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THE IMPACT OF SUBSIDIES, PRICING AND MARKET STRUCTURE ON AFFORDABILITY AND REDISTRIBUTION:

The Case of Cape Town Road Public Transport

By

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Abstract

In an industry plagued by underinvestment and unrest, the emergence of the publicly financed MyCiTi Bus Rapid Transit system has structurally altered the market structure of Cape Town road public transport. Due to the heavy dependence of its rollout on subsidised operating support, and the geographies it has targeted, the distribution of subsidy benefits between households in the city has changed. In this context, this investigation looks to address the question: "Is Cape Town's road public transport affordable, and is subsidised operating support well targeted at poor households?"

To do so, the paper evaluates the impact of the industry transition on transport affordability and subsidy distribution with the use of a best practice systematic framework. Revealed in the affordability analysis is that Cape Town road public transport remains unaffordable for the lower quartile of the household income distribution – a finding exacerbated by Cape Town's racial economic geographies. On top of this, distribution analysis shows the significant and regressive impact of the industry transition on the distributional consequences of Cape Town road public transport subsidisation.

The central premise of this paper is that this evidence warrants the need to investigate alternative subsidy frameworks. Framed by Cape Town's underlying mobility needs and road public transport market structure, this paper designs and simulates the distributional consequences of an alternative subsidy. The simulation reveals that the regressive impact of the transition can be controlled, and the overall distribution improved, by deriving the subsidy framework by a set of demand-side variables. Rather than being viewed as the complete solution, the paper concludes that this simulation signals the need for follow-up research to validate the findings, and to explore the political and operational feasibility of a demand-side subsidy orientation more thoroughly.

Martin Eichhorn

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Abbreviations

ANC – African National Congress

BEE – Black Economic Empowerment

BRT – Bus Rapid Transit

CATA – Cape Amalgamated Taxi Association

CDS - Carruthers, Dick and Sauker

CoCT – City of Cape Town

CODETA - Congress for Democratic Taxi Associations

COSATU – Congress of South African Trade Unions

DORA – Division of Revenue Act

DoT – National Department of Transport

Gabs – Golden Arrow Bus Services

HCI – Hosken Consolidated Investments

IRPTN – Integrated Rapid Public Transport Network

IRT – Integrated Rapid Transit

MBT – Mini-Bus Taxi

MDGs – Millenium Development Goals

NMT – Non-Motorised Transport

NTA – National Taxi Alliance

PTISG – Public Transport Infrastructure Support Grant

PTOG – Public Transport Operating Grant

RBC – Relative Benefit Curve

SACTWU – South African Clothing and Textile Workers Union

SB – Standard Busses

TAL – Transport Affordability Line

TRP – Taxi Recapitalisation Plan

UCT – University of Cape Town

VOC – Vehicle Operating Company

Introduction

Road public transport in South Africa has long been associated with issues of complex politics, public underinvestment and social unrest (Dugard, 2001; Browning, 2004; Phakathi, 2013). The successful bid to host the 2010 FIFA World Cup, and the city-level requirements to provide fan transport, however, provided an opportunity to address these. Through changes in the National Land Transport Act in 2009, an Integrated Rapid Transit component to municipal road public transport was formally mandated (Parliament, 2009). Correspondingly, National Treasury prioritised funding by increasing the Public Transport Infrastructure and Systems Grant (City of Cape Town, 2012). In Cape Town, the process of modernising the road public transport system comprised the development of MyCiTi - a new mode based on the Bus Rapid Transit model.

Since its conception in 1948, the road public transport subsidy has not evolved from its form as a supply-side operating grant (Golding, 2012; SA Cities Network, 2006). Historically, the provision of transport subsidies was motivated on two grounds: to reduce the high transport costs caused by long travel distances to and from work as a result of spatial apartheid policies; and to make urban transport more affordable (DoT, 2006; as cited in Dawood & Mokonyama, 2015). Despite increased expenditure on public transport subsidies year on year, however, benefits to the public have failed to accrue proportionately (Dawood & Mokonyama, 2015). The process of integrating and funding Rapid Transit components, therefore, has distorted what was a fragmented public transport subsidy framework already by structurally altering the operating environment in which the major service providers compete (CoCT, 2013a; Dawood & Mokonyama, 2015).

In Cape Town, the industry transition to accommodate the MyCiTi BRT is affecting the way the subsidy impacts system affordability and distributes between households across the city. There is therefore a need to answer the question: “Is Cape Town’s road public transport affordable, and is subsidised operating support well targeted at poor households?” If the answer to this is “no”, there is a need to reconsider the way the road public transport subsidy is designed and distributed.

The link between poverty, mobility, public transport, and subsidisation is receiving increasing global attention, with emphasis placed on the importance of subsidy distribution mechanisms to the development impact of public transport (AU & UNECA, 2005; DFID, 2002; IFAD, 2003; Holm-Hadulla, 2005; Liu, 2001; Estupinan, et al., 2007). This paper presents a comprehensive contextual investigation of Cape Town road public transport, and analyses the impact of the industry transition on system efficiency, transport affordability and subsidy distribution. Harnessing these findings, the paper suggests that the current transport subsidy is no longer able to achieve its objectives, and that this warrants the need to investigate alternative subsidy frameworks for the city.

Chapter 1 makes use of a prominent benchmark paper to establish the research methodology of this investigation. By doing so, the chapter concretises the four key components of the approach: justifying the contextual need for public transport subsidisation, understanding public transport subsidy instruments, outlining an appropriate toolset for affordability and distribution analysis, and developing a comprehensive understanding of the socioeconomic and operational context. As a result, the benchmark paper is embedded in the structure of this chapter. The benchmark paper is a World Bank publication (2007), authored by Nicolas Estupinan, Andres Gomez-Lobo, Ramon Munoz-Raskin and Tomas Serebrisky, and titled “Affordability and Subsidies in Public Transport: What Do We Mean, What Can Be Done?”

Chapter 2 delves into the contextual analysis of Cape Town's socioeconomic and spatial development. It seeks to confirm the city's post-Apartheid fragmentations, paying particular attention to correlations of income, race, area and unemployment. It reveals these fragmentations to be causally related to the inefficiencies of road public transport provision today, and in turn, suggests the need to incorporate these considerations into the process of subsidy design. Furthermore, the presence of comprehensive, expanding social welfare infrastructure lends itself to the inclusion of means-tested instruments.

In light of these findings, Chapter 3 investigates how this influenced the operational context in which Cape Town's road-based public transport sector has developed. It unpacks the story and circumstance of the sector's growth, and reveals the set of critical events that catalysed its evolution into what we see today. The chapter also tracks the development of the road public transport operational subsidy, in all of its forms, and investigates its appropriation across modes.

Chapter 4 measures the impact of the industry transition on system efficiency, transport affordability, and subsidy distribution. This analysis reveals the regressive impact the initial rollout phases of the MyCiTi BRT have had on the overall subsidy distribution, and that its absorption of subsidised operating support is the least efficient of all modes. Furthermore, the affordability analysis reveals that despite the existence of the subsidy, system affordability continues to be a problem for a significant segment of Cape Town households. These findings are used to motivate the need to explore the feasibility of alternative subsidy frameworks in the city.

With this established, Chapter 5 designs and simulates the distributional consequences that an alternative subsidy might have - were it to be augmented by demand-side variables. The alternative design comprises a function of geographical and means-tested demand-side variables, and the simulation reveals that this shift has the potential to control for the observed regressive impact of the industry transition. Bearing in mind these insights, the paper recommends the need for follow-up research to explore the political and operational feasibility of a demand-side subsidy orientation more thoroughly.

Chapter 1: An Exploration of Transport Subsidies, and their Design

As a starting point, this investigation outlines a systematic framework for transport affordability and subsidy distribution analysis developed by four prominent World Bank economists. Broadly, the benchmark paper addresses four key components for analysis: one, understanding the relationship between affordability, efficiency and subsidies; two, understanding the range of public transport subsidy instruments; three, building an appropriate quantitative toolset for analysis; and four, the need for socioeconomic and operational context to inform all stages of subsidy design. In the interests of consistency and rigour, the systematic framework forms the base of this chapter. The chapter then expands on this base by reviewing other relevant literature, collectively developing the literature review for the paper.

Section 1 presents the two arguments for public transport subsidisation, Section 2 builds and expands the Estupinan, et al. transport subsidies typology and Section 3 details the quantitative toolset for affordability and distribution analysis, and the policy choices that derive each framework. This section, therefore, maps out the direction for the investigation that follows. It places particular emphasis on the importance of using contextual socioeconomic and developmental factors to inform analysis at all stages of the investigative process.

Section 1: Market Failure, Affordability and Subsidies

The first step in justifying transport subsidisation is to unpack the two divergent theoretical arguments of subsidy design: that of allocative efficiency, and that of social redistribution (Estupinan, et al., 2007).

1.1 The Allocative Efficiency Argument

The vast majority of literature in the field of transport policy focusses on justifying the use of public transport subsidies on the grounds of achieving optimal (or least sub-optimal) allocative efficiency, and through understanding the linkages between transport improvement, economic growth and poverty reduction (Liu, 2001). Allocative efficiency is chiefly motivated through the function of reducing fares to levels that are below that dictated by service costs, and making it a viable alternative to the increasing costs of the private car (ECORYS and NEA, 2004). Traditionally, approaches to transport planning in South Africa are vehicle centric, seeking primarily to facilitate the efficient movement of vehicles given the budgetary and revenue constraints that already exist (Bickford, 2013). Estupinan et al. (2007) separate the economic allocative efficiency argument into two categories.

The first of these is the **under-pricing of alternative travel modes** (Estupinan, et al., 2007). The idea is to offset the asymmetrical consumption of public goods by alternative modes of transport through the corrective use of subsidies. As average incomes grow and car ownership increases, the patronage, financial viability, quality and quantity of public transport diminishes (Carruthers, Dick & Sauker, 2005). Further, the absence of adequate congestion pricing for road use, will often lead to local investment aimed at bottleneck elimination, and this will almost certainly benefit the relatively wealthy at the expense of the poor (Carruthers, Dick & Sauker, 2005). Theoretically, users of alternative transport modes do not absorb the full costs that their transit consumption choices impose on society (Estupinan, et al., 2007). Therefore, they receive an implicit subsidy to do so. In addition, it is usually the case that significant subsidies are provided for the construction and maintenance of roads and highways – implying an explicit subsidy to private road users too (Freemark, 2011). By subsidising public transport, resource allocation between alternative transport modes is improved through the under-pricing of fares, and thus functions to balance the share of benefit (Freemark, 2011). Subsidies in place to achieve allocative efficiency range widely due to variances in operating environments. For example, they range between 50-80% of average operating costs in Los-Angeles and Washington, to 100% in London (Estupinan, et al., 2007).

The second explanation of the allocative efficiency argument centres on **scale economies and user costs** (Estupinan, et al., 2007). This is based on the concept of the "Mohring Effect", identified by Mohring (1972), which is based on the assumption that trip-costs are a combination of both the price paid for the chosen mode, and the time-cost to the user. This concept underlies subsidisation efforts to avoid the urge to plan transport systems around maximising fare revenue. Rather, recognizing that transport is a function of user costs provides an argument to increase supply in areas not necessarily deemed the most lucrative in terms of fare collection (Buehler & Pucher, 2011). Essentially, growth in supply translates into reduced waiting time for all passengers (Estupinan, et al., 2007). However, the marginal cost of each additional unit supplied is not operationally justified by the higher value creation: the total reduction in user costs (Estupinan, et al., 2007). As such, the marginal social benefit of an additional unit of supply exceeds the marginal private benefit of doing so, meaning that the socially optimal level of supply requires a subsidy to be achieved (Estupinan, et al., 2007).

1.2 The Social Redistribution Argument

In developing regions, arguments of social redistribution justify subsidisation on the grounds of making public transport more affordable for vulnerable and poor groups (Cropper & Bhattacharya, 2012). Rather than ignoring the diverse issues of developing regions, the social redistribution argument incorporates these as fundamental components of design. The argument starts by recognising the importance of transport – being a derived demand – as a complementary input to the consumption of other social benefits such as education, health services and job opportunities (Freemark, 2011; Estupinan, et al., 2007; Liu, 2001). This entails explicit acknowledgement of the complex trade-offs between residential location, travel distance and travel mode (Venter, 2011). In so doing, the argument concretely aligns the transport subsidy with the pro-poor objectives of the development agenda (AU & UNECA, 2005).

Importantly, however, recognising that transport is important to the poor and marginalised of society is not a sufficient reason for a transport specific subsidy (Estupinan, et al., 2007). Indeed, the list of socially important amenities is long, and each of these could be promoted with the same argument. Transport-specific subsidisation needs to trigger one or more of the following preconditions. Firstly, mobility and affordability needs to be a pressing development issue (Carruthers, Dick & Sauker, 2005). The characteristics of a region can dictate the marginalisation of the poor to a point where it translates into systematic economic exclusion. In such cases, transport will form a critical component of the solution (Estupinan, et al., 2007). Secondly, in areas of high inequality, a progressive transport policy can form an important component of economic redistribution (Maureen & Soma, 2012; Estupinan, et al., 2007).

Section 2: The Transport Subsidy Spectrum: Options and Choices

This section explores various policy instruments for transport subsidy distribution, and identifies how they should be categorised and prioritised in different situations.

2.1 A Typology of Transport Subsidies

This section utilises the subsidy typology framed by the Estupinan et al. benchmark paper, unpacks the three dimensions by which they are classified, and provides examples of their global use in developing contexts. Specifically, they are functions of who the financial transfer targets, the channel through which it is distributed, and the sources that derive its funding (Estupinan, et al., 2007).

2.1.1 Subsidy Classifications

2.1.1.1 Demand-side vs Supply-side Subsidies

Essentially, the transport subsidy can be tailored for one of two sides: that of the service provider (supply-side) and that of the commuter (demand-side) (Maureen & Soma, 2012; Estupinan, et al., 2007; Rebelo, Barone & Vianna, 2010). Importantly, the final goal of both types of subsidy is to benefit the users. In the case of supply-side subsidies, the subsidy plays a balancing role by offering operating and capital support and by reducing the cost-recovery pressures placed on fares. In the case of demand-side subsidies, the primary concern is to correct for asymmetrical distribution across the user base.

2.1.1.2 Distribution Channel

Demand- and supply-side subsidies are further classified by distribution channel, and the degree to which they target specific population groups. Generally, supply-side subsidies are less targeted in that the transfers seldom carry conditional performance and/or service targets, and are considered to be regressive or neutral as a result (Cropper & Bhattacharya, 2012). However, by incorporating such controls, supply-side subsidies can be targeted to some degree.

On the other hand, demand-side subsidies are defined by their targeting mechanism (Estupinan, et al., 2007). Broadly, they are distributed to target groups in four distinct ways (Estupinan, et al., 2007). Firstly, they can utilise some type of welfare instrument to determine the socioeconomic conditions that qualify benefit. Secondly, they can target certain categorical groups such as students, the disabled, pensioners, etc. through concessional schemes. Thirdly, they can utilise self-selection mechanisms through operating concurrent services of differing quality and price. Finally, the subsidy can target specific geographic regions.

2.1.1.3 Funding sources

Finally, subsidies are classified by their source of funding. Typically, they are funded by combinations of direct and indirect general taxation, specific taxes such as local taxation, and cross-subsidies (Estupinan, et al., 2007). Whilst general and specific taxes are non-discriminatory, cross-subsidisation occurs when the revenue of some routes are used to subsidise others.

2.1.2 Subsidy options

2.1.2.1 Unconditional Operating and Capital Subsidies

Unconditional subsidies occur when subsidies transfer to operators in the absence of conditional performance requirements. This usually transpires when public transport companies operate on the assumption of systematic operating loss, and government transfer covers the annual deficit (Estupinan, et al., 2007). Blanket subsidisation in this form means that all routes are subsidised, irrespective of their need or design quality. Covering the losses of all routes mean that the system does not evolve to improve its underperforming components (Freemark, 2011).

When available in an unconditional form, Pucher et al. show that subsidies can have a negative impact on the productivity and costs of transit systems. Subsidy impact studies reveal that the direct benefit of increasing subsidies on users is often small relative to the magnitude of the increase (Pucher, et al., 1983). This is in a large part due to non-conditionality of funding, with Pucher, et al. noting that no federal or local subsidy programme in the US had made funding contingent on performance standards, productivity growth, cost targets, ridership targets or the achievement social, economic and environmental goals (Pucher, et al., 1983). Unconditional transfers are considered the least targeted subsidy instrument.

2.1.2.2 Infrastructure Grants

Government-funded Infrastructure grants are a common way of shifting the pressures of these investments away from the user, and in turn function as an implicit subsidy (Gomez-Lobo, 2007). However, as these types of subsidies do not discriminate between beneficiaries, they tend to be less targeted, and are thus not effective mechanisms to target specific socio-economic groups (Estupinan, et al., 2007). Gomez-Lobo (2007) highlights the difficulty in netting the benefits of public infrastructural due to inherent spillovers across different road and user groups. In the case of Chile, he finds that unless infrastructural investments target specific operators or areas, it is difficult to make inferences about relative benefit (Gomez-Lobo, 2007).

Therefore, unless funded infrastructure is particularly useful to the poor (projects focussed on pro-poor access such as NMT infrastructure), the risk of leakages to non-targeted higher and middle-income class users is high (Estupinan, et al., 2007). Unless they are found to play an important role in correcting for market imperfection, these subsidies are likely to be neutral to regressive.

2.1.2.3 Conditional Direct Operating Subsidy

Conditional Direct Operating Subsidies are the most common form of supply-side transfer, and often exist where the assumption of operational inefficiency is considered a service prerequisite (Bickford, 2013). Conditionality is contingent on deliverables ranging from performance targets such as passenger numbers, scheduling targets, safety, and kilometres travelled, to economic targets such as productivity growth or cost containment, to environmental and socioeconomic targets (Estupinan, et al., 2007).

Even though Conditional Direct Operating Subsidies are better at encouraging system efficiency than the unconditional alternative, it remains difficult to target them effectively within an evolving, developing context. When they are found to be progressive, as has been the case with the Cape Town road transport subsidy historically, it is often a consequence of demand characteristics rather than a strength of instrumentation. Further, the forgone subsidisation of an inefficient service curtails its improvement, and prevents a service from being responsive to context (Freemark, 2011).

2.1.2.4 Implicit Operating Subsidy

Fuel Tax Rebate schemes are a prominent example of an implicit operating subsidy. The benchmark paper highlights the UK's implementation of the Fuel Duty Rebate (FDR), which refunds around 80% of the taxes an operator pays on fuel (Estupinan, et al., 2007). Whilst this might encourage increased supply, it is not conditioned on specific performance targets. Another example is the case of Santiago, Chile, where the differential tax on diesel and gasoline was distorted (11% and 35% respectively), with the view to alter the inherent costs of modal transit (Gomez-Lobo, 2007). Despite this easing the operating cost of bus operators, it also benefited other diesel users, such as the trucking industry, industrial users of diesel, and users of diesel private cars (Gomez-Lobo, 2007). As a result, only a small proportion of the implicit subsidy accrued to transport users.

Because of the linear relationship between the cost of fuel and the rebate, the rebate acts as a discount, and as a result, bus operators are not incentivised to exceed the original supply equilibrium. When designed as an implicit benefit, it is very difficult to ensure that the subsidy will accrue directly to target groups. Furthermore, these subsidies bear zero relation to income or poverty, and essentially function as an unconditional grant (Estupinan, et al., 2007).

2.1.2.5 Means-tested transfer

Means-tested transfers are considered one of the better-targeted subsidy schemes. Beneficiaries of this transfer are generally those already receiving some kind of welfare payment. The eligibility to benefit is evaluated by some pre-existing means-testing instrument, ensuring that recipients are those households that have already been identified as the most in need (Estupinan, et al., 2007).

This transfer can take the form of an unconditional cash transfer, or can be tailored towards the consumption of public transport. New Zealand’s Transition to Work Grant, for example, subsidises various costs of job-search, including travel. This grant assesses applicants on a case-by-case basis, and functions as an unconditional cash-transfer that allows the recipient to allocate between transport and other needs (MSD, 2014). Rankin (2013) notes that the concept of using welfare instruments to facilitate job search has been tied to reducing the up-front costs of travel. Eligibility is a critical concern, as it is difficult to discern an individual’s status of unemployment. Rather, he suggests following the lead of other countries by introducing a monitoring programme that requires proof of the desire to search for employment (Rankin, 2013) by registering with temporary placement agencies or participating in selection procedures, for example. Linking job-search assistance to transport would both reduce the costs of actively seeking work, and increase the responsiveness of job-seekers to work opportunities (Rankin, 2013). The ultimate goal would be for recipients to use the grant to facilitate their inclusion into the mainstream economy, thus reducing their long-term reliance on welfare.

Success of means-tested transfers, however, is very much dependant on the existence of appropriate social welfare infrastructure. For example, a study on the feasibility of demand-side public transport subsidies in Mumbai, India, concluded that transport-related transfers could be ruled out on practical grounds, as no system of cash transfers to the poor existed. As a result, implementation would carry additional set-up costs (Cropper & Bhattacharya, 2012).

Due to the varying nature of welfare grants – for example: pension, disability, child support, etc. – the nature of the transfer can be tailored to a specific group. The unemployed might need transport to access job opportunities, whilst single mothers might need transport to access healthcare clinics. Thus, while its success is conditional on existing infrastructure, means-tested transfers have the potential to target well.

2.1.2.6 Concessionary Fares

Concessionary fares apply to special category passengers deemed to warrant the need of reduced fares. Concessionary fares are prevalent across both developed regions, such as the UK and Australia, and developing regions, such as Mexico City (Estupinan, et al., 2007). In South Africa, Golden Arrow Bus Services offers concessional tickets to pensioners, scholar and the disabled through the sale of discounted trip-bundles.

Despite being an effective way of targeting these specific groups, concessionary fares are only progressive if the targeted groups represent those population segments most in need of transport subsidisation.

2.1.2.7 Transport Vouchers

The transport voucher has the ability to generate a progressive self-selection of beneficiaries. The "Vale Transport Scheme" introduced in Brazil, 1985, operates through the remuneration process (Estupinan, et al., 2007). Employers retain 6% of the formal worker's earnings in exchange for transport vouchers that cover the monthly home to work and return journeys of each worker. Simultaneously, the employer buys the requisite transport vouchers from a selling agency, transport operators accept these vouchers as payment from commuters, and providers trade them back to the issuing agency for money (Estupinan, et al., 2007). In return, firm resources spent on transport vouchers are tax deductible – meaning that general tax revenues (Estupinan, et al., 2007) can fund a significant portion (35% in the Vale Scheme).

The self-selection mechanism operates through the ability of individuals to opt out. If an individual spends more than 6% of his income on transport, he is likely to remain in the system. Conversely, if he spends less, it is in his interest to opt out. Thus, the system can effectively target formal workers of a certain relative income threshold (Estupinan, et al., 2007).

Transport vouchers are particularly effective in cases where unemployment is low, welfare of the poor is a concern, and the increased consumption of transport is considered key to the solution (Cropper & Bhattacharya, 2012). However, because the system structurally excludes the unemployed and informal sectors, errors of exclusion and inclusion in high-unemployment regions with large informal sectors will be high. In such cases, it would need to operate in tandem with other instruments that that target excluded groups.

2.1.2.8 Quality Self-Selection

Quality Self-Selection exists through the interaction between coexisting transport modes of differing service quality. This occurs when a lower quality subsidised service operates alongside a higher quality non-subsidised (or relatively less-subsidised) service. Theoretically, this allows users to opt into the service that most closely aligns to their personal preferences (Estupinan, et al., 2007). When price is the most important determinant of modal choice, as would be the case for poorer users, the cheaper, lower quality service is used. Users more concerned by aspects such as comfort will opt for the higher quality service, and so forth (Estupinan, et al., 2007). This is similar to the case of Cape Town where the Minibus Taxi industry, Golden Arrow and MyCiTi BRT all provide alternative levels of safety, price, flexibility and comfort. The difference, however, is that MyCiTi pegs its fares to the other two, meaning that it loses the "opt in" characteristic of quality self-selection.

One problem with quality self-selection is the requirement for modal disintegration. As the case of the Sao Paulo Metropolitan Region's integrated modal tariffs shows, integrating modes is also an effective way of targeting benefits towards the low-income population (Rebelo, Barone & Vianna, 2010). Thus, the question is one of whether the cost/benefit of integration exceeds the cost/benefit of disintegration.

2.1.2.9 Flat Fare Structure

Subsidisation using a Flat Fare Structure harnesses cross-subsidies. Essentially, flat tariffs are charged for every trip, irrespective of the distance travelled or time of day. In so doing, short commutes are relatively more expensive than long commutes. This can be effective when poorer households have the furthest to travel, and when work and return destinations are highly nodal (Estupinan, et al., 2007).

In Mexico, for example, all transport modes (with the exception of private minibuses) operate on a flat tariff system. This includes the metro, trolley busses, state-owned busses, and the new BRT network (Flynn, 2007). Whilst this system does not discriminate by income, it achieves a progressive distribution through the skewed consumption of long-distance trips by poor households. This technique is especially progressive when short commutes are simultaneously dominated by higher-income groups (Maunganidze, 2011). Maunganidze (2011) notes that this could be particular suited to the development context of Cape Town.

2.2 The Transport Subsidy Choice

As has been shown to be the case empirically, designing a targeted pro-poor subsidy presents contextual challenges. It is often the case that the option that generates the least externalities proves the most appropriate. A discussion of the choice between subsidies highlights the importance of informing policy choice with in-depth contextual analysis. The benchmark paper categorises these choices into four broad considerations: selecting the most appropriate targeting properties, inducing productive efficiency, diversifying funding risk, and controlling administrative costs (Estupinan, et al., 2007). The investigation of alternative subsidy designs for the Cape Town context will utilize these four categories in analysis.

Section 3: Quantitative Tools for Affordability and Distribution Analysis

The Estupinan, et al. systematic framework provides a quantitative toolset designed to measure affordability and distributional incidence of transport subsidies. This section unpacks the concept and measurement of affordability, and seeks to address some of the shortcomings to the traditional measure. It then outlines the techniques this paper employs to measure the distributional consequence of various subsidy iterations.

