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PARATRANSIT MESOECONOMY: CONTROL MEASURES FROM THE SUPPLY SIDE?

Abstract:

The South African Minibus Taxi industry has had to various degrees been affected by government intervention, in micro, and macroeconomic forms. Transporting on average 11.9% and 15% of education trips and 26.88% and 26.18% of working trips between 2003 and 2013 respectively, the minibus sector dominates the market second to walking (Statistics South Africa, 2014; 2003). Recent transport policies seem to discourage the dominance of private cars and minibus vehicles. Meanwhile, the Department of Trade and Industry has developed an incentive package for the production of minibus vehicles. In the microeconomy, transportation policy makers tend to focus on the travel market, whilst manufacturers focus on the demand for minibus vehicles. This study proposes and tests a framework to explore the extent to which travel and production microeconomic indicators relate to dynamic macroeconomic activity over time.

This paper is an experimental exploration of statistical relationships between selected macroeconomic indicators (SMIs) and the national minibus economy measured in vehicle sales and prices. Sales data is sourced from the National Association of Automobile Manufacturers of South Africa (NAAMSA) and price data from a manufacture dominating the market. Firstly, are there statistically significant macroeconomic forces at play in the minibus economy? Secondly, do these SMIs relate to minibus sales data including sales price per seat, registered vehicle population, vehicle sales, market ejections per year and cumulative forms of this data? We investigate this through correlation (a) analysis of price data, (b) sales data, (c) vehicle population in the travel market and (d) SMI data between 2002 and 2011. This is a mesoeconomic study, bridging the policy gap between macroeconomics (i.e. CPI) and microeconomics (i.e. vehicle population in the travel market).

Statistically significant relationships and path dependencies are revealed within the framework developed. Therefore mesoeconomic research in the transport economic sphere is significantly viable. One shortfall of the paper is that the microeconomic analysis is narrow because travel data and vehicle utilisation data is not included. Further quantitative research is required to inform a policy agenda that enables an understanding of macroeconomic forces (national and regional level) that filter through transport economic policy. This study lays a unique avenue to equip transit and automotive decision makers, industries and planners to better forge through changes in the macroeconomy in microeconomic contexts.

Keywords:

paratransit, mesoeconomics, public transport production, industrial policy, minibus taxi

JEL Classification: E20, L50, L62

1 INTRODUCTION

The transport economy is viewed as one that can be measured through mobility, access and land-use in order to manage the demand for travel and the transport system that facilitates this travel (e.g. roads, sidewalks, transport vehicles). Measuring the manner in which the transportation system performs at most geographic levels relates to the measurement of traffic; mobility and accessibility (Litman, 2003). Traffic counts were traditionally used to estimate the extent to which transport infrastructure should be expanded, but since there is large consensus of the induced effects of this (Douglas et al., 1999; Noland, 2001), there is a shift toward accessibility measures as closer representations of travel because they account for the spatial nature of mobility services (Dong et al., 2005; Krygsman, 2004; Krygsman et al., 2007). Between *traffic-counts* and accessibility, measures of travel behaviour are related to estimating the extent to which mode choices are results of planned behaviour and, or habit formation (Guillen et al., 2013; Ajzen, 1991; Aarts et al., 1997; Behrens & Del Mistro, 2010). Within a microeconomic framework consumer preferences are also tools used to estimate trade-offs consumers make and inform the likelihood of using a certain aspects of travel, accessibility or mode choice through discrete modelling (Hensher, 1994; Nkurunziza et al., 2012; Nkurunziza et al., 2012; Arentze et al., 2003; Clark & Crous, 1999; Lombard & Hugo, 2002). In other studies the transport system is related to (a) urban form which enables different degrees of public transport service provision and (b) the manner in which the benefits of transit facilities are captured and valued (Cervero, 2013; Cervero, 2009; Newman, 2009). The blend between balancing the travel demand and developing sustainable transportation system solutions has been the incremental trend of these measures, among many others. Measures of access and mobility constitute microeconomic analysis of transportation demand and supply.

Analysing the travel market is also performed in terms of transportation investments and their contribution (or cost) to the national, regional and local economy. Cost benefit analyses; environmental analyses and multi-criteria analyses are used to measure the current and future value of transport investment alternatives and articulate a decision toward the highest benefit or welfare gain (Voogd, 1983; de Montis et al., 2005; van Wee, 2012; De Brucker et al., 2011). These measures are project based, and can be used to estimate regional benefits through labour and goods exchange; or, when expanded further, augmented to gain perspective of national benefits. At the national scale however, much of the evidence relies on infrastructure investments and their *functional role* relative to Gross Domestic Product (GDP); taxation; and other economic instruments (Fedderke et al., 2006; Banister & Berechman, 2001; Lakshmanan, 2011). In the freight goods context, estimates of transport costs as a portion of GDP are benchmarked in South Africa by the State of Logistics Survey (Joubert et al., 2013). In the transport economic context, studies that relate travel services and investments to an aggregate indicator, such GDP, inflation and so on, are research projects in the macroeconomy.

To the author's knowledge there is no study in South Africa that observes passenger transport market changes for a specific mode, purview macroeconomic forces. This study contributes to this literature by exploring the minibus taxi market as a supply chain of activities that relate with macroeconomic forces. The aim here is to develop a preliminary macroeconomic argument that policies that regulate transportation systems should view the market in both travel and transit unit (i.e. vehicle) supply and demand levels—rather than solely from a service or investment point of view. Therefore, this study aims to bridge the gap between macroeconomic indicators and microeconomic measures of transportation. The importance of doing so alludes to expanding the reach of transport policy, and unveiling new possibilities for economic regulation at mesoeconomic level. This study asks two questions:

1. Is there a policy mismatch between the minibus travel economy and the minibus transportation economy?
2. Are there statistically Selected Macroeconomic Indicators (SMIs) at play in the minibus (meso) economy?
3. Do these SMIs relate to minibus sales data including sales price per seat, registered vehicle population, vehicle sales, market ejections per year and cumulative forms of this data?

