide discounted fares or subsidise public transport passes. (Aspen Valley Hospital, 2010; “Work, Job and Income,” 2010; Lawyers.com, 2010; United Nations, 2004).
- Provide private mass transit services such as work busses (Lawyers.com, 2010; United Nations, 2004).

- Offer transport allowances separate from salary, to reduce the burden of travel on staff (South African Department of Labour, n.d.).

### **(3) Measures to reduce travel**

There are a few measures that attempt to reduce travel in itself (although these are mostly for congestion and Climate Change reasons). For example:

- 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.-c).
- Minimise business travel (International or Intercity) (United Nations, n.d.-c, n.d.-f, n.d.-g, n.d.-h).

The impact of these measures is largely restricted to lower emissions achieved by reduced motor car travel; and they are unlikely to have even this impact in SA and other developing countries where most working commuters do not have private motor vehicles and public transport is not an alternative for them.

Cape Town employers are likely to react with the same scepticism to policies encouraging the management of staff mobility.

#### **2.2.4 Current travel patterns in Cape Town**

The current travel conditions of employees in Cape Town provide a context for the data collection section of this research project.

Mobility patterns in Cape Town are extremely dispersed and the costs are high. The physical dispersion of settlements around the base of the mountain and coastline, as well as the Apartheid legacy of racially segregated settlement areas mean that people travel long distances to work (African Centre for Cities, 2011; National Planning Commission, 2011). The shape and limited public transport system means that the most efficient way to move is by private motorcar. The lower income workers, generally live far from the city centre and jobs, because that is where they can afford the housing and partly due to Apartheid divisions (National Planning Commission, 2011).

*“Poor populations already use public transport and many spend more than 20 % of their income on fares. From the South Africa National Household Survey (NDOT, 2003) it can be estimated that 77% of households and 84% of low income households in South Africa used public transport during the month under survey. Those that did not use public transport probably did not travel...[Table 4] shows the percentage of households in each income category that spent specific amounts on public transport; as well as the % of households that did not use public transport. From this table it can be seen that low income households account for 49% of the country’s households and with some interpolation, it was estimated that 62% [yellow shaded blocks] and 28% [pink shaded blocks] of the low income households spent more than 10% and 20% of household income on public transport respectively” (Del Mistro & Proctor, 2012: 5).*

**Table 4 Percentage of Households Using Public Transport in Income and public Transport Expenditure Categories in South Africa. (Source Del Mistro & Proctor, 2012)**

	Household income (Rands)	(1)	% of PT users in income group in PT expenditure category (NDOT,2003:46 adjusted to include only PT using households)					% hh not using PT
			R1-R50	R51-R100	R101-R150	R151-R200	>R200	
L	R1-R500	23.8	49.6	27.3	9.6	6.3	7.2	18.4
L	R501-R1000	25.2	38.8	24.3	12.2	9.2	15.5	14.0
LM	R1001-R3000	28.7	19.9	17.0	14.0	13.2	35.9	15.1
HM	R3001-R6000	11.0	10.1	12.5	10.8	12.6	54.0	30.4
H	>R6000	11.4	10.7	9.6	8.4	11.2	60.1	64.4

(1) % of households in income category (NDOT, 2003: 29), adjusted for missing data in Del Mistro & Proctor (2012)

Those who cannot afford private cars must use a combination of non-motorised transport, bus, taxi and rail services to access their workplaces (National Planning Commission, 2011). A combination trip of this manner takes a long time and is expensive. Poor commuters using public transport in Cape Town on average travel 16km per direction/day (Tabane, 2005).

The National Development Plan Visions for 2030 (National Planning Commission, 2011: 239) gives a fairly typical example of the commuting burden carried by poorer and less skilled workers in SA.

*A single mother of four children spends five hours each day commuting to and from work. She spends nearly 40 percent of her salary each month on commuting costs. Her journey comprises of a 2km walk to from her house to the taxi stand, where she catches a taxi to the train station which takes her into Pretoria. From there she catches another taxi into the suburb where she works as an office cleaner. She leaves home at 05:00am to get to work by 07:30am, and leaving work at 16:00, she may only get home by 19:00 because the trains are often delayed. She spends more than R700 a month on transport and nearly 100 hours on route.*

This woman is already using the cheapest and quickest means of transport at her disposal. Continuing major investments in more of the same services is unlikely to improve her life now, nor protect her from the shocks to come as expected increases in fuel prices that will cause the financial costs of commuting to increase further and to a point where a poor employee can no longer afford to get to work and access jobs at that distance.

The expectations that governments will be able to increase subsidy payments might not materialise as they will face decreasing revenues as a result of declining economic activity caused by increased oil prices (Del Mistro & Proctor, 2012).

Motorised travel can initially be reduced in existing situations through the elimination of excess travel/commuting, which is “*travel that is made unnecessarily in reaching chosen destinations*” (Del Mistro & Proctor, 2012: 6). A study by Tabane (2005) found excess travel in Cape Town to be 16% and 6% among the non-poor and the poor respectively. This is not a lot of scope for improvement.

### ***2.2.4.1 The costs of these travel patterns***

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

#### ***2.2.4.1.1 Environmental Costs***

The vast dependence on motorised and long travel distance is largely responsible for high volumes of carbon dioxide emissions and congestion problems in Cape Town and cities worldwide.

There are a number of reasons why this is a concern:

- Carbon dioxide is a greenhouse gas and contributes to the destruction of the ozone layer, causing gradual warming of the atmosphere and changing climatic conditions resulting in more extreme weather events such as flooding, fires and droughts (Climate Change) (National Planning Commission, 2011).
- Air pollution and health issues (Bristol University, 2007).
- Non-renewable resources, such as oil (a key component in petrol and diesel for motor cars, trucks, etc.) are depleting at a rapid rate. This is huge global concern. This scarcity is expected to push the price of oil upwards (National Planning Commission, 2011).
- 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).
- The ever-increasing roads and parking surfaces to match the demand for more access for more cars and further distances is resulting in loss of land (Bristol University, 2007). This land can be used for other activities, or as natural green open spaces. The loss of green space has a number of consequences:
  - Hard surfaces increase the volume and velocity of run-off from rainfall.
  - Current stormwater systems cannot handle increased volumes and problems of flooding or insufficiently treated wastewater occurs.
  - The heavy metals and oils dissolve in the water, polluting nearby water sources and wetlands.

#### ***2.2.4.1.2 Social Costs***

The social costs of these travel patterns are mainly carried by the workers themselves and their families. There is little South African literature of the effects of commuting on workers and society, but some international literature has been applied in this discussion.

#### ***Travel times and long travel distances***

There is debate as to whether the travelling time of commuters has stayed the same and distances have increased or vice versa. This is location specific, however both long distances and long travelling 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 increases in travelling times and distances (Aguilera et al., 2009). As a result, tiredness and low energy affects both employee work performance and family life (Mawson et al., 2007).

High volumes of motorised commuting cause a high level of injuries and deaths from road accidents (Bristol University, 2007; National Planning Commission, 2011).

### ***Quality of life***

Employee's disposable income decreases as travel costs increase. Increasing travel costs are induced either from increased travel distance or increasing cost of travel (increasing oil price or carbon emissions tax for example) (Del Mistro & Proctor, 2012).

Employees have to make a difficult trade-off with regard to high land rent costs and shorter travel distances versus longer distances with more affordable land (Okamoto, 2007). Land price decreases with distance from the centre of the city and from public transport. Two worker households are found to have particularly difficult trade-offs with regards to residential location choices, especially poor workers who cannot afford property near the city (Fan, Khattack, & Rodriguez, 2010).

### ***Few alternative options to alleviate costs***

There is little consideration of residence and work location, especially for low income workers who have limited choices of residential location they can afford (National Planning Commission, 2011). Low income workers cannot afford to switch jobs or move when travel costs increase (Okamoto, 2007). This is a key point of this study.

These social and environmental costs of current employee travel behaviour affect employers both directly and indirectly.

### ***2.2.4.2 Implications of this context for data collection***

Economists refer to these environmental and social costs as “externalities”. Externalities are the costs or benefits of production or consumption that are borne or obtained by society and the environment and not the producers or consumers (Cartwright, 2011; Sloman, 2006). The price of products does not fully reflect all of the costs involved and it is society and the environment that carry these unaccounted costs. This is unsustainable.

Up until recently the environmental costs of car dependency, residential dispersion and long commuting distances have been ignored and unaccounted for. Economists and the government are now beginning to add these environmental costs into the price of the opportunity to travel. These include CO<sub>2</sub> 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 its carbon footprints.

A study must begin to map the terrain and understand current perceptions and practices of key stakeholders like employers.

## 2.3 Underlying Theoretical Models of Decision Making

Decision-making is a complex process that involves a variety of trade-offs and value structures that are specific to individuals and are difficult to measure or predict.

The ability to model the psychological decision-making process has been of interest to psychologists, marketing scientists and economists for many years. The research in these different sectors differs in the aim of the research and in the nature of the data collected. Psychologists have been interested in the reasons why people make particular choices, the motivations and psychological processes behind choices. Marketing scientists have a specific purpose behind their research into consumer choice. They seek to understand what motivates consumer choice as a way of predicting consumer trends and to help design marketing campaigns. Economists developed decision-making models to study the economic value of goods that are not traded in markets, and later to understand the effect of policies on the existing choice behaviours of society (Timmermans, 2003).

Most work in this field has been involved in attempting to model consumer choice behaviour in the context of a market. The thought process of decision-making can be modelled by a number of different theories and “rules”. In the 1960s and 1970s models of choice were based on observations of how people behave in real markets and theories borrowed from social physics such as gravity and entropy-maximising models (Timmermans, 2003).

The final section of this review deals with the different ways to model decision-making. Firstly it will discuss the three main theoretical backgrounds for modelling choice: Psychological Theories of Choice, Theories of Preference and Rule-Based Decision Theories. Stated preference theories are then discussed in more detail, followed by a discussion on the research design process. A brief derivation of the Basic Utility Theory that underlies the preference model and is used as an introduction into a brief explanation of the Multinomial Logit Model and likelihood functions for data analysis. Finally, this section ends with a reflection on what can be taken forward into the research design process.

### 2.3.1 Psychological theories of choice

Psychological Theories of consumer choice describe different categories of consumers based on the motivation behind their decision, and divide the market into a number of segments, namely (Woods, 1960):

1. *Habit-determined group* who tend to demonstrate a short-term loyalty to a brand they previously purchased and were satisfied with.
2. *Cognitive group* who make rational decisions and are only loyal to a brand while it is the most rational decision based on price, convenience, etc.
3. *Price-cognitive group* who primarily make choices on the basis of price or economy.
4. *Impulsive buyers* choose products on the basis of physical appeal and are less responsive to brand names.
5. *“Emotional” consumers* who respond to the symbolic appeal of the products and are strongly influenced by images.
6. *New consumer groups* who are unstable with their decision-making behaviour.

These theories predict that an individual follows rules to make a selection from a set of choices with two or more alternatives. These rules provide a mechanism to process information and assess alternatives. There are many different types of decision rules such as random choice, variety seeking, habit or „following the leader’ (Koppelman & Bhat, 2006).

### ***2.3.1.1 Decisions based on rational utility***

Decisions that are made based on rational factors (cognitive behaviour) are primarily considered when modelling decisions of price-cognitive decision makers in the market.

A rational decision-making process has two key aspects: consistency (repeatedly make the same choice selection in identical circumstances) and transitivity (the preference scale illustrates a unique ordering of alternatives – for example, if A is preferred over B, and C is preferred to A then order of preference is consistently C, A and B) (Koppelman & Bhat, 2006).

Random utility theory and discrete multivariate analysis were developed in the 1980s and transformed the way decision-making was modelled. An underlying utility function and utility-maximising behaviour was now used to interpret choice behaviour (Timmermans, 2003; Viney, Lancsar, & Louviere, 2002).

Briefly, this model predicts that certain types of people (in this case rational ones) will always choose the option that maximises his/her utility. Nearly all choice models are founded on this principle.

However, reality is seldom as simple as this. A great deal of evidence shows that choices are not always rational.

### ***2.3.1.2 Habit-based versus variety-seeking behaviour***

Habit and people’s resistance to change is one variable that works against rational utilitarianism as the basis of choice in many cases. Payne, Bettman & Johnson (1993) found that people will tend to reuse past decisions to simplify their choice and lower the risk, when there is too much uncertainty or the cost of finding a new alternative is too high (Cantillo, de Dios Ortuzar, & Williams, 2007).

Habit-based decision-making, is also referred to as “learning” (Kuehn 1962), “last purchase loyalty” (Morrison 1966), “variety-avoiding” (Givon 1984) and “reinforcement” (Kahn, Kalwani & Morrison, 1986). This model has been thoroughly investigated in the transportation sector when investigating choices involved with the construction of a new rail network for example. It is used a lot in marketing science to study brand loyalty (Cantillo et al., 2007). This means that even if a change occurs to raise the utility of alternative B (greater than alternative A), an individual may continue to select the same alternative as before (alternative A) (Cantillo et al., 2007).

On the other hand, in many cases researchers have observed the opposite effect of “variety seeking” (Bawa, 1990). This trend is similar to “novelty seeking” (Rogers, 1979) where certain individuals will seek a new product or brand, in preference to their previous choice.

Bawa (1990) claims that the classification of consumers into either habit-based choosers or variety-seekers is simplistic. He finds that an individual can exhibit inertia and variety seeking behaviour at different times, depending on history of their choices. In this analysis he refers to Berlyne’s theory of

exploratory behaviour describing the attractiveness stimulus as an “inverted U” shape (Bawa, 1990). This allows for the attraction of a product to increase to a point, after which the individual becomes bored (decreasing attractiveness or appeal). Thus an individual can move from inertia (habitual behaviour) of satisfaction with the product to variety seeking behaviour when bored with the brand and switches to another brand or product (Bawa, 1990).

The complexities of modelling decision-making process are vast. In essence, in any situation there may be many variables that influence a choice. Models try to isolate the main determinants of choice in certain kinds of contexts.

In the section that follows, assumptions and best fit functions are used to attempt to describe models that give a degree of order to these complexities.

### **2.3.2 Theories of Preference**

Theories based on eliciting consumer’s preferences are different from psychological theories of choice behaviour. These theories are based on the underlying assumption that people will choose (prefer) the option that maximises their utility – Utility Theory (described in Section 2.3.5.2.1)

Preference based survey techniques often involve applying a value to a preference in terms of the willingness of a consumer to pay for a product. *“Measuring consumer’s preference will allow us to quantify the individual’s economic valuation or willingness to pay (WTP) for public and private initiatives”* (Merino-Castello, 2003).

To measure preferences one needs data. This data can be in the form of actual choices made by consumers in a market setting for example (this is referred to as revealed preference) or the data can be drawn from survey responses to hypothetical choice scenarios (this is referred to as stated preference) (Viney et al., 2002).

The two preference-based methods (revealed and stated preference) are based on the same principle of utility maximisation, but differ in the type of data and collection methods.

#### **2.3.2.1 Revealed Preference**

Where the data is based on actual observations of actual behaviour, the analysis is referred to as a revealed preference survey analysis. Models of random utility can be applied to data to interpret the choice behaviour, such as willingness to pay.

In sectors where there is a lot of data available of previous choices, such as past and existing travel patterns, car availability, etc., revealed preference surveys can provide direct estimations of demand and willingness to pay (value).

This type of analysis is limited because on its own, it only tells us what choices people have made under specific conditions in the past and assumes that conditions remain constant. It does not allow for the effect of future policy or price changes on choices and is thus a weak reflection for predicting choice behaviour.

Observed choice behaviours on their own are not always reliable to reflect current or future individual preferences. There are spatial and contextual restraints that are reflected (or ignored) in observed behaviour that may or may not apply to individual preferences (Timmermans, 2003).

### **2.3.2.2 Stated Preference**

Due to the shortcomings of revealed preference, scholars investigated decisions by asking respondents directly about their preferences (Timmermans, 2003). Choice could now be described in terms of a combination of its attributes (factors that affect the decision). Statistical analysis methods were used to break down the preference of attribute profiles into contributions from attribute levels. The method of conjoint or decompositional preference emerged (Timmermans, 2003).

Stated preference techniques are used when there is no revealed preference data available for reasons such as the product or service is new or not usually provided in a market context (Viney et al., 2002).

Stated preference techniques involve presenting respondents with one or more hypothetical scenarios and asking them to select their preferred option. Within this method, there are a number of techniques that have been developed to obtain consumer's preferences and quantify WTP for goods and services. These are known as contingent valuation, conjoint analysis and choice modelling (Merino-Castello, 2003).

These techniques are used in a number of situations (The Praxi Group, 2007), for example:

- Introducing a new product or a service or altering an existing product or service.
- Forecasting demand.
- Evaluating pricing (allowing for profit maximisation).
- Reacting to changes in the market.

For the purpose of this research, which involves hypothetical circumstances and choices, stated preference methods are most appropriate. For this reason, stated preference methods will be discussed in greater detail in Section 2.3.4.

Other decision modelling theories are based on rules, rather than preferences. These are discussed briefly below.

### **2.3.3 Rule-Based Decision Theories**

The models outlined above apply mathematical equations of utility maximisation to characterize and predict preferences and choices. Rule-based decision theories are non-algebraic methods based on Boolean approaches, where preferences and choices are modelled in terms of a set of logical conditions that need to be satisfied to generate a particular preference or choice (Timmermans, 2003). Examples of these approaches are decision trees (or decision nets) and decision tables.

*Decision trees* or *decision nets* are choice modelling techniques that use a flow diagram method where respondents indicate at different levels of attributes, which alternative they would no longer consider (rejection-inducing attributes) or what trade-offs would compensate for that attribute (Timmermans, 2003).

*Decision tables* originated initially from software engineering and have since been used to describe and “analyse problems that contain procedural decision situations which are characterized by a set of influential conditions, the state of which determines the execution of a set of actions” (Timmermans, 2003:8).

### 2.3.4 Stated Preference Theory

Stated preference techniques involve presenting respondents with one or more hypothetical scenarios and asking them to select their preferred option, in the form of a survey.

These are the techniques used to gather the type of data required to apply the decision models. The stated preference techniques displayed in Figure 4 are explained and followed by summary Tables 5 and 6.

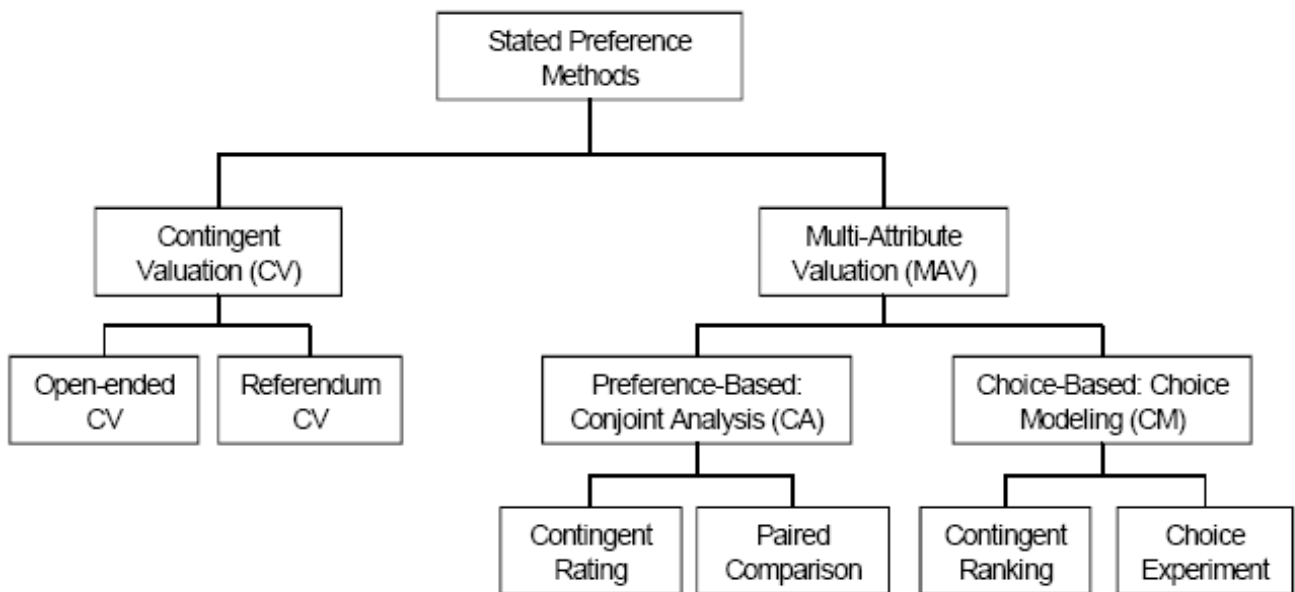


Figure 4 Stated Preference Techniques Source: (Merino-Castello, 2003:5)

#### 2.3.4.1 Contingent Valuation Method (CVM)

Contingent Valuation is a survey-based, stated preference technique that places value on a good by asking respondents what they would do under hypothetical circumstances. There are two types of CVM: namely Open ended (which asks questions such as “how much would you pay for this product described?”) and Referendum or dichotomous (yes or no answers to a question) (Merino-Castello, 2003).

The open-ended CV method is susceptible to bias in the sense that respondents find it very difficult to answer because paying for non-market goods is unfamiliar. As a result, the open-ended CVM is now seldom used. An Ordinary Least Squares (OLS) regression is used to estimate the coefficient values of open-ended CVM and referendum CVM using a random utility function, such as the binary logit model using the maximum likelihood procedure (Merino-Castello, 2003).

There are a number of limitations to both of these methods. These are summarised as (Merino-Castello, 2003):

1. They represent consideration of only one attribute or scenario.
2. Hypothetical scenarios do not give realistic responses.
3. Some respondents may react strategically.

This is why choice models started and in response to these limitations, expanded into Multi-Attribute Valuation Methods that utilise the basics of the Contingent Valuation (Merino-Castello, 2003).

#### 2.3.4.2 Multi-Attribute Valuation (MAV)

The MAV methods are preferred in surveys when valuing different attributes such as levels of service, of a good or service.

Advantages of MAV that resolve some of the limitations of CVM (Merino-Castello, 2003):

1. Many alternatives can be considered.
2. Based on the attribute theory of value which is easier to link with cost models or price models than CV.
3. Attribute levels are usually designed as orthogonal and thus reduce the problems of correlation/"multicollinearity".
4. Easier for the respondent to answer.