3.1 Understanding Affordability

3.1.1 The Affordability Index

The question of affordability is directly relevant to policy makers in that price determination linearly relates to a system's subsidisation needs (Venter, 2011). The Affordability Index is one of the most commonly used measures to capture the affordability of a transport system. Despite its name, it is not necessarily an index, but rather a measure of the percentage of individuals or households within a given population, who spend more than a specified proportion of their income on transport. The index involves calculating the percentage monthly income attributed to transport consumption by households (Estupinan, et al., 2007). This percentage is then compared to some predetermined benchmark level of what is considered affordable. The Affordability Index then indicates the percentage of households that spend in excess of this benchmark. If the index reveals household transport expenditure to be proportionately high, there is an affordability issue with public transport.

This acceptable benchmark level can vary by region. For example, in the 1996 White Paper on National Transport Policy, the South African government established a 10% of policy benchmark; Gomide, Leite and Rebelo (2004) use a 6% policy benchmark in Brazil; and Armstrong-Wright and Thiriez (1987) established the most commonly used benchmark of 10%, or 15% when more than 10% of households spend in excess of this (Estupinan, et al., 2007; Venter & Behrens, 2005).

Formally, the affordability index is defined as:

$$Aff_1 = \frac{\sum_{i=1}^{N} x_i\,(p_i, y).p}{y}$$

Where, $x_i(p_i, y)$ is the number of monthly public transport trips taken by household member i, y is household income (or expenditure, depending on the methodology), and p is the average price of each trip (Estupinan, et al., 2007). The numerator calculates the total household expenditure on transport, which when divided by household income, produces the percentage of household income spent on transport for that household. In summation across all households, the Affordability Index calculates the percentage of households within a population spending more of their income on transportation than the predetermined benchmark.

The index can represent an entire population or a specific segment – for example, the South African DoT calculated in 1992 that 43% of Black African's spent in excess of the 10% benchmark on transport, while at the mean, Black African's spend 11% of their disposable incomes on transport (Venter & Behrens, 2005). If the mean calculation exceeds the affordability benchmark – as it did for the Black African population group in 1992, transport has an affordability issue. The Affordability Index reveals the severity of this issue, and can vary widely across differently shaped income distributions.

Despite its widespread use, however, the index carries inherent weaknesses. The main one of these is that the index can lead to misinterpretation of the transport consumption behaviour of the poorest citizens (Mitric and Carruthers, 2005). Venter and Behrens (2005) note that measuring affordable transport as a percentage of expenditure fails to account for systematic variance with household location or income (Venter & Behrens, 2005). Further, low-income groups priced out of transport would elicit an acceptable affordability statistic due to their low transport expenditure. In reality, this is more an indication of reduced transport consumption than of affordable transport (Estupinan, et al., 2007). The index fails to attribute any shadow cost to quantify the non-monetary transport costs faced by the poor, and thus underestimates their expenditure on transport (Estupinan, et al., 2007). However, despite these specific weaknesses, Venter (2011) suggest that overall, transport expenditure increases strongly with income, but as income increases, transport costs consume a lower proportion (Venter, 2011). While the indicator is still useful, its weaknesses render it limited.

3.1.2 An Alternative "Synthesized Data" Approach

In recognition of these shortcomings, Mitric and Caruthers (2005) suggested an alternative approach. The suggestion was to "synthesize" data on fares and trip-bundles by applying assumptions about household type and travel scenarios. A scenario is to postulate a 4-member household, with one or both adults employed and one child making a school-related trip beyond walking distance (Mitric and Carruthers, 2005). Fare expenditures are estimated for trips at average and extensive lengths, say 5 and 10 km, with income data drawn from surveys (Mitric and Carruthers, 2005). Mitric and Carruthers' ideas were formalised by Carruther, Dick and Sauker (2005).

3.1.3 Carruthers, Dick and Sauker (CDS) Affordability Index

Here, Carruthers, Dick and Sauker use an appropriate number of fixed monthly trips to estimate their index. Accordingly, they redefine affordability as:

> *"The ability to make necessary journeys to work, school, health, and other social services, and make visits to family members or urgent other journeys without having to curtail other essential activities."*
>
> (Carruthers, Dick & Sauker, 2005)

Their index operates on a subtle difference to the traditional affordability index by utilising the "synthesized data" approach. It calculates the percentage of monthly household income that is equivalent to the average cost of the monthly trip-bundle a household must consume to fulfil all necessary journeys (Carruthers, Dick & Sauker, 2005).

Formally, the CDS Index is defined as:

$$CDS\ Aff_1 = \frac{\sum_{i=1}^{N} \bar{x}_i\, p}{y}$$

Where, $\bar{x}_i$ is a fixed parameter that indicates the number of monthly 10km trips taken by household member i that satisfies household transport consumption needs (sixty in the author's case, but might vary according to the characteristics of a city or region), p is the average price of each 10km trip, and y is the per capita income (Estupinan, et al., 2007). This calculation is executed for various percentiles of the household income distribution to gain greater insight into the percentage of earnings different households would need to spend on transport were they to fulfil their necessary journeys every month.

Although the measure is better representative of the needs of the poor than the traditional affordability index, an obvious flaw is that it is inflexible to inevitable changes in price that would result from the demand shock of everyone adjusting their monthly transport consumption upwards to 60 trips per month (Estupinan, et al., 2007).

Despite this, the index is more appropriate for measuring affordability within developing, unequal societies, and is an invaluable tool to gauge system dysfunction. Similar to the traditional affordability index, transport expenditure ratios are compared to a predetermined benchmark. In the case of the CDS index, this benchmark is a calculation of the income level that allows affordable consumption of necessary journeys. It then measures the percent of households for which the cost of consuming necessary journeys is unaffordable, across various populations and sub-populations.

The CDS Index is an invaluable tool of initial approximation, and is useful to initiate further research. It also provides a base from which to analyse changing affordability over time. As such, it is excellent for impact analysis in that it can produce a measure of transport affordability before and after policy intervention (Estupinan, et al., 2007). Due to the high levels of poverty and inequality in Cape Town, the CDS index is a more appropriate affordability indicator than the traditional affordability index.

3.2 Measures of Distributional Incidence

This mathematical approach provided by Estupinan, et al. measures the distribution of subsidy benefits across households, compares the distributional consequences of different policies, and measures targeting and leakage.

3.2.1 Relative Benefit Distribution Curve

The Relative Benefit Curve graphs how a subsidy shares across the household income distribution (Estupinan, et al., 2007). It makes it possible to postulate whether a subsidy targets the intended income groups, and provides policy makers a tool to compare the distributional incidence of a variety of different policy interventions graphically.

Formally, the Relative Benefit Distribution Curve is defined as:

$$r(j) = \sum_{h=1}^{j} \frac{S_h}{S} \,.100$$

Where, h denotes the jth ranked household from lowest to highest income, $r(j)$ is the value of the graph at the jth ranked household, S_h is the benefit accruing to household $h,$ and S is the total benefit provided through the subsidy (Estupinan, et al., 2007).

When illustrated graphically onto a 45° line (which indicates neutral distribution), inferences can be made about the distributional impact of the policy. Curves above the 45° line indicate a progressive policy, and curves below a regressive policy. By graphing the curves for various policies on the same axis, the policies can be ranked by their progressivity (Estupinan, et al., 2007).

3.2.2 Quasi-Gini Coefficient

The Quasi-Gini Coefficient is a useful summary statistic for the relative benefit curve as it reduces the distributional incidence of any given policy to a single number (Estupinan, et al., 2007). The closer the coefficient is to -1, the more progressive the policy; and the closer to 1, the more regressive.

Formally, the Quasi-Gini Coefficient is defined as:

$$QGini = \frac{A}{B} \;, \qquad (-1 < QGini < 1)$$

Where, A measures the area between the relative benefit curve and the 45° line, and B is the total area beneath the 45° line. A<0 when the relative benefit curve is above the 45° line, and A>0 if the relative benefit curve is below the 45° line (Estupinan, et al., 2007).

Whilst it is important to note that the Quasi-Gini Coefficient might be a useful tool when ranking different policies, this ranking loses its meaning when two relative benefit curves intersect (Estupinan, et al., 2007). This is because two different policies with entirely different distributional consequences might share an identical value of - generating the same Quasi-Gini Coefficient. As a result, deeper analysis is required wen curves intersect.

3.2.3 The Ω Statistic

The Ω Statistic provides an appropriate tool for this, measuring the degree to which a subsidy framework targets the households it intends to. It measures the percentage of a subsidy accruing to poor households as a proportion of the representation of poor households in the population (Estupinan, et al., 2007). The definition of a "poor household" can vary across countries. For example, if the policy maker decides that only households within the lowest 30% of the income spectrum constitute poor households, then the Ω Statistic will represent the percentage of the total subsidy accruing to this lower 30%. If Ω>1, the subsidy is progressive, and if Ω<1, it is regressive.

Formally, it is defined as:

$$\Omega = \frac{A}{B}$$

Where, A is the % of accumulated benefits as represented by the intersection of the poverty line and the relative benefit curve, and B is the % of accumulated benefits as represented by the intersection of the poverty line and the neutral 45° line (Estupinan, et al., 2007). This "poverty line" can represent any number of important thresholds. For example, if affordability is a primary concern of subsidisation, the line can represent the threshold below which households find road public transport unaffordable. The Ω Statistic would then reveal the ability of the subsidy framework to target these households. Such analysis would be compelling within the Cape Town context.

3.2.4 Errors of Inclusion and Exclusion

The errors of inclusion and exclusion measure the degree to which benefits fail to accrue to the target population (Estupinan, et al., 2007). Errors of inclusion record the percentage of households that receive the benefit, but do not fall within the subsidy's target population. Correspondingly, errors of exclusion record the percentage of the subsidy's target population that fail to receive benefit (Estupinan, et al., 2007).

As with the Ω Statistic, the policy-maker needs to elect a poverty line that divides the population into poor (P) and non-poor (NP) households. Following this, subsidy beneficiaries are then also divided by this line into poor beneficiaries (PB), and non-poor beneficiaries (NPB) (Estupinan, et al., 2007).

Formally, Errors of Inclusion (1) and Exclusion (2) can be defined as:

$$EoI = \frac{NPB}{PB + NPB} \qquad (1)$$

$$EoE = \frac{P - PB}{P} \qquad (2)$$

Chapter 1 Conclusion

Br drawing from a prominent World Bank benchmark paper, this chapter outlines a recognised approach for conducting affordability and distribution analysis within a developing context. By using this paper to develop a systematic framework, it ensures the method is informed by latest academic thinking, and is augmented by qualitative and mathematical rigour. Whilst these are other available techniques (see Dawood and Mokonyama (2015) for an alternative approach to subsidy analysis in public transport), the Estupinan, et al. framework is tailored for the developing context, and is specifically designed to test the central question of this thesis.

The chapter outlines the four components of this analysis. Firstly, the investigation must examine Cape Town's socioeconomic, developmental and operational context. Factors such as geography, inequality, unemployment, history, social welfare, politics, infrastructure, public resources etc., all warrant exploration. Secondly, this context must translate into a need that justifies subsidisation – either through an argument of allocative efficiency or one of social redistribution. Thirdly, in order to improve Cape Town's road public transport subsidy structure, changes must be instrumented by recognised subsidisation policies, that are feasible and viable in the city's context. Lastly, affordability and distribution analysis requires appropriate techniques, of appropriate mathematical rigour. These four components drive the remainder of the paper.

Chapter 2: Structural Marginalisation: Cape Town's Socioeconomic and Developmental Reality

Aspirations for global competitiveness are problematic for cities in the developing world, where poverty is widespread and resources are limited. This is particularly the case in South Africa where apartheid legacies already provide a strong infrastructure of inequality.

(Lemanski, 2007)

Cape Town's mobility and development needs are a function of its socioeconomic and spatial context. To target a transport subsidy effectively in a developing city with unique needs, one needs to have a comprehensive understanding of what these needs are, how they have been changing over time, and how they might manifest in the future. Cape Town's dispersed and segmented spatial structure exacerbates unemployment and social exclusion, undermines economic efficiency, and complicates public service delivery (Sinclair-Smith & Turok, 2012). This chapter aims to explore the structural divisions that segment the city, and examines the relationships between select socioeconomic indicators to form a contextual base for operational, affordability and distribution analysis.

Section 1 focusses on Cape Town's socioeconomic context, highlighting socioeconomic indicators of income inequality, human development and population growth. Section 2 then explores correlates of race, area and income, revealing their importance to questions of affordability and subsidisation. The section also highlights the rapid development and growth of the region's social security infrastructure, and provides a case for the use of welfare instruments to reduce the errors of exclusion of road public transport subsidisation.

The analysis of this section utilizes data from a number of cited sources. The Census2011 data was compiled into a dataset by the author, from two separate sources. The first is the Adrian Frith demographic compilation, taken from the Census 2011 Community Profile Database and the Census 2011 GIS DVD (Frith, 2011), and the second is the 2011 Census Suburbs compilation of the Strategic Development Information and GIS Department (SDI&GIS) of the City of Cape Town, using GIS and aerial photography (SDI&GIS, 2013). Both sources cite 2011 Census data supplied by Statistics South Africa as the primary source.

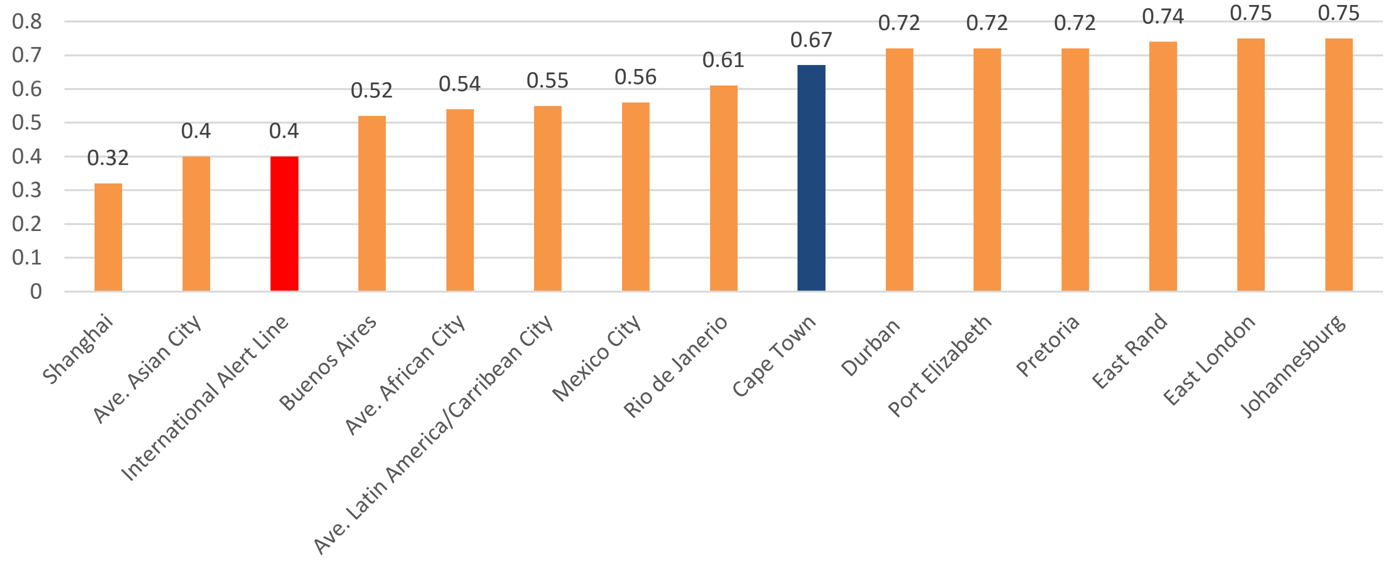
Section 1: Socioeconomic Development in Cape Town

1.1 Income Inequality

The Gini Coefficient is a summary statistic of income inequality, which ranges from 0, in the case of perfect equality, to 1, in the case where one household earns all the income and other households earn nothing (WCGPT, 2011). It is important to note that there is much variance in the technique and data used to calculate Gini Coefficients, and as such, reported coefficients can vary across publications.

Figure 2.1 below compares Cape Town's Gini Coefficient to the major South African cities, as well as other important developing cities and regions. Despite being the most-equal South African city, Cape Town is still highly unequal on a global scale. Further, Cape Town is also highly unequal in context of other major developing centres. Income inequality is also spatially manifest in the city, as many poor communities live on the urban periphery, far from economic opportunity (CoCT, 2013a; De Swart, et al., 2005; Lemanski, 2007; Sinclair-Smith & Turok, 2012). The upper-end of the income spectrum experiences higher income growth, lives in more prosperous areas, benefits from higher private and public investment, and is less likely to be unemployed. This has created something of a poverty trap (De Swart, et al., 2005).

Figure 2.1: Cross-City Gini Coefficients (2009)



*(CoCT, 2013), (Un-Habitat, 2008)

This figure is useful in making cross-city comparisons of Cape Town's inequality. Cape Town's Gini Coefficient is the lowest of the major South African cities, but is still higher than other prominent developing cities such as Shanghai, Buenos Aires, Mexico City and Rio de Janerio. A comparison of the Gini Ratios[1] (Appendix A) show that Cape Town is relatively more unequal than the average developing cities and regions in the world. Furthermore, the Gini Ratio of the International Alert Line[2] is 0.6 of Cape Town's, indicating that Cape Town's inequality is substantially higher than what is considered problematic.

1.2 Human Development Index

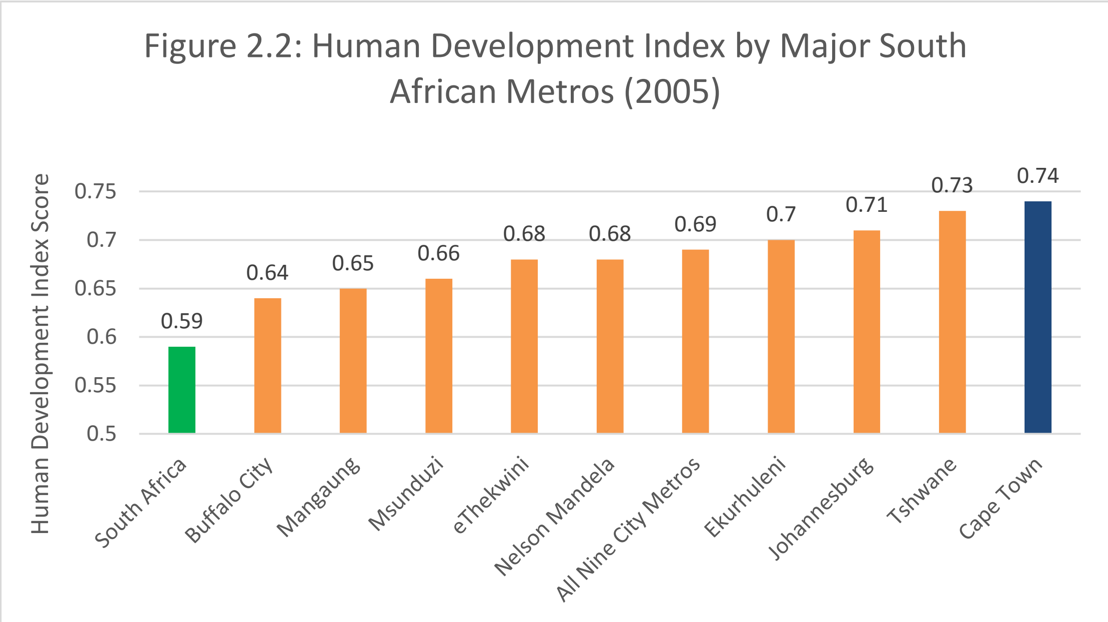
The human development index (HDI) is a composite index of economic and social wellbeing, based on life expectancy, educational attainment and standard of living (SA Cities Network, 2006). The index is measured on a scale of 0 to 1, with 0 being the lowest level of development and 1 the highest. An HDI value of 0.8-1 is regarded a high level of human development; a value of 0.5-0.799 a medium level of

[1] Gini ratios are a comparative statistic with base 0.67 (Cape Town Gini Coefficient) that measures Cape Town's inequality relative to other developing cities and regions. A Gini Ratio > 1, indicates a city more unequal than Cape Town; a Gini Ratio < 1, indicates a city less unequal than Cape Town.

[2] The International Alert Line is a threshold Gini Coefficient, set at 0.4, considered to be the point above which inequality is considered problematically high (Un-Habitat, 2009).

human development; and a value of 0-0.499 a low level of human development (SA Cities Network, 2006).

As depicted in the HDI Ratio table in Appendix A, South Africa is considered a country of medium human development. In 2013, the country's HDI index was measured at 0.658, with its HDI increasing by 0.36% annually since the year 2000 (UNDP, 2014). The figure below illustrates South African city-level HDI estimates.

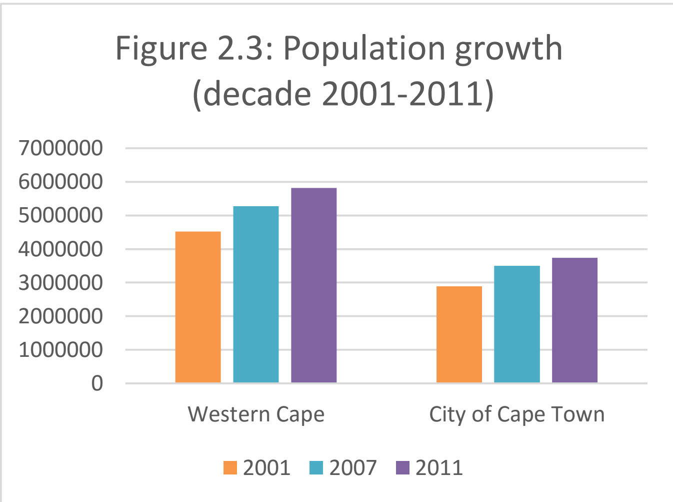


*(SA Cities Network, 2006)

While all South African cities classify as cities of medium levels of human development, they vary notably, ranging from a high of 0.74 in Cape Town to 0.64 for Buffalo City. Only Cape Town, Tshwane, Johannesburg and Ekurhuleni fall above the average within-metro HDI of 0.69. Between 2006 and 2014, however, the level of human development in the country has increased. In studying the HDI indices and ratios depicted by Table B2, South Africa's HDI index has risen to 0.66, positioning itself above the global average.

1.3 Population Growth

Figure 2.3 alongside[3] shows that the City of Cape Town – and the Western Cape overall - has experienced rapid population growth since the end of Apartheid. In the decade 2001 to 2011, the Western Cape grew by 28.7%, whilst the City of Cape Town grew by 29.3%.

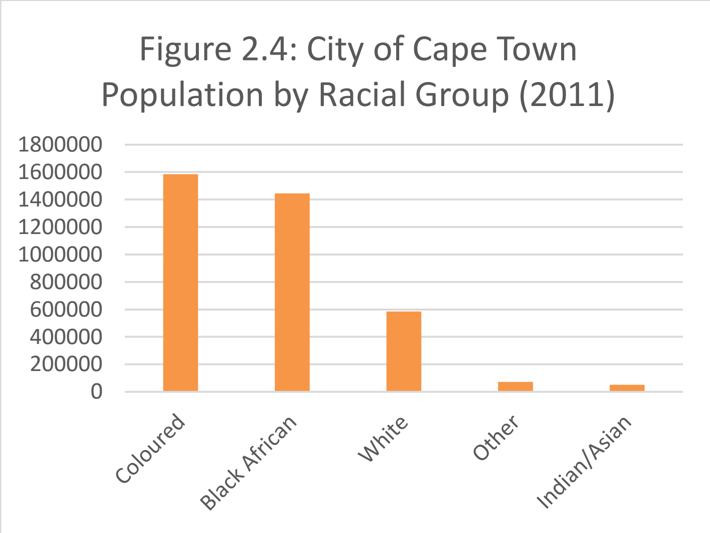


Gross population density, which refers to the number of people living in an area (measured as people per hectare), has also increased. Cape Town has an average

[3] (WCGPT, 2011), Census2011 data

population density of 1529.68/km², with this number fluctuating markedly across its suburban and socioeconomic breakdowns. Part of this phenomenon can be attributed to inward migration from neighbouring provinces. Whilst the population growth rate and urban densification is not necessarily higher than developing country averages over the same period, Cape Town's recent population growth – specifically that in poor, peripheral regions (De Swart, et al., 2005) – has coincided with a sustained period of underinvestment in mobility infrastucture (CoCT, 2009).

When presenting population by race (Figure 2.4 alongside[4]), 42.39% of the population is classified as Coloured, 38.63% is classified as African, and 15.66% is classified as White. Of the remainder, 1.38% are Indian/Asian, and 1.93% is classified as "other". In comparison to other major South African cities, Cape Town has a higher proportion of Coloured citizens, and a lower proportion of African citizens. This comparison of the racial breakdown in other South African cities is depicted in the Table A4, Appendix A.



[4] Census2011 Data, author's calculations

Section 2: Cape Town's Racial Economic Geographies

This subsection draws from Census 2011 data, recompiled into a relevant dataset by the author. For the purposes of this study, household demographic data was reorganised geographically, by dividing the suburbs comprising the CoCT metro into 9 districts. The list of suburbs comprising each district is available in Table A4, and are graphically illustrated in Figure A2, both Appendix A. The 9 districts are summarised in Table 2.1 below.