We investigate this through correlation (a) analysis of price data, (b) sales data, (c) vehicle population in the travel market and (d) SMI data between 2002 and 2011.

The second section provides a background to the problem and the major questions that this study aims to respond to. What follows is a reflection on the major changes in the minibus travel economy from 1978 to 2010. It is within the context presented that the mesoeconomic conceptual framework is presented in the fourth section. In the fifth section datasets from 1994-2010 are analysed and discussed in temporal terms and then used to estimate statistically significant path dependencies. The concluding section explains the relevance of the results in the South African travel mesoeconomy.

2 REVIEW OF CHANGES IN THE MINIBUS TRAVEL ECONOMY

A number of studies have provided reviews of different aspects of the evolution of the minibus sector in South Africa (Walters, 2008; Barrett, 2003; Venter, 2013; Browning, 2006). From a policy making point of view this paper explores the possibility of a policy mismatch between managing minibus vehicle demand, at the operator side, and facilitating transport system configurations that satisfy demand for travel. This is in the face of three changes in the South African minibus travel economy:

1. From an influx of minibus vehicles saturating the market to incentives to upgraded ones through the taxi recapitalisation programme;
2. From an informal transit service to a developmental body engaged in public and private interventions;
3. From minibus oriented public transport to bus oriented services.

2.1 From Influx to Recapitalized Vehicles

Paratransit services are demand-responsive transit services that operate parallel to existing scheduled services. In South Africa, they are considered as minibus-taxis, or *ventures* (serving large neighborhoods) enabling most of the public to access major and local activity centers. They are composed of self-informed operators and, or drivers penetrating peri-urban and rural settlements and linking them internally and to major formal activity centers. It is in the developing world where they thrive as a response to changes in the *travel market*, which is a space between the transport policy/economic environment and the manner in which land-uses and human settlements were managed. In this paper, the demand (users) and supply (operators) of the travel market operate within the land-use and transportation system.

2.1.1 Reacting to Transport Policy

In South Africa, many of these self-informed operators emerged in order render niche services in response to failures in the travel market. The 1930's was an era where public transport was significantly regulated in favor of large bus firms and the passenger railway monopoly (McCaul, 1991). The *"spontaneous"* emergence of the paratransit sector is an outcome of the deregulation of land transport giving rise to the privatization of travel services (Small & Verhoef, 2007; McCaul, 1991) and the legislation[1] of 8-seaters by the Road Transportation Act No. 14 of 1977 (Browning, 2006). Around the same period (60's and 80's): (a) disinvestments in commuter rail were taking place and; (b) political role players were reluctant to *"assign the necessary authority and funding to metropolitan transport authorities"* (Mitchell, 2014). This made room for operators to begin participating in the travel market and rendering mobility services to the public.

2.1.2 Reacting to Land-Use

The impetus for the magnitude and scale of the operations we find in South Africa today owes its presence, and persistence, to the land-use configuration at the time, and its remnants today. Formally planned environments in South Africa were guided by (a) modernism and (b) apartheid as a socio-political policy (Dewar & Todeschini, 2004). Modernism is a planning philosophy that advocates for sectorial land uses based predetermined functions. Apartheid, as a policy, distorted the modernist model by assuming that: the sectorial land uses should be based on ethnicity (Corrado, 2013); the spaces in between serve as buffers to increase the separation; and mobility, through high speed links was a priority ranking higher than access (Dewar & Todeschini, 2004). The Natives Land Act of 1930 regulated the participation, access and inventory or labour in the urban area (Mabogunje, 1990) and Group Areas Act No. 41 of 1950 further extended the animation of Apartheid land-use policies deepening segregation. The sectorial model, resulted in vast distances (and high costs) between

[1] Malcolm Mitchel (2014) argues that the legislation of the minibus taxi was a "loophole" in the Road Transportation Act No. 14 of 1977.

major activity centers and human settlements where most of the labour came from. Khosa (1994) highlights the interplay between transport and land use well:

'The story of the Black taxi industry reflects both the political and economic repression of Blacks in South Africa's history and the contradictory processes generated under South Africa's racial form of capitalism. However, the residential segregation of South Africa's urban landscape and the removal of Black townships to the fringes, paradoxically recreated the conditions for the development of a dynamic taxi industry. (Khosa, 1994)*'*

2.1.3 A Basis for Regulation

Land-use transport issues are important, but the rapid growth in vehicle demand, popularity and the dominance in the travel market have been *spring boards* for various public and private interventions. Figure 1 reveals the rapid growth in vehicle sales between 1978 and 2011. It is evident that the size of the market, from the supply side has progressed exponentially nearing a 2500% growth in the number of vehicles sold.