There are two types of MAV techniques: preference-based and choice-based.

*Preference-based techniques* involve the respondent rating or ranking their preference of alternatives on a type of scale. This is a method of evaluation and does not require commitment to a specific option. These techniques use a deterministic utility function, where individual's ratings are related to utility ( $U_{ij}$ ) via a transformation function  $\phi$  (Merino-Castello, 2003)<sup>6</sup>.

$$U_{ij} = \phi[V_{ij}(X_{ij})]$$

*Choice-based techniques* require respondents to select the most preferred option among two or more alternatives. This technique is a more realistic task for consumers, simulates a direct choice, and is thus the more preferred option in the literature. Choice modelling (also called discrete choice) is a commonly used choice-based technique. These techniques use the random utility function, which contains a deterministic component ( $V_{ij}$ ) and a stochastic one ( $\epsilon_{ij}$ ) (Merino-Castello, 2003)<sup>5</sup>.

$$U_{ij} = V_{ij}(X_{ij}) + \epsilon_{ij}$$

The techniques differ in the quality of information generated, the degree of complexity involved and whether or not their results are sufficiently consistent with usual welfare measures (Bateman et al, 2002).

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<sup>6</sup> Where  $X_{ij}$  is a vector of attributes describing alternatives  $i$  and  $j$ ; and  $V$  is the proportion of the utility that is observable/estimated by the analyst (Koppelman & Bhat, 2006).

The different methods for preference-based and choice-based approaches are discussed in further detail below.

#### 2.3.4.2.1 Preference-Based: Conjoint Analysis (CA)

Conjoint Analysis (CA) is a preference-based approach, thus involves the respondent evaluating and rating a set of alternatives by preferences, rather than selecting one. This can involve the rating of one scenario at a time, with no comparison between scenarios, referred to as *contingent rating*. Another method is to choose the preferred option from the comparison of two alternatives and then indicate the strength of their preference in the form of a scale, referred to as *paired comparison*.

Both methods analyse the data using the Ordinary Least Squares (OLS) regression techniques to form the deterministic utility function (Merino-Castello, 2003).

#### 2.3.4.2.2 Choice-Based: Choice Modelling (CM) (Discrete Choice)

Choice modelling, also referred to as discrete choice experiments, relies on the respondent selecting his/her preferred option from a set of alternatives. *Contingent ranking* and *choice experiment* methods both use the choice-based approach and, thus, the random utility function and maximum likelihood estimation procedure (Merino-Castello, 2003).

In *Contingent Ranking* respondents are asked to rank alternatives in order of preference (from most preferred to least preferred). “*Each alternative is characterized by a number of attributes, which are offered at different levels across options*”(Merino-Castello, 2003).

The *choice experiment* is the most comprehensive survey design and the data gives useful information on the relationships between different attributes and attribute levels.

Both should include the status quo or „no choice’ scenario to prevent errors of forcing respondents to choose between new options.

Table 5 illustrates a summary of the different methods of choice modelling. It provides a simple comparison between the utility functions used in each model (deterministic or random utility model) and if the method is preference or choice-based. The measurement scale illustrates the way in which the scenarios are presented to the respondent and thus how the choice (or preference) is measured. The model specification is compared. The estimation method is compared, illustrating the use of Ordinary Least Squares (OLS) for the preference-based models and maximum likelihood for choice-based models.

**Table 5 Model Specification of Choice Modelling (Discrete Choice) methods**

Source (Merino-Castello, 2003: 13)

	Utility Model	Elicitation format	Measurement Scale	Model Specification	Estimation Method
Contingent rating	Deterministic	Preference based	Score alternative scenarios on a scale of 1-10	Linear Regression Model	OLS
Paired comparison	Deterministic	Preference based	Score pairs of scenarios on a similar scale	Linear Regression Model	OLS
Choice experiment	Random utility	Choice based	The most preferred between 2 or more alternatives	Conditional logit	Maximum likelihood
Contingent ranking	Random utility	Choice based	Rank a list of alternatives from most to least preferred	Rank ordered logit	Maximum likelihood

A summary of the stated preference methods, as well as their advantages and limitations is provided in Table 6.

**Table 6 Summary Table of Survey Methods.** Source (Merino-Castello, 2003 Otherwise indicated in the table)

Description	Advantages	Disadvantages
<p><b>Contingent Valuation (CV)</b></p> <p>Stated preference technique that places value on a good by asking respondents what they would do under hypothetical circumstance described.</p> <p><b>Open-ended</b> (,how much are you willing to pay?)</p> <p><b>Referendum or dichotomous</b> (yes/no questions)</p>	<p>Flexible: can be used to estimate the economic value of real and hypothetical alternatives</p> <p>Easy to analyse and describe.</p> <ol style="list-style-type: none"> <li>Has been widely used over the past 20 yrs.</li> </ol>	<p>The reliability of answers based on hypothetical situations</p> <p>Survey biases relating to lack of information.</p> <p>Can be expensive and requires high competence levels to conduct.</p> <p>Represents consideration of only one attribute or scenario</p>
<p><b>Multi-Attribute Valuation (MAV)</b></p> <p>Asks respondents what they would do under hypothetical circumstance described in with multiple attributes such as levels of service, of a good or service.</p>	<p>The approach of choosing between alternatives generates more information than a CV study.</p> <p>MAV is cheaper to conduct.</p> <p>Many alternatives considered</p> <ol style="list-style-type: none"> <li>Attribute levels are usually designed as orthogonal and thus reduce the problems of correlation/"multicollinearity"</li> <li>Easier to respond to.</li> </ol>	<p>The reliability of answers based on hypothetical situations which may not be familiar to the respondents.</p>

Description	Advantages	Disadvantages
<p><b>PREFERENCE-BASED</b></p> <p>Conjoint Analysis (CA) Respondents rate their preference of alternatives on a type of scale. This is a method of evaluation and does not require commitment to a specific option.</p> <p><b>Contingent rating</b> involves evaluation of one scenario at a time.</p> <p><b>Paired comparison</b> respondents choose the preferred option from the comparison of two alternatives and then indicate the strength of their preference in the form of a scale</p>	<p>Easy to answer.</p>	<p>Not required to make a choice Strong assumptions are required to transform ratings into utilities e.g. the same rating by two respondents may not necessarily mean that the two answers are identical: a rate of “8” by a respondent might be completely different by the same “8” given by another respondent (Markandya, n.d.). OLS regression for deterministic utility function carry strong assumptions. Estimates not consistent with usual welfare methods.</p>
<p><b>CHOICE- BASED</b> Choice Modeling/Discrete Choice Respondents are asked to state preference based on descriptions of the proposed changes. Each change is described in terms of characteristics (price, reliability, safety). The WTP is determined from this preference.</p>	<p>Can be used to value real and hypothetical alternatives. More accurate than CVM because it utilizes preferences/tradeoffs rather than direct monetary values. Can accommodate multiple competitive product, attributes, attribute levels and no purchase options (The Praxi Group, 2007). Results illustrate direct estimates of market share and demand (The Praxi Group, 2007). Identifies drivers of choice (The Praxi Group, 2007).</p>	<p>Time consuming design process involving initial interviews and pre-testing. Analysis of survey data is usually more complicated than CVM with use of discrete choice analysis methods. Uncertainty in the actual value attached may arise from translating answers into monetary values.</p>
<p>Contingent Ranking Respondents are asked to rank a set of alternatives from the most preferred to the least preferred.</p>	<p>Can be used to rank options from a list of scenarios. Provides a lot of information.</p>	<p>Heavy cognitive burden. It is probably easy to identify the most preferred and the least preferred options, but it might not be so easy to rank the options in the middle.</p>
<p>Choice Experiment</p>	<p>1. Comprehensive method that generates the most information on relationship between attributes and attribute levels.</p>	<p>1. Expensive and comprehensive design process.</p>

#### *2.3.4.2.3 Discussion of survey methods*

Discrete choice (choice modelling) seems advantageous in the quality and amount of detail of information extracted. Contingent ranking contains highly complex analysis and multiple levels of nested logit. A choice experiment is simpler than contingent ranking but the method used depends on the information required for the study.

#### *2.3.4.3 Decision modelling techniques used in similar studies*

This dissertation is focussed on the choices made by the employer on the selection of staff and location. This literature review did not uncover any similar studies, but only somewhat related studies looking at commuting costs, modal choice, business and residential choice of location and assessing costs to a company. The survey techniques and methods used to model these situations and choices are useful to seek the most appropriate technique for this study.

#### *Similar studies in South Africa*

In South Africa there have been a few Stated Preference studies done with regard to modal choice. Del Mistro and Arentze (2002) and Van Zyl and Hugo (2002) looked at the applicability of Stated Preference studies in developing countries, in particular whether they could be applied to less literate commuters in South Africa. Both studies found Stated Preference techniques to be a valuable modelling tool for South Africa and that less literate respondents can participate meaningfully in a Stated Preference survey. However, the complexity of the survey and the training of the interviewer significantly affect the quality of answers from the respondents, particularly with regard to less literate respondents.

The Stated Preference decision modelling survey techniques are therefore an appropriate research method in the context of Cape Town – especially as the respondents for this study are educated and literate decision-makers in large companies.

#### *Independent and dependent variables*

The literature describes studies on decisions regarding residential location at the household level (McFadden 1978; Ben-Akiva 1985; Lee & Waddell, 2010). Centred on utility maximisation, housing choice is represented as a cluster of other choices where residents make trade-offs between various “*housing qualities, neighbourhood attributes and accessibilities to best meet their needs*” (Lee & Waddell, 2010:591). This has been described as a trade-off between housing and commuting costs (Moos & Skabuskis, 2010).

One study found that land rents decrease with distance from the CBD and compensate for increasing commuter costs (described as a function of distance) (Berliant & Sabarwal, 2008; Kwon, 2005; Moos & Skabuskis, 2010). Other studies have found that commuting costs increase as a function of distance and income (Berliant & Sabarwal, 2008; Kwon, 2005). Kwon (2005) finds that high costs of commuting pushes up land rent near the CBD as it becomes more accessible.

### ***Equation structure or model used***

A discrete choice model is often used to measure the effect of distance and commuting costs (Berliant & Sabarwal, 2008). Discrete choice modelling methods were developed by McFadden (1978) to analyse residential location at the household level (Lee & Waddell, 2010).

Some studies used a multinomial logit to model resident's decision of location (McFadden 1978; Ben-Akiva 1985). This is due to its ability to deal with a subset of alternatives and the computations are relatively straightforward (Lee & Waddell, 2010).

A paint factory case study developed a cost function by means of a combination of linear and quadratic equations to demonstrate the „linear decision rules’ assumed. A portion of this function represented the hiring and layoff costs of the factory (Van de Panne & Bosje, 1962).

Kwon (2005) and Berliant & Sabarwal (2008) use a Cobb-Douglas utility function  $u(s,z)^l = s^\alpha z^{(1-\alpha)}$ . Berliant & Sabarwal (2008) also uses the quasi-linear utility function  $u(s,z)^{l7} = v(s) + z$  (where  $v$  is increasing and concave), to compare with the results from the Cobb-Douglas utility functions to investigate effect of change in marginal commuting cost per unit land rent paid.

The Canadian study on workplace restructuring and urban form, used a binary logistic regression model to estimate coefficients (Moos & Skabuski, 2010).

More advanced studies on residential location choice used a two-tier nested logit model. A nested logit maximum likelihood estimator approximates the parameters, with a correcting procedure to make sure the estimates are reliable (if random sampling has occurred) (Lee & Waddell, 2010).

### ***Method of analysis***

Likelihood and chi-squared test are almost always used to test the significance of the independent variables (Berliant & Sabarwal, 2008; Kwon, 2005; Lee & Waddell, 2010; Moos & Skabuski, 2010).

Consumer choice literature used regression (Reibstein et al., 1975) and ANOVA analyses (Iyengar & Lepper, 2000; Oulasvirta et al., 2009) to analyse data from Likert scales.

Stated preference, choice-based methods (discrete choice) are predominately used in literature of similar studies and choices. The form of the utility function varies and depends on the specifics of the study. These forms vary from linear, quadratic and Cobb-Douglas utility functions.

Estimators include a binary logistic regression model (Moos & Skabuski, 2010), multinomial logit (McFadden, 1978) and two-tier nested logit model (Lee & Waddell, 2010).

For this reason I will elaborate on the discrete choice modelling process and assumptions in greater detail. A discussion on estimators and likelihoods will follow thereafter.

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<sup>7</sup> “Where  $s$  is the size of their land parcel and  $z$  in the consumption of a composite numeraire” (Where numeraire is a commodity or good in terms of which all other prices are expressed.  $V$  is an increasing concave function of land parcel size.

### 2.3.5 Discrete choice models

These models can be used to predict the decision-making behaviour of an individual (or a group of individuals). Discrete choice models can also be used to determine the relative influence of the decision-maker's characteristics and the different attributes of alternatives in the decision-making process. These models can be used to predict this relative influence fraction for different groups of individuals and identify which individuals are most likely to select one alternative or another (Koppelman & Bhat, 2006).

Discrete choice experiments are based upon the two key assumptions: the fact that any product or service can be described by its characteristics (attributes) and that the nature or level of these characteristics dictates the extent to which an individual values a product or service (Ryan, Bate, Eastmond, & Ludbrook, 2001).

Different attributes of an alternative hold different values to different groups. Discrete choice models help to give an understanding of the value given to each attribute. Koppelman & Bhat (2006) illustrate this with the example that business travellers are more sensitive to the frequency of flight departures and total travel time than travellers planning a vacation.

Individuals are required to make a number of choices from sets of scenarios that are described in terms of attributes (characteristics) and associated levels. Respondents must indicate their preferred scenario for each choice presented (Ryan et al., 2001).

The data collected is then modelled within a satisfaction function to investigate whether or not certain characteristics are significant, their relative importance, the rate of willingness of respondents to trade between characteristics and the overall benefit for different scenarios (Ryan et al., 2001).

There are two main ways of modelling group behaviour: aggregate<sup>8</sup> and disaggregate<sup>9</sup> approach. The disaggregate approach is favoured for a number of reasons (Koppelman & Bhat, 2006):

1. Reflects the influence of individual characteristics and attributes of alternatives in choice behaviour.
2. More transferrable to other situations.
3. Gives an understanding of behaviour to allow proactive interventions to attributes that are of the highest priority (most effective) to individual decision-makers.
4. More reliable data and reduced effect of bias than aggregate methods.

The design of discrete choice experiments is extremely important to ensure that the correct data is collected and reliable conclusions can be made.

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<sup>8</sup> Data is reported for the whole population.

<sup>9</sup> Data is reported in subsections or subtopics.

### **2.3.5.1 Designing Discrete Choice Model**

The following steps describe the aspects to consider when designing a discrete experiment (The Praxi Group, 2007):

**i. Conceptualisation of the research objective and market to be modelled**

This step involves the identification of the group to be modelled (The Praxi Group, 2007) and the type of answers that are required. Defining the research purpose and objective will clarify the next process of identifying and selecting relevant attributes

**ii. Identification of the attributes and attribute levels for the choice experiment**

This requires careful consideration to ensure that a finite set of alternatives, when described in terms of their attributes, can be defined as “*mutually exclusive and collectively exhaustive*” (Koppelman & Bhat, 2006: 65).

**iii. Statistical design: Selection of suitable statistical design to create choice alternatives**

This involves the standard practices for sample selection, which also needs to ensure there are enough independent variables to make the experiment significant.

**iv. Construction of a choice experiment that is realistic and simple for respondents to understand and complete**

It is important that the wording of the questions is relevant to the respondent and clearly expressed, the layout of the questionnaire is simple and that all relevant options are represented in the trade-offs involved in each question.

**v. Selection of method to measure individual choices**

This involves selecting the method that is best suited to measure the choices in the study concerned. This can involve a combination of scales and alternatives presented to respondents. It also includes the consideration of the method of data collection. Surveys can be conducted online, face-to-face or via mail (The Praxi Group, 2007). The questionnaire can be self completed or assisted by an interviewer.

**vi. Utility function: selection of method of estimating a utility function**

A model is used to fit the data to the utility function. There are many different models that can be applied to different data and research purposes. The model chosen will have ways of estimating the parameters that will link the utility function to the choice data. The Multinomial Logit Model, for example, uses the theory of Maximum Likelihood (a likelihood function) to estimate the values of the parameters that will maximise the likelihood function and indicates the probability of choice (Koppelman & Bhat, 2006).

**vii. Development of software to model what-if scenarios with the data, as a decision support tool**

This is the final deliverable: a spreadsheet programme that models what-if scenarios with the data collected, this is referred to as a Decision Support System (DSS) (The Praxi Group, 2007).

### 2.3.5.2 Derivation of the Multinomial Logit Model

Like many other discrete choice models, the Multinomial Logit Model (MNL) is based on the maximisation of utility theory but differs from other models in its assumptions. The main difference is that the MNL model assumes that the error term is described by a Gumbel Distribution (not a normal distribution) (Koppelman & Bhat, 2006).

#### 2.3.5.2.1 Basic Utility Theory

The choice between alternatives is assumed to be driven by the respondent's utility.

The respondent's utility is broken down into two components. The first is the deterministic component, which is a function of the observed attributes of alternatives, consumer characteristics and economic variables (such as income, price of goods etc). The second component is an error term. Formally this is represented as

$$U_{it} = V_{it} + \varepsilon_{it} \quad (1)$$

where  $U_{it}$  is the total utility of choosing alternative  $i$  to the decision maker  $t$ ,  
 $V_{it}$  is the observable (deterministic) portion of the utility which is estimated by the analyst, and  
 $\varepsilon_{it}$  is the error component representing the unobservable by the researcher, but known to the individual.

The deterministic component  $V_{it}$  corresponds to influences that can be observed (by the analyst from any source), 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 (Koppelman & Bhat, 2006).

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:

$$V_{it} - V_{jt} > \varepsilon_{jt} - \varepsilon_{it} \quad (2)$$

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  $V_{it} - V_{jt}$ :

$$P_i = P\left\{\varepsilon(S, X_j) - \varepsilon(S, X_i) < \{V(S, X_i) - V(S, X_j)\}\right\}. \quad (3)$$

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

$S_t$  is a vector of describing 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:

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

Which illustrates the probability of a decision-maker choosing alternative  $i$  when considering the systematic component ( $V_j$ ) of the utility of alternative  $j$ . The relationship between  $\exp(V_i)$  and  $V_i$  is represented by the exponential function that is always positive (Figure 5).

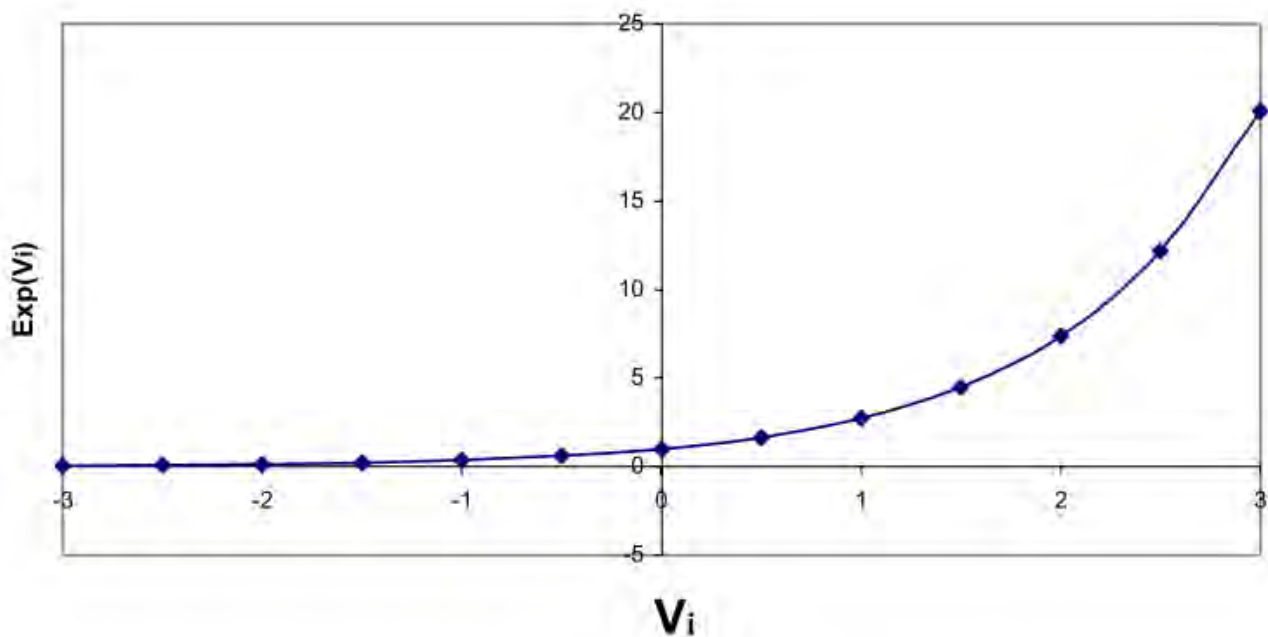


Figure 5 The relationship between  $V_i$  and  $\exp(V_i)$  (Source: Koppelman & Bhat, 2006: 29)

The MNL model assumes the error term to have been 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. 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 as seen in Figure 6 (Koppelman & Bhat, 2006).