Table 2.1: Breakdown and Selected Socioeconomic Indicators of Cape Town's 9 Districts

	No. of Suburbs	Population	Population Share (% Total)	Pop density (pop/km²)	Households	Household share (% total)	Household density (pop/hhd)
Atlantic Seaboard	4	30953	0,9%	3450.725	15004	1,5%	2.06
Southern Suburbs	43	333803	9,3%	1914.886	114422	11,1%	2.92
City Bowl	9	35388	1,0%	2590.63	13235	1,3%	2.67
Northern Suburbs	8	266112	7,4%	3162.353	80361	7,8%	3.31
Blaauwberg	22	289977	8,1%	2133.125	96230	9,3%	3.01
Helderberg	6	188028	5,3%	1959.441	60800	5,9%	3.09
Tygerberg	19	747875	20,9%	3527.047	196813	19,1%	3.80
Cape Flats	20	801965	22,4%	5740.623	180238	17,5%	4.45
Eastern African Townships	7	884534	24,7%	7681.581	273654	26,5%	3.23

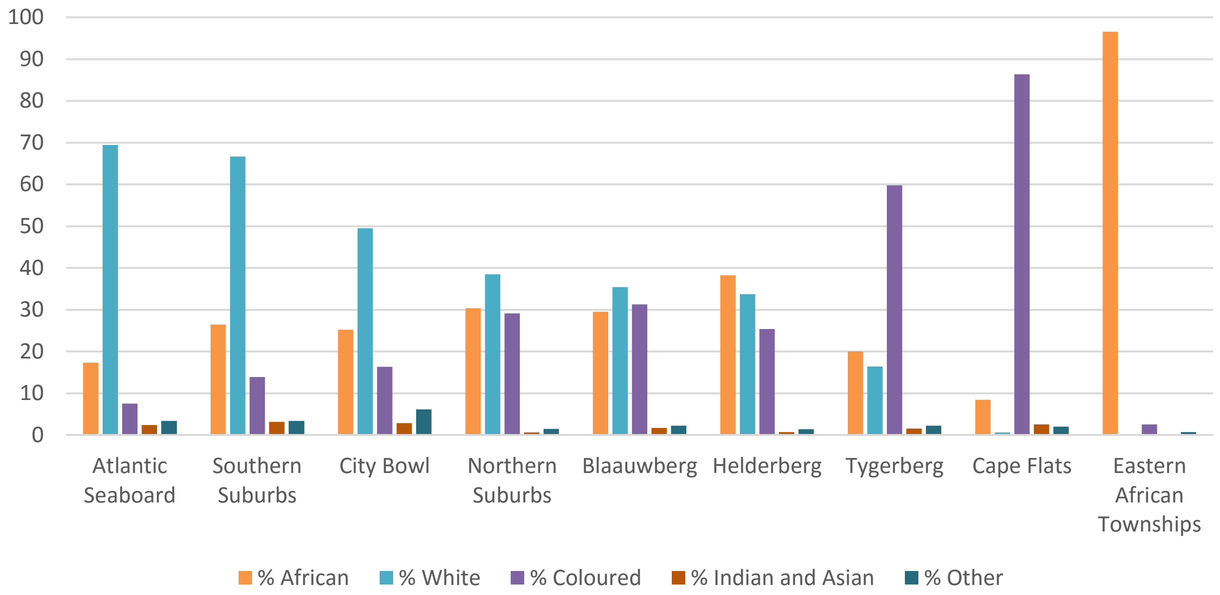
* Census2011 data, author's calculations

The section looks to confirm the impact of asymmetrical post-Apartheid settlement on the structural nature of urban poverty in Cape Town (De Swart, et al., 2005) by examining correlates of income, area and race. The contextual findings suggest the need for these to underpin public transport system and subsidy design.

2.1 Area by Race

The legacy of Apartheid spatial planning still exists today with the majority of the City's suburbs organised by race and income. The graphic below presents the population by race across the metro's 9 districts.

Figure 2.5: Population Split of Cape Town Districts by Race (%)



* Census2011 data, author's calculations

With the exception of the Northern Suburbs, Blaauwberg and Helderberg, the districts are characterised by a dominant racial group. Even these three districts, are racially polarised to an extent. In the Northern Suburbs, for example, the racial split is balanced by racially polarised suburbs. Both Durbanville and Brackenfell's populations are predominantly White, whilst Kraaifontein and Fistantekraal are split evenly between the African and Coloured groups. This is also the case for Blaauwberg and Helderberg.

This trend is also present in the Atlantic Seaboard, the Southern Suburbs and the City Bowl. For example, in the Southern Suburbs the White population group dominates most of the individual suburbs. The presence of contained, "outlier" suburbs – such as Steenberg (predominantly Coloured) and Imizamo Yethu (predominantly African) – skews the perception of how racially polarised the Southern Suburbs district actually is. These "outlier" suburbs are often completely surrounded by suburbs dominated by different racial groups.

2.2 Income by Race

The table below highlights the disaggregated household income brackets by race, according to four significant income brackets.

Table 2.2: Cumulative Density of Household Income, Disaggregated by Race (Western Cape)

	African	Coloured	Indian/Asian	White	Total
Below R1600	77.4%	58.1%	21.7%	12.6%	51.4%
Below R3200	91.6%	81.8%	46.8%	30.2%	71.5%
Below R6400	97.2%	94.5%	73.9%	59.3%	86.6%
Below R12800	99.1%	98.8%	90.0%	82.3%	94.9%

*Census2011 Data, author's calculations

As evidenced, the vast majority of the African (91.6%) and Coloured (81.8%) earn below R3200 per month. This indicates that African and Coloured households are both the poorest and the most populous in the metro. In contrast, 53.2% of Indian/Asian, and 69.8% of White households earn in excess of R3200 per month.

2.3 Area by Income

This section analyses the relationship between income and area. For the purposes of this analysis, the 9 districts have been further broken down into three subsections. Southern Suburbs, City Bowl, Atlantic Seaboard and Northern Suburbs are categorised as "High Income"; Blaauwberg, Helderberg and Tygerberg are categorised as "Middle Income"; and Cape Flats and Eastern African Townships are categorised as "Low Income".

2.3.1 High Income (<70% of population earning above R6400)

The household income distributions for the four High Income districts are displayed in Figure A2. These districts all display income distributions skewed to the right. Under the Apartheid regime, these districts were earmarked for "White" settlement, and as shown in 2.1, are still racially polarised as such. This racial polarisation is strongly correlated with income.

In all four of these districts, over 70% of the earning population earn in excess of R6400 per month. In the Southern Suburbs, Northern Suburbs and the City Bowl, over 40% of households earn in the R12801 – R51200 range, with 42%, 46.8% and 44.1% respectively. In The Atlantic Seaboard, this figure falls to 38.7%.

2.3.2 Middle Income (50%-70% of population earning above R6400)

The household income distributions for the three districts categorised as Middle Income are displayed in Figure A3. The Middle Income districts have a flatter household income distribution. Historically, these were districts of mixed-use, in that large segments of their areas were flagged as industrial processing zones. In other words, they developed according to their land-use, and demanded labour flexibility. This resulted in the districts being more evenly represented by different race and income groups. As is the nature of associated work, these districts developed into nodes of middle-class settlement.

The majority of households in these districts earn above the R6400 per month mark. Blaauwberg is the wealthiest of the three, with 65.8% of households earning in excess of this amount. In contrast, fewer households earn below the R6400 per month mark in Helderberg (45.3%) and Tygerberg (48.1%).

2.3.3 Lower Income (<50% of population earning above R6400)

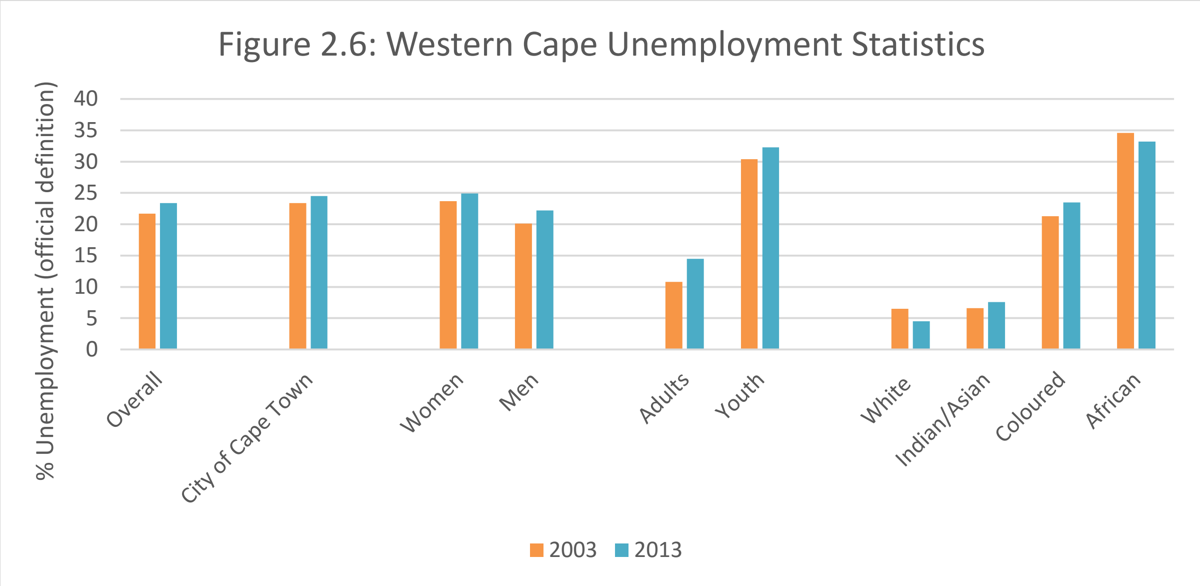
The household income distributions for the two districts categorised as Low Income are displayed in the Figure A4. The reasons that the Cape Flats and Eastern African Townships districts classify as Low Income are contextual. The Cape Flats are a collection of suburbs that were earmarked for the settlement and resettlement of the Cape Town's Coloured population. Vast residential areas were built specifically for this purpose, with the result being the relocation of thousands of already economically disadvantaged Coloured citizens further away from opportunity. Consequentially, the district has been slow to develop, and is a zone of high crime and unemployment (Spinks, 2001).

In a sense, the development of the Eastern African Townships has been similar in that the area became a "catch-all" zone for both the city's poor African citizens, and inward migrants. In contrast, settlement occurred informally and the suburbs that make up the district are characterised by their lack of formal planning (Ndingaye, 2005). Further, the majority of Cape Town's documented post-Apartheid population growth has been focalised within the Eastern African Townships. The area suffers from poor accessibility, poor infrastructure and poor service delivery, and this coupled with its inherently high levels of crime and unemployment have trapped more than three quarters of its residents in poverty (Ellis, 2003; Ndingaye, 2005).

The two districts are the most densely inhabited in Cape Town. The Cape Flats has a population density of 5740/km2 and the Eastern African Townships one of 7681/km2. This is in sharp contrast to the greater City of Cape Town metro's population density of 1529/km2. These findings are in line with findings in De Klerk et al. (2005) regarding the post-Apartheid expansion of racialized economic geographies in Cape Town. This expansion has contributed to urban sprawl and the peripheral densification of the city.

2.4 Unemployment

Since the inception of democracy, Cape Town's formal unemployment rate has increased due to a combination of the rapid post-Apartheid growth of unskilled job-seekers, the influx of migrant labour (De Swart, et al., 2005), and the economy's structural shift away from the productive sectors to more specialized service sectors (CoCT, 2014). This increase in unemployment has been predominantly felt by the African and Coloured population groups (Lemanski, 2007). In 2004, almost a quarter (23.4%) of Cape Town's economically active population was unemployed, which was below the national statistic of 27.1% (Lemanski, 2007). In 2013, the City of Cape Town's unemployment rose to 24.5%. In the Western Cape overall, unemployment is slightly lower, but has also increased between 2003 and 2013, rising from 21.7% to 23.4% (StatsSA, 2013). Given the relative strength of the Cape Town and Western Cape economy, these numbers indicate that unemployment remains a major challenge for the city. The figure below presents the state of unemployment in the Western Cape between 2003 and 2013.



*(WCGPT, 2011), note – CoCT figures are for 2004 and 2007**,** (StatsSA, 2013)

The figure highlights three issues. Firstly, there is a gender bias in that men are less likely to be unemployed than women. Whilst not as pronounced as it is in other provinces, women have a 2.7% higher unemployment rate than men. Women comprise 47.7% of the labour force, while men comprise 52.3% (WCGPT, 2011).

Secondly, there is a deeply entrenched challenge of youth unemployment. Both adults and youth have experienced increasing unemployment between 2003 and 2013. Despite youth unemployment increasing from 30.4% to 32.3% over this period, the prejudice between youth and adults is decreasing. Indeed, in 2003 a youth was 3 times likelier to be unemployed than an adult. In 2013, they were only 2 times likelier. The youth unemployment problem is still significant, however, and is more severe in low-income urban areas. For example, a 2002 livelihoods survey in Khayalitsha and Nyanga found that as much as 67% of individuals aged 18-25 were neither employed, nor enrolled in further education (De Swart, et al., 2005). In the context of rising unemployment overall, the observed shift in employer preferences between adults and youth could reflect the substitution of expensive experienced labour with cheaper inexperienced labour, rather than the existing labour force being complemented with additional youth labour. The observed shift is likely to be a symptom of how the province's unemployment problem is evolving.

Finally, unemployment in the province carries a significant racial component. Most heavily affected by Cape Town's unemployment amongst skilled workers is the Coloured population group, with a loss of 30 000 manufacturing jobs between 1980 and 2001 (Lemanski, 2007). This job loss was further emphasised along gender lines as a significant percentage of these losses were in the clothing and textile sectors - jobs traditionally taken up by women (Lemanski, 2007).

In 2013, African and Coloured individuals were far likelier to be unemployed than White or Indian/Asian individuals. Whilst Whites and Indian/Asians had unemployment rates in 2013 of 4.5% and 7.6% respectively, Coloureds and Africans had unemployment rates of 23.5% and 33.2% - both above the provincial average. This fact encapsulates Cape Town's racial economic polarisation, with its population comprised of two low-unemployment racial groups and two high-unemployment racial groups.

2.5 The Welfare System

It is also important to contextualise the rapid growth of the country's social security system. Indeed, in the decade between 1996 and 2006, social transfers increased from 2.5% of GDP to over 3%, with total beneficiaries increasing by 217% (Bhorat & Van Der Westhuizen, 2010). The social welfare system currently provides seven different social assistant grants – four targeted towards adults, and three targeted towards children. The adult grants are the Disabled Grant (DA), the Grant-in-aid (GIA), the Old Age Grant (OAG) and the War Veteran Grant (WVG), whilst the child grants are the Care Dependency Grant (CGD), the Child Support Grant (CSG) and the Foster Care Grant (FCG). With the exception of the WVG (which is declining in number year on year), all the grants have increased in size. In the Western Cape between 2007 and 2012, the total number of grant recipients increased by 50.7% from 828,980 annually to 1,249,727, with an annual growth rate of 8.56%. The table below details the size and Compound Annual Growth Rates (CAGR) of the seven grants over this period.

Table 2.3: Changing Distribution of Social Welfare Grants, Western Cape (2007-2012)

	OAG	WVG	DG	GIA	FCG	CDG	CSG	Total
2007/2008	173637	460	140492	7220	27925	7399	471847	**828980**
2008/2009	193662	364	137985	7376	28331	7960	516328	**892006**
2009/2010	211967	304	148410	7824	28195	8899	630208	**1035807**
2010/2011	230166	255	149746	8468	28592	9355	728901	**1155483**
2011/2012	245996	213	157626	9048	29003	9960	797881	**1249727**
CAGR (%)	**7.22%**	**-14.27%**	**2.33%**	**4.62%**	**0.76%**	**6.12%**	**11.08%**	**8.56%**

*(SASSA, 2008) (SASSA, 2009) (SASSA, 2010) (SASSA, 2011) (SASSA, 2012), author's calculations

Whilst social assistance grants (mainly the CSG, DG and OAP) alter the levels of inequality only marginally, they have been crucial in reducing poverty among the poorest households (Leibbrandt, M. et al., 2010). In this sense, the rapid growth of the social security system is largely positive. Furthermore, there a significant number of families that cannot obtain (but otherwise qualify) grants because of documentation issues. This suggests two things: there is an important role for the Department of Home Affairs to ease the process of vitals registration (Leibbrandt, M. et al., 2010), and that the growth of the social security system is unlikely to slow in the short to medium term.

There are many who argue that the social grant system should extend to focus directly on the unemployed - who remain uncovered by other grants (Rankin, 2013). While economic growth has supported the sustainability of the growing grant system so far, it is questionable whether a permanent income support for the unemployed would lead to the desired outcomes (Leibbrandt, M. et al., 2010). Many of the unemployed are young school leavers and while they clearly would benefit from a social safety-net or temporary social insurance, the goal of policy should be directed at helping this group enter the labour market and remain in work over the long-term (Leibbrandt, M. et al., 2010). This is relevant to the affordability of transport if linking transport to the social welfare system has potential to reduce the mobility costs of entering the labour market.

Chapter 2 Conclusion

This chapter confirms the segregation of urban Cape Town into racial economic geographies. Socioeconomic indicators of income, race and area are strongly correlated across the city, and this has wide implications on the cost of economic inclusion. Cape Town, like other South African cities, is inorganically composed of high-density, low-income peripheries; haphazard suburban densities; and a population segregated by race and income. As long as this persists, the provision of public transport will remain fundamentally inefficient. This chapter has three key findings. Firstly, Cape Town's segregated economic geographies make affordable mobility a critical development concern. Secondly, haphazard densities in the city - and the continued failure to implement urban densification plans - concretise the subsidisation needs of road public transport. Thirdly, because Cape Town is structurally defined by its racial economic geographies, road public transport subsidies in the city must be designed to accommodate them.

Chapter 3: The Cape Town Road Public Transport Sector

"Public transport confronts many challenges in South Africa, and in particular the persisting legacy of apartheid geography means that the great majority of workers and poor continue to live in displaced dormitory townships distant from work and other amenities. From a transport operator business perspective, the resulting long commutes, typically in one direction in the morning and in the other direction in the evening, are fuel and vehicle inefficient, and difficult to sustain without significant levels of operational subsidy. For the users of public transport, the cost of mobility and the time spent in commuting are hugely draining. The results of urban sprawl, of poorly integrated public transport systems, and of infrastructure and planning that has historically privileged private cars are to be seen daily on many of our congested urban roads."

– Mr Jeremy Cronin, MP, Deputy Minister of Transport, South Africa (DoT, 2012b)

As Cronin notes above, the provision of South African public transport carries an inherent economic need for operating subsidies. In the case of Cape Town, the modal variation between the three major road public transport operators and their subsidy needs has created a fragmented industry. Golden Arrow Bus Services (Gabs) is a 150-year-old company supported by subsidies since 1948. The Mini-Bus Taxi (MBT) industry was borne from the trilateral need to satisfy supply shortages, be price-competitive, and remain operationally efficient. MyCiTi Bus Rapid Transit (BRT) varies further still, emerging as something of a fix-all solution in that its business model is pitched at both the upper and lower ends of the market. This chapter outlines the context in which Cape Town road public transport has evolved, and explains the various elements of system subsidisation.

Section 1 examines the key factors that shaped the Cape Town's road public transport industry into what we find today, and how the emergence of MyCiTi has destabilised a fragile equilibrium. Section 2 then investigates how this has altered the city's road public transport subsidisation needs, and explores the various avenues in which these funding needs are met.

Section 1: The Rise and Fall of Monopoly

This Section explores how road public transport has evolved from its conception into what we find today. It attempts to identify the critical events that drove this process, and to isolate the reasons these events took place.

1.1 Formal Bus Monopoly: Contracted Bus Services

Following the establishment of the Cape Tramways company in December 1862, Cape Town Metro's first public transport infrastructure was established to operate a network of steam-powered trams in the city. This was the beginning of a long-term monopoly ownership of public transport in Cape Town.

1.1.1 Private Operators Flood the Market

In August 1911, the Cape Town Municipality agreed that motorized buses could operate in tandem with the tram network. In response, the Tramways Company acquired a fleet of buses to fill this gap. Concurrently, many private bus companies entered the market, and one of these new entrants was

Gabs. In the absence of regulation, however, this agreement also led to flood the market with poor-quality busses. The vehicles were often homemade and structurally inefficient, the services inconsistent, and fares fluctuated considerably (GABS, 2011). This was the first sign of sub-optimal regulation in the industry.

The growing number of smaller private bus companies presented a threat to the Tramway Company's equilibrium, as they were not bound by the same regulations. This caused operational issues as the smaller companies were able to undercut the Tramway Company's fares, by avoiding rates or road maintenance tax. They were not required to adhere to a timetable, publish a scale of fares or keep to fixed routes (GABS, 2011). In addition, they emplyed predatory tactics by stopping at tram stations to absorb additional passengers. It was clear that new legislation was required to control the transport industry's expansion.

1.1.2 The Merger

The 1931 introduction of the Transportation Board legislation and the Feeder Services Act fundamentally altered the public transport operating environment in Cape Town. The new legislation set the scene to legitimise the monopoly provision of public transport, overseeing the rapid contraction of the haphazard operator arrangement into four remaining companies – the Cape Tramways Company, Gabs, the Peninsula Transport Company and the Northern Transport Company. When Gabs acquired the latter two, only Gabs and Cape Tramways remained. Gabs managed the bus fleet on their designated routes, and Cape Tramways managed their declining tram network and the bus routes through the city (GABS, 2011).

In 1956, the two merged, with Gabs taking over operations, but with the Cape Electric Tramways name being retained (Dickinson, 2004). In 1992, Gabs management bought out City Tramways Limited and the Golden Arrow Bus Services name was restored to the company (GABS, 2011). In 2000, Gabs formed a BEE subsidiary, Sibanye Bus Services, as a means to subcontract its services that connected Atlantis to the rest of the Metro. Sibanye also operates the UCT Jammie Shuttle service.

1.1.3 The HCI takeover

On 20 July 2004, Gabs was bought for R250 million by Hosken Consolidated Investments (HCI). HCI, known as one of the premier Black Economic Empowerment (BEE) companies in South Africa, sought to include a transport arm to its investment portfolio (Nthite, 2004). Its majority shareholder is the South African Clothing and Textile Workers Union (SACTWU), a union affiliated to the Congress of South African Trade Unions (COSATU), and in political alliance with the African National Congress (ANC) (Nthite, 2004).

1.2 The Deregulation and Reregulation of the Informal MBT Industry

This section explore why the MBT industry is associated with controversy and violence, why attempts at reregulation have failed, and how failure to solve the industry's collective action problem led to the emergence of MyCiTi.

1.2.1 Blanket Deregulation

Prior to 1977, a law restricted taxi operations to sedan motorcars fitted with fare meters. In 1977, this expanded to incorporate vehicles with a capacity of fifteen passengers into the taxi industry (Encounter, 2010). The 1987 White Paper then served to deregulate the MBT industry in its entirety, significantly reducing barriers to entry. This represented an unprecedented opportunity for African and Coloured entrepreneurs, having faced structurally excluded from the mainstream economy for decades. In the four years following deregulation, the number of taxi operating licenses in circulation nationally rose tenfold, from 4,000 in 1987 to 40,000 in 1991 (Dugard, 2001).

The immediate consequences of this expansion was exacerbated by the lack of formal regulatory bodies. Independent taxi associations formed to legitimise individual routes, and security was enlisted from street gangs. These associations have been directly connected to the violence that has shadowed the taxi industry (Dugard, 2001). In the absence of state regulation, this problem intensified as groups of smaller associations joined forces to form larger bodies, whose mandate was to regulate loading practices and prices independently. These larger associations became known as the “mother bodies”, and two of the major players – the Cape Amalgamated Taxi Association (CATA), and the Congress for Democratic Taxi Associations (CODETA) – remain in duopoly today (Dugard, 2001).

The absence of industry regulation is likely responsible for most of the post-apartheid taxi violence (Dugard, 2001). In 2010, there 160 informal taxi associations were estimated to exist in the Western Cape (Peninsula Holdings, 2010). Within the CoCT (see Table 3.1), 7,615 active MBT operating licenses are governed by 102 registered MBT associations. Roughly 40% of these attributed to either CODETA or CATA (CoCT, 2013a). The table below illustrates the split between CODETA, CATA and the remaining independent taxi associations by number of operating licenses in circulation, according to the Provincial Taxi Registrar (CoCT, 2013a). Clearly highlighted is that in 2013 – 26 years post-deregulation – the MBT industry remains highly fragmented. CATA and CODETA govern the major transit routes within and around the metro, while independent associations service routes not covered by the two mother bodies. Access to the routes serviced by CODETA and CATA requires full membership to the association.

Table 3.1: Split of MBT Operating Licenses by Association

Association	Active Licenses	Total	Share of Total (%)
CATA	1560	**1776**	**23.3%**
CODETA	1209	**1286**	**16.9%**
Independent	4489	**4553**	**59.8%**
TOTAL	**7258**	**7615**	**100%**

* (CoCT, 2013a)

1.2.2 The Taxi Wars: The Leading Circumstances

This section will attempt to contextualise the post-1990 MBT wars, and then analyse the various interventions put in place to stop them. Much of the insight in 1.2.2 is guided by Jackie Dugard’s 2001 paper, “From low intensity war to mafia war: Taxi violence in South Africa”.

1.2.2.1 Population Explosion

Until 1985, 70% of the Western Cape population was comprised of the Coloured population group (Dugard, 2001). When the Influx Control System ended in 1985, however, a substantial inflow of African migrants came into the area. Furthermore, during the 25 years from 1985 to 2010, the Cape Town urban population almost doubled in size from 1,925,000 to 3,492,000 (United Nations, 2013). Without access to formal housing, most Africans settled in informal settlements such as Guguletu, Langa, Nyanga and Khayelitsha. Transport within, between and from these predominantly African settlements was a significant, and neglected, problem (Dugard, 2001).

1.2.2.2 Apartheid Spatial Planning

Because of Apartheid spatial planning, the city's working class were concentrated at segregated nodes, and were in turn the most isolated from commercial centres. As a result, there existed vast volumes of commuters who required long-distance daily transport, and did not have access to private cars. To compound this, informal settlements were haphazardly structured, were growing rapidly, were historically under-serviced by rail, and had under-developed basic access infrastructure. The result was that the demand for adequate public transport increased exponentially over a short period, and the existing providers were unable to respond.

1.2.2.3 The Isolation of Entrepreneurs

Apartheid structurally inhibited African and Coloured entrepreneurial activity for decades. As informal business was limited to demarcated commercial centres and capital was scarce, market-access was highly constrained. This created inherently high economic barriers to entry. The relaxation of access-laws during the democratic transition, therefore, served to reduce these barriers considerably. The supply-gap in the transport sector placed these entrepreneurs in a strong position to benefit. They were of advantageous proximity to the market, the set-up and administrative costs were relatively low, and the informality of the business environment afforded operational flexibility.