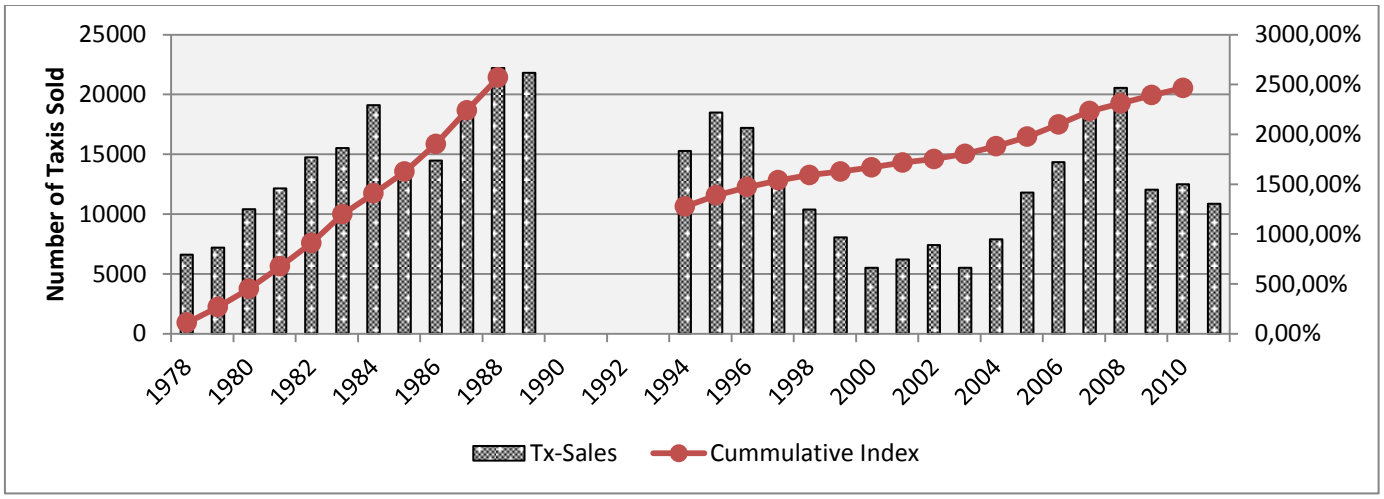

Figure 1: One Model of Minibus Taxi Sales and the Cumulative Index (NAAMSA, 2012)

It is also reasonable to contend that most of the vehicles sold in the 1990's did not dominate the market later in 2000. Transporting on average 11.9% and 15% of education trips and 26.88% and 26.18% of working trips between 2003 and 2013 respectively, the minibus sector dominates the market second to walking (Statistics South Africa, 2014; 2003). Interventions in the minibus taxi market tend to mediate the transformative relationships between public and private sectors—essentially driving the market towards some type of regulated form.

2.2 Public & Private Intervention

The relationship between government and owner-operators has been a challenging initiative to introduce changes to the paratransit sector—giving form to the manner in which market participants behave (e.g. minibus taxi consumers). Especially in the advent of the White Paper of Land Transport Policy, which argued for its regulation and improvement (upgrade); the National Land Transport Act which argues for entry

monitoring and regulation through permit systems and currently IRTPNs wherein public transport should play a catalytic role rippling into development plans and frameworks (Department of Transport, 2007; VIVA, 2007). Many of the interventions that rattle the paratransit sector attempt to mold the system to (a) better reflect public sector's convictions about what the sector ought to be like; and (b) how the market participants imagine their economic role in both the travel economy.

From Table 1, we notice a list of a few government and industry interventions in the paratransit market from determinants of demand and determinants of supply. Most of the interventions focus on converting the sector in a way that best reflects formal (scheduled) services (Lomme, 2008). Only one intervention presents an operational aspect, but it relates to the minimizing the destructive (and deadly) competitive practices that are possible when the sector is unregulated (Cervero, 2000).

Table 1: Selected Interventions in the Paratransit Market

No.	Market	Market Control Measures	Main Goal	Key Objective	Possible Market Effect
a)	Transport	**Taxi Recapitalization Programme**	Refurbish the paratransit sector fleet by the end of 2010 (Lomme, 2008).	Replace 16 seaters with new 14-18 and 19-35 seaters (Walters, 2008).	Change in vehicle technology and service quality.
b)	Travel	**Competitive Subsidies for Rail and Bus Services** (van Ryneveld, 2008)	Excluding capital expenditure, operational subsidies should "achieve an equitable distribution of resources".	Improving efficiencies in order to reduce the subsidization of transportation operations whilst.	Placing downward pressure on minibus prices because competitors are subsidised (Lombard et al., 2001).
c)	Transport	**Taxi Finance Services**	Improvements in vehicular finances, borrowings, financial suppliments and assitance from the private sector to enable access to vehicles (Khosa, 1994).	National Taxi Finance Company (Mokopanele, 2004) and other banking institutions have relationships with the taxi sector.	Increased access to vehicle consumption.
d)	Transport	**Operator-Owner Business Education**	Educating paratransit operators and owners in business and management.	To educate operators and owners about business and financial management skills in order to improve the profitability and rationality in services.	Changes in operational preferences or behaviour.

e)	Travel	**Formation of Associations**	Associations are turned into recognizable legal and corporate entities (Lomme, 2008).	SANTACO, NTA etc. Represent paratransit sector interests and aim for the expansion of the sector to other transportation sectors in addition to better labour formation and management.	Internal structuring and possible collusion.
f)	Travel	**Corporatization (BRT Companies)** (Schalekamp et al., 2010)		Registered taxi association/operator companies are included and absorbed in the IRTPNs as feeders, distributors or contracted operators.	Change in operational preferences and market behaviour.
g)	Travel	**Permit Administration**	Area and route based associations, and route based permits issued.	They aim to stabilize competition by shifting it from being on the route to operators competing for the routes.	Local Control over the access the travel market.
e)	Transport	**Automotive Manufacturing Incentives** (DTI, 2013)	Increase the domestic production of minibus vehicles for Southern African markets	Increase employment; Encourage industrial activities; Reduce the cost of importing minibus vehicles. Provide South Africa with a people carrier.	Lower initial cost of producing vehicles.
f)	Transport	**New Production Plants**	Produce quality, affordable and fuel efficient minibus taxi vehicles to meet demand.	Localise domestic production at 80 units per day; 20 000 units per year for the other. Capture the greatest share of the market for vehicle demand.	Increased supply of vehicles, lower production costs (i.e. economies of scale).

In a sense these interventions remind us of Barrett's (2003) labour attempt to present labour as a regulatory entry point to the sector, or even Schalekamp's et al. (2010) reflections on the sector's potential to be better absorbed into the IRTPN framework as a regulatory entry point from, in part, the operational point of view. They also lay a pivotal foundation for a discussion on the process of negotiating such this process of absorbing affected parts of the sector (Schalekamp & Behrens, 2013). Furthermore, much of the sector has been viewed within microeconomic lenses from both demand and supply contexts—relating specifically to the travel economy.

Each of these changes in determinants affects the configuration of the travel economy and the manner in which participants and operators behave in relation to demanding vehicles. Be it changes in operations, subsidies, labour, corporatization and the likes. To my knowledge there is no research that approaches the paratransit sector by

'taking better account of market constraints as well as opportunities' (Lomme, 2008) through a macroeconomic lens. At this point in research in transportation economics, shifting from direct control efforts, incentives and constraints that affect the minibus taxi vehicle market, to enquiring into the paratransit market relation to macroeconomic indicators is a valuable way to construct an empirical observation.