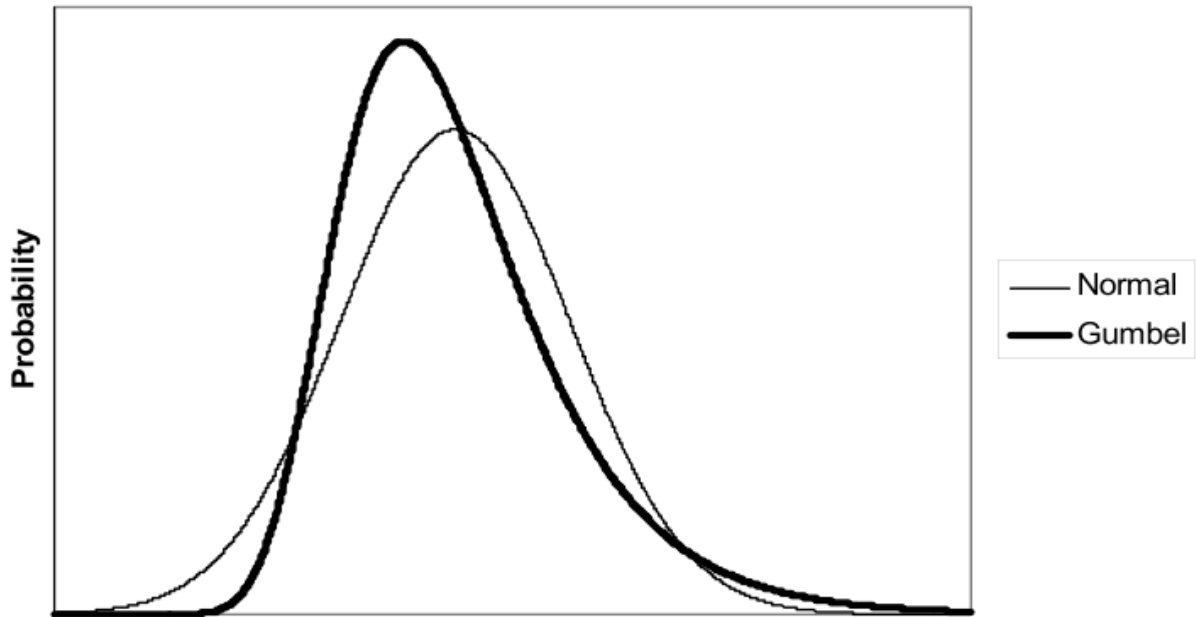


Figure 6 The probability density function for Normal and Gumbel distributions (with the same mean and variance) (Source: Koppelman & Bhat, 2006: 27)

A sigmoidal or S-shape is used to model probability because it limits the probability range between zero (when the relative utility between one alternative and the others is low) and one (when the relative utility between one alternative and the others is high) (Koppelman & Bhat, 2006). Thus at these „edges’ a small change in the utility of the alternative will have little effect on the probability of that alternative being chosen. This is reversed in the „middle’ range (with a steep slope) where changes in utility have significant effects on the probability of the alternative being chosen. This can be seen in Figure 7.

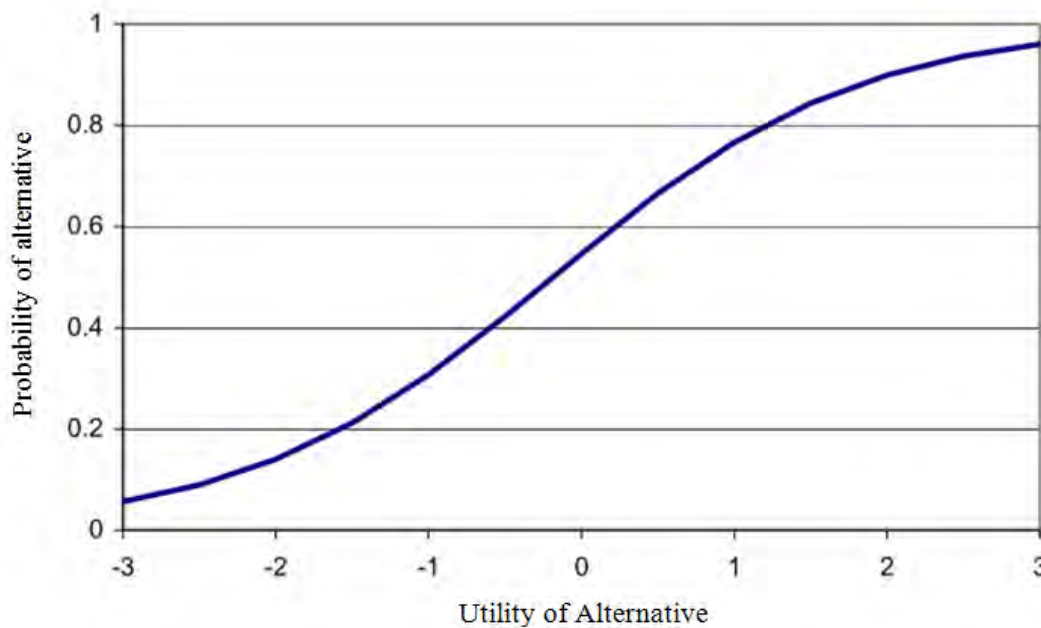


Figure 7 The Sigmoid or S shape of Multinomial Logit Probabilities (adapted from Koppelman & Bhat, 2006: 32)

Thus 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).

#### 2.3.5.2.2 *The theory of maximum likelihood*

The MNL model uses the theory of Maximum Likelihood (a likelihood function) to estimate the value of the parameter 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 of the *log likelihood* function to zero to find the value of  $\beta$  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).

### 2.3.6 Concluding decision-making theory

Literature on modelling the decision-based process is complex but well documented in the literature. This investigation forms the basis of the formulation of a methodology and process of gathering the most effective information to fulfil this research.

## 2.4 General conclusions

The current commuting habits in Cape Town are unsustainable, particularly for the low to middle income populations who are vulnerable to fluctuations in the price of transport resulting from increasing oil prices and long commuting distances. A local solution for developing cities is required to mitigate this problem. The solution proposed in this study is to minimise travel between home and work. This can be achieved by shifts to greater use for public transport and also by reducing distances travelled.

The prediction that cities in developing countries are expected to double in population over the next 25 years serves as motivation for this solution as a strategic and sustainable way to deal with this growth.

Reducing travel distance implies reducing the number of trip end choices, but the effects of this is difficult to predict. This research looked to the literature to understand what the effects of reduced employee catchment sizes would have on employers.

From the literature on consumer choice it is clear that there is some benefit to limiting choices. There are many social, environmental and economic benefits to be gained from shorter commuting distances and reducing motorised travel, that directly and indirectly affect employers. Although employers currently do not carry the costs of long commuting distances, making employers more aware and share in these costs may enable employers to see the benefit in changing recruitment behaviour and benefit in the proposed solution of reduced travel.

The final section looked at ways to model the employer's decision process. Modelling the costs associated with limiting an employer's choices and attempting to find a value of "sufficient" choice of employee catchment size or recruitment choices will be difficult. A stated preference survey was found to be the most suitable method for a study of a complex hypothetical situation (where costs of employing staff from the whole metropolitan area will be imposed upon the employer), as well as the

investigation of the trade-offs involved in recruitment decisions and the value to employers' of having access to more potential employees to choose from.

University of Cape Town

### 3 Method

#### 3.1 Overview

This chapter will discuss the investigation into the different ways of answering the following research question:

*What employee catchment size do employers feel is „sufficient’ for recruitment of staff for their business?*

It will then go on to describe the method that is seen to capture the „best’ results for this research project. This will involve a discussion on how to classify information in order to ask employers questions about their employees, as well as a discussion on the different ways to measure the value of having a larger catchment (i.e. more employees to choose from). Different ways of presenting costs to employers were explored, such as transferring public transport costs onto employers in the form of travel subsidies for staff travelling long distances or carbon emissions taxes for excess emissions produced.

This chapter will take the form of the stages involved in formulating a discrete choice experiment, e.g. namely (Hensher, Rose, & Greene, 2009):

1. Conceptualisation of the research objective and market to be modelled.
2. Identification of the attributes and attribute levels for the choice experiment.
3. Statistical design: Selection of suitable statistical design to create choice alternatives.
4. Construction of a choice experiment that is realistic and simple for respondents to understand and complete.
5. Selection of method to measure individual choices.
6. Utility function: selection of method of estimating a utility function.
7. Development of software to model what-if scenarios with the data, as a decision support tool.

#### 3.2 Conceptualisation of research objectives and target market

From an analysis of the current literature there is very little evidence of employers considering employee commuting distances and costs. The complexity of this research is to try to make employers think within a paradigm that they have never considered before. The current employment decisions and resulting travel patterns represent no cost to employers and it is very difficult to ask about the value of employees within a mindset where employee commuting has a very real cost to employees and employers.

Essentially this research is looking to identify the amount of potential employees a company sees as (a) too small (insufficient choice), (b) sufficient and (c) catchment sizes with unlimited choices and no cost of employee commuting.

The concept of sufficient catchment size (the number of people of a specific skill level looking for a job each month) will vary with each job grade within the company. The value of this estimated catchment size for business is critical to the formulation of the larger project of city restructuring and attempting to calculate the approximate catchment sizes for sub-cities within Cape Town, the numbers of people required by the numbers and types of businesses within each catchment.

Keeping this overarching research goal in mind, the hypothesis of this research is:

*There is an employee catchment size, beyond which the benefits to the employer are negligible.*

In other words, the purpose of this study is to determine the implications of reducing the size of the catchment of potential employees on the employer and to determine whether a catchment size exists beyond which employer benefits become negligible.

This involves sub-questions, involving investigation into:

- *The consequences of having to employ the possibly less than the “best” person for the job and whether there is only one „best’ person for the job.*
- *Whether employers already practice satisficing (rather than maximising/optimising) behaviour with regard to employee selection.*
- *The factors that affect business location decisions.*

The way in which employers locate with other employers - benefits of agglomeration of employers - was considered, but is out of the scope of this research and will not be addressed.

### **3.3 Brainstorming methodologies**

The **hypothesis** of this research is: *There is an employee catchment size, beyond which the benefits to the employer are negligible.*

There are two main parts to investigating this hypothesis: firstly, the need to understand employer thinking and secondly, how to get the employer to pay for the value/costs of an unlimited employee catchment.

#### **3.3.1 Understanding current employer thinking**

This study will explore the extent to which employers consider commuting distance in current hiring decisions and whether public transport or traffic congestion is already a factor that causes employers to resist hiring staff from far away.

It will investigate whether Cape Town employers do currently have the benefit of access to potential employees across the whole of the Cape Town area. The attitude of employers and their current employment patterns will reveal whether the recruitment decisions to employ from far are actually at no cost to the employer or whether employers do acknowledge this cost and in what form (congestion, staff lateness, staff inefficiency, financial burden on staff, etc.).

Lastly, it will look at ways to graph the value of a larger employee catchment size to Cape Town employers.

### **3.3.2 Motivating employers to pay for increased access to employees**

If employers currently do not carry the cost of recruiting employees from all over the Cape Town region, to find a value of having more employees to choose from (larger employee catchment area) would be difficult. In this case, there would need to be ways of imposing costs for employers in order to elicit a value.

Measurable variables are needed to investigate the value to employers or, in other words, the employer's willingness to pay for larger catchment sizes. Since employers currently do not pay for employee mobility and extensive access to employees, the status quo will represent employers' decisions at no cost. As a result, an artificial cost needs to be applied to be able to measure willingness to pay.

A few variations were considered:

1. A monetary tax or travel subsidy following a legal requirement stating employees cannot spend more than a percentage of their salary on commuting (using different costs of public transport to estimate how much is spent and how much the subsidy would be).
2. A tax on carbon emissions of employees (using the value of tons of a carbon trading mechanism to evaluate the tax).
3. Employer Managed Transport Plans financed by the employer.

These aspects are further discussed in the sections that follow.

#### ***3.3.2.1 Imposing restrictions on employers for employee commuting distances***

This involves a series of questions that will extract this kind of information. Scenarios that would affect employers by restricting the catchment were suggested as:

1. Legislation ensuring workers cannot spend more than a certain percentage of their salary on commuting.
2. Fines paid by the company for each employee travelling further than a certain distance.
3. Tax incentives for green travel initiatives/incentives.

Questions focussing on their reaction to these scenarios, as well as what they consider are their alternative options (such as outsource labour, employ locally, invest in machinery that reduces labour, cut back on business, shut down, etc.) would be beneficial to this study.

This would provide information on what employers feel would need to happen for them to accept such restrictions.

#### ***3.3.2.2 Employers willingness to employ staff who live far from work***

This method involved presenting employers with the assumption that a law restricts employees travel costs to less than a certain percentage of their salary and employers are forced to cover the remaining costs. By asking employers if they would agree to pay employee transport costs of R100, R200, R500, R1000 per month (per employee type). *This would be to investigate the point at which employers refuse to pay the increased costs for each employee level.*

However, the difficulty comes in where the employer will have uncertainty/bias because he/she will know the employee. Also, the choice is not to fire them or continue employing them, but rather if they would hire someone from that distance again if the individual resigns. This method runs the risk of implying wages for low skilled workers in certain areas will inflate beyond a sustainable point. This, and the difficulty that employers have with labour unions will be an insensitive way of carrying out this research.

### ***3.3.2.3 Employer Travel Plans as a way to impose costs to employers of increased employee catchment***

Employers, mostly internationally, can be seen to be implementing ways to make current commuting patterns more sustainable. The motivation behind these actions is “green” not on value of the employee or minimising commuting.

In the literature the only attempts for employers to share the cost of employee commuting is in the form of Employer Travel Plans (ETP) which are predominantly aimed at reducing parking costs to employers and promoting “green business”.

This approach could be one way of presenting employers with a scenario that they can relate to and decisions that they could visualise. Although employer travel plans are not common in South Africa, in the UK and Europe they are becoming increasingly popular. In the Netherlands employer travel plans have been part of legislation since 1989 (Rye, 1999).

Travel plans, however, do shift the focus of the research towards the reasons behind the potential changes in the work place that this research is trying to measure, and not measuring the value or decisions required for this research.

It also seems that employers in South Africa are reluctant to seriously consider or implement travel plans because there is no legal requirement. It is left up to the individual employers, which is why there is very little information or literature on employer travel plans in South Africa.

There is South African legislation that dictates that companies provide employer-paid transport to employees travelling after 7pm (Personal communication with training manager from company 5, 2012).

Recruitment agencies contacted had no knowledge of any firms with employer travel plans. South African companies will consider and employ the policy of car allowances for medium to senior management (which is a tax incentive) and possibly relocation costs. That is the extent to which employers have adopted employee travel costs and none have developed travel plans.

However, there are a few companies who are implementing elements of Employer Transport Plans because they have realised the benefit to their company. A consulting firm that recently moved office locations did provide salary increases to workers who were now travelling further and struggling with the increased commuting costs. This firm also provides free parking for employees who car pool or drive a Prius to encourage their green image (Personal communication with member from company 1, 2012).

### **3.3.3 Methods to elicit/measure willingness to pay for larger catchment sizes**

Stated Preference methods are most commonly used to measure the willingness to pay. Other methods, such as Likert scales and/or a Delphi approach, can elicit the likelihood of employers paying for different aspects in ETPs but do not reveal actual values of willingness to pay.

### **3.3.4 Methods to elicit employer attitudes and reactions to employee catchment size**

There are a number of different ways to elicit employer attitudes and reactions to employee catchment size, for example:

- Likert scales would provide information on attitudes and reactions of employers with numeric answers from a scale. For example, asking questions such as: “On a scale of 1 to 10, how important is the location where the potential employee lives in the recruitment decision?” (Where 1 is „not even considered’ and 10 is “vitaly important”)
- Open-ended questions that ask the respondent to explain important factors, their attitudes and the personal predictions of their reactions.
- Delphi: With 2 - 3 phases to a Delphi study, the first phase would include questions and the second phase would be feedback with the initial results and ask more qualifying questions about the initial research. These can include Likert scale questions and open-ended questions.

### **3.3.5 Modelling Employee Catchment Size**

It is expected that employers are currently using the entire Cape Town catchment area, employing staff who live up to, and sometimes beyond, 40km from their business location.

To carry out this research requires an understanding of the current recruitment patterns and employee catchment sizes used by employers.

#### ***3.3.5.1 Methods to determine employee catchment size for employers***

A revealed preference survey can be done with real information from companies with the location of their business and the residential areas where each employee lives. This, however, illustrates the situation where there is no direct cost to employers for recruiting from far. It would also be considering the “employee catchment size” in terms of the entire population, with distance from the company. While it is important to understand the current employee catchment sizes used by companies in Cape Town and whether commuting distance is a concern to companies at all, this information alone cannot identify the value employers place on having more people to recruit from. This is most likely to require a Stated Preference method.

The Delphi Approach could incorporate this hypothetical nature and the experience from „experts’ (in this case experienced employers and management) to gain their results on the valuation of employee catchments sizes. It has a second phase where, after time to think and when presented with their answers and those of their fellow „expert employers’, they have the opportunity to add more value to the first set of data by changing ideas, making additional comments, etc. (Piecyk & McKinnon, 2008). However, this method is very time consuming for a study such as this with tight time constraints.

### **3.3.5.2 Recruitment agencies**

Another way of looking at the recruitment pool would be to look at the number of people who apply for a position in a company, in relation to the number of people who are interviewed and the number of people hired. This method explored the hiring or interview process and was intended to investigate the number of suitable employees from which employers prefer to make a selection.

This idea was then extended to incorporate the probability of the „good potential employees’ (i.e. the interviewed short list) and the „best’ (the person hired) could be calculated in relation to the population size and thus catchment sizes. This idea is explained further in Section 3.3.5.6.

This investigation started with the idea of interviewing recruitment agencies, but these only deal with the high income and highly skilled workers and would provide no information on employer decisions about lower skilled labour. The value that the employer would have by paying for more options could also not be elicited from this approach because, again, it was only testing current patterns with no direct cost to employers of having a wider choice of employees.

### **3.3.5.3 Labour brokers**

When recruitment agencies were seen to focus only on the highly skilled workforce, the option of interviewing labour brokers was considered. This option could reduce the possibility of employers feeling sensitive about confidentiality issues over staff information because the topic would be approached on a purely business logic. We would ask a question like “at what point would your clients stop hiring your services if labour costs increase by 2%, 5%, 10% (for example) due to taxes, fines or legislation?”

The use of labour brokers for low skilled labour could also possibly be a way employers would try to avoid paying transport costs of those low-skilled employees who live far from work. This is an interesting aspect to consider. Labour brokers would bear this cost and not the “employer”. However, labour brokers are involved in very sensitive and volatile negotiations with the labour unions at the moment. Labour brokers, such as Supacare, may be unwilling to assist this investigation.

### **3.3.5.4 Advertisements**

We also considered searching for advertisements for low paid, low skilled jobs in newspapers and enquiring how many people applied, how many were short-listed, how many were interviewed and how many were appointed. There could be problems of confidentiality and reluctance to share this information. And again, this carries the problem of considering current employment conditions only.

### **3.3.5.5 Recruitment Patterns of large companies**

This was further developed into the method of asking the Human Resources department of large companies about the last few placements (per job level) that they filled. While this provides valuable information on the amount of options employers feel comfortable choosing from, this still exists in a context where access to workers or employee commuting has no cost to the employer.

### 3.3.5.6 The probability of the ‘best’ being in different catchment sizes

A variation of the recruitment process method was also considered. This method would take the number of applicants interviewed for a position and calculate the probability that one or two or three of those “best suited” applicants will fall within catchment sizes of the population. Then assessing the confidence the employer would have after making a hiring decision from that scenario or not.

A section of a document on labour supply and demand, found that there are roughly between 10 and 20 potential job seekers per job advert in South Africa (Transport Education Training Authority -TETA, 2011). A breakdown by sector gave (TETA, 2011):

**Table 7 Supply versus demand in career sector in South Africa**

Sector	No. job seekers per advert <sup>10</sup>
Engineering, Distribution, Warehousing and freight sectors	Less than 10
Transport & Aviation sector	10 – 20
Economic sectors	10 – 20
Admin, office and support staff	>30

Another method was to try to represent catchment of potential employees and different sizes of sub-catchments using a model of equations and diagrams (overlapping catchment areas).

A hypothetical even distribution of skills and location within a circular catchment area would need to be assumed. By assuming an average staff turnover per job grade, the numbers of potential employees in flux at any time (or in one month or one year) could be estimated. Then assumptions would need to be made about the number of businesses that would simultaneously attract these job seekers. Lastly, equations would be developed to relate the increasing or decreasing catchment size (radius) and the number of potential employees from which the company in question would actually be required to choose its employees.

These various options with increasing and decreasing catchment areas could then be presented to employers through a stated preference survey to investigate where employers feel they have “sufficient” choice and thus reasonable size of catchment.

Both of these methods are mathematically intense and contain a lot of assumptions and, therefore, a large error in developing the model. The assumption of even distribution of skills is particularly unsettling because it is well-known that Cape Town has a very uneven distribution of skills levels over distance. These methods do not capture the trade-offs involved in recruitment decisions or elicit the value employers place on having more or fewer potential employees to recruit from.

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<sup>10</sup> These are not the number of people who apply per advert, but rather the number of users active on the Career Junction website over a 6 month period (TETA, 2011).

### 3.3.6 Selection of the „best’ method

A method analysing only the existing recruitment behaviour or preferences would not be able to calculate the value employers have for increased access to employees because currently they do not pay so they expect to be able to select the best employees from a wide selection, the entire Cape Town population if need be. However, as the cost of employing labour over long distances increases, so the benefits of unlimited choice will reduce. This study tried to investigate how employers react to or value employee catchment size in this completely different business environment and potential future situation.

For this situation, a hypothetical situation needed to make the costs of excessive employee commuting obvious to the employer and imposed upon them as a direct cost. One way to elicit the value of larger employee catchment size is to identify the trade-offs in the business environment that employers deal with in the decision-making process of recruiting. This lent itself to a stated preference survey, described in the sections that follow.

## 3.4 Final Method

### 3.4.1 Overview

The stated preference survey consisted of two phases: the initial phase was to analyse information on current commuting patterns of a company’s staff and, secondly, to conduct short interviews with a number of senior staff who are involved in recruitment about employee recruitment practices.

The interview was to determine the trade-offs between the number of potential employees to recruit from and the costs of employee travel. This was done by considering a hypothetical scenario that assumed that the government has introduced a policy that:

- (1) Employees cannot spend more than a specified percentage of their salary on commuting costs. As a result, employers may need to subsidise the transport of their staff.
- (2) Companies are charged for carbon dioxide emissions from excessive staff commuting in the form of a carbon or “green” tax.

Employees were divided into two main groups:

1. The first group relating to low to lower-middle income staff who use public transport.
2. The second involving middle income staff who use private transport.

The employer was presented with eight pairs of recruitment scenarios. Each question encouraged the considerations of two scenarios (a pair), one with a smaller employee catchment size and lower costs and the other with a larger catchment size, but higher costs. The employers were asked to select the scenario they would most prefer. The scenarios were described by a number of attributes/consequences:

- The proportion of the employer’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<sub>2</sub> emissions) of staff commuting (the percentage increase or decrease from the current average company's CO<sub>2</sub> emissions at the moment).
- The cost of employee travel to the business. This cost comprised of a transport subsidy to the employee and carbon tax to the government.

Finally, information on the factors affecting the business location was collected to further inform the data from the recruitment scenarios.

A diagrammatic summary of this method can be seen in Figure 8.