1.2.2.4 Deregulation

Pre-1987, Cape Town's transport system was expensive, inadequate and inefficient in catering for the poor. Non-White South Africans spent hours each day, and up to 20% of their incomes on travel (Dugard, 2001). The existing transport structures were hugely inappropriate, and required massive overhaul to cope with the rapidly changing patterns of demand.

In response, the White Paper on Transport Policy (1987), along with the Transport Deregulation Act (1988), achieved two significant things. First, it advocated the blanket deregulation of the taxi industry, and second, it redefined the legalised use of 16-seater minibuses, allowing MBTs the freedom to operate as taxis under the act. Collectively, this allowed the industry to develop as it has.

1.2.2.5 What Deregulation Meant in Practice

Firstly, MBT owners applying for operating permits did not have to prove a need for their service in a particular area, or demonstrate any degree of financial security or competence. This resulting in the issue vast volumes of permits (Dugard, 2001). At the same time, corruption was endemic. Although the official price for a permit was between R100 and R200 (depending on the route), authorities gave cut-price deals to favoured applicants (Dugard, 2001). Moreover, unchecked by the authorities, taxi drivers were able to operate without permits, leading to the mass entry of illegal operators into the system (Dugard, 2001). The accelerated expansion of the market, the intensifying community and political unrest, and rapid population growth, set the scene for the taxi wars (Dugard, 2001).

The development of the taxi wars over time is explained in detail in Dugard (2001), but for the purposes of this paper, they are less relevant.

1.2.3 The Taxi Recapitalisation Plan

Broadly speaking, the Taxi Recapitalisation Plan (TRP), first proposed by transport minister Mac Maharaj in May 1999, was drawn up in response to the taxi wars (Browning, 2004). This premise centred on how it lent government control for the first time since 1987. This was therefore the first step in the process of reregulating the industry.

The critical issue, however, was that the R50,000 scrapping allowance was not large enough to incentivise TRP participation. TRP vehicles were too expensive for individual owners, whose turnover – already strained by taxi association membership – could not absorb the monthly repayments. The National Taxi Alliance (NTA) argued that considering the cost of new taxi's (anything from R350,000 to R500,000) a minimum subsidy of R100,000 was needed to achieve the outcomes the TRP set out to do (Molefi, 2013). By setting the allowance so low, the TRP effectively played out to marginalise small-fleet owners by raising the fixed capital costs to entry. Only the large-fleet operators were in a position to benefit.

Whether benefitting the big players was an intended outcome of the TRP is unclear. However, one has to consider the environment into which the TRP was introduced. Following years of violence, the government was desperate to implement peace. As the MBT associations were in control of the wars, they had the power to stop them. Within these associations, the bigger operators have considerably more standing than the small, and thus the big operators were the key to influencing the associations.

The TRP allowed the big players to expand their operations, whilst the only way for the smaller players to participate in the programme was by exiting the industry entirely. Therefore, the TRP led to increase the market share of the big operators by pushing smaller ones out of the industry. This has driven the understanding of the TRP as a mechanism to legally buy off the taxi elites to solve the collective action problem, and put an end to the wars. The TRPs effectiveness in doing so, however, was poor (Dugard, 2001), and this built pressure on authorities to take control of the industry by means of a different route.

1.3 The Emergence of MyCiTi: Why and How It Happened

1.3.1 The FIFA World Cup: Cape Town in the Shop Window

The introduction of the MyCiTi BRT system in Cape Town is a function of the period it was introduced. 2010 marked the year that South Africa was to host the FIFA Football World Cup, and part of the city-level requirements were to provide appropriate stadia access for fans. The FIFA World Cup, and the associated increase in the Public Transport Infrastructure and Systems Grant (PTISG) from National Treasury, thus catalysed the industry transition. The inclusion of an Integrated Rapid Transit (IRT) component to municipal public transport was mandated in the 2009 NLTA. In line with a number of the major South African metros, the CoCT decided to introduce a BRT system to Cape Town's road public transport network.

1.3.2 Key Legislative Changes

The 2009 NLTA provided the new legislation required for local municipalities to implement the IRT component of the Integrated Public Transport Network (IPTN) model. The first significant amendment was to shift the responsibility of public transport strategy, implementation and planning from provincial to municipal government (Parliament, 2009). Certain key changes to the act are unpacked below.

NLTA section 39: Rationalisation of public transport services

> *(1) When a planning authority in rationalising public transport services in its area concludes, based on its integrated transport plan, that there is a surplus of legally operated services by operators on a particular route as a result of which an existing non-contracted public transport service is no longer required, the planning authority must, where possible –*
>
> *(a) offer the operator an alternative service; or*
> *(b) allow the operator to continue providing the service and impose a moratorium on the issuing of new operating licences on that route.*
> (Parliament, 2009)

This section makes a key distinction between those operators who are operating legally and are contracted, and those who are operating legally and are non-contracted, and the way that the latter will be phased out in the presence of increasing supply from contracted operators. This invariably refers to MBTs operating under control of taxi associations, and stipulates the options of resolution.

NLTA section 47: Rationalisation of existing services: general

> *(1) All permits issued for a definite period remain valid but lapse when that period expires, provided that if such a permit is still valid on a date calculated as seven years from the date of commencement of this Act [2009], it will lapse on that date [2016].*
> *(2) All permits issued for an indefinite period remain valid, ... but lapse seven years after the date of commencement of this Act...*
> *...*
> *(4) The holder of any permit that lapses or is cancelled in terms of this Part is not entitled to any compensation by virtue of its lapsing.*
> (Parliament, 2009)

By "rationalising" the existing services, the Act essentially provides for the discontinuation of existing operators in the context of a new emergent service. Section 47 redefines both the existing contracts with definite validity periods to a maximum of seven years, and those with indefinite validity periods to definite validity periods of seven years. Thus, all permits in existence prior to the Act will cease to exist post-2016. This gives authorities the power to renew only those contracts deemed necessary to the IRT. The Act also rubber-stamps the fact that no lapse in contract will warrant compensation.

NLTA section 52: Maximum validity period of operating licences

> *(1) An operating licence is valid for a maximum period of seven years, but where a negotiated contract has been awarded to an operator under section 41 for more than seven years, such an operating licence must be issued for the period of the contract ...*
> *(2) Operating licences must be granted for a fixed period determined by the entity granting them, where applicable based on the directions of the planning authority ...*
> *(3) In determining the validity period of operating licences for non-contracted services, the following must be considered, subject to the dictates, if any, of relevant integrated transport plans*
>
> *(a) Current and envisaged trends in utilisation on the route or routes, or, where applicable, in the area, concerned;*
> *…*
> *(c) where applicable, the likelihood that in future the service may no longer be required in terms of the integrated transport plan; and*
> *(d) the likelihood that the service may become the subject of a commercial service contract or a subsidised service contract.*
> (Parliament, 2009)

Following Section 47, all newly negotiated operating contracts following the 2009 NLTA implementation would have a validity of seven years.[5] This allows the IRT rollout flexibility to move into new areas with the knowledge that existing operators could be phased out, subject to those guidelines addressed in Section 39.

These three sections of the act therefore provided a platform for municipal governments to implement their IRT strategies. Crucially, it allowed municipal government to phase duplicated services into areas already serviced by existing operators. It also granted government absolute control over the taxi industry, and as such achieved what the TRP could not. As existing operating permits begin to expire, the municipal sphere gains the ability to shape and reshape the informal industry with complete discretion.

Section 2: The Evolution of the Cape Town Public Transport Subsidy

Parallel to these formative processes of industry transition was a very real need for congruent change in public transport finance. As detailed in the 2006 State of the Cities report, two key constraints faced the county's public transport network. The first was the need to revisit and reshape the transport subsidy system, and the second was to address the affordability and accessibility of the public transport system, particularly for the poor (SA Cities Network, 2006). It recognized that public transport expenditure had a major impact on the household budgets of the poor, and that this household investment could amount to far greater than the municipal services bill – which implies transport as a luxury good (SA Cities Network, 2006). By timeline, this report was published at roughly the same time of the TRP launch and the early conceptions of the new IRPTN. As such, it is apt to use it as a benchmark from which improvements are measured.

[5] The exception being a section 41 contract, which may not exceed 12 years, and is awarded to existing operators who are absorbed into the greater IRT network (Parliament, 2009).

However, since the 2006 report, little has changed for South African cities in terms of the way the transport subsidy functions, and the experience of Cape Town is no different. The road public transport operating subsidy has generally stagnated in value, and its design does little to target its benefits to those at the lower end of the income spectrum. However, with the prioritisation of municipal IRT solutions, the industry has entered a phase of transition.

In his 2011 paper on how this newfound focus on IRT will affect the public fiscus, Palmer notes that the system is likely to demand operating subsidies far in excess of what is being forecast (Palmer, 2011). As he puts it, the major goal in public transport planning is to shift passengers, firstly, from private cars onto public transport and, secondly, from taxis and conventional buses to mass transit systems such as rail and BRT (Palmer, 2011). Transport users are subsidised both directly, through operating and capital grants, and indirectly, through the public good provision of mobility infrastructure and maintenance grants.

In 2013, for example, the South African National Road Agency (SANRAL) received R9,7bn for the maintenance and upgrading of national roads, and the Western Cape provincial government received the Provincial Road Maintenance Grant (PRMG) of R478m (up from R411m in 2012) for the maintenance of provincial and municipal roads (DoT, 2012a; DoT, 2013). These indirect subsidies are non-discriminatory by definition – however, the benefits appropriate disproportionately towards the users of private modes.

The assumption is that the derivation and allocation of these indirect road subsidies, whilst important from a development perspective, are normally distributed between road public transport operators. The question of whether the subsidisation of private modes requires the parallel subsidisation of public modes, is one of allocative efficiency, and is less important a consideration to the social redistribution argument. In turn, this section focusses on unpacking the direct road-based public transport subsidy as it stands, and breaks down its allocation between the three major industry players.

2.1 Contracted Busses (Gabs and Sibanye) Operational Subsidy[6]

Through changes to the Division of Revenue Act (DORA) in 2009, the contracted bus subsidy changed the first time since 1948. The new structure functions on a per-kilometre travelled methodology, capped at 40m kilometres annually (Golding, 2012). In theory, the per-kilometre construct allowed Gabs to operate a more rounded public transport service as both on- and off-peak trips were subsidised equally. However, the move by DORA to limit the number of subsidised kilometres Gabs has acted as a constraint to operations as the cap has been met every year since conception (Golding, 2012). In the 2011/2012 financial year the PTOG totalled R666m (DoT, 2012a), rising to R696m in 2012/21013 (DoT, 2013). This is distributed between Gabs and Sibanye according to market share, with Gabs allocated 36.6m km annually and Sibanye 3.8m (CoCT, 2013). Whilst Sibanye operates within their cap, Gabs exceeds it considerably. In 2013, Gabs travelled 56m km - roughly 20m over their cap (CoCT, 2013). In practice, Sibanye’s operations are fully subsidised, whereas Gabs is subsidised for only 65% of their distance travelled.

[6] Details summarized in Appendix B, Table B1

2.1.1. Transfer Characteristics, Conditionalities, Distribution Channels and Funding

The transfer is a Conditional Direct Operating Subsidy, received on the supply-side. It is allocated according to a per-kilometre framework, capped at 40m kilometres annually. The Subsidy is channelled to the user through the mechanism of blanket tariff reductions. As such, all users of the service benefit equally, and the subsidy does not intentionally target specific users. However, the subsidy is still reasonable well targeted given the characteristics of contracted bus demand.

Contracted busses also offer clip-card services, which provide discounted tariffs for bundled trip purchases. There are two options. The first is a 10-trip clip-card that carries 14-day validity. The second is a “monthly” clip-card, allowing 47 trips over a 37-day period. The price and discount attributed to the clip card varies according to the route and distance needs of the individual passenger. Concessional tickets are also offered to pensioners, scholars and the disabled.

The entirety of the operating subsidy allocated to Contracted Busses derives from the provincially allocated PTOG, as stipulated by the DoT. The PTOG is managed by National Treasury and allocated by Provincial Government. The PTOG was distributed between the 9 Provincial Governments over the 2011/2012 and 2012/2013 financial years as follows:

Table 3.2: PTOG Allocations by Province

NAME OF METRO	Amount R'000	% of total	Amount R'000	% of total
Year	2011/2012	2011/2012	2012/2013	2012/2013
Eastern Cape	166,953	4,02%	174,466	4,04%
Free State	184,566	4,44%	192,872	4,47%
Gauteng	1,577,612	37,99%	1,625,746	37,66%
Kwazulu Natal	773,473	18,62%	808,279	18,72%
Limpopo	249,498	6,01%	260,725	6,04%
Mpumalanga	420,099	10,11%	439,003	10,17%
North West	77,211	1,86%	80,686	1,87%
Northern Cape	37,565	0,90%	39,255	0,91%
Western Cape	666,255	16,04%	696,237	16,13%
Total	**4153232**	**100,00%**	**4317269**	**100,00%**

*(DoT, 2012a) (DoT, 2013), author’s calculations

The Provincial Government then stipulates the division of these funds according to its individually contracted providers. In the Western Cape, this sum is allocated to Gabs and Sibanye in its entirety through interim contracts.

2.2 BRT (MyCiTi) Operational and Capital Subsidies[7]

2.2.1 Transfer Characteristics, Conditionalities, Distribution Channels and Funding

The MyCiTi system derives all of its capital and infrastructure funding from the Public Transport Infrastructure and Systems Grant (PTISG), which is designed to cover all appropriate related

[7] Details summarized in Appendix B, Table B2

expenditure. The PTISG is a national grant, frame-worked in DORA. Key wording in the framework includes the 'Grant purpose' which is as follows:

> *"To provide for accelerated planning, construction and implementation of public and nonmotorised transport networks in major cities in South Africa. This includes network related infrastructure and information systems as well as transitional measures such as the inclusion of directly affected public transport operators and workers and also once-off measures to ensure the availability of network vehicle fleets for the 2010 FIFA World Cup and for network Phase 1A services"*
>
> (City of Cape Town, 2012)

The reference to 'transitional measures' in the framework is significant in defining the grant's scope. A significant condition of the PTISG is that the 'total city wide IRPTN system must cover direct vehicle operator costs from fare revenue, any other local sources of revenue and PTOG if applicable'. However, it adds that 'This applies to the city-wide network as a whole and not necessarily to initial phases' of transition (City of Cape Town, 2012).

This note is crucial to the understanding of how the City is using the PTISG. In its interpretation of the PTISG framework, the city uses PTISG funding to cover the "total recurrent costs requirement not covered by fare and advertising revenue" (City of Cape Town, 2012) during the MyCiTi rollout process. Implicit in this interpretation is that the City recognises that once the interim phases are complete, the PTISG will no longer be an appropriate source of operating support.

As such, a portion of the PTISG functions as an Unconditional Operating Subsidy to cover roughly half of system operating losses. The other half comprises Council Funds, which by definition is also an Unconditional Operating Subsidy in that the amount is both exogenously raised and transferred inwardly as operating support (City of Cape Town, 2012). This amount comprises localised property rates and a share of the nationally collected fuel levy. Other localised sources include parking levies, the leasing of commercial space at facilities, merchandising, and emissions trading. The City of Cape Town Council has approved that up to 4% of its income allocates to public transport operations (CoCT, 2013b).Both these amounts are transferred on the supply-side, and are typical payments within public transport systems that are deficit-prone. Vehicle Operating Companies (VOCs) are then permitted to cover their individual operating losses by drawing from this sum, contingent on their adherence to their contractually stipulated schedules and vehicle maintenance (CoCT, 2013a).

The fare structure is a stepped distance-based system in which passengers pays a boarding charge on entry, and a distance-based charge on exit (TCT, 2014). The policy currently indicates that there will be six distance-based steps in use in the whole city (MyCiTi, 2014). This implies distance-based cross-subsidisation, as per-km rates increase the shorter the distance. Given the system's deficit-prone status, rather than a traditional cross-subsidy, this construct implies that the individual user absorbs a greater subsidy per km the further from the inner city he boards, as further travelling busses are associated with higher input costs, and thus higher losses.

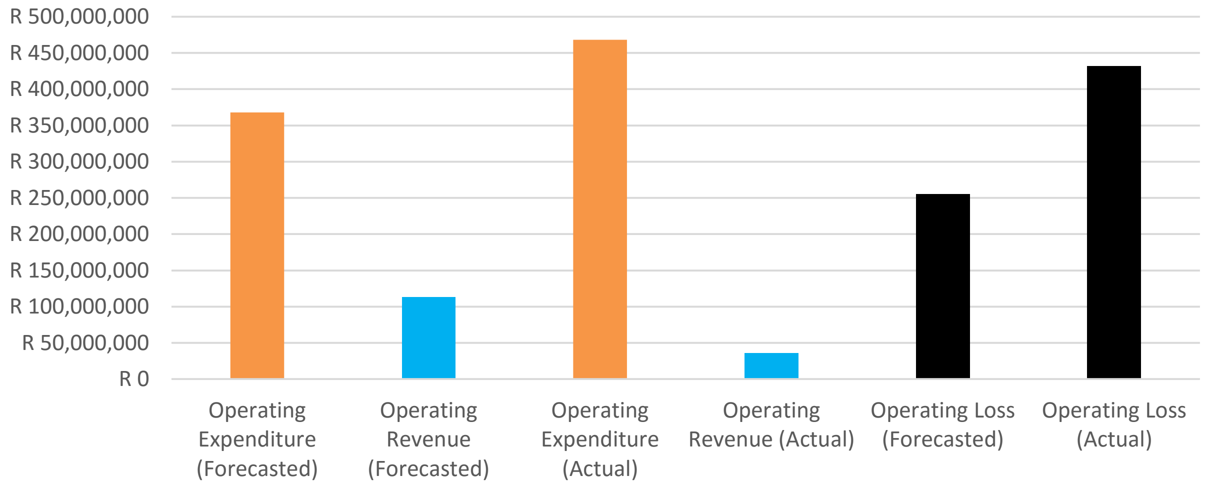
As a result, the system is likely to better target once the RT rollout is complete in that greater efficiencies will reduce per-vehicles operating losses, thus improving the cross-subsidy. Further, the potential of urban densification along routes could also lead to wider destination nodes and higher seat-turnover on routes. It is, however, important to note that these gains in targeting will be relative and not absolute, and the most marginalised of the population will still pay more for journeys into the inner city than those less so.

Different tariffs also apply for peak and off-peak travel (MyCiTi, 2014). This encourages demand in periods of typically low usage. This also implies that emptier, off-peak busses receive a distortedly high subsidy than fuller, peak busses. This is subsidy inefficient with low passenger volumes.

In addition, IRPTN systems derive capital and infrastructural funding from the PTISG too. As capital and infrastructure subsidies can be effective at both inducing and increasing productive efficiency (Obeng and Sakano, 1997), they can be deemed an appropriate and necessary supply-side subsidy. Accordingly, only those funds from the PTISG that are utilised to subsidise operational costs are considered flexible.

For the purposes of this paper, the operating subsidy is treated as Operating Expenditure less Operating Revenue. As pointed out in Palmer (2011), this amount has been far in excess of city forecasts. For example, a comparison of "forecasted" vs "actual" operating expenditures and revenues for the 2012/2013 financial year show that MyCiTi's subsidy requirements have been larger than expected.

Figure 3.1: Predicted and Actual MyCiTi Operating Shortfall (2012/2013)



*(CoCT, 2013b), (City of Cape Town, 2012), author's calculations

As is illustrated, the actual subsidy requirements of the system in 2012/2013 were 69% higher than initial forecasts.

2.3 Implicit subsidy to the MBT Industry[8]

While MBTs receive no formal subsidies, the TRP provides taxi owners access to a capital subsidy, which will reduce their operating costs through the reduction of interest and redemption payments (SA Cities Network, 2006). It is important to note, however, that the TRP will also introduce stricter vehicle safety standards and operating conditions, resulting in increased operating costs for taxi

[8] Details summarized in Appendix B, Table B3

operators (SA Cities Network, 2006). Despite this, these additional operational costs are not provisioned for by the PTOG, and there are no current plans to do so.

The TRP provision is set annually at R500m, which has been underutilised in both the 2011/12 and 2012/13 financial years. Of the provision, R448,113,000 was distributed in 2011/12, with this figure falling to R407,437,000 in 2012/13. From this, using the CT Metro market share of the MBT industry as a proxy for the Metro's Taxi Recapitalisation uptake in the region, one can calculate the CT Metro benefit at R23,223,909[9]. The allowance provided through the TRP is considered a form of capital subsidy (Palmer, 2011; Walters, 2012). However, in line with Palmer, 2011, this amount is assumed to function as an (implicit) operating subsidy transfer for the purposes of this paper (Palmer, 2011). There is no indication to suggest any kind of allocation bias across provinces.

2.3.1 Transfer Characteristics, Conditionalities, Distribution Channels and Funding

The subsidy is an implicit operating grant, taking the form of a Conditional Direct Operating Subsidy. It is non-discriminatory in design, but functions to discriminate between participants through a process of self-selection. Wealthier MBT owners can utilise the TRP to expand and improve their fleet, whilst the financial burden it places on smaller, less wealthy participants is more likely to restrict them to market exit (Walters, 2012). The implicit subsidy operates through the TRP and is funded by direct and indirect general taxation, through National Treasury.

Chapter 3 Conclusion

This chapter reveals the impact of Cape Town's racial economic geographies on the evolution of the city's road public transport system. The reality is that operational inefficiency is inherent to the sector, creating a pervasive need for subsidised operating support. The central question of this chapter is how the emergence of the MyCiTi BRT has changed the context for subsidisation in the sector.

Analysis centred on the legislation tabled to assist industry transition, including the incremental devolution of planning power from national and provincial government to the municipal level. This process has disrupted the status quo, and has radically altered the sector's absolute and relative subsidisation needs – largely catalysed by funding the MyCiTi BRT. As the market structure continues to evolve, increased pressure is placed on the public fiscus, and this has influenced the distributional consequences of operational subsidies between households. The cross-modal absorption of operating support, and the impact of the transition on system efficiency, affordability and distribution, is explored in the chapter to follow.

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[9] Own calculation, taken as CT Market share of daily passenger trips as % of national total. Total Daily National passenger trips = 5.8m (Palmer, 2011), Total Daily CT Metro passenger trips = 323300 (CoCT, 2013). CT Metro therefore 5.57% of National total. 407437000*0.057=23223909.

Chapter 4: Efficiency, Affordability and Distribution

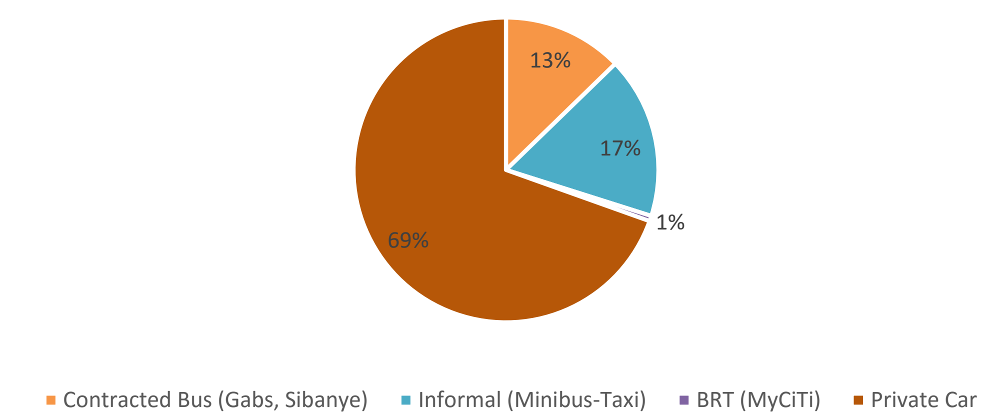
Chapter 4 explores themes of subsidy absorption and efficiency, transport affordability and subsidy distribution. Section 1 addresses issues of market share, subsidy absorption and efficiency. Section 2 then asks whether the road public transport system is affordable, and calculates CDS Affordability Indices to gain insight into the affordability of household transport consumption. Section 3 outlines the methodological approach of the distribution analysis, factoring the Cape Town context and the set of assumptions needed to address various data constraints. Finally, section 4 measures the distributional consequences of the current subsidy with the Estupinan, et al. quantitative framework.

Section 1: Summary Statistics: Across-mode Subsidy Comparison and Efficiency Analysis

Given the allocation of the three main types of road-based public transport, it is interesting to explore cross-modal subsidy absorption and efficiency. The following analysis unpacks the allocation of the road public transport subsidy between modes, considering the insight into their business models and operational structures provided by Chapter 3.

Adapted from the CoCT ITP (2013), the figure below highlights the relative modal splits of road transport, as measured by daily passenger volumes. It is important to note is that the private car is the most commonly used form of road transport utilised in the city (69%), and that absorbing new public transport users from this segment is one of the key objectives of BRT. Contracted busses and the MBT industry dominate the remaining 31%, with BRT comprising only 1% of daily passenger trips in 2013.

Figure 4.1: Modal Split by Daily Road Passenger Trips



*(CoCT, 2013a)

By further disseminating the annual subsidy by mode, one can compare modal subsidy absorption on a daily basis (Table 4.1 below). The table compares the amount of subsidisation each mode absorbed for each individual passenger trip in the 2012/2013 financial year. This line of analysis allows insight into the relative subsidy efficiencies at the modal level.

At this stage of its rollout, MyCiTi is by far the least subsidy-efficient of the modes as its operating support of around R430m for the 2012/2013 year translates into a daily passenger subsidy of R110. In comparison, the other modes achieve far higher efficiencies. The MBT industry, which receives implicit subsidisation through the TRP, achieves close to operational efficiency in that its daily passenger subsidy equates to only 20 cents. This is the result of services being informal, unregulated and flexible. Contracted busses fall somewhere in the middle. However, given their highly regulated contracted service obligations, a daily passenger subsidy of R8 is far more subsidy-efficient than MyCiTi.