2.3 From Minibus to Bus Oriented Transit Services

The travel market landscape in South African policy, strategy and practice is undergoing significant change purview the role the paratransit sector. Through Integrated Rapid Transport Networks (IRTPN), largely in the form of Bus Rapid Transit (BRT), public transport strategies aim to catalyze the accelerated recovery and improvement of public transport services (Department of Transport, 2007; 2010) closer to fundamental land transport policy objectives presented in Table 2. Much of the objectives require that transit interchanges are highly accessible, transit services are convenient; are proximate to activity centers (e.g. destinations) and they dominate the travel market.

The land-use changes that accompany this transformation are livable compact cities and towns that provide high access to major centers (Cooporative Governance and Traditional Affairs, 2014). Dense transport corridors to support the viability of public transport (Stolworthy & Maunganidze, 2013), coupled with mix land-uses coupled with dense human settlements and key amenities (City of Johannesburg, 2013) are advocated for—and are already taking form.

Table 2: Coverage and Patronage: A Balancing Act (Department of Transport, 1996; 2007; 2010)

Coverage		**Patronage**	
Social Needs	*Geographic Equity*	*Financial Return*	*Vehicle Trip Reduction*
• **10% of Disposable Income.** • **Reasonably accommodate all user types.** • **Public transport information services.**	• 40km/direction • 1 hour/direction • Proximity to work locations in rural and urban areas. • 85% Metro population within 1km from station*. • Walking distances <1km in urban areas given 100km of dedicated walkways and cycle ways.	• Economically viable with minimum financial support. • Peak= 5-10min; Off-Peak= 10-30min.* • Service Hours: 5 am to Midnight in large metros.*	• 80% Public Transport; 20% Car. • 20% shift in car trips to public transport by 2020*. s

*These are based on the Integrated Rapid Transport Network strategies currently underway

To link the major activity centres to communities, transit oriented neighbourhoods that house large populations within an 800m radius consolidate local travel demand and feed major centres through rapid corridors (National Treasury, 2013; 2014). Fiscal instruments for these efforts are already in place (The Presidency, 2014). A major question in the midst of all the efforts is what is the role of the minibus sector?

Firstly, attempts to integrate minibus operators that are affected by BRT, for example, into the BRT system through incentivising their participation as shareholders and operators of these new systems were made (Venter, 2013; Schalekamp et al., 2010; Schalekamp, 2011; Khanou, 2012). Minibus services were found to yield the greatest benefit when they functioned as feeders, from local areas, to trunk systems that lead to major centres (Del Mistro & Behrens, 2012), however Ferro and colleagues (2013) argue that a hybrid of formal (e.g. BRT) and paratransit operations that aim to meet the same objectives is likely to suit local contexts best. Finally, the third perspective on the minibus sector is that it within the systems life-cycle context the paratransit sector functions has reached maturity in terms of its market share and growth possibilities and a shift toward a different configuration toward it's advancement is necessary (Venter, 2013). The shift in SANTACO's eyes is multidimensional: entering into various travel markets be it in aviation, rail and so on (SANTACO, 2010). The paratransit sector appears to be undergoing a significant transition, especially in cities and towns that take transport and land-use policies and the fiscal support to action.

3 CONCEPTUAL FRAMEWORK

The approaches above have largely been oriented towards understanding, managing and meeting user demand for the travel system. This section reviews the minibus transportation economy within a conceptual framework.

Minibus taxi operators are individual entrepreneurs, serving their own interests fuelled by the need to accumulate capital (Khosa, 1994) and meet financial targets and reach profit on a daily bases through owning and or operating transit vehicles (Barrett, 2003; Cervero, 2000) to serve the travel system. The travel system itself is a product of a supply chain of automobility which involves the supply of transit units (e.g. transport vehicles) within which users are transported and a sociological component of class and culture (Urry, 2004). Throughout this supply chain, and the lifespan of transit units, emit emissions that have only recently been revealed within their path dependencies (Chester & Horvath, 2009). The implications of the major transitions in the minibus travel economy have significant effects on the transportation economy, since they constitute a change in the determinants of demanding minibus vehicles.

Furthermore, vehicles that transport people and facilitate travel are produced and supplied to the market on the basis of industry related policies—not directly the demand for travel or the policies thereof. In the National Land Transport Act No. 5 of 2009, minibus services are regulated only in terms of market entry in terms of permits to operate certain routes (section 59(1)-89(3)), compliance with permit rules (section 90(1)-90(2) and vehicle standards based on National Regulator for Compulsory

Specifications (NRCS). Thus, the minibus economy is one where the consumption of each vehicle is for the production of travel services. The degree to which travel services are produced is regulated administratively—rather than economically. Is the production of such vehicles encouraged?

Yes it is encouraged especially since recent vehicle production programmes incentivise the local production of minibus taxi vehicles for the Southern African market (Lamprecht, 2012; Ensor, 2012). The People-carrier Automotive Investment Scheme (P-AIS) is one such incentive by the Department of Trade and Industry (DTI). The P-AIS is *'designed to stimulate a growth path for the people-carrier vehicle industry through investment in new and/or replacement models and components that will result in new employment, retention of current employment, and/or strengthen the automotive vehicles value chain'* (DTI, 2013). Minibus vehicle manufacturers have the capacity to produce the other estimated an annual production of 20 000 (Lamprecht, 2012) to 50 000 (Cokanye, 2013) transit units per year. The value chain incentives can reach up to 66% of the value of production, thus attracting new producers in the market, and potentially lower sales prices in real terms.

A general expectation is thus that lower sales prices for the minibuses are a result of (a) rivalry between producers, (b) decreased import costs and (c) substantial industrial incentives. These are exogenous, therefore uncontrolled by minibus operators, and they amplify the determinants of demand and shifting the demand market. To conceptualise this, how does the travel economy relate to the transportation economy? Secondly, how do we structure the relationship between the two in a framework?