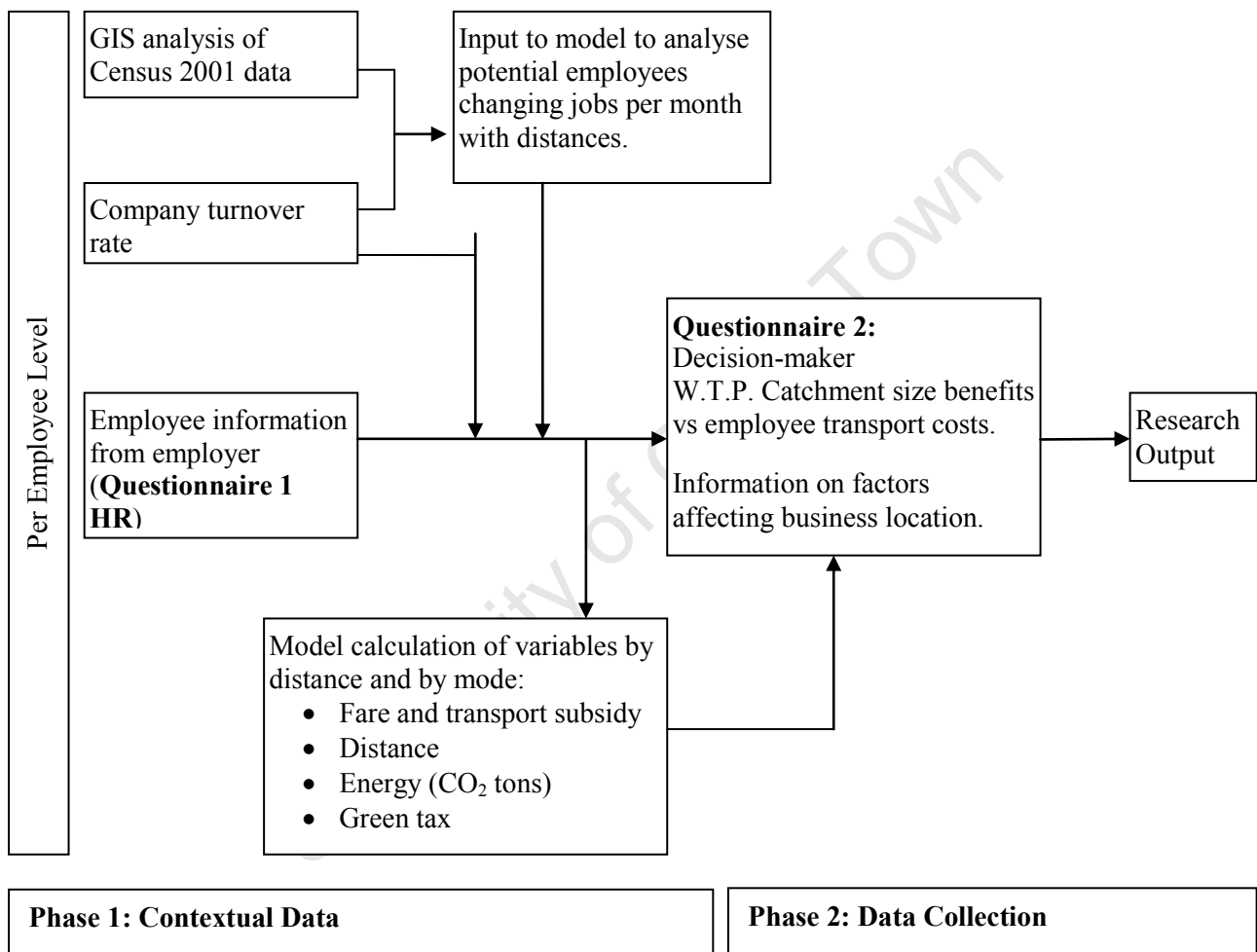


Figure 8 Diagram of the method used in this study

### 3.4.2 Selection of survey method

The initial phase of this research method required contextual information from the companies to ensure that the scenarios presented are realistic to the decision-makers in the company. This research also needed to model the decisions of managers who are involved in the recruitment process and not any staff member.

Because the concept behind this research is complex and very different to the typical way that employers would think, face-to-face interviews with managers involved in recruitment were the best way to collect the data required for analysis. An interviewer would guide them through the questionnaire and could clarify any questions.

### **3.4.3 Attributes and attribute levels considered**

The attributes describe the considerations (variables) in the decision process. There are two central factors that the decision-maker will trade-off between two scenarios, namely:

1. Employee Catchment size (number of employees available to recruit from).
2. Costs of employee commuting.

These are explained in sections that follow.

#### ***3.4.3.1 Potential employees in flux as a measure of distance***

The total population surrounding the company at different radial distances would not be a good way to represent the “employee catchment size” for an employer to accurately envision making a realistic decision between recruitment scenarios. Employers have experience in how many interviews and applicants they would need to be able to find a suitable person for the job. Thus employers have experience with the numbers of applicants that usually apply for a position and of those applicants how many are likely to be shortlisted to fill the position. In this case, it was decided to consider the employee catchment size in terms of people, within the income bracket of the job advertised, that would be looking to change jobs per month. However, this is for all types of jobs within the specified income level.

To express the population at a rate of persons looking for jobs, in relation to geographic distance from the company, required preparation.

The geographic location of the company was plotted in ArcGIS. Radial zones of 5km, 10km, 15km, 20km, 25km, 30km and 40km were created. The staff distribution from each company within 10km, 15km, 25km and 40km was used in the calculations for the questionnaire. This was because four levels of distance/catchment size would allow a non-linear relationship to emerge as reflecting the effect of distance on choice making by employers.

The Census 2001 (Statistics South Africa, 2001) dataset was linked with the GIS map and the suburbs within each buffer zone were isolated. From this data, the population per suburb, of each applicable income level<sup>11</sup> was summed for each “circular zone”.

The average turnover rate<sup>12</sup> (per income group) of the company was applied to this “population” to reveal the number of people within that radial distance and income level, changing jobs per month.

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<sup>11</sup> Population figures were left the same as 2001, but income boundary values were adjusted to 2012 values using 5% inflation per annum.

<sup>12</sup> The turnover rate was calculated from the information received from each company, in terms of the date each employee was hired. More details on this can be seen in section 3.4.6.2.2 and APPENDIX 5.

In this way, distance is converted into a more practical figure for recruitment scenarios. Distance on its own is also not appropriate because of the Apartheid legacy of the city which defined the location of richer and poorer suburbs. By looking at people and distance, it provides a more realistic recruitment situation for employers.

### 3.4.3.2 *Costs of commuting*

A hypothetical situation converted the travel patterns of employees into direct costs to the employer. There are financial costs of commuting that are carried by the employee, but some of these can be transferred to the employer.

Environmental damage from current transport patterns and the effects of climate change are a motivating factor for this research into the restructuring of cities in developing countries to manage and mitigate these effects. Thus, it follows that a way of placing value on the changes and restricting catchment areas is via environmental costs.

#### 3.4.3.2.1 *Transport subsidy to the employee*

There are a number of different ways to measure the cost of public transport. A law that sets the maximum percentage of income spent by employees on commuting could be done in two ways; either by coercing firms to increase salaries to lower the percentage of income spent on commuting or to pay a travel subsidy to those employees whose commuting costs exceed the maximum percentage of their income. Employers are more likely to pay a transport subsidy; hence this is used in the study. An economic analysis looks at the „cost’ of commuting by considering the time of commuting converted into a cost and the price of fares.

In the case of this study, it might be easier for employers to subsidise the actual cost of fares. It should be noted that a significant government subsidy brings the cost of public transport to current fare levels, but because this study is concerned with the cost of transport for the users, the actual fare price was used to estimate the „cost’ of commuting and thus the subsidy from the employer to the employee.

The employer was made aware of the difference between a certain percentage (8% in this study<sup>13</sup>) of an employee’s salary and the transportation costs of commuting (based on the mode and distance they travel).

It was assumed that employers did not pay subsidies to employees travelling by car because they potentially have the option to shift to cheaper modes, move to closer residence or change jobs.

The low to lower-middle income group were assumed to use public transport. The cost of commuting was calculated from the fare structure equation of bus fare with distance (x)<sup>14</sup>:

$$y = 0.1541x + 5.2879$$

where  $y$  is the fare at distance  $x$  (Del Mistro & Manguanidze, 2012). The details can be seen in APPENDIX 2.

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<sup>13</sup> This was calculated from information on an affordability study in Cape Town.

<sup>14</sup> To account for inflation to 2012, 12% was added to the coefficients from the graph in APPENDIX 2 (Del Mistro & Manguanidze, 2012).

#### 3.4.3.2.2 *Carbon dioxide emissions and energy costs*

Environmental costs alone will be insufficient to motivate business to change its behaviour. Nevertheless, environmental costs and the image of “green business” is gaining publicity and is an important aspect to consider.

In this way, employers can be presented with the CO<sub>2</sub> emissions produced by each employee’s commuting patterns. These add context to the recruitment decision and contribute to the carbon footprint of the firm itself. This tonnage itself can be a variable of cost where companies, who are concerned with reducing their carbon footprint and promoting a green image, will be stimulated to choose employees who produce fewer emissions or pay for the implementation of employer travel plans to facilitate green commuting.

Nedbank finds commuting contributes to approximately 20% of their total carbon footprint (Nedbank, 2011). The CO<sub>2</sub> emission were calculated in the model (discussed in Section 3.4.6.2.5.) from emission factors from DEFRA (2011) which were combined with calculations to include the CO<sub>2</sub> from the production of petrol/diesel, calculated CO<sub>2</sub> emissions per employee with distance (Sasol, 2011)<sup>15</sup>. Please refer to APPENDIX 3 for detailed calculations.

For some employers it may be more effective to induce a carbon tax on the “excess emissions” produced by the company. In this situation, commuting emissions of staff may be easier to reduce than those from mechanical processes of the company and as a result will be the focus of the questions. In this case a tax will be placed on the tons of carbon produced by the employee commuting.

This “green tax” was calculated using R120/ton CO<sub>2</sub> equivalent (DNA Economics & IMBEWU Sustainability Legal Specialists, 2012).

A third way of generating value from carbon emissions was by comparing the emissions to the potential income that could be generated by trading saved carbon emissions through various carbon trading forums, such as the Clean Development Mechanism or CERS.

This third method was not used because the first two were simpler to understand and the carbon trading mechanism is not working successfully at the moment in South Africa. Also, South African employers have very little experience with it, so it is not a realistic measure.

#### **3.4.4 Defining the sample**

The population for this study would be all employers in Cape Town. But this had to be narrowed down to a specific type of company that would satisfy certain conditions.

##### **3.4.4.1 Selection criteria for companies**

To allow for a sufficient distribution of employees living in different suburbs at different distances from their place of work, per job level, will require the consideration of companies with more than 151 employees (Chamber of Commerce, 2012).

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<sup>15</sup> 0,54 kgCO<sub>2</sub>e/passenger km (car) and 0,1 kgCO<sub>2</sub>e /passenger km (bus) were used in the model.

The second criterion is to gather information from companies in different economic sectors. These sectors can be from the following:

1. Academic Institution
2. Manufacturing activities (factories)
3. Government institution
4. Parastatals
5. Financial institutions
6. Commercial retail activities
7. Medical/health institution
8. Labour broker
9. Construction sector
10. Entertainment industry

Table 8 illustrates examples of companies in Cape Town taken from the Chamber of Commerce website with more than 151 employees, randomly selecting companies from the Cape Town CBD, Southern Suburbs and Bellville.

Of the 20 companies approached, seven companies agreed to participate in this study. One could not be considered because there was no way of specifying where each staff member worked on which day and staff were transported by the company anyway. Another could not be used because all the staff already lived within 5km of the factory.

Five companies satisfied the requirements for the study and span across the service sector (hospital), retail sector, parastatal institution, academic institution<sup>16</sup> and consulting firm.

#### ***3.4.4.2 Activities not suitable for this study***

This study requires data from a company with one single workplace. Contracting companies that have different work locations will routinely transport their employees from a central point to different sites. This is not informative to this study.

The restaurant industry also has legislation for the company to transport staff at night. This would interfere with the data for this research.

Large retail companies such as Pick „n Pay or Truworths have large numbers of employees, but they also have different retail outlets and a main office. Thus workers might work at the local outlet and not participate in long distance commuting to a single workplace. However, a single workplace with a large amount of employees can be treated as a single company on its own site. This was done in the case of the retail company used in this study.

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<sup>16</sup> Only non-academic staff were considered from this company. Academic staff are too specialized and often advertised for at a national and international level.

**Table 8 Examples of a variety of large companies in Cape Town**

Sector	Examples
Academic Institution	UCT, UWC, WITS, UJ, etc
Manufacturing activities (factories)	Polyoak Packaging, Enterprise Bakery, South African Brewery, Lancashire Manufacturing Co. (schoolwear), I&J (frozen food), Alstom John Thompson (boiler manufacturers), Nampak Tissues (paper product), Toyota
Government institution/ Parastatals	City of Cape Town Eskom, Transnet, Metrorail, Telkom
Financial institutions	Banks: Nedbank, Standard Bank, First National Bank, Investec Bank Ltd., Auditors/Accountants: Ernst & Young, KPMG, Financial services: Old Mutual (insurance), Santam Beperk (insurance),
Commercial/retail activities	Retail: Pick ,n Pay, Woolworths, Cape Union Mart, Truworths, Call Centre: Global Telesales (Pty) Ltd.
Medical/Health institution	Durbanville Privaat Hospitaal, Netcare Hospital,
Labour Broker	Supacare
Construction	Aurecon (consulting engineers)
Entertainment activities	Grand West Casino, Good Hope Palace Hotels (Pty) Ltd.

### 3.4.5 Statistical design of experiment

The experimental design depends on the number of attributes at different levels. The first attribute is the “employee catchment size” (or employees in flux) which was considered at four levels (i.e. catchment sizes at 10km, 15km, 25km and 40km radii). Another three attributes, each at two levels (a high and low value) were also included, namely:

1. Average distance staff would need to commute.
2. The CO<sub>2</sub> emissions from the situation (expressed in relation to the staff’s current emissions).
3. The financial cost of employee travel to the business (transport subsidy + carbon tax).

These attributes were applied to the two different employee groups, separately: the first income group of employees earning R3000 – R10 000 per month and the second group includes employees earning R10 001 – R30 000 per month<sup>17</sup>.

The guidelines set out by Kocur et. al. (1982) were used to ensure an orthogonal design of the variable combinations. It was assumed that there would be no 2-factor interactions between any of the variables.

Thus two  $4 \times 2^3$  experiments were designed to have 8 tests each<sup>18</sup> (Kocur et al., 1982), eight tests for the first income group and eight tests for the second income group. This means that there are four questions, comparing two scenarios (‘test’ combinations of variables), for each income group.

<sup>17</sup> These values are in 2012 figures.

<sup>18</sup> This combination of  $4 \times 2^3$  variables refers to Department Plan Code 88a (without 2-factor interactions within the model) which requires 8 tests, of the combination from Master Plan number 2 (columns 1,7,8,9). (Kocur et al., 1982)

An excel spreadsheet was set up to automate the design of the questionnaire. The values of the variables were calculated from a model (discussed in Section 3.4.6.2). It must be noted that for each of the four levels of employee catchment size (expressed in Tables 9 and 10 as percentage of current catchment), there is one calculated value for the other three variables. This is illustrated in Table 9. Each of the three variables was then altered to form two corresponding levels of each variable, a high and low value, by increasing and decreasing the values by 20%. This is shown in Table 10.

**Table 9 The base values for each variable calculated by the Model**

Variables				
Catchment size	Percentage of employee catchment	Ave. travel dist (km)	CO <sub>2</sub> Change (kgs CO <sub>2</sub> /employee /month)	Total cost to business
0	28%	16	-39	R 11
1	48%	24	-21	R 17
2	90%	37	7	R 32
3	100%	52	41	R 53

**Table 10 The high and low values for three of the variables were calculated for each employee catchment area**

Varying Costs					
Catchment size	Percentage of catchment	Ave. travel dist (km)	% Change CO <sub>2</sub> /employee /month	Total cost	
0	28%	13	-42%	R 9	(L) Low value
		19	-62%	R 13	(H) High value
1	48%	19	-22%	R 14	(L)
		29	-34%	R 21	(H)
2	90%	30	8%	R 26	(H)
		44	12%	R 39	(L)
3	100%	42	44%	R 42	(H)
		63	67%	R 63	(L)

These values were then ordered into the profiles (Table 11) designed to be orthogonal (columns 1,7,8,9 of Master Plan number 2) (Kocur et al., 1982).

**Table 11 The profiles generated**

PROFILES				
	Percentage of catchment	Ave. travel dist (km)	% Change CO <sub>2</sub> /employee /month	Total cost
1	28%	13	-42%	R 9
2	28%	19	-62%	R 13
3	48%	19	-22%	R 21
4	48%	29	-34%	R 14
5	90%	30	12%	R 26
6	90%	44	8%	R 39
7	100%	42	44%	R 42
8	100%	63	67%	R 63

By randomising a list of profiles 1 to 8, pairs of profiles were generated (Table 12).

**Table 12 The paired profiles for the question**

Question	Pairs	
1	6	2
2	4	7
3	8	5
4	1	3

The same steps were used for both income groups, the only difference would be the initial values that were generated from the Model (those in Table 9). The final layout of the questionnaire can be seen in APPENDIX 7.

### **3.4.5.1 Sample Size Calculation**

Hensher et al. (2009) state that the least common alternative has to appear in the survey at least 50 times. Because each respondent is viewing all eight scenarios of each income group, the minimum sample would be 50 people. However, because some questionnaires cannot be used for various reasons, 20% (of 50) was added to give a minimum sample size of 60 interviews with employers.

### **3.4.6 Questionnaire design**

#### **3.4.6.1 Preparation phase: gathering information for the questionnaire**

A number of different concepts needed to be explored to shape the formulation of the questionnaire.

##### *3.4.6.1.1 The distribution of population and skills in Cape Town (from Census 2001 data)*

The population figures were received from the National Census 2001 (Statistics South Africa, 2001). This data consisted of more than 600 suburbs and the population corresponding to these suburbs in a multitude of different descriptions, such as income levels, professions, how many member households, etc.

##### *3.4.6.1.2 Categorising employees*

An investigation into job grading methods was to allow employees to be categorised per job level. This was important to be able to get a value of catchment size per job grade or position of employee. For example, an employer might value larger catchments (numbers) of management level employees and unskilled workers differently.

There are many different job grading systems that can be used. The literature on job grading systems described and compared a number of methods (APPENDIX 4).

The very low wage workers may only be below the lowest grade of the Paterson system (the grading system most commonly used in SA companies). These are workers who lack a formal job description or work temporary jobs in the form of informal jobs like cleaning work, gardening, etc. This category may require the addition of a further job grade below level A.

The application of job grading systems, even with combining levels, was still too complex for this study and would result in questionnaires that were too long. In the end it was decided to divide employees into two groups.

This research was primarily concerned with employees who have limited choices, i.e. the lower to middle income populations who are vulnerable to fluctuations in transport costs. With this in mind, a number of assumptions were made to simplify the categorisation of employee income brackets which were divided into two groups (levels):

- 1) The first one relating to low to lower-middle income staff (earning between R3 000 – R10 000 per month) who are assumed to generally use public transport.
- 2) The second involving middle income staff (earning between R10 001 – R30 000) who are assumed to generally use private transport.

The first income level starts at R3 000 per month because this is just above the minimum wage in South Africa, so only permanent employees are included and not temporary staff. The first group extends to employees earning R10 000 per month, because it was felt that after this point the staff would most likely be more skilled and employers would have different considerations in the recruitment process.

The second group of employees began with R10 001 per month because this is approximately the salary of technicians and starting professionals. The salary of this group was only considered to range to the value of R30 000 per month because employees beyond this level are usually highly skilled and have the tendency to be advertised on a national and even international level.

The assumption was made that the first group of employees commuted by public transport and the second group commuted by private vehicles, is of course an oversimplification for the Model calculations. This is explained in the section that follows.

#### ***3.4.6.2 Model to generate the input values for the questionnaire***

A model was designed to process the information received from the individual companies into figures that could be used for the questionnaires. This involved a few steps.

##### ***3.4.6.2.1 Calculating the employees in flux and the employee catchment size***

The Census 2001(Statistics South Africa, 2001) data was able to be synchronised with a map of Cape Town in ArcGIS. In this way, all the data from the suburbs surrounding the firm's location (entered with coordinates accessed from Google Earth) could be isolated by the radial zones previously created.

This allowed for the tabulation of all suburbs within 5km (for example) of the business location and the population figures for the population earning different income levels. These income figures were adjusted for inflation to 2012 rates and the corresponding income groups were added proportionately to fit the income groups selected for this research project.

The total populations earning between R3 000 – R10 000 and R10 001 – R30 000 within radial zones of 5km, 10km, 15km, 20km, 25km, 30km and 40km were calculated.

#### *3.4.6.2.2 Calculating the company's average turnover rate*

Included in the information received from the company, was the date that each employee joined the company. The number of years each employee had been with the company was averaged in each salary group and was assumed to be the half life of all the employees in that group. This was used to estimate the average annual staff turnover rate. Example calculations for this can be seen in APPENDIX 5.

The turnover rate for Level 1 and Level 2 employees was applied to the total populations within each radial zone to estimate the number of people changing jobs per income level per month within that employee catchment area.

#### *3.4.6.2.3 Calculating the average commuting distance for the company*

The average commuting distance was calculated using weighted averages. This means that the number of people from each radial zone was multiplied by the average distance of that zone. The average distance was calculated as  $\frac{2}{3}(\text{radius})$  and multiplied by a factor of 1.4 because roads do not travel directly into the centre, but meander, adding distance.

This was summed over the total distance and divided by the number of employees of that income level. This gives the average travel distance (trip length) and then multiplied by two will give the daily travel distance for employees of each income level.

This was used to illustrate the current situation for the company, as well as to estimate the current CO<sub>2</sub> emissions.

#### *3.4.6.2.4 Calculating the travel subsidy*

The assumption was that the low to lower-middle income employees commute using public transport, specifically by bus. This is problematic because many staff probably travel by train or taxi or a combination of all three; many probably use private cars too. While this is an over simplification, it would be too difficult to ask each company to provide information of the mode employees use to travel to work, on top of the other information requested from them. Modal choice is a separate issue completely.