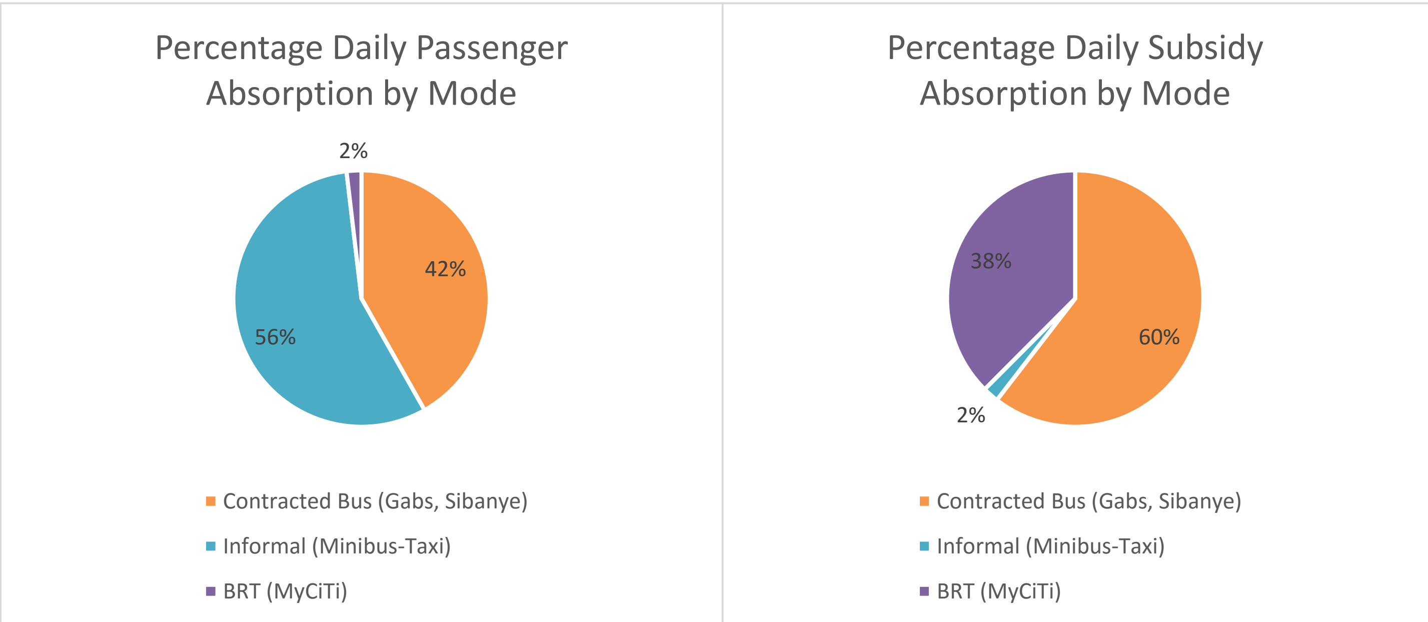
Table 4.1: Across-Mode Operating Subsidy Absorption and Efficiency, 2012/2013

Road Mode	Total Annual Subsidy	Total Daily Subsidy	Daily Passenger Trips	Daily Passenger Subsidy
Contracted Bus (Gabs, Sibanye)	R 696 237 000	R 1 907 498.63	240000	R 7.95
Informal (Minibus-Taxi)	R 23 223 909	R 63 627.15	323263	R 0.20
BRT (MyCiTi)	R 431 986 000	R 1 183 523.29	10754	R 110.05
Private Car	0	0	1310833	0
Public Transport Subtotal			**574017**	
Total	**R 1 151 446 909**	**R 3 154 649**	**1884850**	**R 118.20**

*(CoCT, 2013a), author's calculations

Based on further analysis, one can compare allocative efficiency. Figure 4.2 below displays the contrasting cross-mode daily subsidy and passenger absorptions. Clearly, while Contracted Busses absorb 60% of the total daily operating subsidy and 42% share of daily passengers is moderately inequitable, the other modes drive the system's allocative inefficiency. The MBT industry transports 56% of daily passengers and absorbs 2% of the subsidy, and BRT transports 2% of total daily passengers and absorbs 38% of the subsidy. Offhandedly, this suggests MyCiTi's subsidy absorption as too high, and the MBT industry's as too low.

Figure 4.2: Comparative Passenger and Subsidy Absorptions by Mode



*author's calculations

Table 4.2 below presents cross-modal analysis of subsidy efficiency. At the outset, it is important to note the limitations of these comparisons when taken out of context, but they provide useful insight into the inefficiency of the current distributive arrangement, and the disruption caused by the industry transition.

Table 4.2: Between-Mode Subsidy Efficiency Comparison

Efficiency Comparison Table[10]	Contracted Bus (Gabs, Sibanye)	Informal (Minibus-Taxi)	BRT (MyCiTi)
Contracted Bus (Gabs, Sibanye)		0.024	13.84
Informal (Minibus-Taxi)	40.38		559.13
BRT (MyCiTi)	0.072	0.001	

*author's calculations

The table cross-compares each mode in terms of their daily passenger subsidies. It reads that for every R1 of operating support received by contracted busses, the informal MBT industry requires R0.024 and BRT R13.84 of operating support to achieve the equivalent passenger efficiency. Without taking these statistics out of context[11], the table outlines the degree of current imbalance. For example, whist the MBT industry does not produce a service that is 560 times "better" than MyCiTi; it produces one that is 560 times more subsidy-efficient – when judging efficiency by passenger numbers. It also allows an ordinal ranking of the modes by subsidy-efficiency, and it is clear that MyCiTi's service and cost-structures distort the subsidy efficiency of the system overall. Whilst this imbalance is likely to correct as the MyCiTi rollout continues, only a monumental increase in BRT usership will allow it to be financially viable in absence of the PTISG. Realistically, as the system is forced to rely less on the PTISG for operational support, the City will be forced to dig deeper into its "council funds", thus diverting these funds from other functions.

Section 2: Affordability Analysis of Cape Town Road Public Transport

As is understood, Cape Town's context dictates a road based public transport system dependant on subsidized operating support. However, this does not mean that these subsidies improve affordability (Venter & Behrens, 2005). In turn, section investigates whether the current system is affordable. If analysis reveals affordability to be an issue, there is a need to explore ways to improve the distributional consequences of the subsidy.

As noted in Chapter 1, the standard Affordability Index is inherently limited, and is difficult to calculate reliably in the absence of clean household income and expenditure data. As such, the Carruthers, Dick

[10] Efficiency Calculation is taken as (DailyOppSub/DailyPass) of Mode B, divided by (DailyOppSub/DailyPass) of Mode A. Table reads as Contracted Busses are 13.84 times more passenger efficient than BRT for every R1 of Daily Operating Subsidy, etc.

[11] An important caveat of this cross-modal comparison is the difference in objectives and operating environments. One objectives of BRT is to shift private cars users onto BRT. In order to encourage new public transport users from the upper-end of the income spectrum, BRT must compete with the transport characteristics of the private car. It is important to understand, therefore, that this means developing a superior service to what exists, and that this is inherently more expensive. Another objective is to encourage densification along routes, and to address some of Cape Town's spatial inefficiencies. Thus, the BRT system is considered critical to Cape Town's larger development goals – with short-term operating inefficiency believed a worthwhile investment in the long-term sustainability of the road public transport sector. In the same breath, the efficiencies achieved by the informal MBT industry are the product of their informality. MBTs are unscheduled and unregulated, are known to overload, and often select pickup and dropoff points at random. This flexible operating environment allows a greater influence on their revenues and profits. As a result, the efficiency data is likely to be skewed upwards in the case of BRT, and downwards in the case of the informal MBT industry.

and Sauker (CDS) Index is considerably more appropriate for this analysis – especially considering the endemic inequality and economic segregation in Cape Town. This section measures the affordability of Cape Town road public transport system by calculating the CDS Index across various household income percentiles and areas, providing a composite understanding of the spatial and social components of affordability.

2.1 The Affordability Index[12] and the CDS Index[13]

As noted in Chapter 1, the standard Affordability Index calculates the percentage of monthly income devoted to transport consumption by households; comparing this percentage to a benchmark level set at 10% (Estupinan et al., 2007, Venter & Behrens, 2005). The Affordability Index then measures the percentage of households in the population that exceed this benchmark. This measure is not specific to public transport, but transport in general, and is poor at assessing affordability for the income poor.

Accurately calculating the standard Affordability Index is challenging for this thesis for a number of reasons. Firstly, there is a lack of clean data on household transport expenditure across different user and income groups, and secondly, it would require a number of assumptions about the consumption patterns of these user groups. As noted in Venter (2011), the poor often pay more per public transport trip than their rich counterparts due to the location of the poor in the urban periphery – resulting in higher absolute fares (Venter, 2011). This suggests that using transport expenditure as an indicator for affordability can be misleading as low observed trip rates of the poor lead to unreasonably low ratios of transport expenditure to income (Venter, 2011). Thus, the validity of over-segmented data using the Affordability Index comes into question.

As discussed in Chapter 1, the CDS is more appropriate for segmentation as it calculates affordability against tailored trip-bundles, not reported consumption. In the absence of clean data, the transport expenditure to income ratio can also be calculated at the mean (see Diaz Olvera, et al. (2004), cited in Venter and Behrens (2005)), but this is less interesting in a highly segmented. The CDS Index, therefore, provides a more appropriate measure of affordability for the Cape Town Context. It produces a measure representative of the percentage of monthly household income that a household would need to spend to ensure the consumption of necessary monthly journeys (Estupinan, et al., 2007). The index is specific to public transport, and is designed to control for the downward bias in reported transport consumption by poor households.

In the case of South Africa, determining necessary monthly journeys by a base of 60 trips is high given the complexity of the urban poor's consumption needs. As a result, this analysis will treat 60 monthly trips as an upper boundary, 30 as a lower boundary, and 45 as the midpoint.

The affordability investigation utilises household income data from the Census 2011 dataset, published tariff data for Standard Busses and BRT, and a combination of www.taximap.co.za and a user interview for MBT informal tariff data[14]. In the estimation of the CDS Index, the numerator calculates the per-household monthly costs of making necessary monthly journeys, and the denominator is a measure of household income. In turn, the calculation below takes the approach of estimating the numerator and

[12] Defined in Chapter 1, Section 3.1.1
[13] Defined in Chapter 1, Section 3.1.3
[14] It is important to note that using data from separate sources, during different periods, can limit the accuracy of findings. Measuring affordability using data from a single survey would be preferable.

denominator separately. It derives the CDS Index for the Cape Town Metro and its 9 Districts at chosen percentiles, for each trip bundle.

2.2 Measuring Affordability in Cape Town: The CDS Index

2.2.1 Deriving the Numerator

The CDS Index requires a price estimate for an average 10km trip on road public transport. Both BRT and Standard Busses utilize a distance-based targeting mechanism, to varying degrees. In this sense: the further the trip, the more subsidized the travel – irrespective of demography. MBT fares are non-standardized, but also apply an ad-hoc distance component to fare setting.

Using the modal split model, once can ascertain that Standard Busses share 41.9%, BRT shares 3.3%, and the MBT industry shares 54.8% of total daily passenger trips. The table below estimates the mean price of a 10km trip for road public transport users[15].

Table 4.4: Average Price per 10km trip by Mode

Mode	Average Price (10km trip)	Modal Split
Standard Busses	R9.30	41.9%
BRT	R6.52	3.3%
MBT Industry	R8.06	54.8%
Amended average	R8.51[16]	100%

*Appendix C1, author's calculations

Using the calculated average price for a 10km trip of R8.51, the average price for necessary monthly public transport journeys is detailed in the table below, according to three trip metrics[17].

Table 4.5: Average Monthly Transport Expenditure by Trip-bundles

Monthly 10km trips	Monthly Transport Expenditure (R8.51 per trip)
30	R255.30
45	R382.95
60	R510.60

*author's calculations

2.2.2 Deriving the Denominator

Income levels for the Cape Town Metro and Districts were augmented from Census2011 income data. Because the data was collected by income bracket and suburb, this data was required to be reworked to an appropriate scale. Firstly, this data was captured summatively by district, and secondly, was used to estimate exponential Income Distribution Functions (IDFs) to capture the income distribution across households.[18] The use of these IDFs allowed for the estimation of household income levels at various percentiles, and thus provided the necessary income data for calculation of the CDS Index. Note that reported income by households is categorised firstly into income and no income households, and secondly, income households were categorised by income bracket. The data used for the CDS index

[15] The full calculation of average price per 10km trip is available in Appendix C1

[16] Average 10km trip taken as: R9.30*41.9/100+R6.52*3.3/100 + R8.06*54.8/100= R8.51

[17] Note that these are single trips such that 60 trips is equivalent to 30 return trips, and so forth

[18] The derived IDFs are available in Appendix C2

deals only with households with reported incomes as the inclusion of no income households would greatly distort the calculated IDFs.

Table 4.6: Household Income Levels for Cape Town and its 9 Districts at Chosen Percentiles of the Income Distribution

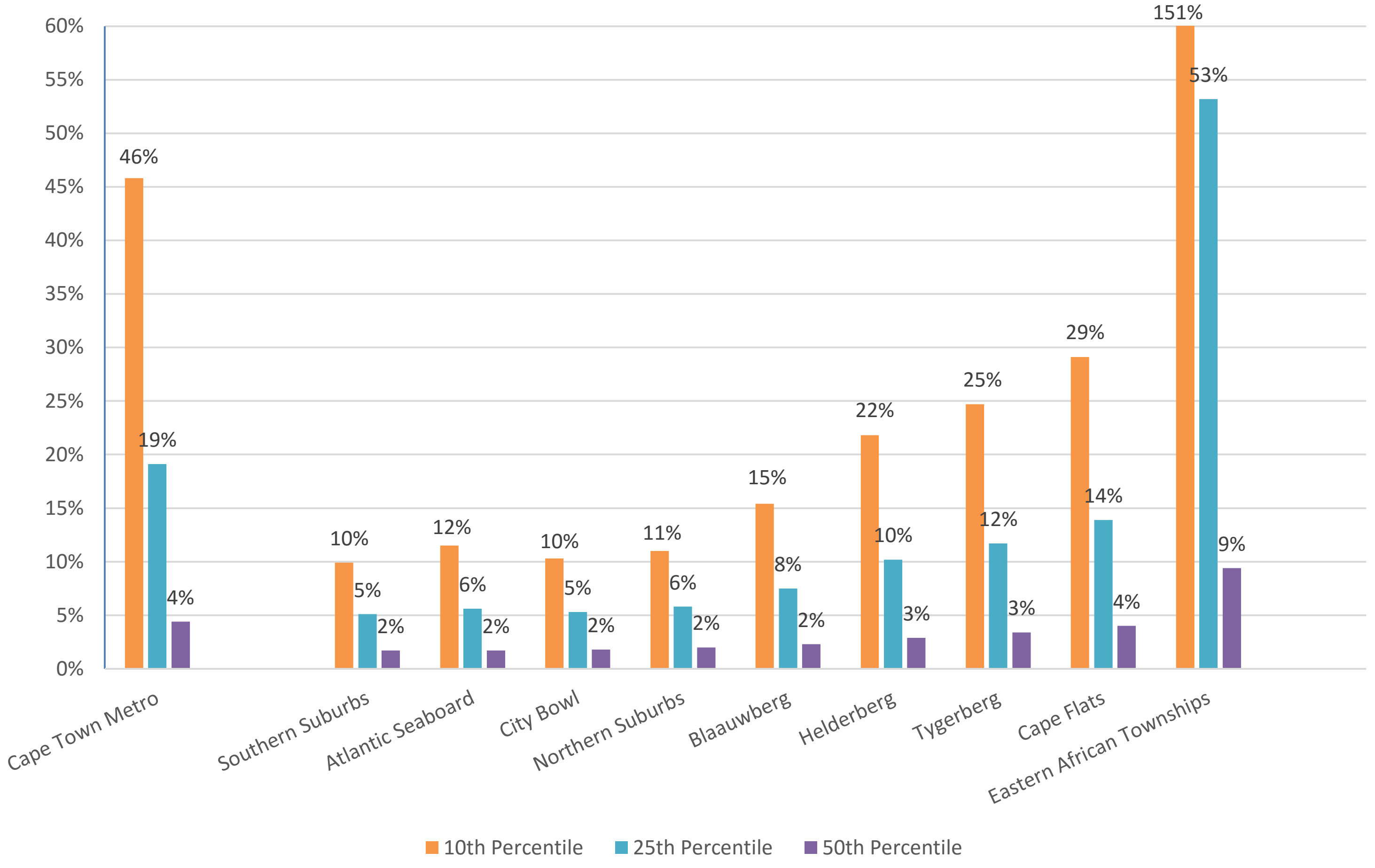
Region	10%	25%	50%
Cape Town Metro	R834	R2001	R8594
Southern Suburbs	R3845	R7529	R23074
Atlantic Seaboard	R3330	R6831	R22622
City Bowl	R3717	R7203	R21694
Northern Suburbs	R3462	R6559	R19027
Blaauwberg	R2481	R5089	R16853
Helderberg	R1755	R3760	R13390
Tygerberg	R1548	R3267	R11346
Cape Flats	R1313	R2755	R9474
Eastern African Townships	R254	R718	R4060

*Census2011 Data, author's calculations

2.2.3 Index Calculation and Interpretation

This analysis develops the CDS Index for the Cape Town Metro and its 9 Districts at the 10%, 25% and 50% level, according to the metric of 30, 45 and 60 monthly trips. Intuitively, as the trip metric is linear, there will always be a higher percentage of the population below the affordability threshold at the 60-trip metric than the 45, and so on. The full breakdown of the CDS Indices are available in Appendix C3. The CDS Indices for Cape Town Metro and its 9 Districts at the 45 monthly trip bundle are captured in Figure 4.3 below, which is led by the discussion. Important to note in interpretation is where the acceptable affordability thresholds fall. The CDS Affordability threshold is set at 10% overall, and at 15% for the lower decile. This is to say that a CDS Index of 12.5% at the 25th or 50th percentiles is deemed unacceptable, whilst at the 10th percentile is deemed acceptable. The labels on the graph indicate the percentage of household income required to consume 45 public transport trips per month – a trip bundle representative of household-level necessary monthly journeys.

Figure 4.3: CDS Indices of Cape Town Metro and its 9 Districts (%), 45 Monthly Trip-Bundle



*author's calculations

CDS Index at Median (50%) level

At the median level of the household income distribution, the CDS Indices indicate that road public transport is acceptably affordable for households in the Cape Town Metro, and within its 9 Districts. In fact at the 50th percentile, only in the Eastern African Townships, for a monthly allocation of 60 single (or 30 return) trips, does the CDS index exceed the 10% benchmark. This finding reflects the fact that in highly unequal societies, median-level affordability analysis can mask the true state of transport affordability.

CDS Index at Lower Quartile (25%)

When measuring at the 25th percentile of the household income distribution, the CDS Indices indicate that road public transport is less affordable for households. In Cape Town Metro, public transport is unaffordable for the lower quartile across all three trip-bundles. Due to the unequal distribution of wealth in the city, the more marginalised Districts drive this phenomenon. As is evident, households at the 25th percentile in the five highest-income Districts (Southern Suburbs, Atlantic Seaboard, City Bowl, Northern Suburbs and Blaauwberg) find road public transport affordable.

On the other hand, road public transport in the Helderberg, Tygerberg and Cape Flats Districts is unaffordable for 45 and 60 trip-bundles, and in the Eastern African Townships it is highly unaffordable across all three. Due to the budget constraint complexity facing the poor, households need to weigh up the importance of mobility against a multitude of other everyday needs for survival. If 45 monthly trips amount to 53% of monthly household income, transport and its associated benefits would be considered a luxury good relative to other daily needs.

CDS Index at Lower Decile (10%)

Finally, at the 10th percentile of the household income distribution, Cape Town and its Districts return extremely high CDS Indices. For the lower decile, the Armstrong-Wright and Thiriez threshold rises to 15% (Estupinan, et al., 2007). Overall, the Cape Town Metro CDS Index is above the 30% level for all three trip-bundles. When broken down by its Districts, one can again deduce that the high observed CDS Indices are driven by the city's poorer regions. Whilst the Southern Suburbs, Atlantic Seaboard, City Bowl and Northern Suburbs all report sub-15% CDS Indices, Blaauwberg's bottom 10% of households now fall into the unaffordable range for the 45 and 60 trip-bundles. This is probably due to its poorer outlying suburbs such as Mamre and Atlantis.

In comparison, all four of the Cape Town Metro's poorest Districts report critically high CDS Indices in excess of 15%. Blaauwberg, Helderberg and Tygerberg fall within 10% of the acceptable 15% benchmark, whilst the Cape Flats CDS Index is roughly double this.

The Eastern African Townships District, on the other hand, stands alone in contrast. The CDS Index of its lower 10% is staggeringly high at over 100% across all three trip-bundles, and at 151% for 45 trips. This is to say that, for the lower 10% of households, 30 monthly trips are not only expensive, but impossible. Targeting these lower four Districts should therefore be considered a critical determinant of how the road public transport subsidy is designed – with preferential attention being given to the Eastern African Townships.

Section 3: Distribution Analysis: Approach and Assumptions

This section outlines the approach and assumptions that underpin the subsidy distribution analysis that follows.

3.1 Constructing a Transport Affordability Line for Income Households

As a departure point, one needs to identify the targeted segments of subsidy beneficiaries. Motivated by the social redistribution argument, these are those population segments most in need of subsidy support. To do so, we identify the percentage of the population for whom transport is unaffordable. By using the Armstrong-Wright and Thierez benchmark adopted by the DoT of 10% affordability (Venter & Behrens, 2005), one can calculate a "Transport Affordability Line" that measures the threshold household income level required to make 45 monthly trips. Households earning less than this threshold income level will exist below the Transport Affordability Line (TAL) and are considered intended recipients of subsidy benefits. Those households earning above the TAL are considered unintended recipients.

By this methodology, if 45 monthly 10km trips cost on average R382.95, then all those earning below the monthly income for which this is 10% (R3829 per month or below) would be considered to live below the TAL. The table below makes use of the Income Distribution Functions (IDFs) derived from Cencus2011 household income data to determine the percentage of households that fall below this mark.

Table 4.7: Household Income Percentiles earning at the TAL in Cape Town Metro and its 9 Districts

Region	Household percentile at TAL (excl. no-income)
Cape Town Metro	36.1
Southern Suburbs	9.8
Atlantic Seaboard	12.8
City Bowl	10.6
Northern Suburbs	12.3
Blaauwberg	19.0
Helderberg	25.3
Tygerberg	28.1
Cape Flats	31.6
Eastern African Townships	49.1

*author's calculations

Within the Cape Town Metro, households positioned at the 36.1th percentile and below earn R3829 per month or less – and thereby fall below the TAL. The disseminated TALs by District provide an indication of the geographic spread of intended transport subsidy recipients across the city. These numbers are again a powerful indicator of system dysfunction. Even when only accounting for households with reported income, 36.1% of them cannot afford necessary transport journeys every month in the metro. When no-income households are included, the TAL will shift further along the household income distribution.

3.2 Errors of Exclusion and No-income Households

As the IDFs do not include no-income households, they underestimate the TAL. The reason no-income households were excluded from the affordability analysis is that the CDS Index cannot be calculated for households with a reported monthly income of zero. Distribution analysis, however, requires the household income distribution to incorporate both income and no-income houses so that errors of exclusion can be measured.

As only households that with a monthly income (informal/formal employment and/or grant income) are able to consume transport, only these households can benefit from the subsidy. Conversely, the 13.7% of total Cape Town Metro households reporting no income are structurally excluded from subsidy benefits. The TAL for earning households (36.1%) must therefore be extended to incorporate no-income households. In recognition of this, the TAL used in the distribution analysis expands to 49.8% to include no-income households.

3.3 Allocating the Relative Benefit of the Subsidy

Another point of contention is how to measure the way the benefit allocates across the household income spectrum. Golden Arrow's 2012 Customer Satisfaction Survey provides the income breakdown of its users. This study comprised a comprehensive user survey, conducted by four authors affiliated to the Cape Peninsula University of Technology Department of Mathematics and Physics. The report surveyed 2472 users at each of Gab's five major termini: Khayalitsha, Mitchells Plain, Killarney, Cape Town, and Bellville (Farmer, et al., 2012).

This information was unavailable for customers of Sibanye, the MBT industry and BRT. As a result, this paper was forced to make significant assumptions to allow distribution analysis. As Standard Busses and the MBT industry both developed to serve demographics that could not afford private cars, suffered from constrained mobility, and generally originated from the same areas, racial and income groups, they are assumed near perfect substitutes. As such, Standard Busses and MBT industry will adopt the passenger breakdown of Golden Arrow (Farmer, et al., 2012), and this breakdown will be applied and allocated across the households of the Cape Town Metro. Even though modally based household survey data is preferable, the passenger income data of the Farmer et al. report was the most extensive income breakdown of Standard Bus users that could be sourced.

On the other hand, the MyCiTi BRT serviced non-traditional regions in that its rollout prioritised regions of undersupply. Furthermore, at the end of the 2012/13 operational period, comprehensive BRT passenger data was not available. As such, the paper made the assumption that the BRT subsidy is evenly distributed across the households that comprise its service area. As this assumption is significant, accurate survey data of income breakdown of BRT passengers across its service areas would serve to greatly enhance and validate this investigation.

The BRT system utilizes a system of distance-based cross-subsidization. Because this effect is not calculable by income group, however, the benefits of cross-subsidisation are also considered evenly shared across the households that comprise its service area. The included Districts are the City Bowl, Atlantic Seaboard and Blaauwberg, as well as five suburbs within the Southern Suburbs: Llundudno, Hout Bay, Imizamo Yethu, Woodstock and Salt River.