3.1 Integrating the Minibus Travel Economy and the Minibus Transportation Economy

Travel market changes, regulations and industrial incentives occur at different ends of the minibus transportation economy. Figure 2 is used to present this point. Travel markets are where transportation systems (supply-side) are used to facilitate the mobility and access of final consumers of travel (demand side: D_t) at a certain generalised cost ($_cG$). In our case for a minibus taxis only capture a portion of the entire market $\left({}^{q}/_{Q} = minibus\ taxi\ share\right)$ --assuming that q also represents the transportation system's capacity to absorb customers. Transportation markets are where instruments that are responsible for the production of transportation systems are viewed in relation to economic measures. In this case, vehicle sales are viewed as the demand (D_v) for transit units ($_sQ_e$) that enable minibus operators/owners to participate in the travel market ($_sQ_e$ - Q_e.) at a certain sales price ($_sP_e$).

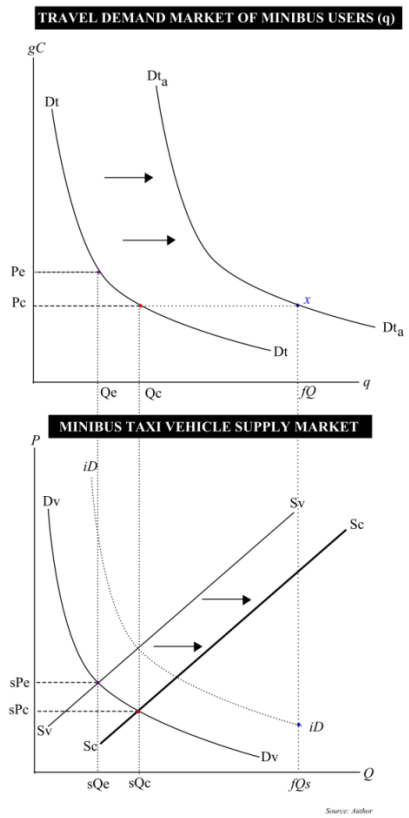

Figure 2: Travel Demand and Minibus Vehicle Supply Present and Future

This distinction describes the starting point for analyzing the basic interactions, ceteris paribus. Changes in industrial policy, for example, mentioned above shift the supply curve in the transportation market from S_v to S_c. Thus setting a lower *equilibrium* sales price ($_sP_c$) and increasing the number of transit units demanded ($_sQ_c$), in the travel market the mode's system capacity to carry demand increases (Q_c) at a lower per user generalised cost (P_c). The land use and transport efforts to manage the travel demand market and future population growth can reasonably be defined as a new, future demand curve. Point x describes the market capacity and supply to meet increased demand. Increased vehicle volumes in the transportation system, emerge by implication, and in the case of minibus taxis-- in their current operational structure-- diminishing returns arise as markets are saturated (e.g. mature life cycle and unchanged business model). In the microeconomic context of the travel market, benefits in major corridors vanish due to traffic congestion—and lowers welfare gains; and in the macroeconomic land scape, industrial benefits increase as revenues exceed break-even and employment is high—positive contributions to the national economy—ergo, increasing welfare gains in another market. In summary, if the minibus travel economy shifts encourage bus use of minibus use whilst industrial incentives in the minibus transportation economy encourage minibus production (for export or domestic consumption) then there is a policy mismatch. Why not incentivize bus transit production? Or if public transport is encouraged, why not discourage private car production to better align with transportation economic policies with the

travel economy? A more holistic view of all the layers that make up the transportation economy at large is therefore necessary.

3.2 The Minibus Transportation Economy

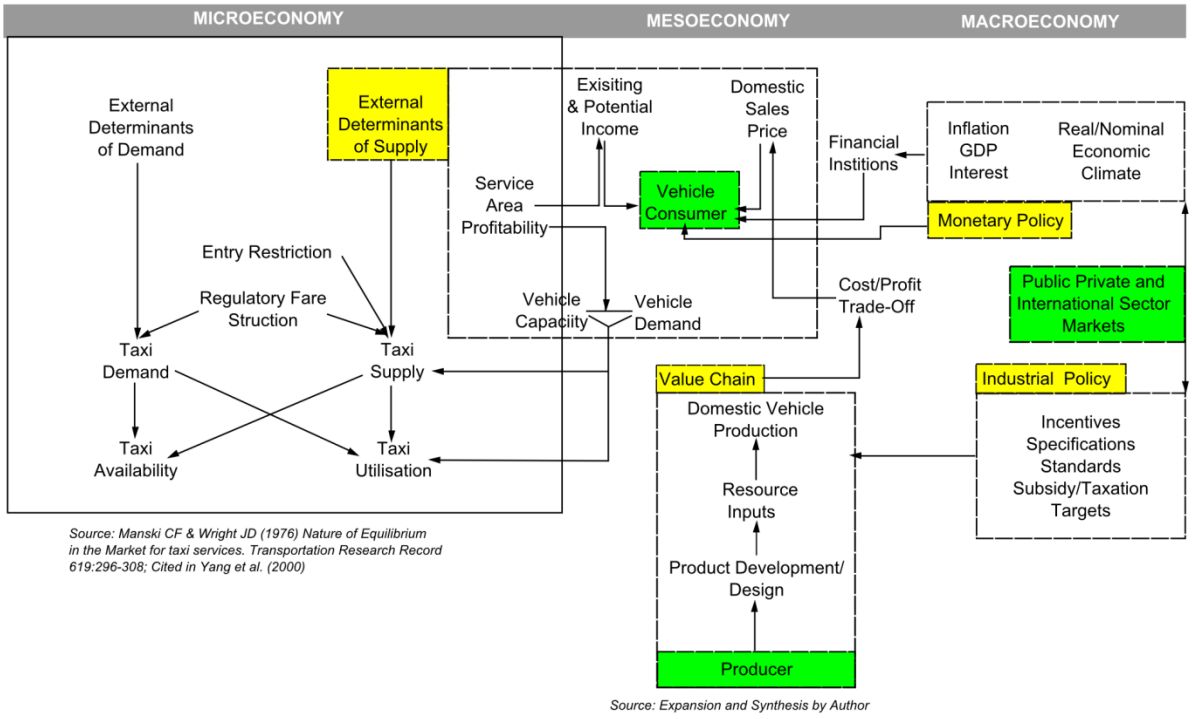

Figure 3: An Expanded View of the Paratransit Market in Macro, Meso and Micro Contexts