The assumption that all middle income employees travel by private vehicle is not as problematic, because the overwhelming majority of staff within this income level will use private cars. This group does not receive transport subsidies because they still have opportunities to move to cheaper forms of commuting.

Thus, the costs of commuting were calculated using the average distance per zone, multiplied by the bus fare equation of Rand per km (Del Mistro & Manguanidze, 2012). For the employees in the second salary group the AA rate of R2,53 per km was used (AA, 2012). The details are included in APPENDIX 2.

A table (Table 13) was set up that split the R3 000 – R10 000 income level into seven sub groups of income and it was assumed that the distribution would be an even 14.3% of the total staff within the first income level earned within each sub-group.

The affordable fare (per month) was calculated as 8% of the monthly income. The actual fare per month was calculated for four average radial distances within circular catchment zones of 10km, 15km, 25km and 40km.

For example, staff earning R3000-R3999 per month (first column in Table 13), can afford to pay monthly transport fares of R240 per month without spending more than 8% of their income on commuting. The actual commuting fares if they lived within 10km from the work place would be R288 per month, if they lived 10km – 15km from the work place it would cost them an average of R315 per month to commute, it would cost R358 per month if they lived 15km – 25km away and R411 per month for staff living between 25km- 40km from the work place.

The hypothetical scenario presented in the interviews assumed that employers would pay the portion of an employee's commuting cost that exceeded 8% of their income. As such, the difference between the affordable fare and the actual monthly fare for the average distance within each radial catchment zone was calculated. This can be seen as R48 per month per employee living within 10km from the workplace and earning between R3 000 – R3 999 per month. For employees with the same income but living further from the firm's location this subsidy would increase to R75 per month per employee living 10km-15km from the workplace, R118 per month per employee living 15km-25km from the workplace and R171 per month per employee living greater than 25km (and less than 40km) from the workplace.

As seen in Table 13, as the income increases 8% of their income increases and the average monthly fares remains the same. This meant that for the higher incomes, the employer only pays a subsidy when they live much further from the company. For example, employers only pay R11 per month per employee earning R5 000 – R5 999 per month and living greater than 25km from the workplace. Employers do not pay any subsidy to employees earning above R6 000 per month because the cost of public transport is lower than 8% of their salary.

The average subsidy for Level 1 staff that the employer would be required to pay per employee per catchment zone was calculated in the lower part of Table 13. Because it was assumed that within the company's total Level 1 staff, 14.3% would be earning R3 000 – R3 999 per month, the subsidy values were multiplied by 14.3%. Thus  $R48 * 14.3/100 = R 7$  per month. The same was done for the other values, the adjusted subsidies were summed horizontally across the sub-groups to provide the total subsidy an employer would pay per employee per month in each catchment zone. This is the figure that was used as the transport subsidy that would be required from the employer to each additional recruit from the wider area.

**Table 13 Calculation of the employer’s transport subsidy within the R3000-R10000pm income level**

Income per month	R 3 000	R 4 000	R 5 000	R 6 000	R 7 000	R 8 000	R 9 000
Affordable fares (per month)	R 240	R 320	R 400	R 480	R 560	R 640	R 720
% workers in each sub-group of income	14.3	14.3	14.3	14.3	14.3	14.3	14.3
<b>FARE (per month)</b>	<b>Subsidy</b>						
0-10km	R 287.69	R 48	R -	R -	R -	R -	R -
10-15km	R 314.97	R 75	R -	R -	R -	R -	R -
15-25km	R 358.13	R 118	R 38	R -	R -	R -	R -
>25km (40km)	R 410.57	R 171	R 91	R 11	R -	R -	R -
		14.3	0	0	0	0	0
		14.3	0	0	0	0	0
		14.3	14.3	0	0	0	0
		14.3	14.3	14.3	0	0	0

**Average cost to company per employee**

0-10km	R 6.81	R 6.81	R -	R -	R -	R -	R -
10-15km	R 10.71	R 10.71	R -	R -	R -	R -	R -
15-25km	R 22.32	R 16.88	R 5.45	R -	R -	R -	R -
>25km (40km)	R 38.82	R 24.37	R 12.94	R 1.51	R -	R -	R -

**3.4.6.2.5 Calculating the CO<sub>2</sub> emissions and “green tax”**

The emissions for staff were calculated by multiplying the company’s average distance travelled per day (two trips) by the emissions factors. These were 0.1 kg CO<sub>2</sub> per passenger km for the low to lower-middle income staff travelling by public transport (bus) and 0.54 kg CO<sub>2</sub> per passenger km for the middle income staff in private cars. The calculations for these emissions factors can be seen in APPENDIX 3.

However, this gives the current emissions of the company’s staff. For the stated preference scenarios defining a hypothetical maximum catchment area, the average distance travelled per day was assumed to be the average distance of that maximum employee catchment area or “zone”. Weighted average distances that took into account that more people possibly did not travel the geographically average distance could not be used. For this reason, when employers were given the option of having access to 100 % of their current catchment (i.e. 40km radius) to recruit from, the average distance travelled by employees and the average CO<sub>2</sub> emissions per employee per month were seen to increase sometimes to 50% above the original status quo situation. This is due to the fact that the weighted distance of the company is currently less than two-third of the 40km radius currently recruited from.

The “green tax” was calculated by multiplying the average emissions (for each group) by R120/ton CO<sub>2</sub> (DNA Economics & IMBEWU Sustainability Legal Specialists, 2012).

Once the model was set up to calculate these values and the Stated Preference Model was set up to organise the orthogonal profiles into pairs, the wording and layout of the questionnaires needed to be refined.

### ***3.4.6.3 Questionnaire for the Human Resources Department of each company***

There are two phases to the research and data collection process. The initial phase involved contact with the companies and the collection of contextual data to be analysed for the second phase. The second phase consisted of interviews with managers who are involved in recruitment, to collect the core data for analysis.

An initial questionnaire was developed to introduce the company to the research and explain exactly what information was needed. It reassured the company that neither their name nor the name of their company would be disclosed, and only anonymous aggregate results will be reported. The names, addresses or salaries of employees would not be required, as only the income bracket, the residential suburb and age<sup>19</sup> of each employee, as well as the date at which they had joined the firm was requested. The layout of this data was illustrated in a table in the questionnaire which can be seen in APPENDIX 6.

It must be noted, that the incomes required were the „gross income’ or the „cost to company’ before any deductions such as medical aid, etc.

### ***3.4.6.4 Questionnaire for the decision-maker***

The questionnaire for the managers involved in recruitment consisted of three sections: a general introductory section, the stated preference questionnaire containing pairs of recruitment scenarios and the last section that collected general information on business location choice.

After a brief paragraph introducing the background to the study, the hypothetical scenario was explained that employers would be responsible to pay for employees’ excessive<sup>20</sup> transport costs 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.

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

The status quo figures of the company’s current employee commuting profile were included in order to provide context for the questionnaire and making the recruitment choices 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, the weighted average distance of commuting and the corresponding average CO<sub>2</sub> emissions for each income level. These would serve as the baseline data for the recruitment scenarios in the stated preference questions that followed. An example of this can be seen in the box that follows:

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<sup>19</sup> The age of the employees was only requested in case the demographics were analysed at a later stage in the research.

<sup>20</sup> Assumption that cost of transport greater than 8% of salary would be paid by employer as subsidy to the employee.

Your company's current situation

Based on information received from your company and your firm's location, here are a few interesting figures that may help to put the following questions into context.

For your company I have estimated that:

- The current catchment size is approximately an area with a 40 km radius comprising of approximately 4800 persons earning between R3 000- R10 000 and 2000 persons earning between R10001 – R30 000pm seeking work each month.
- On average, your low to lower-middle income staff travel 34 km per day and middle income staff travel 26 km per day.
- The staff commuting with public transport emit approximately 74 kg CO<sub>2</sub> per employee per month and those travelling in private vehicles produce approximately 313 kg CO<sub>2</sub> per employee per month.

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 for middle income employees.

Recruitment decisions were presented to the employers in terms of 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<sub>2</sub> emissions) of staff commuting (in relation to the current emissions of the company).
- The financial cost of employee travel to the business. This cost is comprised of a transport subsidy to the employee and carbon tax to the government.

Employers were asked to indicate which of the two scenarios they preferred. These were displayed as four questions per income level; an example of which is presented below:

Question 1	Scenario 1	Scenario 2
The proportion of your current recruitment pool available to you.	90%	28%
The average distance employees will travel per day (km).	44	19
The environmental impact of staff commuting will change by this percentage.	8%	-62%
The amount of money your company will be expected to pay (Rands per employee per month).	R 39	R 13
	Please tick	Choice

There were four questions for each of the two income categories, but these were divided further with the element of time or urgency. Two of the four questions referred to recruitment scenarios that were to be made immediately or "this month" and the other two were recruitment scenarios which could be made over a longer period of recruiting, i.e. over three months.

The reason for this longer period is that there would be essentially three times the number of potential employees because of the number of people looking to change jobs each month. This investigated whether decisions made over longer time periods could allow for smaller employee catchment areas because there were additional people coming on stream each month.

The number of people to recruit per question was calculated in relation to the number of staff members hired in that company in the last year in the income group under review. For example, the questionnaire would state (from the information received from the company previously):

*“Over the last year, your company has employed 15 new low to lower-middle income staff.*

*Suppose you need to employ three people this month. The tables below describe two scenarios of the consequences of recruiting. Which of the two scenarios would you prefer?”*

And for question 3 and 4 it would state: *“Now suppose you had three months in which to recruit 10 people, which of the following recruitment scenarios would you prefer?”*

The number of people to recruit was calculated by dividing the number of people hired in the last year by twelve, to get the figure of people hired per month and then increased by 20% and rounded off the next whole number to generate the higher value. For the three month time scale, the previous number (per month) was multiplied by three and rounded upwards. However, this was not always the case if the company had only employed two staff of that income level over the last year for example, the questionnaire would ask about employing one person this month and then two people over three months.

The last section gathered information on the advantages and disadvantages of the firm’s current location and the importance of different factors affecting the location of the business. This was included to add value to the stated preference answers with regard to employers’ priorities and further research.

The questionnaire can be seen in APPENDIX 7.

### **3.4.7 Testing the questionnaire**

The questionnaire that was finally used in the interviews was the product of much iteration of the sample questionnaires. There was a great deal of experimentation with different layouts, wording of the questions and the introduction explanation, as well as the content of the questions that were finally included in the interview questionnaire.

#### **3.4.7.1 Pre-survey / focus groups**

The initial questionnaires had questions regarding employer’s priorities and asking whether employee commuting was a factor when employing new staff and how much they believed employee commuting affected their company and their staff.

Other questions that were excluded asked who employers thought was responsible for helping employees with the commuting crisis – government, the employee, the employer or a combination. They were excluded as they did not focus on the core of the research to be analysed and were additional to the stated preference employment scenarios, which made the questionnaire very long.

This phase also included the application to the UCT Ethics Committee of the Centre for Research in Engineering Education<sup>21</sup>. Only once the Committee's approval was received could the survey continue.

### **3.4.7.2 Pilot survey**

Due to time constraints, only three pilot surveys were completed: two with employers and one with a PhD student who had carried out her research with employers in Cape Town companies as well.

The first employer found it confusing to have so many variables and a difficult concept. He said that the costs should be expressed together as one cost because it was an important part of the decision.

After the combination of the costs and further simplification of the layout, he was asked to make further comments. He made some changes to the wording of the explanation and introduction of the study to make it more accessible to „businessmen’. He was also asked about the units employers would usually prefer; would they prefer the figures in monthly or yearly values, and per employee or for the whole company. This would depend on the company, but he suggested it would be easier if they were presented “*per employee per month*” because the company would be employing one new person in the situation for example. However, some companies do work in yearly, „cost to company figures’, but he said it would not make a difference to see them in monthly figures. He also suggested the addition of the third section of the questionnaire that looks at the priorities of employers regarding business location.

The second pilot survey was with the PhD student who helped simplify the wording of the introduction again and phrasing of the questions. She used her experience of what employers struggled to conceptualise or what would elicit ambiguous answers from her study. She suggested a change towards expressing the CO<sub>2</sub> emissions as a percentage increase or decrease from the current situation, instead of just the kg’s CO<sub>2</sub> per employee per month.

The third pilot interview was with another employer. He suggested changes to the way the number of potential employees were expressed. They were initially expressed as the number of people changing jobs per month within the area and thus available to recruit from. He suggested that it was difficult to visualise this number, but that employers would better be able to visualise the changes to the current situation. Such as, “would you be able to find a good person for the job within half of your current catchment?” Thus, the layout was changed to present the percentage of the current employee catchment that would be available to recruit from.

The final version of a typical questionnaire is given in APPENDIX 7.

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<sup>21</sup> UCT requires all research conducted in the name of the university to secure ethics approval to ensure that the studies comply with the University's code of research ethics.

### **3.4.7.3 Surveys and Training**

The interview was conducted by reading the second page to the respondent and then proceeding to the questions on the following page.

A research assistant was introduced to the research topic a few days prior to the start of the interviews. This introduction included an explanation of the background and motivation for this study, the assumptions behind the model and how the variables were calculated. The research assistant sat in on the four initial interviews and then took the lead in another two interviews where the researcher was present. After this it was decided that he would be able to lead interviews unaccompanied.

### **3.4.8 Analysis Model**

The data was run using a modelling programme called Limdep (Greene, 1998). The model results were obtained from a Multinomial Logit Model (MNL) which was based on the maximisation of utility theory. The literature in Section 2.3.5. describes the theory behind the MNL model, Basic Utility Theory and the Theory of Maximum Likelihood.

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## 4 Findings and Results

This chapter will describe the characteristics of the data collected in this study. It will then proceed to describe the steps taken to find the model that best explains the data. It describes the best fitting models and the estimated parameters. The results are then investigated in terms of the estimated utilities. This chapter concludes with a summary of the findings and brief analysis of the semi-structured data collected on the advantages and disadvantages of business location and limiting catchment areas.

### 4.1 Overview of survey results

#### 4.1.1 The choice of companies to interview

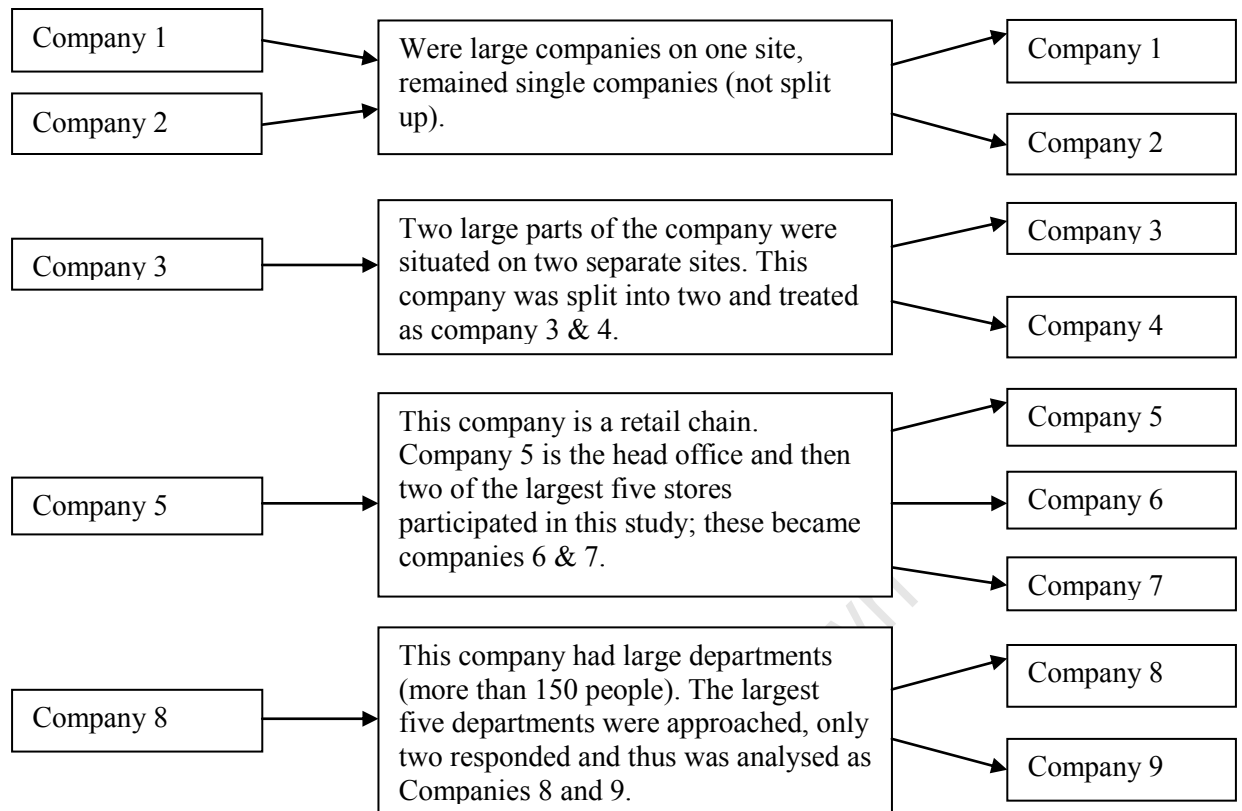
Large companies<sup>22</sup> situated on a single site were randomly contacted. Construction companies, for example, could not be considered because they already transport their employees to various sites. Of the 20 companies approached, five companies agreed to participate in the study and satisfied the requirements. These companies span across the following sectors; service (hospital), retail sector, public institution, academic institution<sup>23</sup> and engineering (consulting).

Some of the larger companies were split into separate companies. This process is illustrated in Figure 9. For example, a company with two different offices in Cape Town was analysed as two separate companies on different sites because of the different characteristics of the suburbs close to the location or in the example of a retail store – each store was treated as a separate business. Another large company, although it was contained on one site, had more than 150 people within each department and was analysed as separate companies because the recruitment decisions within departments would not be the same as for the entire business. For example, if the entire company employed 500 Level 1 staff in a year, the manager in a department would only be employing 20-30 of those staff. For this reason, with the very large company, only the largest five departments or stores were contacted and treated as separate companies in this study. In both cases, only two of the largest five departments and stores responded. In this way, five companies became nine companies, as seen in Figure 9. Further characteristics of these companies are described in Table 14.

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<sup>22</sup> Companies with more than 150 employees, taken from the Chamber of commerce website.

<sup>23</sup> Only non-academic staff were considered from this company. Academic staff are too specialized and often advertised for at a national and international level.



**Figure 9 Processing companies for analysis**

The key difference between the respondent companies is related to the staff skills profile and this is expressed in the L1/L2 ratio. This ratio was calculated by dividing the number of Level 1 staff by the number of Level 2 staff. A high L1/L2 ratio shows companies with large amounts of low to lower-middle income (Level 1) staff in relation to middle income (Level 2) staff. These are companies 6 and 7. Companies such as 3 and 4 have very low L1/L2 ratios and thus have very few low to lower-middle income staff compared to middle income staff.

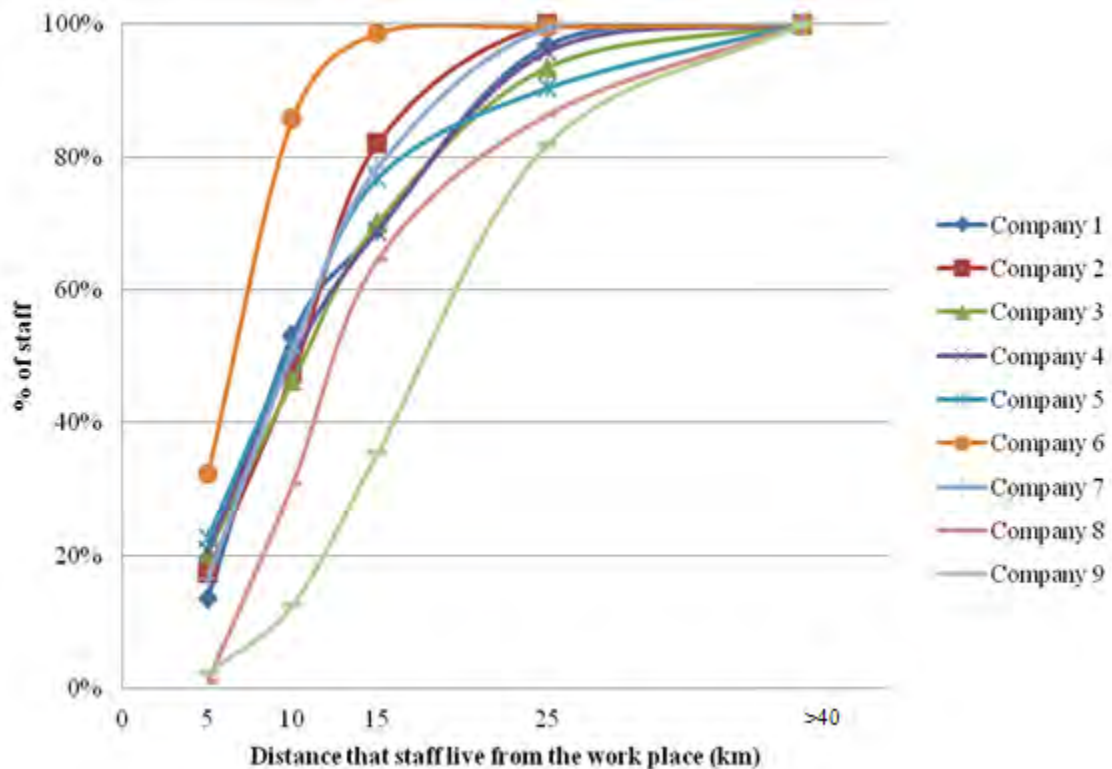
As explained in Section 3.4.6.2., the average turnover rate for the companies and the total number of staff were characteristics of the companies used in the calculations for the questionnaires presented to the employers. Table 14 also shows the average daily commuting distance which was calculated from the weighted average of the current staff travel distances for each company. It can be seen that Level 1 employees tend to travel slightly further than Level 2 staff. Company 6 had significantly lower average travel distances than the other companies, i.e. their staff live close to the workplace. This can also be seen in Figure 10.

**Table 14 Summary characteristics of the companies participating in this study (Author's calculations)**

	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

Figure 10 shows the current employment profiles of the companies, with distance. Company 8 and 9 have the least number of staff living nearby their workplace.



**Figure 10 The distance that (Level 1 and Level 2 combined) employees live from the workplace, per company. (Author's calculations)**

### 4.1.2 Respondents

Interviews were conducted with 47 managers involved in recruitment from „nine’ companies, with a total response rate of 0.32 (or 32%). The response rate is defined by the total number of respondents divided by the total numbers of people (potential respondents) approached. A low response rate indicated the difficulty involved in acquiring interviews.