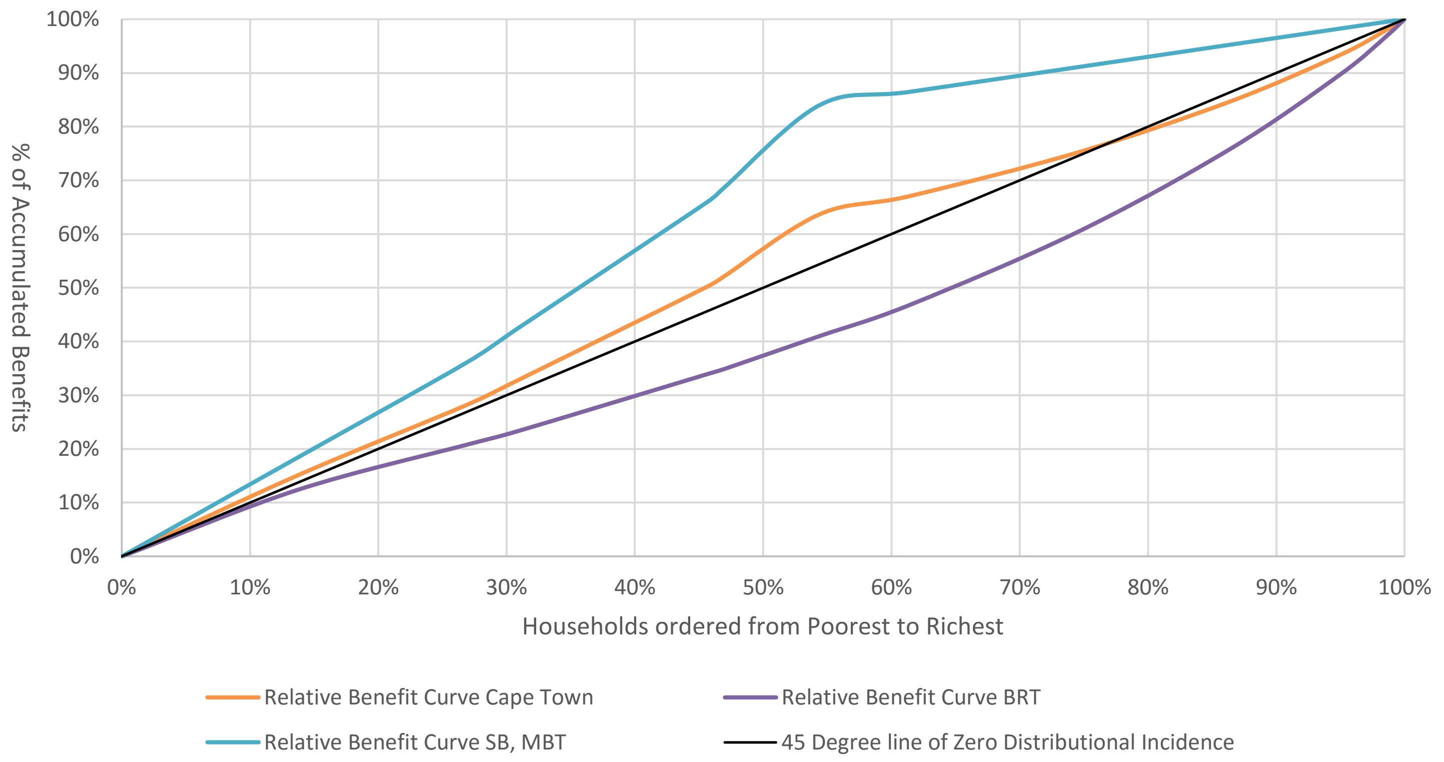
This distribution analysis is cross-sectional, and is specific to the 2012/13 operational period. As the rollout continues, this distributional analysis would be enhanced by a more dynamic time-series approach as and when the data is generated.

Section 4: Distribution Analysis for Cape Town Road Public Transport

4.1 Relative Benefit Distribution Curve

The Relative Benefit Curve[19] (RBC) graphs the manner in which the benefit of road public transport subsidy is shared across Cape Town's household income distribution.

Figure 4.4: Relative Benefit Curve of Cape Town's Subsidy Distribution



*author's calculations

The figure graphically depicts the distributional effects of Cape Town's public transport subsidy across the household income spectrum. As is evident, Cape Town's subsidy is progressively distributed where it is above the 45 degree line of neutral distributional incidence. It then crosses the 45 degree line at the household ranked at the 75% mark, and distributes the final 25% of the subsidy regressively. Overall, therefore, the subsidy is marginally progressive.

Methodologically, the Cape Town RBC is the summation of the BRT RBC and the Standard Bus and MBT RBCs. By plotting the three RBCs on the same axis, one can develop an understanding of BRT's impact on the transport subsidy. Whilst the SB, MBT RBC is representative of the way its share of the operational subsidy is distributed, it is also a near perfect correlate of what Cape Town's RBC would have looked like prior to the industry transition. As has been found, the PTOG was highly progressive pre-BRT through the set of circumstantial conditions in which it developed. The SB, MBT RBC distributes 85% of the subsidy to the poorest 55% of households. The BRT RBC, however, distributes 42% of the subsidy to the poorest 55% of households.

[19] Defined in Chapter 1, Section 3.2.1

Once the BRT and SB, MBT RBCs are integrated together to define the Cape Town RBC, the distributional consequences of the road public transport subsidy becomes more regressive – with the RBC shifting closer to the neutral 45 degree line. In Cape Town overall, 64% of the subsidies accrues to the poorest 55% of households.

4.2 Quasi-Gini Coefficient

The Quasi-Gini Coefficient[20] is a summary statistic that reduces the distributional incidence of a subsidy to a single number (Estupinan, et al., 2007). The closer to -1 is the Quasi-Gini Coefficient, the more progressive is the policy, and the closer to 1, the more regressive.

$$QGini_{Cape\ Town} = -0.042$$

$$QGini_{SB,MBT} = -0.259$$

$$QGini_{BRT} = 0.319$$

Cape Town's Quasi-Gini Coefficient indicates – and indeed, confirms – what we already knew: that it is overall marginally progressive, and is derived as the summation of the distributive impacts of Standard Busses, the MBT industry and BRT. In turn, the difference between the Cape Town QGini and the SB, MBT QGini reflects the "significant and regressive impact of industry transition on the distributional consequences of the Cape Town road public transport operating support". In short, this QGini concretises the finding that the processes of industry transition have regressively impact the share of subsidy benefits between Cape Town households, increasing its Quasi-Gini Coefficient from -0.259 pre-BRT to -0.042 post-BRT.

4.3 The Ω Statistic

The Ω Statistic[21] measures the percentage of a subsidy accruing to targeted households as a proportion of the percentage of the total population represented by targeted households (Estupinan, et al., 2007). If Ω>1, the subsidy is progressive, and if Ω<1, it is regressive.

In this analysis, the Transport Affordability Line (TAL) denotes the threshold between targeted and non-targeted households for subsidy benefits. The TAL is defined at the 49.8th percentile of the Cape Town household income distribution, and at a monthly income of R3829 per month.

$$\Omega_{Cape\ Town} = 1.145$$

$$\Omega_{SB,MBT} = 1.506$$

$$\Omega_{BRT} = 0.743$$

Cape Town's Ω Statistic subsects the SB, MBT and BRT Ω Statistics at close to their midpoint, reemphasising BRT's distortional absorption of the subsidy - especially given its market share of 3.3%. More interestingly, however, is that the Ω Statistic measures the degree to which the subsidy targets the beneficiaries it is intended for. In cross-modal comparison, the SB, MBT Ω Statistic indicates that these modes are twice as effective at targeting those living below the TAL that BRT.

[20] Defined in Chapter 1, Section 3.2.2
[21] Defined in Chapter 1, Section 3.2.3

This suggests two things. Firstly, the City's decision to prioritise geographic areas of undersupply for the phased BRT rollout impacted the BRT Ω Statistic downwards. As the pre-BRT system serviced low-income areas, this meant that areas of undersupply were high-income areas. As a result, investments in IRT development via the PTISG were concentrated in high-income areas – upsetting the overall distributional consequences of the subsidy. Correspondingly, this precluded the intended subsidy beneficiaries from subsidy benefits. This means that, by design, the early phases of BRT rollout were always likely to regressively impact the targeting of households below the TAL overall, and in turn would produce an underwhelming Ω Statistic.

Secondly, the BRT Ω Statistic suggests that its subsidised operating support benefits a large proportion of households for whom public transport is already affordable. This is problematic in that the primary mechanism that it uses to target subsidy beneficiaries – a stepped, distance-based cross-subsidisation system – is failing to target the poor. As the rollout continues, this phenomenon should reduce as BRT A) reaches a wider variety of households on the income distribution, and B) encourages the kind of inner-city densification that will help reduce the overall inefficiencies of road public transport.

4.4 Errors of Inclusion and Exclusion

The errors of inclusion and exclusion[22] measure the degree to which benefits leak to unintended recipients.

4.4.1 Errors of Inclusion (EoI)

Errors of inclusion record the percentage of households that receive the benefit, but do not fall below the TAL.

$$EoI_{Cape\ Town} = 50.4 \quad (1)$$

$$EoI_{SB,MBT} = 28.9 \quad (1)$$

$$EoI_{BRT} = 71.3 \quad (1)$$

Over and above the fact that the BRT has a very high EoI statistic – over 71% of its benefits accrue to households earning above the TAL – the impact of industry transition of EoI in the system overall is marked. If 50.4% of households benefitting from the transport subsidy earn above R3829 per month, then this confirms that the problem of affordability is one of allocation failure. Because BRT is both pegged to existing tariffs, and more expensive to run than the other modes, it has greater subsidy needs. This renders the BRT system's share of the subsidy inconsistent with its share of passengers. As the BRT system has far fewer beneficiaries than the other modes, its users receive a higher individual benefit than do the users of other modes.

This is a salient point when understanding EoI. As the EoI is an indicator that qualifies a household as a beneficiary through its inclusion in the system, it fails to differentiate between a household that receives double the benefit of another. The BRT system's impact on the distributional consequences of the subsidy overall, has been to distort the equitable share of benefits between households, rather than to greatly upset the absolute ratio of beneficiaries below and above the TAL.

[22] Defined in Chapter 1, Section 3.2.4

4.4.2 Errors of Exclusion (EoE)

The Errors of Exclusion is a measure of the percentage of households below the TAL that fail to receive any benefits – despite the fact that they qualify. This paper is assuming that only no-income households (households reporting zero employment or grant income) are excluded from road public transport subsidy benefits entirely.

$$EoE_{Cape\ Town} = 27.5 \qquad (2)$$

$$EoE_{SB,MBT} = 27.5 \qquad (2)$$

$$EoE_{BRT} = 24.9 \qquad (2)$$

These EoE estimates suggest three departures from previous indicators. Firstly, the variation between modes is less pronounced. Secondly, BRT has the most progressive EoE estimate of the three due to the lower percentage of no-income households in its service areas. Thirdly, all three EoE estimates are very high, and reveal a critical failure of the current road public transport subsidy.

That all three estimates are so high is an indication that issues of exclusion existed prior to the industry transition, and is driven by Cape Town's endemically high levels of unemployment. Of the total number of households in Cape Town, 13.7% report zero employment or grant income. Due to the fact that some unemployed households report grant income, the true number of unemployed households in Cape Town would exceed this 13.7% mark. There no-income households are excluded from grant benefits, road public transport subsidy benefits, and in turn, economic opportunities.

That no-income households comprise 27.5% of households below the TAL in Cape Town suggests a critical failure of the system. The issue has two interdependent sides. Because no-income households have no source of income, they cannot access the subsidy benefits of the transport system, and because no-income households cannot access the transport system, they are unable to improve their income status via employment. Thus, the system is flawed in that by failing to target no-income households, it implies the structural exclusion of 27.5% of households below the TAL.

Chapter 4 Conclusion

This chapter engaged in efficiency, affordability and distribution analysis for Cape Town's road public transport system, and its subsidised operating support. The efficiency analysis revealed that the modal absorption of road public transport operating support, and the efficiency of its use, has been greatly distorted by the industry transition. The MyCiTi BRT is the least subsidy efficient of the three modes, requiring at least 13 times as much daily passenger subsidisation in 2013 as the other modes.

The key outcome of the affordability analysis is that when one examines lower percentiles of the household income distribution, and hence the poor, households face transport costs for their necessary monthly journeys that are beyond the critical range of acceptability and sustainability. Put simply, transport pricing, market composition and the very structure of the road public transport system in Cape Town is becoming increasingly anti-poor. This analysis also highlights the fact that in high-poverty regions, reported transport consumption is an inappropriate tool for affordability analysis. In the absence of segmented household income and travel data, the CDS Index is a useful alternative to the traditional Affordability Index. Furthermore, in regions of high inequality, there are huge contrasts in earning power between the upper-50% and lower-50% of the income distribution.

This contrast is of crucial importance to subsidy design. As the poor comprise such a large proportion of the population, a transport system that is not geared towards the poor is a transport system not geared towards the majority.

The analysis of the distributional consequences of the Cape Town road public transport subsidy, although static, reveal that the initial roll-out phases of MyCiTi have radically reduced the progressivity of the subsidy. The distorted appropriation and phased investment of newly allocated road public transport funds have neutralised the incidence of operating subsidies in the sector. Furthermore, it reveals that the ability of the subsidy to target households who find necessary monthly journeys unaffordable is undermined by the failure to allocate benefits to no-income households. This finding highlights the need to review the current design of the subsidy – with emphasis on the need to reduce the exclusion of no-income households. In an attempt to control for some of these observed subsidy weaknesses, Chapter 5 designs and simulates an alternative subsidy framework for Cape Town by reorienting it to the demand-side.

Chapter 5: Designing and Simulation Cape Town's New Subsidy

This final chapter designs an alternative road public transport subsidy framework for Cape Town, and simulates its distributional consequences. The simulation compares the subsidy distribution of the new subsidy to the current model in order to gauge its potential impact. Section 1 applies the Estupinan, et al. framework for subsidy choice to the Cape Town context in order to formulate an appropriate policy combination for the city. Section 2 defines the approach and assumptions of the simulation, while Section 3 conducts the simulation itself.

Section 1: Designing the Subsidy Framework

This section compares the available policy options to Cape Town's contextualised needs, and theorises the policy combination for the new subsidy.

1.1 Targeting Properties

The main reason supply-side subsidies are poorly targeted is because they fail to discriminate between different categories of beneficiaries. Because Cape Town's subsidy effectively enforces a blanket price reduction, all households using road public transport receive an equivalent subsidy irrespective of income. Despite this, because road public transport evolved to service low-income users, poor households benefited by default. Following industry transition, however, the subsidy also accrues to high-income households, eroding the ability of the subsidy to target households below the TAL. Demand-side subsidies have a greater ability to target poor households in that they carry specific eligibility criteria and screening mechanisms.

When applying the literature to Cape Town, three points emerge. Firstly, a subsidy that targets the poor through procedures of means-testing is viable in Cape Town given its established and growing social welfare infrastructure. Secondly, there is scope to cross-subsidise the city's transport system through an improved distance-based pricing scheme given the peripheral orientation of low-income districts. Thirdly, because of Cape Town's economic segregation, if the subsidy can effectively target specific geographies, it will be able to effectively target by income.

1.2 Inducing Productive Efficiency

Influencing productive efficiency is another important consideration for the design of the new subsidy. Shifting the operational subsidy from the supply-side to the demand-side will not necessarily influence the degree to which an operator's services are subsidized. It will however affect the dynamics of the demand for the service. There is reason to believe that supply-side subsides reduce operational productive efficiency (Estupinan, et al., 2007), and thus by reducing an operator's dependence on operational support, it could lead to a streamlining of operations (Freemark, 2011).

In parallel, Obeng and Sakano (1997; 2000) show that capital and infrastructural support can actually increase an operator's productive efficiency (Estupinan, et al., 2007). This implies that the current PTISG subsidy comprises a necessary component of the transport subsidy, and is therefore important to retain. As the City of Cape Town is utilizing significant portions of the PTISG as operating support for the IRT rollout, its role has blurred - and will continue to be until the full rollout is complete. If the portion of the PTISG utilised as operating support is retained after full rollout, it can be redirected toward the new subsidy orientation.

When adjusting to a new subsidy model, it is important to limit any negative externalities. Operators will need time to restructure their business models to cope with the changing dynamics of demand, and have historically displayed resistance to change of any kind. It would thus be unwise to implement the entire alternative subsidy model immediately; with a system of time-based incremental implementation better to ensure a smooth transition.

1.3 Subsidy Funding Mechanisms

Currently, the subsidy is funded by a variety of taxes from a variety of sources. In short, these sources are the PTISG, the PTOG, the TRP, and Council Funds. Estupinan, et al. suggest that as all taxes are associated with deadweight loss, transport subsidies should be funded by taxes that generate the least (Estupinan, et al., 2007). In turn, the suggested blueprint is to prioritise national taxation over local taxation. It is important to note that these findings are in context of single-source funding, and the paper fails to address the benefits of a differentiated funding-mix. Further, subsidies are more sustainable when the regulating authority (the CoCT) has complete discretion of the network (Dawood & Mokonyama, 2015). Thus, the major funding innovation would be to shift control of all levels of funding and implementation to municipal level – thereby devolving control from national and provincial government to the municipality.

Cross-subsidisation is another important mechanism of subsidy funding. A pure flat-fare approach would require the industry to be regulated to a degree that has not yet been attempted. Given that the high fragmentation of the market make flat-fares impractical, they can only be considered seriously once BRT is further rolled out. Alternative cross-subsidies, however, function feasibly through geographic and distance-based schemes.

In terms of risk management, Council Funds play an important role. As long as the City is able to balance BRT subsidisation needs between Council Funds and the PTISG, it retains an important degree of autonomy in the planning process. Reducing absolute reliance on national funding means that it has greater certainty of funding for future phases of the rollout. As the future of the PTISG is unclear, diversifying associated risks reflects responsible public planning.

1.4 Administrative Costs

Controlling the administrative costs of transport subsidy distribution is another factor. Supply-side subsidies are the easiest and cheapest to implement, while demand-side subsidies generally involve more complex transfer instruments with higher costs (Estupinan, et al., 2007). Because Cape Town is entering a digital phase and has comprehensive social security infrastructure already in place, it is foreseeable that a demand-side shift could abate administrative costs. Cape Town's clearly defined economic geographies also allow for reduced costs of cross-subsidised distance and geographic targeting.

The administrative costs of implementation will be further eased by the practicality of devolving all regulating and planning authority to the municipal sphere.

1.5 Formulating the Best Subsidy Option for Impact Analysis

The most appropriate road public transport subsidy for Cape Town will be a weighted combination of the options above. The new subsidy framework must be designed to improve the social impact of subsidisation by better targeting households below the TAL – including no-income households. It must also factor components that encourage increased economic efficiency and balance the service incentives of the various modes. The design challenge is to incorporate these needs into a single, functional system.

In constructing the alternative subsidy framework, the only supply-side transfer worth retaining is the capital and infrastructure funding components of the PTISG. The remainder of subsidised funds should target beneficiaries through a combination of geographic and distance-based cross-subsidisation and instrumented means-testing. The subsidy must also incorporate components that balance service incentives between long and short routes, and ensure the subsidy distributes equitably between the households that benefit.

1.6 Geographic and Means-tested Targeting

Geographic targeting can be implemented in a number of ways. The current ticketing system, across all modes, utilises a distance-based system that arranges price as a diminishing function of distance travelled. There is no mechanism, however, that links actual operating costs with the fares charged (CSIR, 2001). As a result, there are wide discrepancies between the fares and services of different modes, and the travel constraints of households. This has led to subsidy misallocation (CSIR, 2001). The design challenge of the new subsidy framework is therefore to tie fares, operating costs and subsidy allocations into a cohesive system linked to affordability.

The most obvious method of administering a geographically targeted subsidy in Cape Town is by applying an income-based zonal system. Because the city is economically segregated by geographic districts, these are easily divided into zones according to the proportion of households below the TAL in each zone. These zones do not necessarily need to be arranged by distance from the Cape Town CBD, or other commercial nodes. For example, even if a district is further from the CBD than the Eastern African Townships, it will still be less subsidised if it contains fewer households below the TAL. In order to control service incentives, the new subsidy framework will also need to cross-subsidise by distance

Means-tested targeting can improve access to no-income households. The difficulty with targeting no-income households, however, is that it involves testing an unobservable characteristic. This issue is threefold: firstly, while it is easy to prove formal employment, formal unemployment documentation does not exist. Secondly, even if it did, individuals could be simultaneously formally unemployed and earning an unobserved income in the informal economy. Thirdly, a subset of technically unemployed households earn grant income. It is therefore inherently difficult to prove a household's status as no-income, and this complicates the delivery of a targeted grant.

The attribute that sets the proposed Job Search Assist Grant apart from existing grants, however, is that it does not involve a monetary transfer, and therefore carries lower externality risk. The reality is that 13.7% of Cape Town households - or 27.5% households below the TAL - are structurally excluded from road public transport subsidy benefits. This concept requires further research (see Rankin (2013) for a discussion on viability in South Africa), and presents an opportunity to investigate potential options for its implementation. Considering the centrality of this household segment to the premise of this paper – all caveats acknowledged – no-income households are considered partially accessible in the design and simulation of the new subsidy framework.

Section 2: New Subsidy Simulation: Approach and Assumptions

2.1 Methodological Approach

The “New Subsidy” framework for road public transport is the product of subsidy components found to be important to the Cape Town context. In adopting a zone-based system, Cape Town divides into 4 zones that group Cape Town Metro’s 9 districts by their transport subsidisation needs[23]. The subsidy is then allocated between these four zones according to four independent indicators: Distance, Affordability, Population, and Unemployment. These indicators essentially represent four different channels of cross-subsidisation. Distance cross-subsidises longer trips by shorter trips. Affordability cross-subsidises poorer zones by richer zones. Population cross-subsidises high-population zones by low-population zones. Unemployment cross-subsidises no-income households by income households. The ratio in which these indicators are weighted is flexibly adjustable, with the optimal ratio being that to achieve the most progressive distribution without undermining economic viability.

The weighting of indicators to channel the distribution of the overall subsidy is defined by the equation:

$$Subsidy\ Distribution_{Total} = aDist + \ bPop + cAff + dUnem$$

, where *a+b+c+d =1*

The allocation of subsidy benefits between each zone is defined by the equation:

$$Subsidy\ Benefit_{Zone\ 1} = \frac{Dist_{Zone\ 1}}{Dist_{total}} + \frac{Pop_{Zone\ 1}}{Pop_{total}} + \frac{Aff_{Zone\ 1}}{Aff_{total}} + \frac{Unem_{Zone\ 1}}{Unem_{total}}$$

Where, **Distance** *(Dist)* performs an economic role to balance the operational incentives of trip length. The measure involves the construction of a distance statistic that is a combined weighting of the distance between the CBD and the centre of each district, and the area of each district. The statistic is interpreted as the distance-related mobility needs of each zone. The final distance indicator apportions the distance-related mobility needs of Cape Town’s four zones as a percentage of Cape Town’s total distance-related mobility needs (defined as the summation of the distance indicators of the four zones).

Population *(Pop)* is important to ensure that the subsidy maintains an equitable distribution across all households in the city. The population indicator is a simple statistic, calculated as the percentage of Cape Town’s total households in each zone.

Affordability *(Aff)* is the indicator that drives the social impact of the subsidy, in that is serves the role of determining the relationship between socioeconomic need and the weighting of benefit. The affordability indicator is a statistic calculated as the percentage of Cape Town’s total households below the TAL that reside in each zone.

Finally, **Unemployment** *(Unem)* is an indicator in place to reduce errors of exclusion. The unemployment indicator calculates the percentage of Cape Town’s no-income households that reside in each zone. It is noted that the use of no-income households as a proxy for unemployment is imprecise as some unemployed households receive grant income. However, the unemployment

[23] Zone 1 - Atlantic Seaboard and City Bowl; Zone 2 - Southern Suberbs, Northern Suburbs and Blaauwberg; Zone 3 - Tygerberg, Helderberg and Cape Flats; and Zone 4 - Eastern African Townships.

variable is named as such due to its relationship to the job market, and its targeting through the means-tested Job Search Assist Grant.

2.2 Key Assumptions

A key assumption of the analysis is that the percentage of households that both earn in excess of R51200 per month (upper 4.95%) and consistently use public transport is negligible, and is treated as zero. In this sense, it assumes that all subsidy benefits distribute evenly between households earning R51200 per month or below (lower 95.05%). It is worth noting therefore, that this analysis is likely to underestimate the progressivity of the subsidy in that, given the available data, around 70% of current road public transport users earn below R5000 per month.

Another assumption regards the mapping of the four allocation measures across households. By using a zonal-approach, the paper uses the District-level household income data and IDFs - both calculated with Census2011 household income data - to define importance of each cross-subsidisation indicator to each zone. Thus, the assumption is that the correlations observed between income, unemployment and area are sufficient to allow accurate geographic targeting of households below the TAL.

The final assumption is that the theoretical concept of a “Job Search Assist” grant comprised of non-monetary transport vouchers – despite the technical challenges to implementation - is not only viable, but can also be done immediately. It assumes that if 5% of the subsidy is allocated to no-income households, then its benefits accrue to lower-5th percentile of the household income distribution (or the lower 36.5% of no-income households). It is important to note that this assumption is both ad hoc and speculative, and that the underlying premise of the Job Search Support grant requires a more rigorous investigation into its viability.