This paper is a conceptual shift from the traditional microeconomic view of the minibus travel and transportation economy. The conceptual scheme presented in **Chyba! Nenalezen zdroj odkazů.** above, is an extension of Manski and Wright's (1976) view of the taxi market cited in Yang, Lau, Wong, & Lo (2000). The initial diagramme is in the microeconomic domain, accounting for the manner in which taxi utilisation is formed through entry restriction and regulatory fare structures. Expanding the *external determinants of supply and demand* pivotal to this paper, accounts for:

- the **factors that influence the vehicle consumer** in the paratransit market;
- the industrial **costs of producing** the vehicle and the **subsequent sales prices** which indicate how much an operator-owner may need to cover the investment costs;
- the producer of the transit vehicle itself is influenced by **industrial policies** and their requirements and incentives; and finally
- the role of exogeneos economic factors that are articulated and contained within the **monetary policy** of a country.

It is a presentation of *a system of automobility*, as Urry (2004) puts it, involving the various sectors to realise the supply of transportation services that meet the demand for access to activities. In macroeconomic traditions of chain reactions, if there is an

increase in demand for travel → demand for transit units increases at some capacity → within some limited infrastructure → increase in the number of vehicles demanded → increase in the necessity to produce transit units. This study proposes and tests the above framework to explore the extent to which travel and production microeconomic indicators relate to dynamic macroeconomic activity over time. It follows the tradition in macroeconomic policy of finding relationships in a ceteris paribus environment.

4 RESEARCH METHOD

4.1 Data Used to Test the Framework

The data for the analyses of the paratransit vehicle market within a macroeconomic environment is secondary data. Market indicators are sourced from the South African Reserve Bank (interest rates and inflation); Gross Domestic Product and population related estimates are sourced from the World Bank Data platform's development indicators; minibus taxi vehicle sales volumes were sourced from the National Association for Automotive Manufacturers South Africa in 2012; and sales prices were sourced from one popular minibus taxi manufacturer through correspondence in 2014. The actual vehicle population estimates were sourced from the Road Traffic Management Corporation in 2015[2]. It is only between 1994 and 2009 where all the data is available, although minibus sales, for example, are sourced from the 1970's. The data in Table 3 is used to perform three analyses.

Firstly, since the population of minibus vehicles is where travel services take place, minibus vehicle sales in relation to the population should be assessed. Secondly a view of the sales price and minibus taxi dynamics over time is necessary to facilitate a reflection on the *responsiveness* of the market to changes in real and nominal sales prices. Lastly, assessing the correlation between variables and analyzing the market relative to selected macroeconomic indicators is central to estimating relationships and identifying path dependencies.

Table 3: Data Used to Test the Framework

Year	Nominal Growth Index	Real Growth Index	Total Population Index	CPI	Minibus Registered Vehicle Population	Nominal GDP/Capita Index	Minibus Taxi Sales	Nominal Sales Price Per Seat	Real Sales Price Per Seat
1994	-113.1	198.2	97.9	91.1	220298	91.8	15274	R 6 997.8	R 7 684.6
1995	100.0	100.0	100.0	100.0	238381	100.0	18473	R 7 869.2	R 7 869.2
1996	464.7	0.3	102.2	107.4	240337	93.0	17207	R 7 861.9	R 7 323.4
1997	-363.8	202.7	104.5	116.0	244926	94.1	12637	R 7 096.8	R 6 120.5

[2] RTMC : http://www.rtmc.co.za/index.php/reports/traffic-reports

1998	62.2	80.7	106.9	122.8	250838	83.0	10387	R 6 655.6	R 5 418.4
1999	-618.0	264.9	109.4	128.0	253201	80.3	8039	R 7 551.8	R 5 899.2
2000	-166.5	132.6	112.1	133.4	248837	78.2	5504	R 8 264.2	R 6 197.2
2001	-139.3	105.0	114.9	139.1	244598	68.3	6198	R 8 198.8	R 5 896.1
2002	-659.1	240.1	117.3	148.2	240427	63.2	7416	R 11 182.8	R 7 544.8
2003	-391.7	175.9	118.9	154.1	241938	94.4	5502	R 11 395.5	R 7 395.9
2004	2580.6	-519.7	120.5	155.5	245753	121.5	7886	R 11 561.0	R 7 436.5
2005	1497.0	-303.7	121.9	158.9	256205	135.5	11791	R 11 662.3	R 7 341.2
2006	598.9	-140.1	123.3	163.5	266175	141.6	14329	R 14 206.2	R 8 688.6
2007	233.1	-14.6	124.7	170.6	276599	153.5	18815	R 14 915.4	R 8 742.8
2008	440.3	-51.1	126.1	182.1	279976	145.3	20555	R 17 613.3	R 9 670.3
2009	-278.9	163.5	127.5	189.3	282941	148.6	12040	R 18 697.8	R 9 878.9
2010	116.5	117.3	128.8	193.5	268660	188.2	12476	R 18 995.9	R 9 815.7

The analysis of the secondary data sourced relies on two approaches: (1) temporal analysis of Selected Macroeconomic Indicators (SMIs) in relation to indicators of the minibus economy; (2) statistical analysis of significant relationships between SMIs and the minibus economy in order to identify path dependencies.

5 DATA ANALYSIS

5.1 Temporal Analysis

5.1.1 Population & Sales

Figure 4 presents the minibus taxi vehicle (MTV) sales, population and accumulations. The general assumptions are that: (a) the (registered) vehicle population is a product of cumulated sales; (b) all the vehicle sales are domestic—none are exported; (c) the difference between the registered vehicle population and cumulated sales is indicative of the cumulative number of vehicles ejected by the market; and (d) the registered vehicle population are all the minibus taxis that operate official public transport services.