## 4.2 Results

### 4.2.1 The expected results

Based on the consumer choice literature on “too much choice” it is expected that there will be increasing satisfaction with increasing choices, but there is a point beyond which the satisfaction increases at a slower rate or even decreases. With this trend, it is expected to find an initial increasing positive utility with increasing catchment sizes, but after a certain catchment size the utility will begin to decrease with catchment size. It is expected that distance, CO<sub>2</sub> emissions and financial cost (transport subsidy and carbon tax) coefficients will have negative impact on utilities.

### 4.2.2 Analysing the data

The parameters of the model were estimated with both employees wage levels together. The variables from the questionnaires were:

- 1) Employee catchment size.
- 2) Staff commuting distance.
- 3) CO<sub>2</sub> 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 estimated with dummy variables for different aspects of the decision-making process, because the relationship might not necessarily be linear. These were incorporated because it is possible that employers made different decisions regarding different income/skills levels of employees or when employers were faced with urgency of recruitment decisions within one month or over three months. Dummy variables for each of the four sizes of employee catchments faced by employers could give better information of the relationship between utility and each catchment size.

It was not expected that data from each company would differ significantly because the companies were similar. The main difference between some of the companies was the skills level of the firm and the product or service of the company. A dummy variable was used to differentiate between two types of companies: the “top heavy” or highly skilled company whose main service depends on the quality and skills of their staff versus those companies who employ mostly lower income, less skilled staff who support the main product/service of the company.

In summary 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 sizes, in terms of the percentage of staff available to recruit from were defined as catchment 1, 2, 3, and 4.
- 4) A separation of highly skilled companies or companies of lower skilled staff. As such, companies 1,2,3,4,5,8,9 were grouped and companies 6, 7 were grouped.

In order to estimate the coefficients for dummy variables, modelling requires that one dummy variable should be left out of the model specification. This provides the reference point for estimating the parameters.

The selection of the most appropriate model to explain the data requires analysis of two aspects of the model: goodness of fit and the estimated parameters of the model.

### ***I. Multinomial Logit Model (MNL)***

The MNL gives the Utility Equation that best fits the data, with the rho-squared value as a measure of success.

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

#### **a) Model Fit**

The goodness of fit was analysis through the following options:

- i. The difference between the log likelihood base value when the model is estimated with no explanatory variables and the one using the estimated coefficients of the model. The difference that is closest to zero is the one that has explained the data best.
- ii. The adjusted rho-squared (adjusted  $\rho^2$ ) for a good fit in an MNL model should be between 0.2-0.4 (Hensher et al.,2009).

#### **b) Estimated parameters**

- i. The probability test (p-value) provides a statistical estimate of the probability that the variable is being included erroneously, i.e. when it is not relevant to the model. A value of less than 0.05 is acceptable.
- ii. The signs of the variable's coefficients need to be logical. A negative coefficient for a variable means that the variable will have a negative influence on utility. The signs of the coefficients should be logical in that the costs should have negative coefficients and the benefits positive coefficients.

### 4.2.3 Multinomial Logit Model (MNL) for all data

The multinomial logit (MNL) tested the influence of all the variables on their choice of employees. From the table of the full set of results shown in APPENDIX 9.1, the best fitting models were selected and are displayed in Table 15 below.

The adjusted rho-squared values are all extremely poor which would suggest that models do not reflect the data. Hence, further investigation was carried out by splitting the data with regard to levels of income i.e. Level 1 and Level 2 employee data.

**Table 15 Selected MNL results for all data**

	Model 1		Model 2		Model 5		Model 6	
MODEL NAME	MNL Catchment, CO <sub>2</sub> , Cost, Distance.		MNL Catchment, CO <sub>2</sub> , Cost.		MNL Catchment, CO <sub>2</sub> , Cost Dummy variables: L1 & L2.		MNL CO <sub>2</sub> , Cost. Dummy variables: Catchment 1,2,3,4	
Log likelihood BASE	-260.62		-260.62		-260.62		-260.62	
Log likelihood MODEL	-237.68		-249.31		-248.75		-240.35	
Rho-squared	0.08		0.04		0.04		0.07	
Observations	752		752		752		752	
VARIABLES	$\beta$	p-test	$\beta$	p-test	$\beta$	p-test	$\beta$	p-test
Catchment (%)	2.31	0.0005	2.04	0.00	1.94	0.00		
CO <sub>2</sub> <sup>24</sup>	-1.61	0.0027	-0.90	0.08	-0.87	0.09	0.79	0.29
Cost <sup>25</sup>	0.05	0.0022	-0.02	0.03	-0.02	0.04	0.00	0.92
Distance	-0.09	0.0000						
Level 1 staff					-0.16	0.29		
Level 2 staff					1.16	*		
Catchment 1							1.58	0.22
Catchment 2							1.59	0.08
Catchment 3							1.42	0.04
Catchment 4							0	*

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

The complete set of results for the Level 1 data can be seen in APPENDIX 9.2. The best fitting model characteristics are shown in Table 16 and compared in this section.

The MNL models shown in Table 16 showed significant improvements to the analysis of all the data. The log likelihoods of the models were very similar, with adjusted rho-squared values of 0.23 or 0.24 which lies within the range of 'good fit'.

Distance as a variable was removed from the models because it was not statistically significant and it was suspected of violating the IID (Independence and identically distributed error terms) assumption because it was incorporated in the calculation of the catchment sizes.

<sup>24</sup> Unit = percentage change in the company's CO<sub>2</sub> emissions.

<sup>25</sup> Unit = Rand per employee per month (based on the Carbon Tax of kgs CO<sub>2</sub> emissions and Transport Subsidy for Level 1 employees from the average distance travelled per employee per month in each catchment size).

Models containing dummy variables for skilled companies (or less skilled companies) and urgency of recruitment (one month and three months) performed weakly in comparison to those shown in Table 16. They were not found to be statistically significant in employers' recruitment decisions of Level 1 staff.

To investigate the influence of each catchment size on the employers' utility, models were run with the four catchment sizes as dummy variables.

Model 11 with the largest improvement of log likelihood values from no coefficients (-130.31) to -97.30 (with coefficients estimated by the mode), but cost was not statistically significant (p-value > 0.05). Model 13 was run without financial cost and can be seen to be the best performing model to represent the Level 1 employee data.

**Table 16 The parameters produced by the MNL model for Level 1 employees**

	Model 1		Model 2		Model 4		Model 11		Model 13	
MODEL NAME	MNL Catchment, CO <sub>2</sub> , Distance, Cost		MNL Catchment, CO <sub>2</sub> , Cost		MNL CO <sub>2</sub> , Catchment		MNL Cost, CO <sub>2</sub> , Catchment 2,3,4		CO <sub>2</sub> , Catchment 2,3,4	
Log likelihood BASE	-130.31		-130.31		-130.31		-130.31		<b>-130.31</b>	
Log likelihood MODEL	-98.64		-98.64		-98.85		-97.30		<b>-97.36</b>	
Rho-squared	0.23		0.23		0.23		0.23		<b>0.24</b>	
Observations	376		376		376		376		<b>376</b>	
VARIABLES	$\beta$	p-test	$\beta$	p-test	$\beta$	p-test	$\beta$	p-test	$\beta$	p-test
Catchment (%)	4.22	0.00	4.22	0.00	4.61	0.0004				
CO <sub>2</sub>	-3.93	0.04	-3.93	0.04	-4.98	0.0000	-5.38	0.16	<b>-6.46</b>	<b>0.01</b>
Cost	-0.02	0.64	-0.02	0.52			-0.02	0.73		
Distance	0.00	1.00								
Catchment 1							0	*	<b>0</b>	*
Catchment 2							1.51	0.02	<b>1.49</b>	<b>0.02</b>
Catchment 3							3.61	0.04	<b>3.91</b>	<b>0.01</b>
Catchment 4							4.88	0.06	<b>5.12</b>	<b>0.05</b>

#### 4.2.5 Final Model for Level 1 employee data

The final model that best explains the data regarding Level 1 employee data is Model 13 which includes CO<sub>2</sub> and dummy variables for catchment 1, 2, 3 and 4.

The model fit was good with a log likelihood value of -97.36, adjusted rho-squared of 0.24 and all variables were statistically significant.

The magnitude shows the contribution of each variable to the total utility (part-worth utility) and the sign indicates whether the variable has a positive or negative effect on utility. Carbon dioxide (CO<sub>2</sub>) emissions produced by staff commuting had a negative impact on the employers' utility and contributed 6.46 times to each unit of disutility.

The catchment sizes were modelled as dummy variables and are interpreted relative to each other. Catchment 1 was left out of the model and thus the other catchment coefficients are discussed in relation to that of catchment 1. Positive coefficients for catchments 2, 3 and 4 indicate an increase of utility when selecting catchments 2, 3 and 4 over catchment 1.

When faced with the choice of catchment size, the model showed that employers had a higher part-worth utility attached to catchment 2 over catchment 1 because the magnitude of the coefficient is higher for catchment 2 (1.49) compared to that of 0 for catchment 1. The same can be said for catchments 3 and 4 with coefficients of 3.91 and 5.12 respectively. Disutility increased with catchment size, because CO<sub>2</sub> increases with distance.

The parameters estimated by the MNL model were used to develop the utility equation that incorporates the estimated contributions of each variable to each unit of the employer's utility.

The utility equation that follows is:

$$\begin{aligned} \text{Utility}_{\text{Level 1 staff}} = & (-6.46) * (\text{CO}_2) + (0) * (\text{Catchment 1}) + (1.49) * (\text{Catchment 2}) \\ & + (3.91) * (\text{Catchment 3}) + (5.12) * (\text{Catchment 4}) \end{aligned} \quad (5)$$

#### 4.2.6 Analysis of middle income (Level 2) employee data

The employers' choices regarding middle income (Level 2) employees was analysed in a similar process. The complete table of results can be seen in APPENDIX 9.3. The best fitting model results discussed in this section can be seen in Table 17.

Models 1 and 10 showed the best improvement to the base model with log likelihoods of -115,26 and -115,01 respectively and the adjusted rho-squared values of 0.1.

Model 1, however, had a positive coefficient for cost and was not statistically significant. This could be due to the some correlation between distance, CO<sub>2</sub> and cost values, which may be a violation of the IID assumption.

Model 2 was run without distance as a variable and found that CO<sub>2</sub> emissions were not statistically significant (p-value > 0.05). This was another suspected violation of the IID rule where the financial cost for Level 2 staff was only made up of the carbon tax, which is based on and thus directly proportional to the CO<sub>2</sub> emissions produced by Level 2 staff commuting. The cost did not include travel subsidy because of the assumption Level 2 staff would use private vehicles and thus still have the option to shift their choice of mode to a more affordable one. For these reasons, Model 3 was run with variables of catchment size and cost only. The coefficients had logical signs and the p-values improved, but the adjusted rho-squared dropped to 0.08 (further from the required range of 0.2-0.4).

Model 10 had the best log likelihood value and a rho-squared of 0.1. This model included variables for cost and the four catchment sizes (1, 2, 3 and 4). The p-values showed all variables were statistically significant.

Model 14 tried to improve Model 10 by including CO<sub>2</sub> instead of financial cost which had previously improved the model for Level 1 data, but the rho-squared dropped to 0.08 and the p-values showed all variables were not statistically significant.

The models incorporating other dummy variables did not improve the model neither the type of company (highly skilled or not) nor the urgency of recruitment decisions (one month vs. three months) were statistically significant to employers when choosing preferred recruitment scenarios for Level 2 staff.

Thus Model 10 was the closest to a good fit reached so far and explained the data reasonably well, however the adjusted rho-squared did not lie within the required range.

The weak fit of the model could be due to a number of different factors:

- Hypothetical bias - Managers may have had difficulty conceptualising the abstract concepts in this study. For example, Cape Town has rigid racial and social profiles of the current residential suburbs. Employers could have made decisions of the size of catchment they require to find a suitable employee in the mindset that some of their middle income staff currently live in suburbs far from work and thus they would always need access to these areas for example. This mindset could have been stronger than the consideration of the potential employees in flux presented in the questionnaire.
- The semi-structured final section of the questionnaire referred to the advantages and disadvantages of business location. The results from this section are discussed in Section 4.5. and illustrated that employers see the value of shorter commuting distances to the business, to the employees and the environment but the financial cost may not have been high enough to cause a trade-off with having more high income 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 17 MNL logit model for data regarding Level 2 employees**

	Model 1		Model 2		Model 3		<b>Model 10</b>		Model 14	
MODEL NAME	MNL Catchment, CO <sub>2</sub> , Distance, Cost		MNL Catchment, CO <sub>2</sub> , Cost		MNL CO <sub>2</sub> , Catchment		<b>MNL Cost, Catchment 2,3,4</b>		MNL CO <sub>2</sub> , Catchment 2,3,4	
Log likelihood BASE	-130.31		-130.31		-130.31		<b>-130.31</b>		-130.31	
Log likelihood MODEL	-115.26		-118.42		-118.99		<b>-115.01</b>		-116.97	
Rho-squared	0.10		0.08		0.08		<b>0.10</b>		0.08	
Observations	376		376		376		<b>376</b>		376	
VARIABLES	$\beta$	p-test	$\beta$	p-test	$\beta$	p-test	$\beta$	p-test	$\beta$	p-test
Catchment (%)	3.77	0.00	3.82	0.00	3.09	0.00				
CO <sub>2</sub>	-1.34	0.04	-0.62	0.29					1.04	0.26
Cost	0.04	0.12	-0.02	0.02	-0.02	0.00	<b>-0.05</b>	<b>0.02</b>		
Distance	-0.08	0.01								
Catchment 1							<b>0</b>	*	0	*
Catchment 2							<b>2.38</b>	<b>0.00</b>	0.49	0.19
Catchment 3							<b>2.74</b>	<b>0.00</b>	0.51	0.50
Catchment 4							<b>4.38</b>	<b>0.01</b>	-0.49	0.68

#### 4.2.7 Final model for middle income employees

The final model that best explains the data regarding Level 2 employee data is the MNL analysis of financial cost and dummy variables for catchment 1, 2, 3 and 4.

The model fit was good with a log likelihood value of -115.01, adjusted rho-squared of 0.1 and all variables were statistically significant.

The parameters estimated by the model show the financial cost of carbon tax imposed on the employer has a negative impact on the employers' utility and contributed 0.05 times the value of the variable to each unit of disutility.

The catchment sizes were again modelled as dummy variables and other are discussed in relation to catchment 1 (the option excluded in the model). Positive coefficients for catchments 2, 3 and 4 show an increase of utility when selecting catchment 2, 3 and 4 over catchment 1.

Employers also had a higher part-worth utilities associated with higher catchment numbers, i.e. catchments 2, 3 and 4 over catchment 1 because the coefficient values of 2.38, 2.74 and 4.38 respectively are higher than the 0 for catchment 1. Employers experienced increased part-worth utilities as the size of the catchment increased.

The parameters estimated by the MNL model were used to develop the utility equation that incorporates the estimated contributions of each variable to each unit of the employer's utility.

The utility equation for Level 2 employees is:

$$\text{Utility}_{\text{Level 2 staff}} = (-0.05) * (\text{Cost}) + (0) * (\text{Catchment 1}) + (2.38) * (\text{Catchment 2}) + (2.74) * (\text{Catchment 3}) + (4.38) * (\text{Catchment 4}) \quad (6)$$

While this was not a model of perfect fit, it can still be useful to look at the trends in the part-worth utilities generated from the parameters estimated by the model for the different recruitment scenarios of differing catchment sizes.

### 4.3 Utilities

Economists use utility to express preference of a set of goods or services (Hensher, Rose, & Greene, 2009). The preference for different catchment sizes to employers can thus be investigated through analysis of the utilities derived from the model estimated in Sections 4.2.5 and 4.2.7. The maximum likelihood method is an optimisation technique that is used to estimate the coefficients. The part-worth utilities of the catchment size are implicit in the coefficients derived for each catchment size in the equations that model employer utility for Level 1 and Level 2 employees respectively.

In each case it can be seen that the part-worth utility increases with catchment size, as expected. However, the total utility resulting from a choice of catchment size consisted of not only the benefits due to catchment size but also the disbenefits of travel due to catchment size, since increasing catchment size is accompanied by increase travel costs, CO<sub>2</sub> emissions and how these are perceived by employers. The utility derived by the employers interviewed is represented by the equations 5 and 6.

The utility curves were plotted in six figures; i.e. versus catchment number, versus the percentage of total catchment and versus catchment radius for employees of Levels 1 and 2. The equations and goodness of fit values for these curves were presented, from which conclusions of the value of point of inflection in the curves were reached.

#### 4.3.1 Utility curves for Level 1 employees

The utility curves from equation 5 for the employers in this study are illustrated in Figures 11 - 13. Figure 11 shows a parabolic utility curve with a maximum point of utility (inflection point) somewhere around catchment 2 (between catchment 1 and 3). After this point, utility decreases with increasing catchment size. The catchment number (1, 2, 3 or 4) is not meaningful on its own, but rather when expressed in terms of the radii of the catchment or in percentage of the current catchment (or recruitment pool) that is available to recruit from.

The utility curve in Figure 12 shows a maximum point of inflection between 20% and 70% of the current recruitment pool available to the employers. Figure 13 shows the maximum utility at a radial distance between 10km and 25km from the business location.

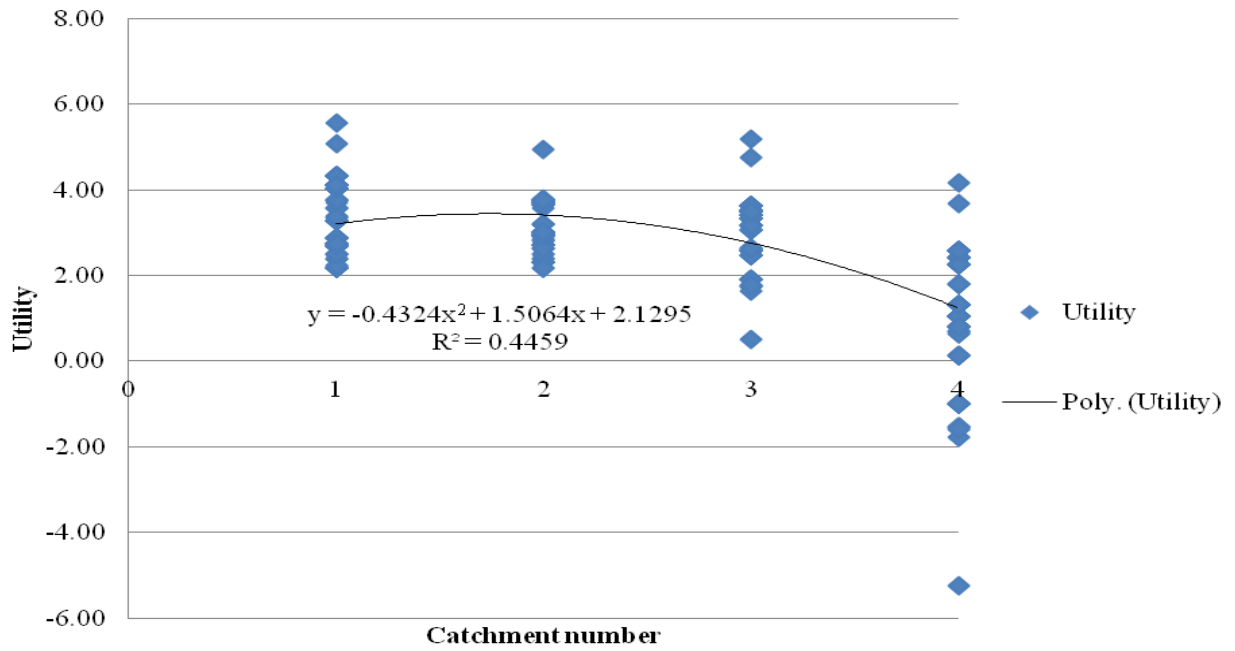


Figure 11 Effect of catchment size of Level 1 Staff on utility perceived by employers

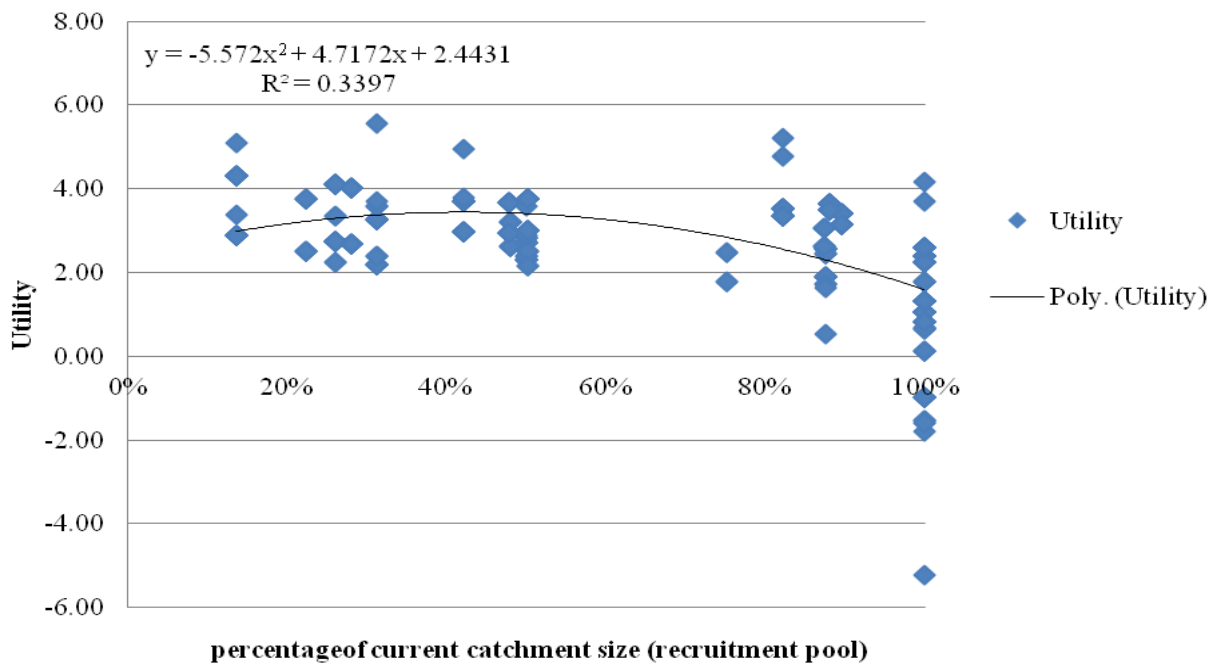


Figure 12 Effect of percentage of current catchment size of Level 1 Staff on utility perceived by employers