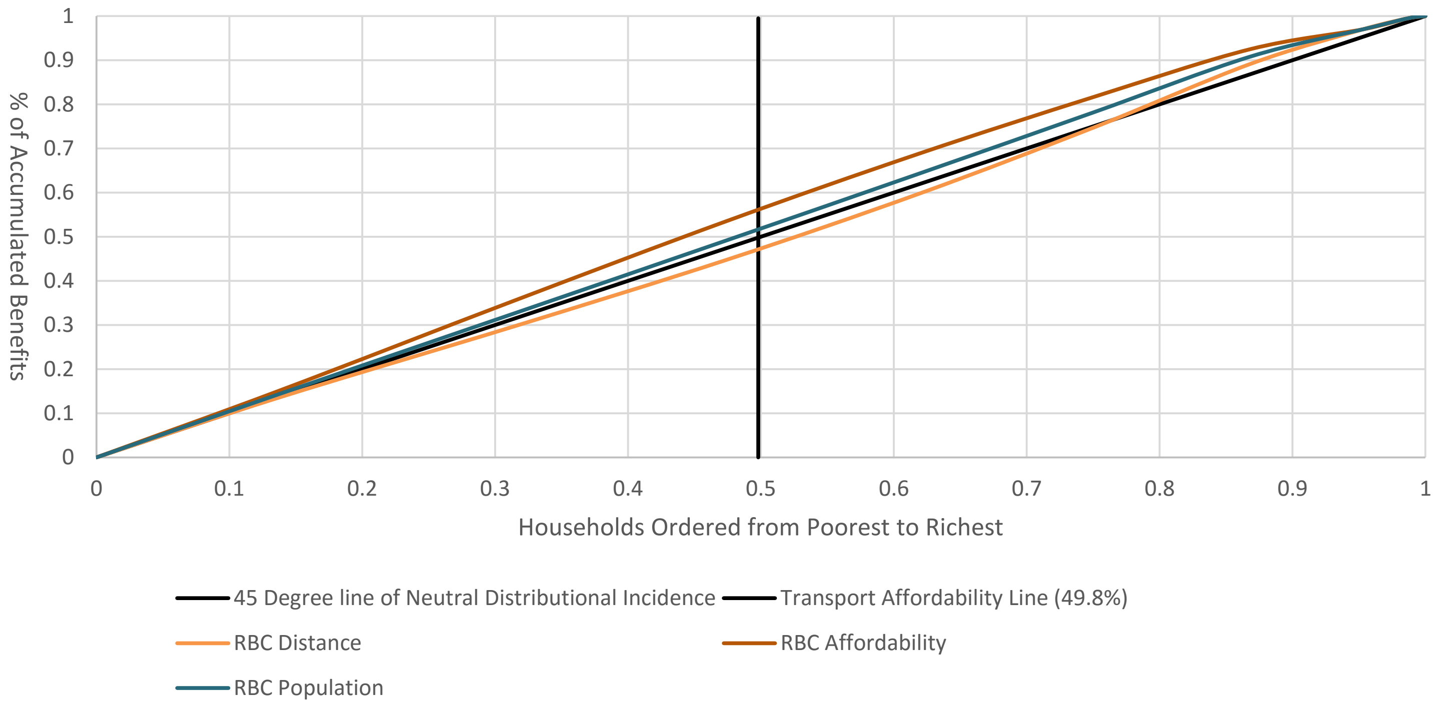
Section 3: Simulating the Distributional Impact of the New Subsidy

This section simulates the distributional consequences of the proposed new subsidy framework using the Estupinan, et al framework for distribution analysis.

3.1 Relative Benefit Curve by Indicator

This graph below investigates the distributional consequences of the three continuous variables of analysis: Distance, Affordability and Population. This approach allows the three variables to be ranked according to their pro-poor impact on distribution.

Figure 5.1: Relative Benefit Curve of Equity Indicators



*author’s calculations

Table 5.1: Descriptive Statistics of Equity Variables

	RBC Distance	RBC Affordability	RBC Population
QGini	0.014028	-0.0862247	-0.03621
Ω Statistic	0.943775	1.13453815	1.044177
EoI	0.614137	0.50405562	0.556199
EoE	0.2751	0.2751004	0.2751

*author’s calculations

Of the four derived indicators of the new subsidy, only Distance, Affordability and Distance are continuous functions over the entire household income distribution. Unemployment, on the other hand, affects only no-income households. In order to maintain the overall integrity of the subsidy, and to respect the independent function of each indicator, no variable will be allocated a weight of less than 5% of the total subsidy, regardless of its impact on the distribution.

By plotting the individual distributional impacts of Distance, Affordability and Population, we obtain an idea of their individual distributive qualities. Other than the individual roles they play in maintaining the overall functionality of the subsidy, one needs to understand their impact on overall distribution. As one can see in both the figure above and the corresponding table, Affordability is clearly the most progressive indicator, which is in line with its purpose, and suggests that it dictates a far heavier weight in the subsidy than the other two.

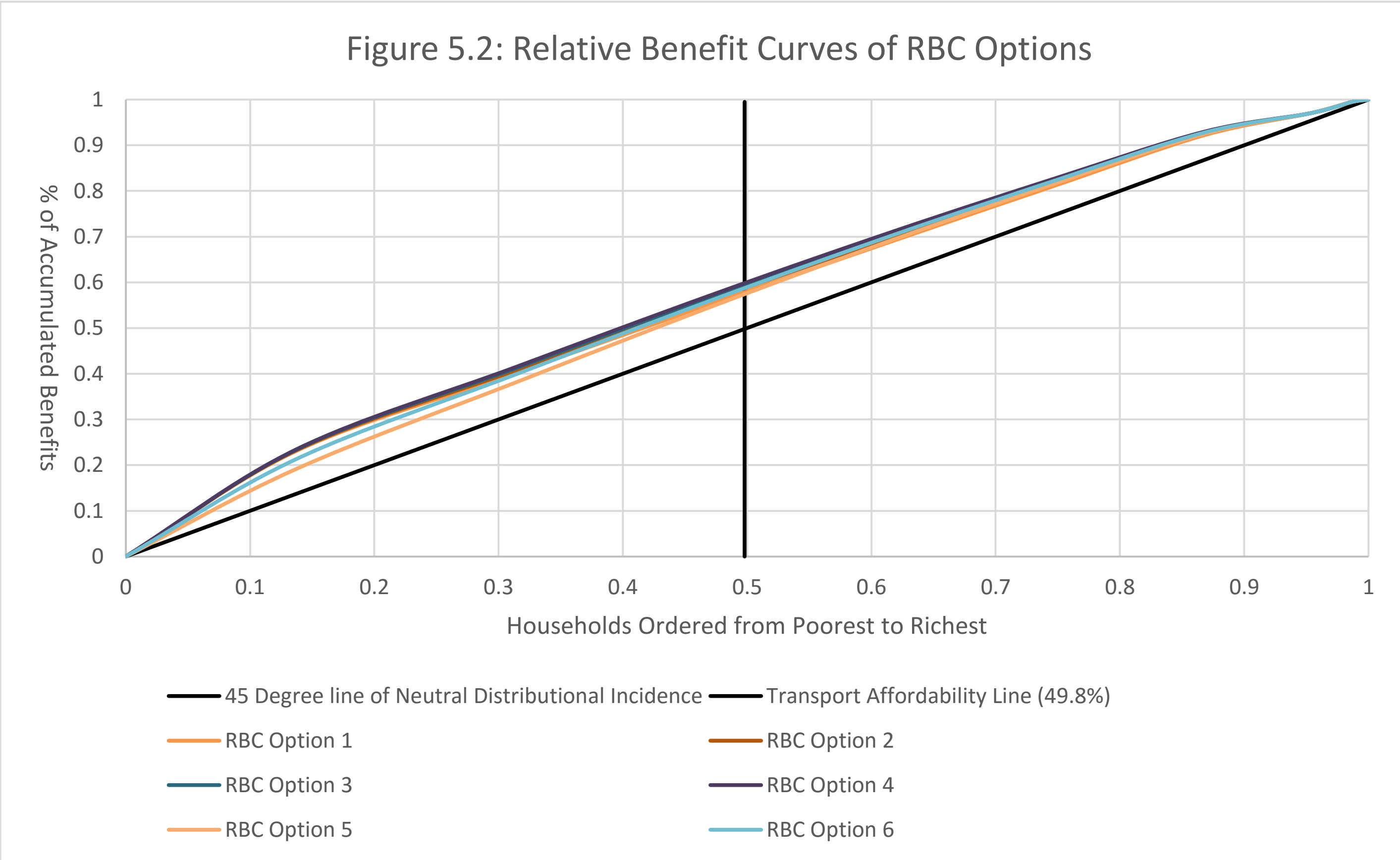
3.2 Relative Benefit Curve Option Choice

This section compares six differently weighted combinations of the four variables by their distributional incidence. Table 5.2 shows the six different weightings of the indicators, and Figure 5.2 illustrated their individual relative benefit curves.

Table 5.2: Obtaining Optimal Weightings of Equity Variables for RBC Options

	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Distance	20	10	5	5	5	5
Affordability	50	60	70	80	80	82.5
Population	20	20	15	5	10	5
Unemployment	10	10	10	10	5	7.5

*author's calculations



*author's calculations

Table 5.3: Descriptive Statistics of RBC Options

	RBC Option 1	RBC Option 2	RBC Option 3	RBC Option 4	RBC Option 5	RBC Option 6
QGini	-0.13342	-0.1434442	-0.15119	-0.155959287	-0.11483	-0.13664728
Ω Statistic	1.164659	1.1746988	1.164659	1.164658635	1.164659	1.164658635
EoI	0.436137	0.43094496	0.436137	0.436137072	0.460022	0.447761194
EoE	0.074297	0.07429719	0.074297	0.074297189	0.174699	0.124497992

*author's calculations

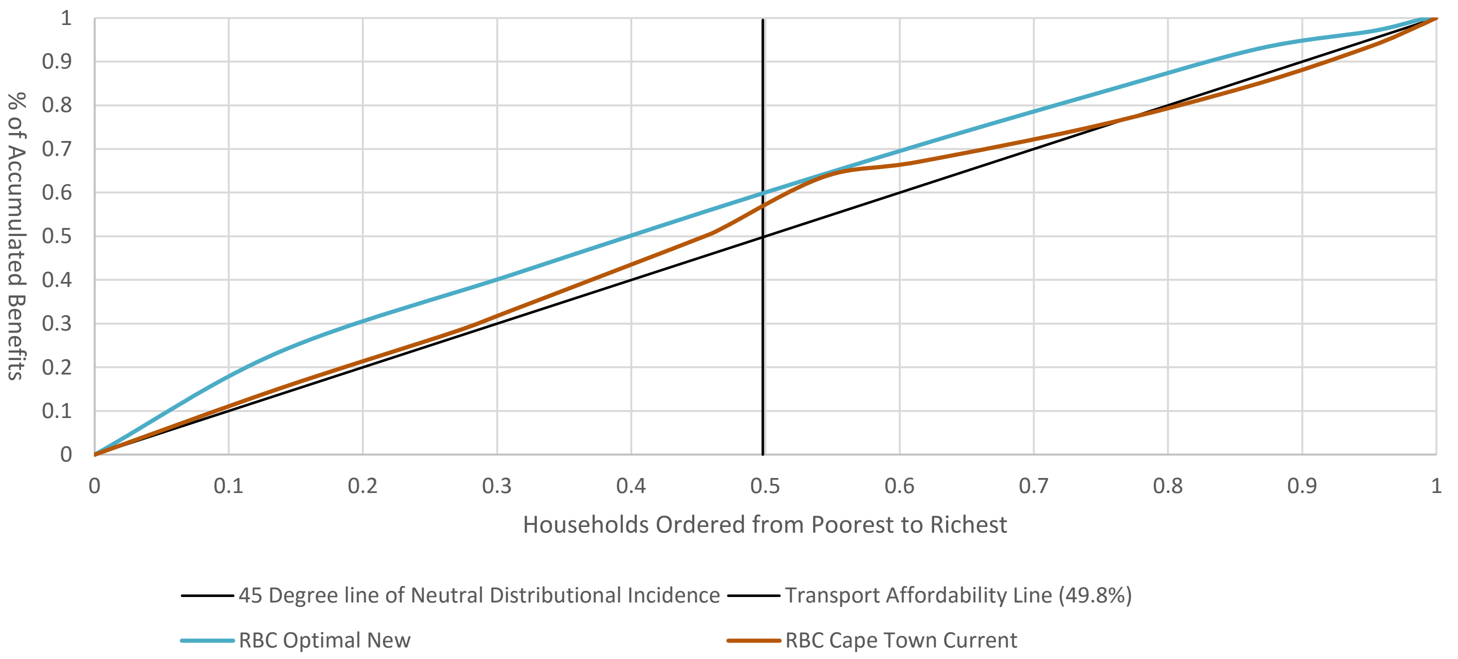
As incremental weight adjustments of the variables for the six RBC options impact the overall distribution of each only subtly, it is difficult to gauge the distributional consequences of each RBC option by viewing the graphical representation of the curves in isolation.

When investigating their distribution statistics, however, one can gain greater insight. Due to their similar points of intersection with the TAL line, their Ω, EoI, and EoE statistics lose their interpretative power. The Quasi-Gini Coefficients, however, allows for the curves to be ranked for their ability to target households below the TAL. It is further interesting to note the crucial role played by the Unemployment indicator in improving the pro-poor distribution and reducing errors of exclusion. As the current subsidy structurally excludes no-income households from subsidy benefits, allocating any benefit at all to no-income households is likely to have a significant impact on distribution. RBC Option 4 represents the optimal weighting of the chosen indicators due to it being the most progressive.

3.3 Impact Analysis Simulation

This section compares the distributional impact of RBC Option 4 to that of the Cape Town's current road public transport subsidy framework.

Figure 5.3: Impact of Subsidy Change on Cape Town Subsidy RBC



*author's calculations

Table 5.4: Descriptive Statistics of New and Old Subsidy

	RBC Optimal New	RBC Cape Town Current
QGini	-0.15596	-0.0419619
Ω Statistic	1.164659	1.14457831
EoI	0.436137	0.50405562
EoE	0.074297	27.5100402

*author's calculations

In a comparison, the New Subsidy is more progressive than the current Cape Town subsidy according to all five measures. In the sense that this is a pure simulation (based on significant assumptions), these findings have limited power of interpretation in the absence of accompanying and follow-up research. The power of this simulation, however, is that it implies the possibility of controlling for the critical weaknesses of the current subsidy through a reorientation of its design to the demand-side.

By aligning the objectives of transport subsidisation to the social redistribution argument, and deriving the allocation variables from the demand-side, the subsidy achieves the twin objectives of being both more progressive and resilient to the industry transition. The demand-side approach further allows scope to allocate benefit to no-income households, and the use of an income-based zonal system to allocate benefit incentivises IRT investment into the areas that need it most first.

Furthermore, the weighting of the variables is designed to be flexible. This means that as MyCiTi expands and residential, commercial and business development on routes assist inner-city densification, the weightings of the allocation variables can be adjusted incrementally. For example, as inner-city densification and system interconnectivity increases, the cross-subsidisation model can slowly shift emphasis towards the pure distance-based model MyCiTi uses at present. The insight is that the kind of distance-based model being used currently can be progressive, but indeed only when the city is ready for it to be so.

Chapter 5 Conclusion

The simulation contained in Chapter 5 entailed the construction of four demand-side subsidisation indicators that weighted the benefit and distribution of the subsidy between four zones - each comprised of one or more of Cape Town's 9 Districts. Essentially, this method was chosen for its demand-side orientation, and its incorporation of a geographic element to account for Cape Town's segregated economic geographies. The use of the weighting system allows for the kind of flexibility required to compensate for industry transition. As MyCiTi continues to expand, and changing spatial densities start to reduce demand nodality, the weightings can adjust appropriately.

Importantly, this simulation should be recognised as *an* alternative – not *the* alternative. The simulation provides insight in four respects. Firstly, it shows that focussing allocation on the demand-side can be more progressive than the supply-side, as it allows contextual, historical, spatial and social factors to be taken into account. Secondly, it shows that the distribution of the subsidy can be improved by deriving it by a set of different subsidisation variables, and that this provides a more rounded alternative to the purely distance-based cross-subsidisation model employed currently. Thirdly, it simulates the potential progressive impact of targeting no-income households. Fourthly, it shows the benefit of flexibly weighting these variables, as it allows the framework to be incrementally re-augmented as the public transport and socioeconomic landscapes evolves over time.

Beyond the scope of this analysis is the question of feasibility from an implementation perspective. As a large component of the Cape Town IRT model focusses on modal integration, implementing an alternative subsidy model is contingent on the ability of planners to integrate successfully. As has been the case historically, the politics of road public transport in the city are particularly volatile. The kind of stakeholder cooperation required to implement a demand-side subsidy, therefore, would be contextually challenging. Furthermore, if the system fails to target no-income households effectively (or at all), the New Subsidy framework will lose much of its potential pro-poor impact.

Conclusion

The major innovation of this paper has been to answer the question "Is Cape Town's road public transport affordable, and is subsidised operating support well targeted at poor households?" by conducting analysis with the systematic framework provided in Estupinan, et al. The approach outlined in Chapter 1 emphasised the need to contextualise subsidy needs, and to inform findings and recommendations with the socio-political and operational factors unique to each developing environment. This entailed an investigation of Cape Town's racial economic geographies, and the factors that have shaped its road public transport network into what we find today. In turn, the paper developed a comprehensive base from which to measure transport affordability, and the distribution and targeting of the road public transport subsidy.

To begin this investigation, Chapter 2 unpacked Cape Town's development within the context of Apartheid policies of economic and racial segregation. The analysis found evidence of strong correlation between area, race and income, and showed these to be critical determinants of transport affordability and subsidy distribution. Key to this is acknowledging that Cape Town's inorganic structure directly influences the potential efficiencies of public transport provision. With poor households located in segmented, high-density urban peripheries; an isolated CBD; and low-density, high-income inner suburbs, travel for the city's poor was nodal, single-direction and long-distance. This made the need for travel subsidisation inherent.

Given these findings, the third chapter explored the operational context that shaped and distorted the market structure of road public transport in the city into what we find today. The transport system evolved to serve demand, and as demand originated from peripheral low-income areas, it meant the operating subsidy accrued to the poor. By consequence, providing that these operational conditions held, allocating benefit to poor households did not require careful targetting. The emergence of the MyCiti BRT, however, has influenced the operating environment to a point that these conditions no longer hold.

Cross-modal analysis of market share and subsidy efficiency in Chapter 4 revealed MyCiTi's interim rollout phases to be particularly subsidy absorptive, with BRT the least subsidy efficient of the three road-based modes. Chapter 4 then tackled the critical themes of system affordability and subsidy distribution. In the affordability analysis, the CDS indices revealed that in highly unequal, developing regions it is inappropriate to measure affordability at the mean. When measuring at the 25th percentile of the household income distribution, households in Cape Town are required to spend 19.1% of their income on transport if they are to satisfy their basic mobility needs. Concurrently, the construction a Transport Affordability Line revealed that 49.8% of Cape Town households experience unaffordable transport, which implies that the pricing and structure of the system itself is becoming increasingly anti-poor. The corresponding distribution analysis revealed that the emergence of MyCiTi has almost completely eroded the pro-poor impact of the subsidy prior to its existence. At the interim stage of its rollout at the end of the 2012/13 financial year, its distribution of subsidy benefits was regressive, and its incorporation into the market has rendered the subsidy distribution overall as neutral. This provided robust argument to explore the viability of more appropriate subsidy frameworks for the sector.

In light of these finding, Chapter 5 looked to design and simulate the distributional consequences an alternative subsidy might have, were it to be derived on the demand-side. Using the preceding analysis as a guide, the various elements of subsidy choice were considered. This suggested the alternative subsidy would need to incorporate elements of cross-subsidisation, means-testing and geographic targeting schemes. Cape Town's nine Districts were grouped into four Zones based on their affordability needs, and the subsidy was distributed between these zones according to the benefit weighted to each zone by four subsidy variables. These four variables were constructed to incorporate social and economic themes of population, affordability, distance from the CBD and the exclusion of no-income households. The variables were then weighted to maximise the progressive impact of the subsidy, insofar as it did not undermine overall economic viability. Distributional analysis of the simulated subsidy revealed the New Subsidy framework as more progressive than Cape Town's current framework, on account of all indicators.

Considering the assumptions that were required for this simulation, it is important to limit interpretation to the insight it provides. The key contribution of the simulation is the way it offers an alternative understanding to how subsidy distribution in Cape Town can be augmented, and that a departure from the current supply-side model can allow for a more contextually appropriate design. It provides insight on the benefit of weighting subsidisation variables according to the city's current needs, and providing the flexibility for these weightings to change as these needs evolve over time time. Finally, the simulation shows the potential progressive impact that would come from targeting no-income households. In light of the ongoing industry transition, and the regressive early impact of MyCiTi on the distribution of road public transport operating support, these should be central considerations.

This paper concludes with the recommendation that these findings warrant the need for follow-up research. There is a need to generate appropriately segmented household income and travel data for more accurate distribution analysis and modelling, and for political economy analysis to explore the feasibility of a demand-side subsidy orientation from an implementation perspective. Affordability and distribution analysis in this paper also suffers from being static, and as the MyCiTi rollout continues, time-series data will be generated to allow analysis that is more dynamic. There is also a need to measure the potential impact of subsidy alteration on fares, and in turn, what this means for affordability.

Some gaps in the simulation should also be addressed. For example, the simulation fails to take environmental concerns and costs into account, as was done in Dawood & Mokonyama (2015). Various avenues can be explored to improve the alternative subsidy framework proposed in this paper – including what an iteration that combined supply-side and demand-side variables might look like. Lastly, the Job Search Assist grant and the general concept of targeting no-income households with social welfare requires deeper exploration, and should be subjected to further control trials to gauge potential impact. By highlighting these considerations, this research provides an important baseline from which subsequent research can expand.

Appendix A

Table A1: Comparative Developing City Gini Coefficients and Gini Ratios

	Gini Coefficient	Gini Ratio
Johannesburg	0,75	1,12
East London	0,75	1,12
East Rand	0,74	1,10
Pretoria	0,72	1,07
Port Elizabeth	0,72	1,07
Durban	0,72	1,07
Cape Town	**0,67**	**1,00**
Rio de Janerio	0,61	0,91
Mexico City	0,56	0,84
Average Latin American and Carribean City	0,55	0,82
Buenos Aires	0,52	0,78
International Alert Line	**0,40**	**0,60**
Average African City	**0,54**	**0,81**
Abidjan	0,53	0,79
Accra	0,5	0,75
Addis Ababa	0,45	0,67
Dar es Salaam	0,38	0,57
Kigali	0,52	0,78
Maputo City	0,52	0,78
Nairobi	0,59	0,88
Youande	0,44	0,66
Average Asian City	**0,40**	**0,60**
Bangkok	0,49	0,73
Beijing	0,22	0,33
Colombo	0,46	0,69
Fuzhou	0,34	0,51
Hong Kong	0,53	0,79
Jakarta	0,32	0,48
Manila	0,41	0,61
Phnom Penh	0,36	0,54
Shanghai	0,32	0,48

*(Un-Habitat, 2009), author's calculations

Table A2: Comparative Developing City Human Development Indices (HDI) and HDI Ratios

	HDI	HDI Ratio
Top 10		
Norway	0,944	1,43465
Australia	0,933	1,417933
Switzerland	0,917	1,393617
Netherlands	0,915	1,390578
United States	0,914	1,389058
Germany	0,911	1,384498
New Zealand	0,910	1,382979
Canada	0,902	1,370821
Singapore	0,901	1,369301
Denmark	0,900	1,367781
Median		
Bolivia (Plurinational State of)	0,667	1,013678
Moldova (Republic of)	0,663	1,007599
El Salvador	0,662	1,006079
Uzbekistan	0,661	1,004559
Philippines	0,66	1,00304
South Africa	**0,658**	**1**
Syrian Arab Republic	0,658	1
Iraq	0,642	0,975684
Guyana	0,638	0,969605
Viet Nam	0,638	0,969605
Cape Verde	0,636	0,966565
Bottom 10		
Guinea-Bissau	0,396	0,601824
Mozambique	0,393	0,597264
Guinea	0,392	0,595745
Burundi	0,389	0,591185
Burkina Faso	0,388	0,589666
Eritrea	0,381	0,579027
Sierra Leone	0,374	0,568389
Chad	0,372	0,56535
Central African Republic	0,341	0,518237
Congo (Democratic Republic of the)	0,338	0,513678
Niger	0,337	0,512158

* (UNDP, 2014), author's calculation

Table A3: Racial Breakdown of Populations of Major South African Cities

	African	Coloured	White	Indian/Asian	Other	Total Population
Cape Town	38.6%	42.4%	15.7%	1.4%	1.9%	3,740,026
Johannesburg	64.2%	13.9%	13.9%	6.7%	1.3%	4,434,827
Durban	51.1%	8.6%	15.3%	24%	7.6%	3,442,361
Pretoria	42%	2.5%	52.5%	1.9%	1.2%	2,921, 488
Bloemfontein	56.1%	12.8%	29.8%	0.8%	0.5%	256,185
Port Elizabeth	30.6%	27%	37.8%	3.2%	1.4%	312,392

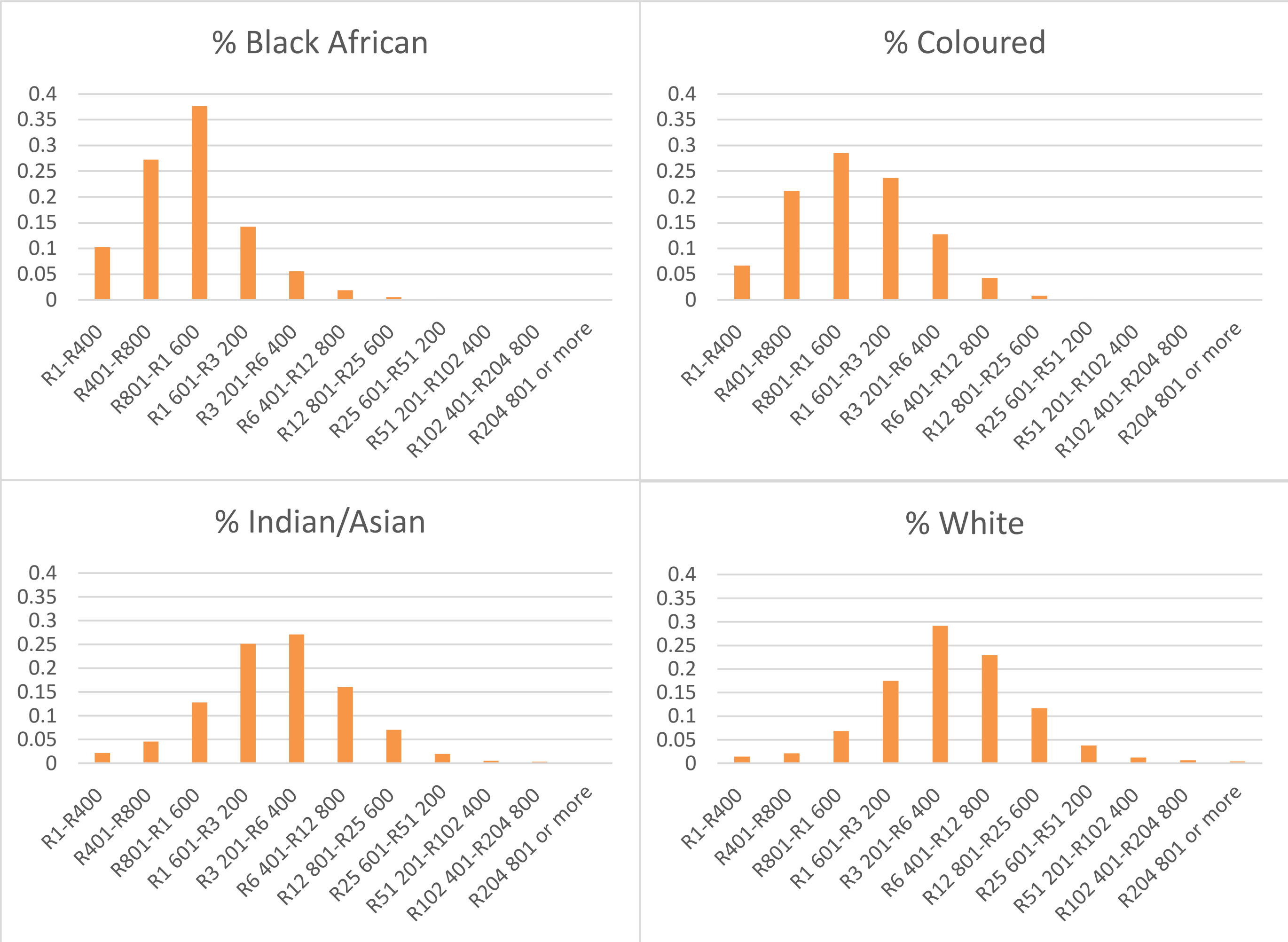
*Census 2011 Data, author's calculations