Under these assumptions, vehicle sales seem to make a small annual contribution to the registered vehicle population. In view of Figure 4, the size of the registered

minibus market seems to be growing slowly at 6% per year on average from 220 298 to 268 660 vehicles between 1994 and 2010. Comparing the size of the cumulative vehicle sales with the registered vehicle population, the size of the registered market seems to be growing at a smaller rate than the accumulated sales. This on one hand may reinforce the position that the minibus market has matured (Venter, 2013), on the other hand what does the difference between cumulative sales and the registered vehicle market intimate?

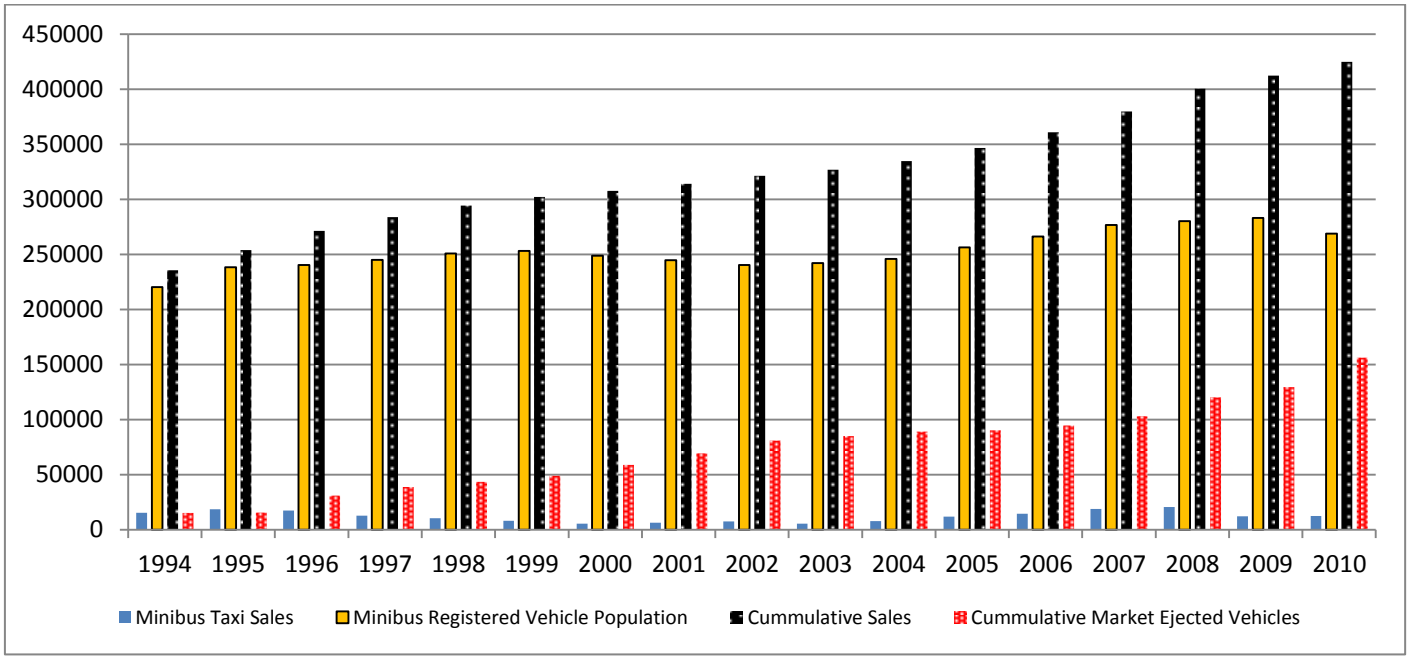

Figure 4: Minibus Taxi Vehicle (MTV) Population and Sales (1994-2010)

The cumulative number of minibus vehicles sold in 2010 is nearly double the size of the 1994 registered market. We assume here that difference between the cumulative number of vehicles sold $(S_{y_i+\sum s_{y_{i-n}}})$ by the year (y_i) in question, and the number of registered minibus vehicles (R_{y_i}) suggests the total number of vehicles ejected from the market for that specific year (E_{y_i}). This is shown in Equation 1.

Equation 1

$$E_{y_i} = S_{y_i+\sum s_{y_{i-n}}} - R_{y_i}$$

On average the minibus market seems to eject 8000 vehicles per year. Furthermore, 1989 cumulative vehicles sold were 176 222 and by 2010 the number of ejected vehicles were 11% less than the 1989 estimate. A reasonable inference is that 89% of vehicles that were in the registered market in the late 80's were ejected by 2010. Put differently, the minibus market appears to undergo an overhaul over time—which is what the taxi recapitalisation programme aimed to accelerate by increasing the access to minibus vehicles, and incentivizing the scrapping of old vehicles (see Table 1). Thus, by 2010, most of the vehicle market in the 80's was refurbished—*'naturally'* and through recapitalisation. Without consistent data, we did not estimate the effect of the taxi recapitalisation process—especially the rate at which it increased/decreased the

ejection of vehicles in the market. Since the recapitalization process intimated an effort to ease the access to vehicles, vehicle sales may reveal an underlying stream of dynamics within the minibus market. With the above in mind, do vehicle sales interact with (1) the registered vehicle population and (2) sales price in real and nominal terms? Do these interactions reveal facets related to vehicle ejection?

5.1.2 Sales Prices in the Nominal and Real Economy

The consumption of minibus vehicles takes place under nominal conditions, and should be analysed in real economic terms-- by doing so we account for the effect of inflation (Fourie & Burger, 2009; Mohr & Fourie, 2008), and then begin to assess the underlying dynamics in the minibus market. This section comparatively discusses the nominal and real economy of minibus vehicle sales at average prices per seat.