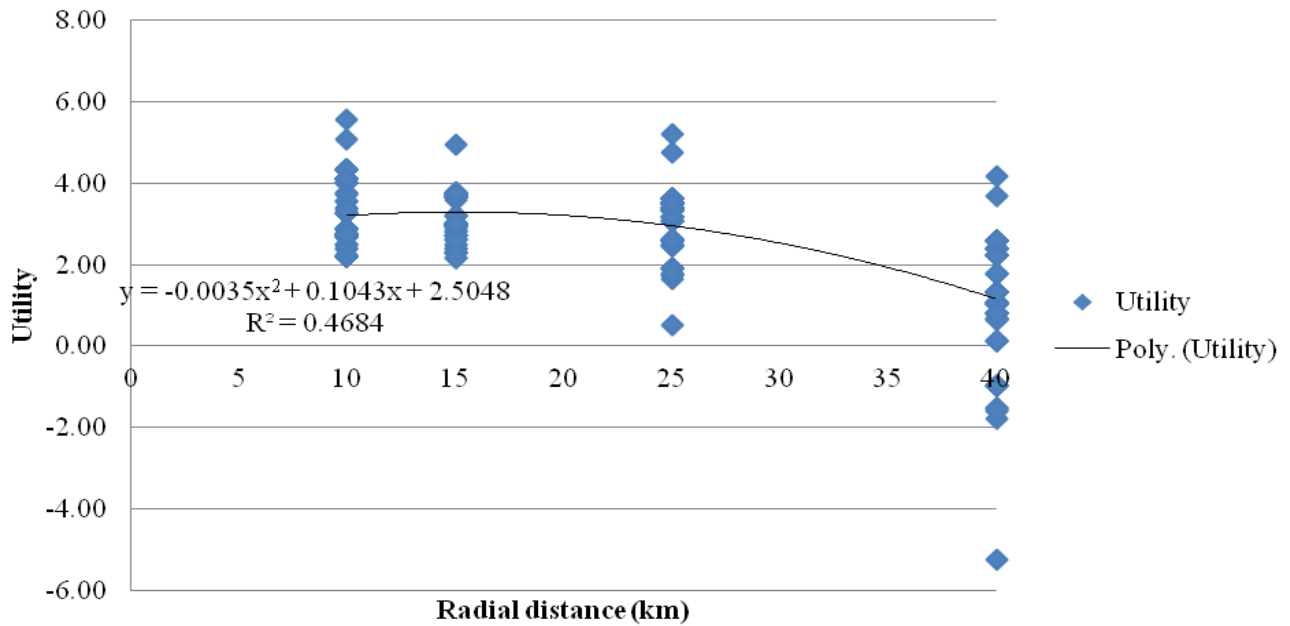


Figure 13 Effect of the radius of the catchment of Level 1 Staff on utility perceived by employers

#### 4.3.2 Utility curves for Level 2 employees

The utility curves for Level 2 employee data were derived from equation 6. The trends of utility with increasing catchment size can be seen in Figures 14 - 16. The equations and goodness of fit values for these curves are presented in figure and are used to estimate the point of inflection in the curves.

The utility curve in Figure 14 shows a steeply increasing utility with catchment size, especially from catchment 1 (with negative utility) to catchment 2 which is positive. Utility continues to increase steeply with catchment size, but at a slightly lower rate for catchments 2, 3 and 4. The change in gradient indicates a point of inflection in the rate of increasing utility for employers when gaining access to increasing catchment sizes available to recruit from. This point of inflection may lie somewhere between catchments 1 and 2. As previously mentioned, it is more useful to describe the catchments in terms of the radial distance of the catchment size or the percentage of catchment size.

Figure 15 shows a utility curve also steeply increasing from negative to positive utility with initial increases in catchment size (from 20% - 40%). Utility continues to increase but with increasing catchment size but again at a slightly slower rate (more gradual gradient) thus the point of inflection may occur when employers have between 20% and 40% of their current catchment (recruitment pool) available to recruit from. In Figure 16, this point is again reached at a radius of between 15km and 25km from the business location.

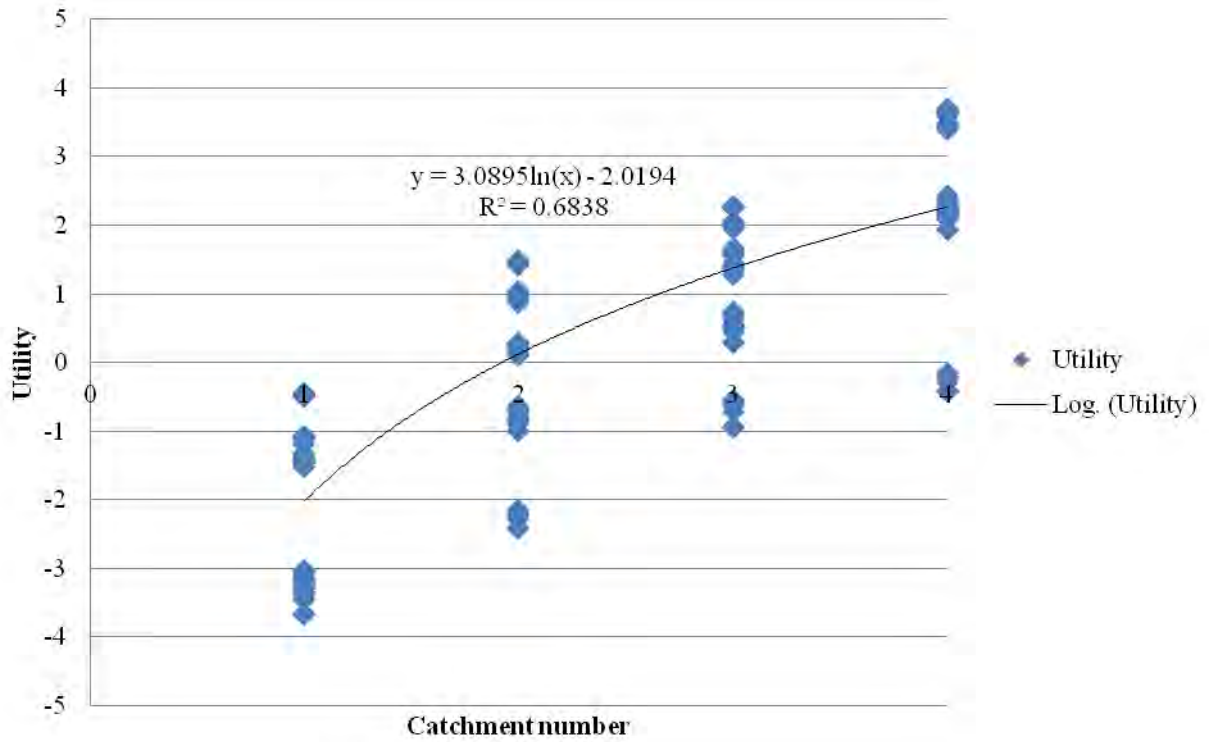


Figure 14 Effect of catchment size of Level 2 Staff on utility perceived by employers

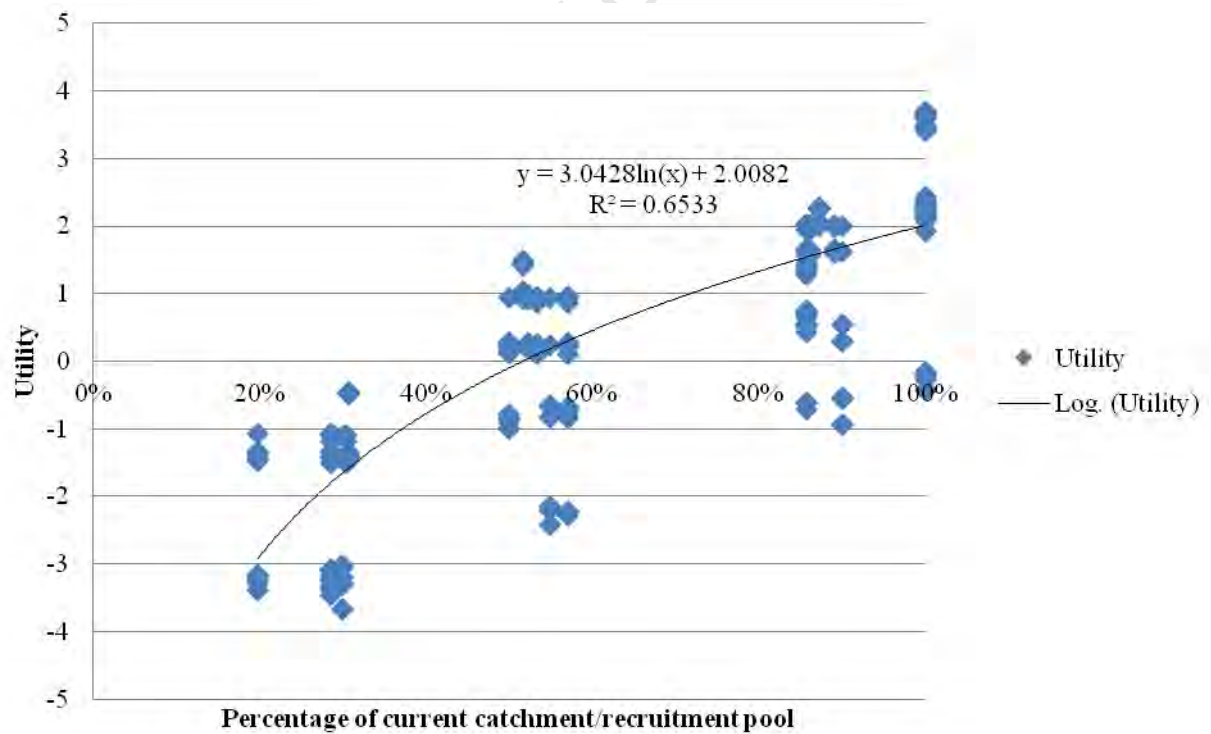


Figure 15 Effect of percentage of current catchment size of Level 2 Staff on utility perceived by employers

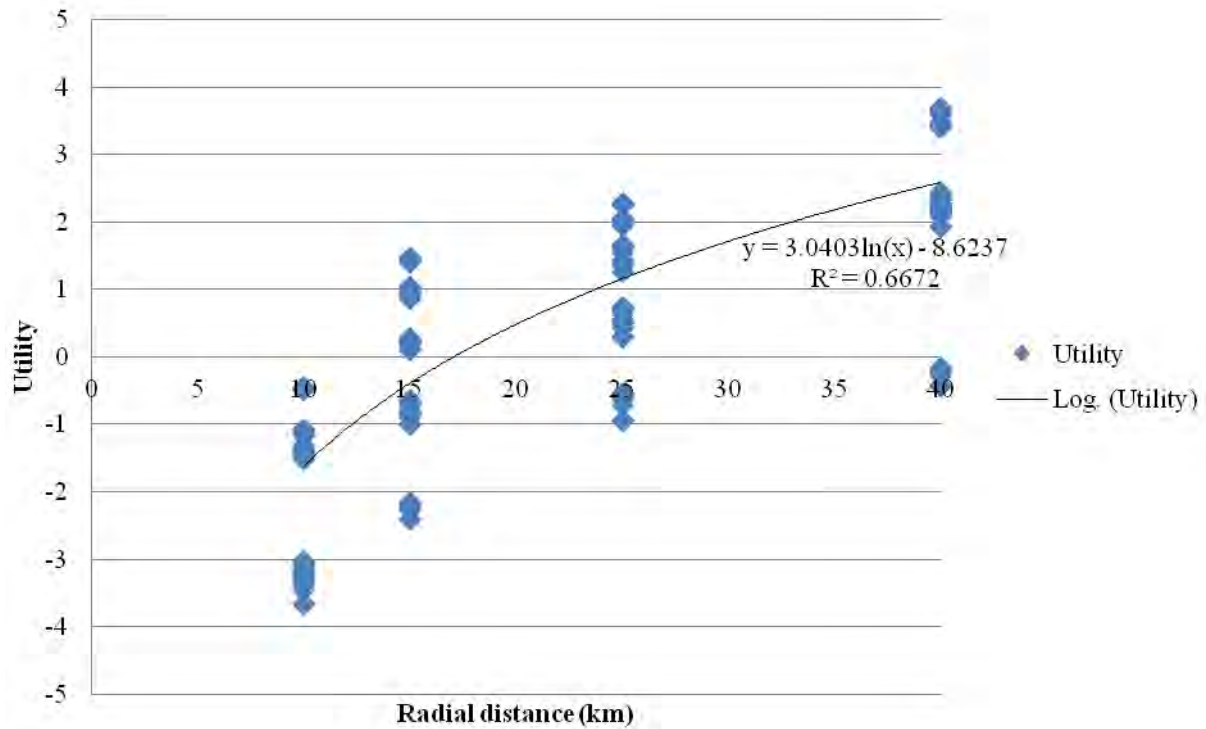


Figure 16 Effect of the radius of the catchment of Level 2 Staff on utility perceived by employers

### 4.3.3 Summary of results

The results from the data and the models used were summarised in Table 19.

Table 18 Summary table of results

	Level 1	Level 2
Model	MNL (CO <sub>2</sub> and dummy variables for Catchment 1, 2,3, 4)	MNL (Cost and dummy variables for Catchment 1, 2,3, 4)
$\Delta$ log likelihood	32.95	15.3
$\rho^2$ adj	0.24	0.10
Utility Equation	Utility <sub>Level 1 staff</sub> = (-6.46)*(CO <sub>2</sub> ) + (0)*(Catchment 1) + (1.49)*(Catchment 2) + (3.91)*(Catchment 3) + (5.12)*(Catchment 4)	Utility <sub>Level 2 staff</sub> = (-0.05)*(Cost) + (0)*(Catchment 1) + (2.38)*(Catchment 2) + (2.74)*(Catchment 3) + (4.38)*(Catchment 4)
Significance of variables (p-values)	0.01 (CO <sub>2</sub> ); 0.02 (Catchment 2) ; 0.01 (Catchment 3); 0.05 (Catchment 4)	0.02 (Cost); 0.00 (Catchment 2) ; 0.00 (Catchment 3); 0.01 (Catchment 4)
Influence of utility with catchment size	2nd degree polynomial relationship, maximum turning point between catchment 1 and 3.	Logarithmic relationship with point of inflection (change in gradient) between catchments 1 and 2.
Influence on utility with % of current recruitment pool	2nd degree polynomial relationship with inflection point between 20% and 70% of the employer's current recruitment pool.	Logarithmic relationship with inflection point approximately between 20% and 40% of the employer's current recruitment pool.
Influence on utility with distance from the business location	2nd degree polynomial relationship that reaches maximum utility at a radial distance between 10km and 25km.	Logarithmic relationship with a point of inflection at a radial distance of between 15km and 25km.

## 4.4 Probabilities and willingness to pay

This section describes which catchment sizes were preferred by employers for Level 1 and 2 staff recruitment decisions and the monetary value employers associated with having more potential employees to recruit from.

### 4.4.1 Probabilities

The probabilities (Table 19) further support the trend in the utility graphs and showed that when recruiting lower income staff, there was a higher probability that employers preferred a smaller catchment, i.e. the options selected most frequently were catchments 1 and 2. However they were willing to consider a wider catchment size when recruiting higher income staff, i.e. catchments 3 and 4 were selected most frequently.

### 4.4.2 Willingness to pay (WTP)

By relating the part-utilities to cost, a monetary value was given to express the value that employers had for access to different catchment sizes.

Table 19 shows that employers recruiting Level 2 staff would be willing to pay R48, R55 and R88 per employee per month for 50%, 90% and 100% of their current catchment size. Employers were willing to pay R48 per employee per month to increase their access to potential employees by 20% (from catchment 1 (30% catchment size) to catchment 2 (50% catchment size) – which can be converted to R2,40 per employee per month for 1% increase in catchment size. The 40% increase from 50% to 90% of the catchment size was only valued at R7 per employee per month (R 0.18 per employee per month for 1% increase in catchment size), but the final 10% was valued at R33 per employee per month (R3.3 per employee per month for 1% increase in catchment size).

For employers considering Level 2 staff, the value of getting more access than the smallest catchment size was very valuable, but so was the last 10% to have access to the full 100% of their current catchment size.

**Table 19 Summary of the probability and willingness to pay calculations.**

	Level 1 <sup>26</sup>		Level 2		
	Coefficients	Probabilities	Coefficients	Probabilities	WTP (R/employee/month)
CO <sub>2</sub>	-6.46				
Cost			-0.05		1
Catchment 1	0	0.27	0	0.06	0.00
Catchment 2	1.49	0.30	2.38	0.26	47.60
Catchment 3	3.91	0.22	2.74	0.42	54.80
Catchment 4	5.12	0.23	4.38	0.29	87.60

<sup>26</sup> Willingness to pay could not be calculated for Level 1 choice data because the negative coefficient or „cost’ is expressed as the percentage change in the company’s CO<sub>2</sub> emissions. Thus a monetary value for kgs CO<sub>2</sub> could not be applied to this data to allow for a willingness to pay analysis.

#### 4.5 Results from the qualitative semi-structured interview

The most frequently mentioned advantages and disadvantages of the current firm's location are shown in Figure 17 and 18. For those that had good access to public transport this was the most frequently stated advantage of their firm's location. Those that did not have good access to public transport mentioned it frequently as a disadvantage of their firm's location. The next most commonly mentioned disadvantages of business locations were congestion and parking problems and long travel distance for staff.

This shows that access and employee commuting is very important to employers as confirmed in the data shown in the Figure 19. This also shows that access to public transport is overwhelmingly 'very important' to employers in factors affecting business location.