Table A4: Suburb Composition of Cape Town Mero's Nine Districts

City Bowl	Atlantic Seaboard	Southern Suburbs	Northern Suburbs	Tygerberg	Helderberg	Blaauwberg	Cape Flats	Eastern African Townships
Vredehoek	Camps Bay	Newlands	Durbanville	Bellville	Strand	Bloubergstrand	Athlone	Khayelitsha
Tamboerskloof	Sea Point	Claremont	Brackenfell	Blackheath	Gordons Bay	Milnerton	Grassy Park	Gugulethu
Oranjezicht	Green Point	Rondebosch/ Rosebank	Scottsdene	Belhar	Somerset West	Melkbosstrand	Lansdowne	Crossroads
Gardens	Clifton	Bishopscourt	Kraaifontein	Kuils River	Macassar	Atlantis	Mitchells Plain	Mfuleni
Cape Town CBD		Bergvliet	Wallacedene	Delft	Firgrove	Mamre	Lavender Hill	Phillipi
Foreshore		Fish Hoek	Bloekombos	Elsies Rivier	Croydon	Paarden Eiland	Ottery	Langa
Schotschekloof		Tokai	Eversdal	Parow		Table View	Hanover Park	Nyanga
V & A Waterfront		Plumstead	Kenridge	Maitland		Sunningdale	Hazendal	
Zonnebloem		Constantia		Kensington		Parklands	Silvertown	
		Kenilworth		Ndabeni		Montague Gardens	Sybrand Park	
		Wynberg		Goodwood		Joe Slovo Park	Lotus River	
		Pinelands		Bellville South		Phoenix	Pelican Park	
		Diep River		Bishops Lavis		Marconi Beam	Zeekoei Vlei	
		Hout Bay		Panorama		Summer Greens	Parkwood	
		Dreyersdal		Monte Vista		Tijgerhof/Sand drift	Fairways	
		Kalk Bay		Edgemead		Century City	Capricorn	
		Kirstenhof		Bothasig		Rugby	Vrygrond	
		Meadowridge		Eersterivier		Ysterplaat Airbase	Bonteheuwel	
		Mowbray		Blue Downs		Brooklyn	Heideveld	
		Observatory				Dunoon	Manenberg	
		Steenberg Estate				Richwood		
		Woodstock				Doornbach		
		Heathfield						
		Salt River						
		Coniston Park						
		Muizenberg						
		Noordhoek						
		Kommetjie						
		Imizamo Yethu						
		Fairways						
		Sheraton Park						
		Southfield						
		Steenberg						
		Westlake						
		Retreat						
		Lakeside						
		St James						
		Glencairn						
		Simons Town						
		Scarborough						
		Llundudno						
		Sun Valley						
		Masiphumelele						

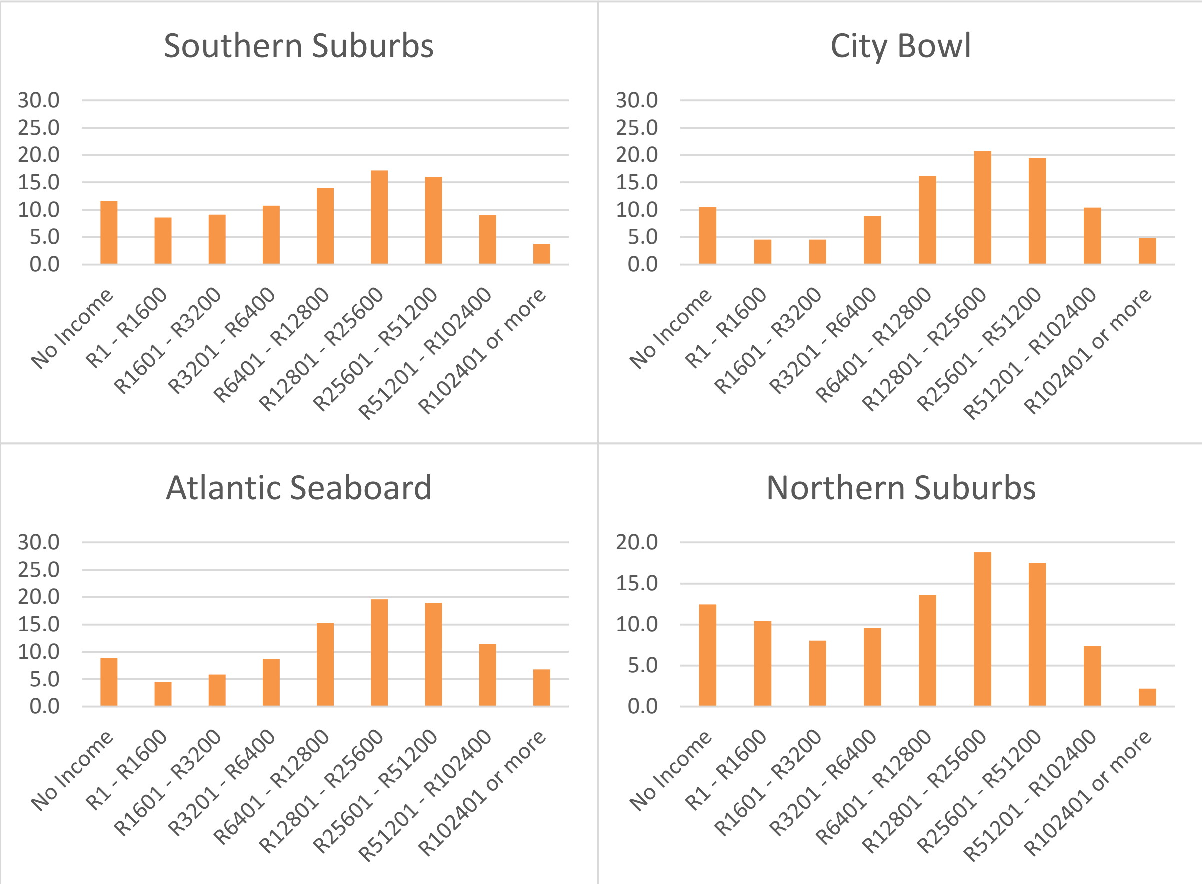
*classification using (Frith, 2011) spatial framework

Figure A1: Cape Town Income Distributions by Racial Group



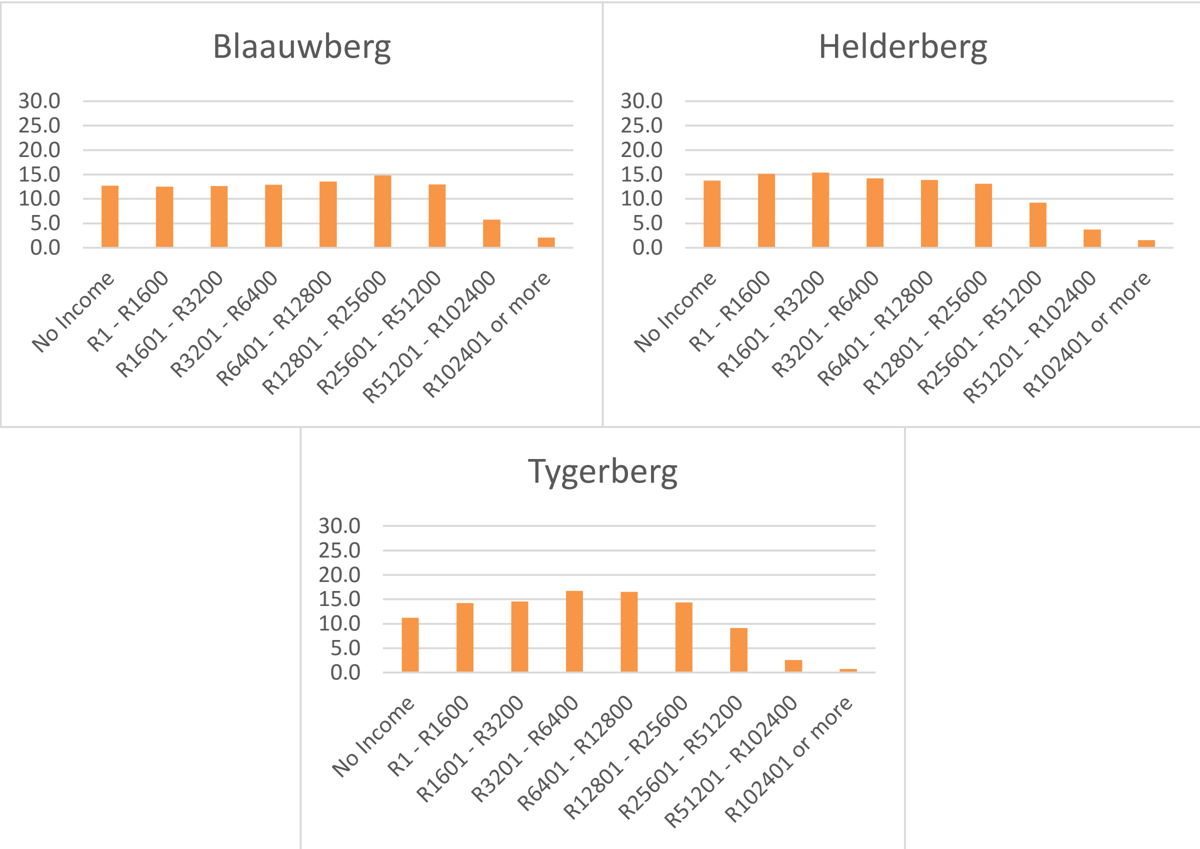
*Census2011 Data, author's calculations

Figure A2: Income Distributions by High Income Districts (% of total)



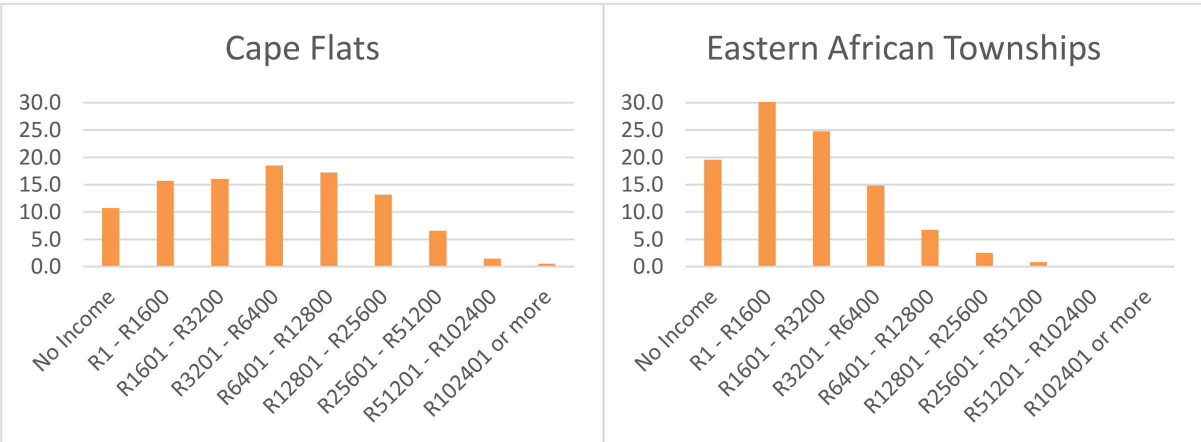
*Census2011 Data, author's calculations

Figure A3: Income Distributions by Middle Income Districts (% of total)



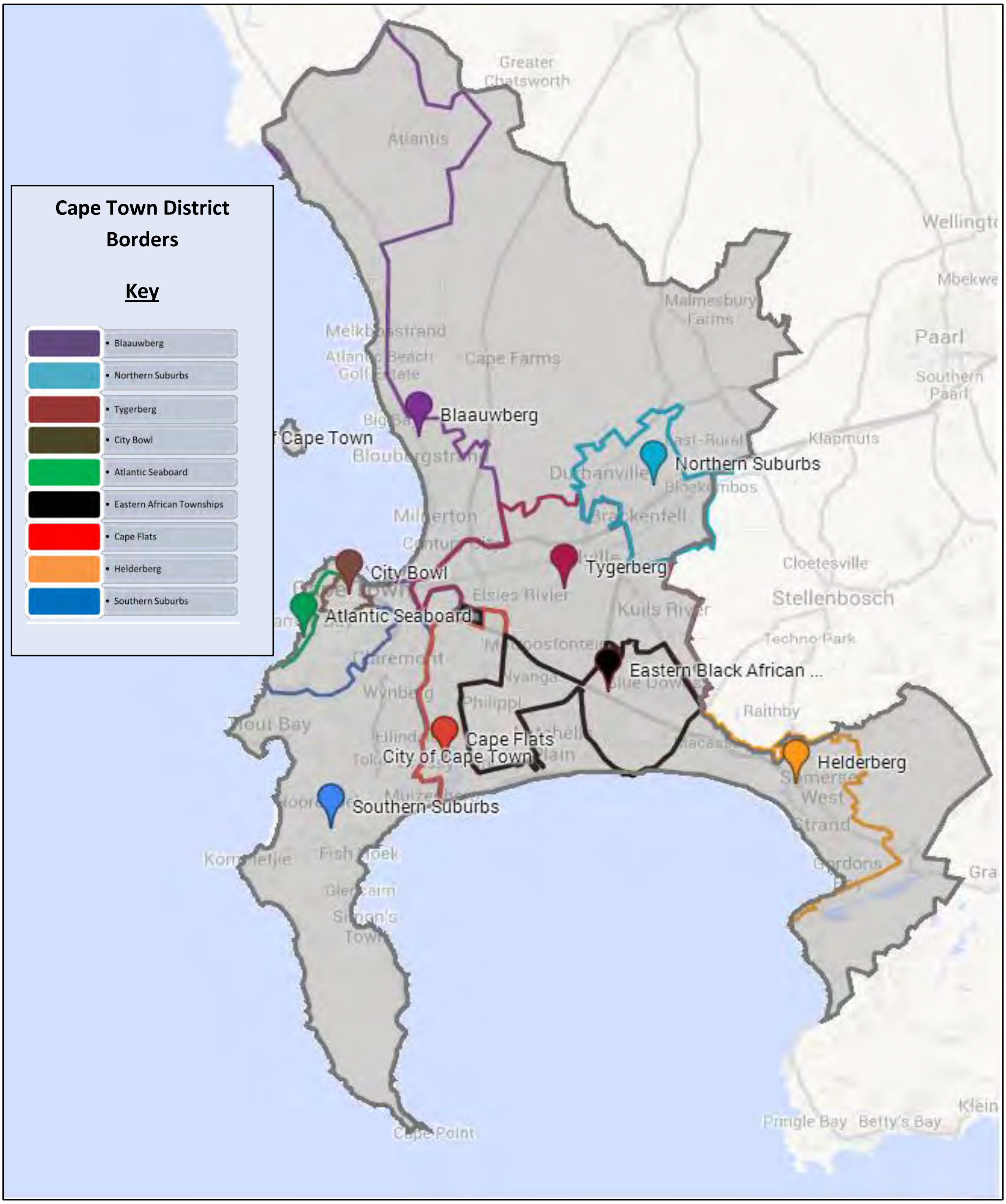
*Census2011 Data, author's calculations

Figure A4: Income Distributions by Lower Income Districts (% of total)



*Census2011 Data, author's calculations

Figure A5: Geographic Representation of the Cape Town Metro and its 9 Districts[24]



*map developed by author using Google Maps Engine, with the (Frith, 2011) spatial framework

24 The Districts are comprised of separate and continuous bodies of land, the exception being Langa (shaded black). The borders between each District are colour coded, and extend to the coastline where appropriate.

Appendix B

Table B1: Subsidy Classification Summary - Contracted Busses

Subsidy Classification	Contracted Busses (Golden Arrow, Sibanye)
Transfer characteristics	Supply-side Conditional Direct Operating Subsidy Fixed per KM, capped at 40m km annually
Distribution channel	Non-discriminatory; distributed evenly across users
Funding sources	**PTOG** Provincial Government via National Treasury Direct and indirect general taxation
Annual Total (2012/2013)[25]	**PTOG** R696 237 000 Gabs - R630 749 361 Sibanye - R65 487 638

* (DoT, 2013), author's calculations

Table B2: Subsidy Classification Summary – IRT Busses

Subsidy Classification	IRT Busses (MyCiTi)
Transfer characteristics	Supply-side Infrastructure Grant Unconditional Operating and Capital Subsidy Capital Infrastructure projects and Operating shortfall coverage
Distribution channel	Non-discriminatory; distributed evenly across users
Funding sources	**PTISG (Infrastructure support)** National Government via National Treasury Direct and indirect general taxation **PTISG (Operating and Capital Cost support)** National Government via National Treasury Direct and indirect general taxation **Council Funds (Operating Shortfall)** Property Rates – Local Taxation Share of Nationally Collected Fuel Levy
Annual Total (2012/2013)[26]	**PTISG (Capital and Infrastructure)** R2 029 553 000 **PTISG (Operating)** R218 411 000 **Council Funds (Operating)** R249 675 000

* (CoCT, 2013b), author's calculations

[25] PTOG amount allocated between Gabs and Sibanye based on own calculations, utilising the subsidy allocation ratio of 36.6:3.8, as stipulated by CoCT (2013a). Calculations assume equal per km subsidy rate in absence of reliable information to the contrary.

[26] Figures taken from the MyCiTi Integrated Rapid Transit Project Progress Report No. 36, February 2013 (CoCT, 2013b).

Table B3: Subsidy Classification Summary – MBT Industry

Subsidy Classification	Informal Network (Taxi Industry)
Transfer characteristics	Supply-side Conditional Direct Operating Subsidy Implicit operating grant
Distribution channel	Non-discriminatory; Wealthier owners through self-selection
Funding sources	**Taxi Recapitalisation Programme** National Government via National Treasury Direct and indirect general taxation
Annual Total (2012/2013)[27]	R407 437 000 Nationally, R23 223 909 in CT Metro

* (DoT, 2013), author's calculations

Appendix C

CDS Index calculations

Table C1: Calculating Average Fare per 10km Trip – Standard Busses

Route	Distance (km)	Single Trip Fare	R/km
Cape Town – Atlantis	48	R35.35	0.76
Cape Town – Khayalitsha	31	R26.00	0.84
Cape Town – Durbanville	28	R25.80	0.92
Cape Town – Mitchell's Plain	26	R25.80	0.99
Cape Town – Langa	14	R16.20	1.16
Cape Town – Wynberg	13	R13.60	1.05
Average			**0.93**
Average 10km trip	**10**	**R9.30**	**0.93**

*(Gabs, 2013), author's calculations[28]

Table C2: Calculating Average Fare per 10km Trip – IRT Busses

Distance Band	Single Fare (On Peak)	Single Fare (off Peak)	Average Fare	R/km
0-5km	R8.90	R6.80	R7.85	1.57
5-10km	R9.80	R7.70	R8.75	0.88
10-20km	R12.50	R9.40	R10.95	0.55
20-30km	R14.80	R12.40	R13.60	0.45
30-40km	R16.50	R13.80	R15.15	0.38
40-50km	R20.30	R16.90	R18.60	0.37
50-60km	R23.90	R19.90	R21.90	0.37
Average				**0.652**
Average 10km trip			**R6.52**	**0.652**

*(MyCiTi, 2014), author's calculations

[27] Figure taken from the National Department of Transport Annual Report, 2012/2103 (DoT, 2013).
[28] Note that due to the long-distance nature of Standard Bus trips, all origin-destination trips are in excess of 10km. Thus the derivation of average 10km trip fares could not incorporate sub-10km fares.

Table C3: Calculating Average Fare per 10km Trip – MBT Industry[29]

Route	Distance	Fare	R/KM
Century City – Khayalitsha	32km	R15	0,47
Claremont – Khayalitsha	27km	R14	0,52
Cape Town – Hout Bay	18km	R10	0,56
Claremont – Gugulethu	16km	R9	0,56
Bellville – Cape Town	22km	R13	0,59
Cape Town – Langa	13km	R8	0,62
Bellville – Langa	15km	R10	0,66
Nyanga – Claremont	13km	R9	0,69
Cape Town – Gugulethu	17km	R12	0,71
Wynberg – Cape Town	14km	R10	0,71
Fishhoek - Ocean View	7.9km	R6	0,76
Langa - Mowbray	7.3km	R6	0,82
Wynberg - Retreat	7km	R6	0,86
Claremont – Hanover Park	6.9km	R6	0,87
Bellville - Durbanville	8.7km	R8	0,92
Athlone - Hanover Park	6.2km	R6	0,96
UWC - Bellville	6.1km	R6	0,98
Langa - Athlone	5.3km	R6	1,13
Cape Town - V&A Waterfront	4.1km	R5	1,22
Kenilworth Cnt - Claremont	4km	R6	1,5
Average			0,8055
Average 10km Trip	**10km**	**R8,06**	**0,8055**

*

(TaxiMap, 2014), author's own calculations

Table C4: Monthly Household Incomes at Various Percentiles of the Distribution for Cape Town Metro and its 9 Districts

Region	IDF	10%	25%	50%
Cape Town Metro	$y = 465.82e^{0.0583x}$	R834	R2001	R8594
Southern Suburbs	$y = 2456.5e^{0.0448x}$	R3845	R7529	R23074
Atlantic Seaboard	$y = 2062.5e^{0.0479x}$	R3330	R6831	R22622
City Bowl	$y = 2391.8e^{0.0441x}$	R3717	R7203	R21694
Northern Suburbs	$y = 2261.1e^{0.0426x}$	R3462	R6559	R19027
Blaauwberg	$y = 1536.5e^{0.0479x}$	R2481	R5089	R16853
Helderberg	$y = 1056e^{0.0508x}$	R1755	R3760	R13390
Tygerberg	$y = 940.7e^{0.0498x}$	R1548	R3267	R11346
Cape Flats	$y = 801.34e^{0.0494x}$	R1313	R2755	R9474
Eastern African Townships	$y = 126.98e^{0.0693x}$	R254	R718	R4060

*Census2011 Data, author's calculations

[29] MBT trip fares were taken from the database published on www.taximap.co.za, with distances taken from Google Maps. Due to the informal nature of the industry and ad hoc fare-setting, the author acknowledges that these fares are subject to inaccuracy. The method used was to average the R/km of 20 randomly selected routes – 10 in excess of 10km, and 10 below 10km.

Table C5: CDS Index at Median (50%) level

Region	30 Monthly Trips	45 Monthly Trips	60 Monthly Trips
Cape Town Metro	3.0%	4.4%	5.9%
Southern Suburbs	1.1%	1.7%	2.2%
Atlantic Seaboard	1.1%	1.7%	2.3%
City Bowl	1.2%	1.8%	2.3%
Northern Suburbs	1.3%	2.0%	2.7%
Blaauwberg	1.5%	2.3%	3.0%
Helderberg	1.9%	2.9%	3.8%
Tygerberg	2.2%	3.4%	4.5%
Cape Flats	2.7%	4.0%	5.4%
Eastern African Townships	6.3%	9.4%	12.6%

*author's calculations

Table C6: CDS Index at Lower Quartile (25%)

Region	30 Monthly Trips	45 Monthly Trips	60 Monthly Trips
Cape Town Metro	12.7%	19.1%	25.5%
Southern Suburbs	3.4%	5.1%	6.8%
Atlantic Seaboard	3.7%	5.6%	7.5%
City Bowl	3.5%	5.3%	7.1%
Northern Suburbs	3.9%	5.8%	7.8%
Blaauwberg	5.0%	7.5%	10.0%
Helderberg	6.8%	10.2%	13.6%
Tygerberg	7.8%	11.7%	15.6%
Cape Flats	9.3%	13.9%	18.5%
Eastern African Townships	35.5%	53.2%	71.0%

*author's calculations

Table C7: CDS Index at Lower Decile (10%)

Region	30 Monthly Trips	45 Monthly Trips	60 Monthly Trips
Cape Town Metro	30.6%	45.8%	61.1%
Southern Suburbs	6.6%	9.9%	13.3%
Atlantic Seaboard	7.7%	11.5%	15.3%
City Bowl	6.9%	10.3%	13.7%
Northern Suburbs	7.4%	11.0%	14.7%
Blaauwberg	10.3%	15.4%	20.5%
Helderberg	14.5%	21.8%	29.0%
Tygerberg	16.5%	24.7%	32.9%
Cape Flats	19.4%	29.1%	38.8%
Eastern African Townships	100.3%	150.5%	200.7%

*author's calculations

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