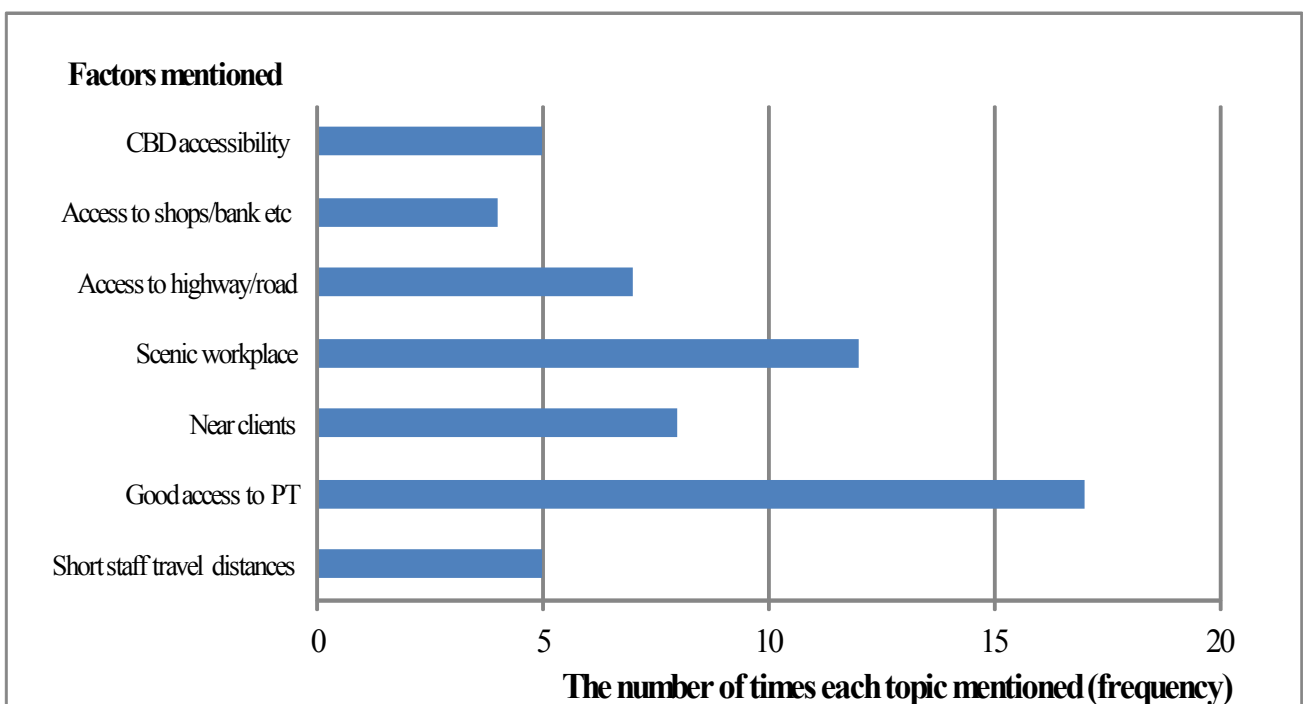


Figure 17 The main advantage of the firms' current locations

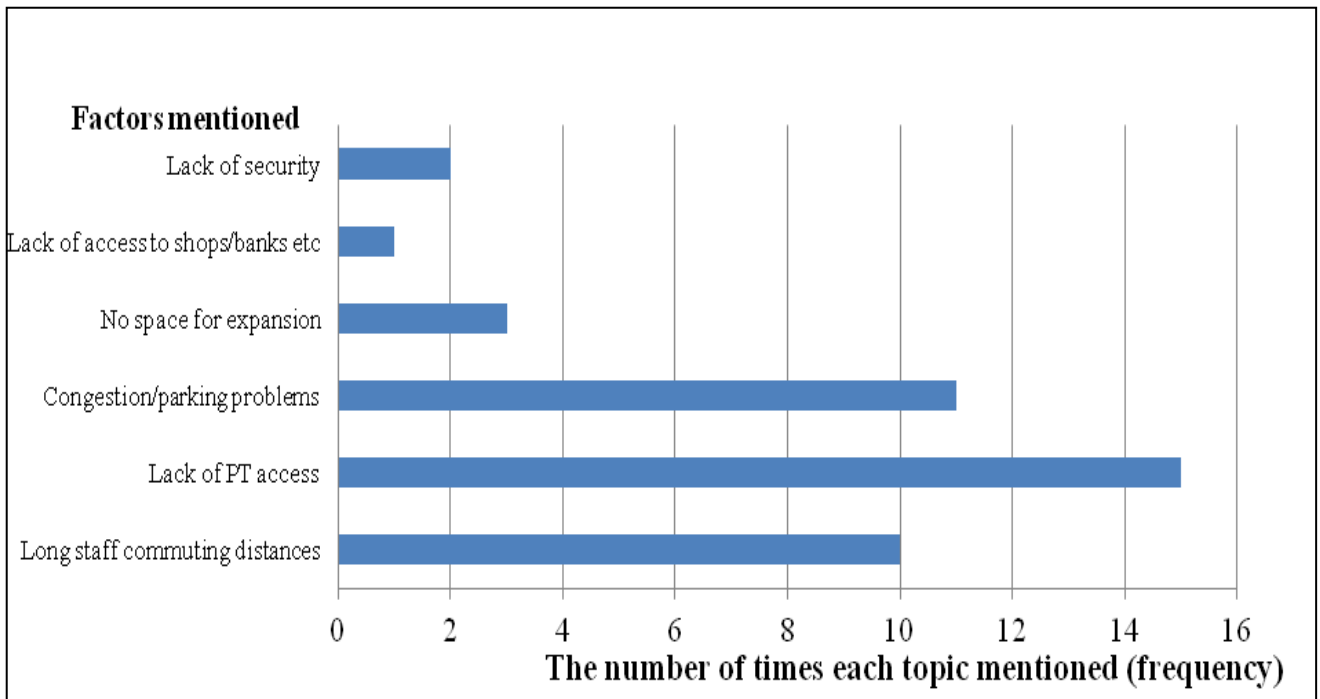


Figure 18 The main disadvantages of the firms' current location

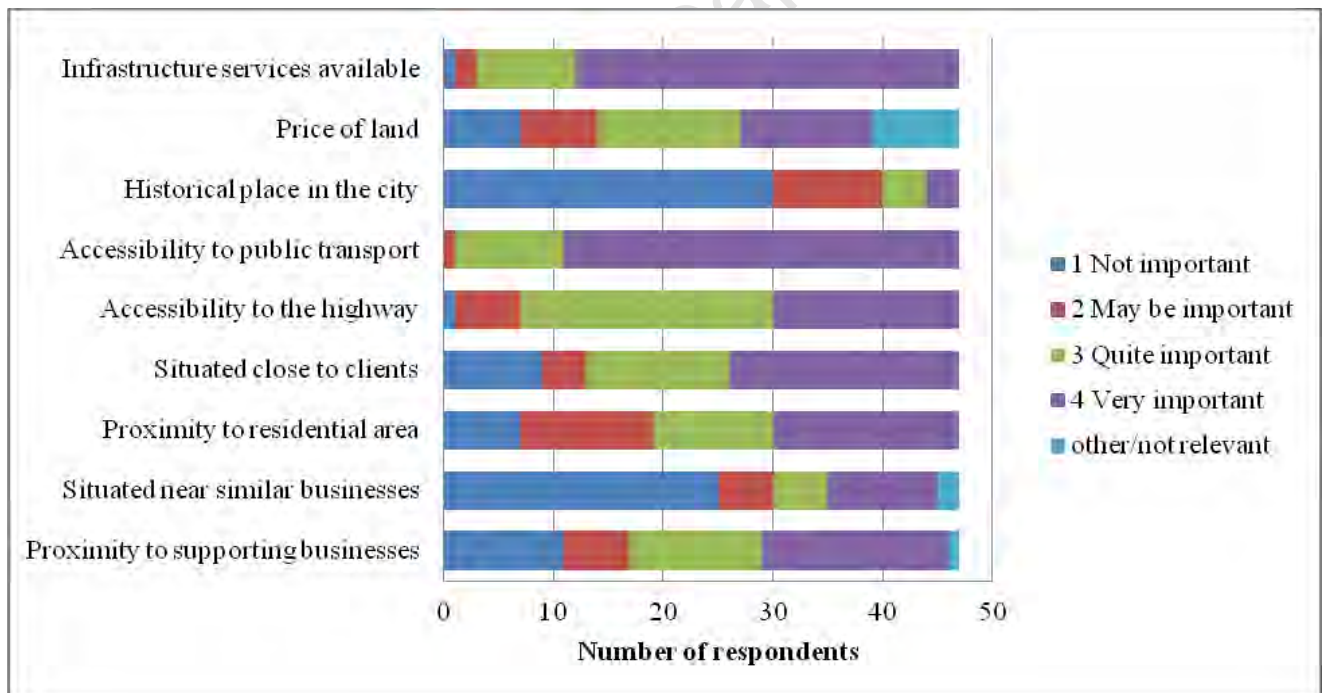


Figure 19 Importance of different factors affecting business location

Employers also see the advantages and disadvantages of shorter employee travel distances. The advantages employers expressed were:

- 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.

The disadvantages expressed by the employers when considering limited catchment pools:

- 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 cannot afford the land closer to the company. Paying subsidy and carbon tax would increase business costs.
- Housing nearby the business is expensive, consequently no residential areas of staff nearby.
- It would be difficult to comply with employment equity ratios if only employ from closer areas.
- Unfair because one would not be allowing people to make their own choices and then it would exclude people with certain demographics.
- No disadvantages.

Other comments of importance that emerged from the interviews were:

- Companies already transport staff after 7pm according to the Basic Conditions of Employment Act (Republic of South Africa, 1997).
- Concerns over not being able to find the best person for the job from a „reduced pool’, especially because the residential areas around the business are very expensive and the staff cannot afford to live there.
- Carbon dioxide emissions and Climate Change were occasionally expressed as important, but it was also stated that they are not currently important enough for employers to change business behaviour.
- The highest cost to have access to the largest catchment size (100% of their current catchment size) of Level 2 staff was R92 per month, which is very little in relation to the salary of R10 000 – R30 000 per month already paid by the employer.

Employers see benefits of employing staff that live closer to the company, but also express serious concerns over the inability to find the correct skills and person for the job in a limited recruitment pool.

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## 5 General Discussion

This chapter discusses the findings in light of the literature and the objectives of this research. It discusses the value of employee catchment size to Cape Town employers, as well as the costs of long staff commuting distances described in the literature seem to affect employers most. Then it explains the implications of these findings on plans for restructuring cities. Finally, the challenges experienced in the conceptual design of the research project, the method and data collection and the analysis are also discussed.

### 5.1 The effect of limiting employee choice for employers

Redesigning cities is a long term solution to the complex problem of dependence on non-renewable resources such as oil and population growth along current urban patterns. This is extremely complex and, if it is to succeed, deep research is needed into the preconditions for and implications of doing this.

Employers are one of the key stakeholders in this process and it is absolutely necessary to understand how they would see the issues of sustainably dealing with population growth and increasing oil price: their fears, their current perceptions and understanding of the problem as well as possible solutions. It will then be possible to consider how to get employers to actively participate in the restructuring process.

The data already shows that employers see access to public transport (i.e. reduced travel costs) as a major advantage to business. As travel costs inevitably rise, the only sustainable way of keeping the cost of getting to work manageable in the future may be to reduce travel distances.

The main **objective** of this research was to begin to understand the cost to employers of limiting their choice in the recruitment of employees. It seeks also to begin to estimate the number of choices “C” that are sufficient for employers to achieve the benefits shown as “B” in Figure 20.

Specifically, the objective of this study was to determine the relationship between benefit to the employer from having greater choice from a large catchment of employees and the size of this catchment (i.e. number of potential employees).

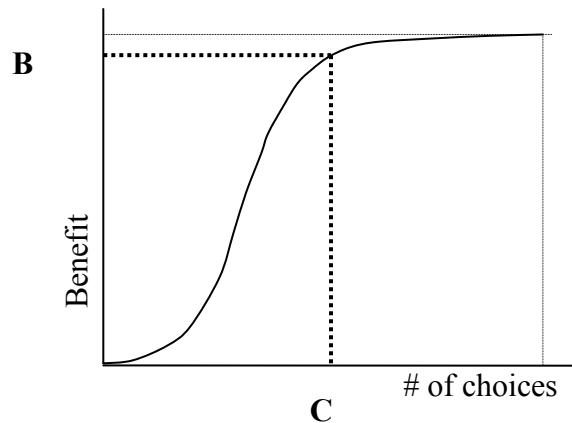


Figure 20 The relationship between benefit to employers and number of choices of potential employees

### 5.1.1 The literature on limiting consumer choice and its relevance for this study

As discussed in Section 2.1., the literature on limiting consumer choice shows that effects are highly dependent on context. Similarly, in this study employers had different perspectives on the implications of limited choice for their companies and for different staff income levels.

In the semi-structured interviews employers often expressed the view that the high costs of commuting were a disadvantage of their firm's current location and that there would be a definite benefit for their company in staff commuting shorter distances.

The interviews also confirmed the conclusions discussed Section 2.2.4., that there are many real costs in the long commuting patterns of current Cape Town residents. As in the literature, the contribution of CO<sub>2</sub> emissions to Climate Change was mentioned, but unlike the literature, the emphasis was on the social costs and benefits rather than environmental.

The social costs to employees and their families or the benefits to employee quality of life from shorter commuting distances were highlighted. Employers expressed many factors presented in the literature such as tiredness and low energy that affects both employee work performance and family life (Aguilera, Wenglenski, & Proulhac, 2009; Mawson et al., 2007; National Planning Commission, 2011).

The evidence from the interviews shows that there is consensus amongst employers that there is incongruence between residence and work location, especially for low income workers who have limited choices of residential locations they can afford. This supported the findings from the review of the literature in Section 2.2.4. (Aguilera, Wenglenski, & Proulhac, 2009; National Planning Commission, 2011; Okamoto, 2007).

### 5.1.2 The value of catchment sizes to Cape Town employers

The utility curves provide evidence that inflection does occur in the employers' perceived value (benefit) of employee catchment size and indicates possible range in which it might occur.

The graphs indicate inflection points that can be described as follows:

- Level 1 data reaches inflection point between 20% and 70% of the current catchment size (Figure 12) and a catchment with a radius between 10km and 25km (Figure 13), after which utility decreases with increasing catchment size.
- Level 2 data reaches an inflection point between 20% and 40% of the current catchment size (Figure 15) and radial distance between 15km and 25km (Figure 16), beyond which the utility will increase but at a lower rate (more gradually).

Probabilities and willingness to pay results also showed evidence of employers preferring a larger pool of potential employees from where they recruit middle income staff than when recruiting low to lower-middle income staff.

Further research into the range might produce a more accurate value of the point of inflection or that this point might vary for different employers as it does for different levels of employees.

### 5.1.3 Implications for city restructuring

The implications of these findings for city restructuring are considerable.

Some employers already see the benefits of employing staff that live closer to the company. The most common benefits to staff were the improvements to the employee quality of life with reduced travel time, less money spent on commuting and more time and energy for quality time with their families.

The most common benefits to business were expressed as:

- A happier and more productive workforce and reduced lateness and absenteeism. These would translate into loyalty from the community.
- Employees that lived closer to work would be more willing to come in after hours for training occasionally and work overtime in emergency situations.
- It would save money for companies already transporting staff after 7pm.
- It would help alleviate problems of transport malfunctions (strikes/delays) because employers would be able to organise transport more easily to fetch the staff.
- Employers also mentioned environmental advantages of reduced emissions, although it is unlikely that this concern would drive behaviour change unless there were serious financial consequences attached to emissions.

However, employers also expressed serious concerns over the inability to find the correct skills and person for the job in a limited recruitment pool. This is mainly a concern because housing close to the centre of the city is expensive and lower to middle income populations cannot afford to live there. As such companies may not have the right income class of people living near them.

Companies also expressed a difficulty in complying with legal equity ratios because of the racial groupings that are very rigid in current suburbs as a result of Apartheid land use policies. Another concern was that it would be unfair or unethical because one would not allow people to make their own choices and then it would further disadvantage people of certain demographics that live far from the city and who are usually poor.

While these are real concerns now, the changes with densification and proactive location of the population growth over the next 25 years will provide opportunities to overcome these concerns. This suggests the creation of sub-cities with mixed skills, races, income levels, economic and recreational activities. This will not reduce the personal freedom of the poor but actually increase their choice because the poor populations will now be able to afford more diverse employment and social opportunities.

#### **5.1.4 The point of “sufficient choice”**

Borrowing the concept of ‘sufficient choice’ from the consumer choice literature, there appears to be a turning point in the satisfaction or benefit to the employers as the benefit stops increasing and begins to decrease (or the rate of increase slows considerably) with an increasing employee catchment pool.

At this stage it is clear that an inflection occurs in the value of employee catchment size to employers and provides a possible range in which it might occur.

For employers recruiting Level 1 staff, this inflection occurs between 20% and 70% of the current recruitment pool (Figure 12) and between 10km and 25km radius (Figure 13). For Level 2 staff, this point of inflection would lie between 20% and 40% of their current recruitment pool (Figure 15) and between 15km and 25km radius (Figure 16).

Further research into the range might produce a more accurate value of the point of inflection or that this point might vary for different employers as it does for different levels of employees.

#### **5.1.5 Existing awareness of the benefits of restricting recruitment choice**

Interviews with representatives of the different companies provided data in support of the central argument of this study, suggesting that employers could easily be persuaded to accept limitations to employee choice if it can be shown to have benefits that outweigh the costs.

One large retail company already recruits from the area close to their stores. The company collects all CVs from potential employees at a centralised Human Resources department. Then the applicants write a basic literacy test and the CVs of those that pass this test are grouped according to the nearest residential suburbs that serve as a catchment for each store. These CVs are then sent to the store manager and they will interview them. Companies 6 and 7 had the shortest travel distances (see Table 14).

As previously described, SA companies legally have to provide transport for staff after 7pm (Republic of South Africa, 1997), so many companies that work extended hours are incentivised to recruit locally or from a similar catchment area. They recognise the increased expense to the company if staff were to live further away from the work place.

For this company, the benefits of employing staff from the surrounding communities are considerable, and include encouraging loyalty and customers from the same area. As a store manager described, families will support the store that employs their family members. As such, he highlights how supporting local communities is beneficial to the business, the employees and the community as a whole, and has been part of company policy for a long time. He also described the problems facing

stores located in upmarket suburbs that cannot find people in the surrounding suburbs willing to work for them. These then have to recruit from further away, but still do this from a catchment of applicants within suburbs that are closest to them.

This company also claims that they train their staff and promote mainly from within, with almost no Level 2 staff being recruited from outside the company. This company was the exception and illustrates well the kind of benefits that flow from a voluntary restriction of the recruitment area.

Another company has green plans and provides free parking for employees who drive a Prius, green buildings, bicycle racks and raised salaries for staff travelling further due to a move in company location. However, actions of this kind, as discussed in Section 2.2.3., do not offer a long term or sustainable solution for a city like Cape Town. These measures apply only to middle to high income staff who buy houses close enough to cycle to work or who can afford a Prius (and thus afford parking costs too). They do not benefit the low to lower-middle income staff who are most vulnerable to the increasing transport costs.

Among companies that have not thought about this, there appears to be a willingness to understand this research. One company admitted to paying very little attention to where staff travel from and showed interest in receiving information from the study. They were interested to know where their staff lived, how far they travelled, how much it cost them and the idea of carbon tax for staff commuting.

## **5.2 Challenges and difficulties**

### **5.2.1 Methodological challenges**

#### ***5.2.1.1 Conceptual difficulties of this research and problems***

It was difficult to define the concept of limiting employer choice as limiting employee catchment size and attach a value to it. The concept behind this research was to find a sustainable solution for an increasing future population. The solution proposed for restructuring the city will only be successful and self-sustaining with densely populated, mixed skilled catchment areas. If the hypothetical situation and the “percentage catchment size” was not fully understood, then employers bring hypothetical bias or existing bias regarding assumptions with the current urban structure and demographics of the suburbs. For example, Cape Town currently has rigid racial and social profiles of the current residential suburbs.

It was difficult to explain to employers that this research was to investigate 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. Employers often struggled to understand this concept after only being exposed to it for the first time when the cover sheet of the questionnaire introduced the concept (even if previously described in email correspondence, etc.). In other words, employers were not familiar with making choices considering CO<sub>2</sub>, additional transport levies, etc. when recruiting. Interviews often required further explanations which could introduce errors in the decisions of employers making decisions without fully understanding the concept.

It was important to be aware but not focus on the other side of the coin: the employees. Often employers would get distracted in thinking from the employees point of view and how it would be

wrong to exclude an employee simply because of where they live. It often had to be explained that this is separate research into how many jobs available at different skills levels, different opportunities, issues of human identity and personal choice, etc. Employers had to be continually reminded to answer from the point of view of a manager of the business and the employer.

Restructuring cities by creating self-sustaining sub-cities within a city, forms the conceptual framework for this research. This stems primarily from a concern for the poor and vulnerable populations of society. It also explores the ability of the high income, managers and economic decision makers of society to influence the shape and future of a city. Their decisions, however, are often not made with concern for the poor populations but rather in their own perceived interests. The research suggests that restructuring like this, in the long term, can benefit the poor and businesses.

## **5.2.2 Survey instrument design and errors**

### **5.2.2.1 Measurement of variables**

The variables of employee catchment size, CO<sub>2</sub> emissions (for Level 1 staff) and for Level 2 staff the variable of financial cost (Carbon Tax) were found to be significant for employer's decisions regarding recruitment. This was more the case for decisions regarding Level 1 employees shown by the good model fit, less so for Level 2 employees.

Perhaps a source of error in this study would be the assumption that employers consider the same variables for Level 1 and Level 2 recruitment decisions. There may be other factors that employers consider when recruiting Level 2 staff. The cost of employment for Level 2 staff may not have been high enough to force a real trade-off for employers. This did arise in interviews, especially with regard to Level 2 employees where an additional R92 per month carbon tax was minimal compared to a R30 000 per month salary the employer was already paying every month.

### **5.2.2.2 Sources of error**

The different types of companies interviewed introduce errors in the data, i.e. wide differences in preference for different skills of their staff. Also, the data received from companies contained errors where some employee details were deleted because some of the correct information was missing.

Errors may also have been introduced in the processing of data for the questionnaires in the calculations for average turnover rates, CO<sub>2</sub> emissions and assumptions regarding Level 1 staff using bus transport and Level 2 staff using private motor vehicles, amongst others.

## **5.2.3 Data collection process**

There were a number of challenges in the data collection process. It was extremely difficult to get interviews with managers of large companies because many did not see the value or relevance of the work for their company. This resulted in an insufficient sample size.

It was difficult, in the time available, to get enough interviews to add weight to the conclusions in this study.

## 5.2.4 Results and Analysis

Numerous iterations of the model were tried to find one that would best explain the data. This involved:

1. MNL analysis tools.
2. Separating data into decisions regarding Level 1 and Level 2 employees.
3. Incorporating dummy variables for different aspects of the decision making process, such as catchment size, urgency of the recruitment decision and whether the company is a highly skilled company or not.

The goodness of fit of the models to estimate employer utility for Level 1 employees was very good, but the model describing Level 2 employees was not as good.

### 5.2.4.1 Differences between companies

Generalising across diverse companies with diverse employee needs is problematic. In reality catchment sizes will be different for different types of workers and skills. However, the average values used were suitable for the purpose of this study, to determine the costs to employers of limiting catchment sizes and to gather information to be used in the calculations for the approximate size of sub-cities.

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## 6 Conclusions and Recommendations

### 6.1 Implications for employers of limited employee catchment sizes

This thesis clearly showed that there is an inflection that occurs in employers' perceived value (benefit) of employee catchment size and indicates a possible range at which this inflection occurs. For employers recruiting staff earning between R3 000 – R10 000 per month, this inflection occurs between 20% and 70% of the current recruitment pool and between 10km and 25km radius. For employers considering employment of staff earning from R10 001 – R30 000 per month, this point of inflection would lie between 20% and 40% of their current recruitment pool and between 15km and 25km radius.

These findings are limited to employers of large companies in Cape Town. Expressing the catchment size in population figures allows for geographical densities and differences in income distribution for the different company locations and may have application in other cities as well as Cape Town.

The implications of this for city restructuring are considerable. By understanding the fears and current perceptions of employers it may be possible to consider how to get employers to engage as positive players in the city restructuring process.

Employers also emphasised the importance of public transport to their business, which would imply the importance of affordable access to staff and clients. Currently, public transport is equated to cheap access to staff. In the future this is unlikely, as travel costs inevitably rise, the only way to reduce travel costs will be to reduce travel distances.

Employers already see benefits of employing staff that live closer to the company. The improvements to the employee quality of life would translate into a happier and more productive workforce for the company. Employees would be more willing to come in after hours for training and reduced lateness and absenteeism.

Employers, however, were sceptical of the limited recruitment pool and the fact that many of their staff members cannot afford to live closer to the city and to the company.

Thus for the city restructuring to work as a sustainable solution for the future, the fears of the employers need to be overcome. The racial, economic and educationally separated suburbs need to be densified with proactively located growing population to create sub-cities within the city that contain mixed skills, cultures, income levels, economic and recreational activities. In this context, limiting employee catchment size will be a win-win for environmental, social and economic sustainability.

## 6.2 Sources of error in the study

As in any study there are potential sources of error that need to be acknowledged. These, as discussed in Chapter 5, are:

- A larger sample size would make the data more reliable.
- Presence of hypothetical bias of the current situation or behaviour. Employers were not used to, or familiar with making such choices i.e. considering CO<sub>2</sub>, additional transport levies, etc. when recruiting.
- Time constraints limited the scale and scope of this study. For example, there were limited companies and sectors included in this study.
- Companies were all in central CBD area and industrial southern suburbs, only one company in the northern suburbs and all (except one of the retail stores) were surrounded by high income suburbs.

## 6.3 Recommendations

More studies, with larger samples could improve the statistical significance of this study; and the accuracy of the relationship between catchment size and utility derived by employers could be improved by reducing the range of catchment size in the options offered to respondents.

There are a number of aspects to be investigated in further research to assist this research to become valuable in city restructuring:

- The cost of limiting the choices or personal freedom of employees and how much choice of lifestyles and business is sufficient.
- The patterns of business agglomeration that is beneficial for economic self-sustainability of the sub-cities, i.e. the number of business required to be grouped within the sub-city to make it self-sustaining.
- The residential densities and population sizes that would sustain the economic sector of the sub-city and minimal/no travel between the sub-cities.

Policies to promote companies to recruit employees closer to work locations would support the current spatial strategies of planned urban growth and densification along corridors and strategic nodes, mixed land-use and mixed income neighbourhoods.

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## APPENDICES

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