Equation 2

$$nP_i^m = \frac{p_{v_{ij}}}{C_{v_j}}$$

Equation 3

$$rP_i^m = \frac{p_{v_{ij}}}{C_{v_j}} \times \frac{CPI_{1995}}{CPI_i}$$

To estimate the average nominal sales price per seat (nP_i^m) for a particular year (i), the price for each minibus vehicle model (v_j) was spread over its number of seats (C) and averaged for that year. The real sales price per seat (rP_i^m), was estimated where the Consumer Price Index was based on 1995.

In Figure 5, the percentage change of sales prices per seat in the nominal market is an inflation of the real market sales prices-- 1%<10% inflation of changes. Over time, the nominal and the real price diverge to very different scales: almost a R10 000 differences by 2010. Consumers of minibus taxi vehicles interact directly with the nominal prices, and per capita Gross Domestic Product (GDP)—but they *experience* the real prices and income when transacting in the market every year. From the 1994-2010 trajectories presented in Figure 5 three key periods can be discussed.

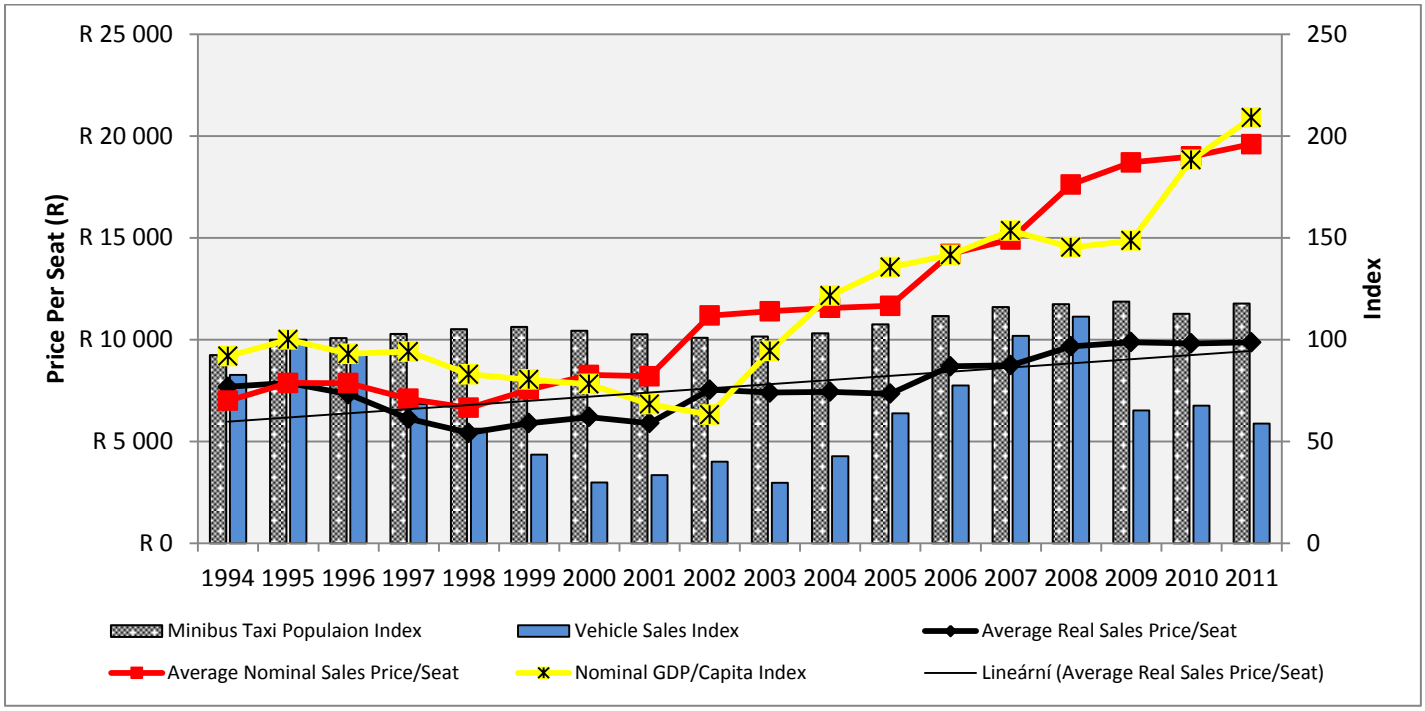

Figure 5: Vehicle Market Interactions with Nominal and Real Prices between 1994 and 2011

1995-2000 vehicle sales began contracting in line with the nominal GDP, whilst real prices were decreasing and the minibus vehicle population expanded slightly--peaking at 2000. *2001-2006* vehicle sales were relatively sluggish whilst the nominal income per capita rose steeply from 2003 onwards. The vehicle consumption market expanded from *2006 to 2009* at similar rates as the nominal per capita GDP, whilst real sales price per seat went from R8 688 to R9 878, respectively, within the same period. The surge in sales was reinforced by contracting real interest rates concaving from 5.5% to 3.2% and then expanding to 4.3% by 2009[3]. Although the prime rates were kept relatively constant, the 2008-2010 global recession had already loomed, and real prices remained flat, with stiffer sales even as nominal income per capita increased into 2011. It is apparent that vehicle sales interact with interest rates, and nominal GDP estimates—responding and reflecting changes over time.

5.1.3 Real Economy Trajectory

Over time, the real economy appears to manifest a different set of responses from those most obvious—as in the nominal sector. If we measure volatility by the magnitude of change over time then in Figure 6 below, the nominal economy is most volatile between 1995 and 2004; the real price elasticity of demand is most volatile between 2004 and 2011. Observed more closely there is some interaction. For instance, the 1996 spike in nominal elasticity follows a 20% increase in sales. The 2004 spike in real elasticity follows a 25% decrease in sales. There is however no significant pattern of correlation between the variables. What is evident is the stark

[3] Interest rate data was sourced from the South African Reserve Bank's *Selected Historical Data* portal here: https://www.resbank.co.za/Research/Rates/Pages/SelectedHistoricalExchangeAndInterestRates.aspx

difference between nominal market and real market elasticities—well beyond the scale effects. Both these elasticities reflect the change in sales. The change in sales translates to volatile real price elasticities of demand when they are greater than 20% beyond 2004.

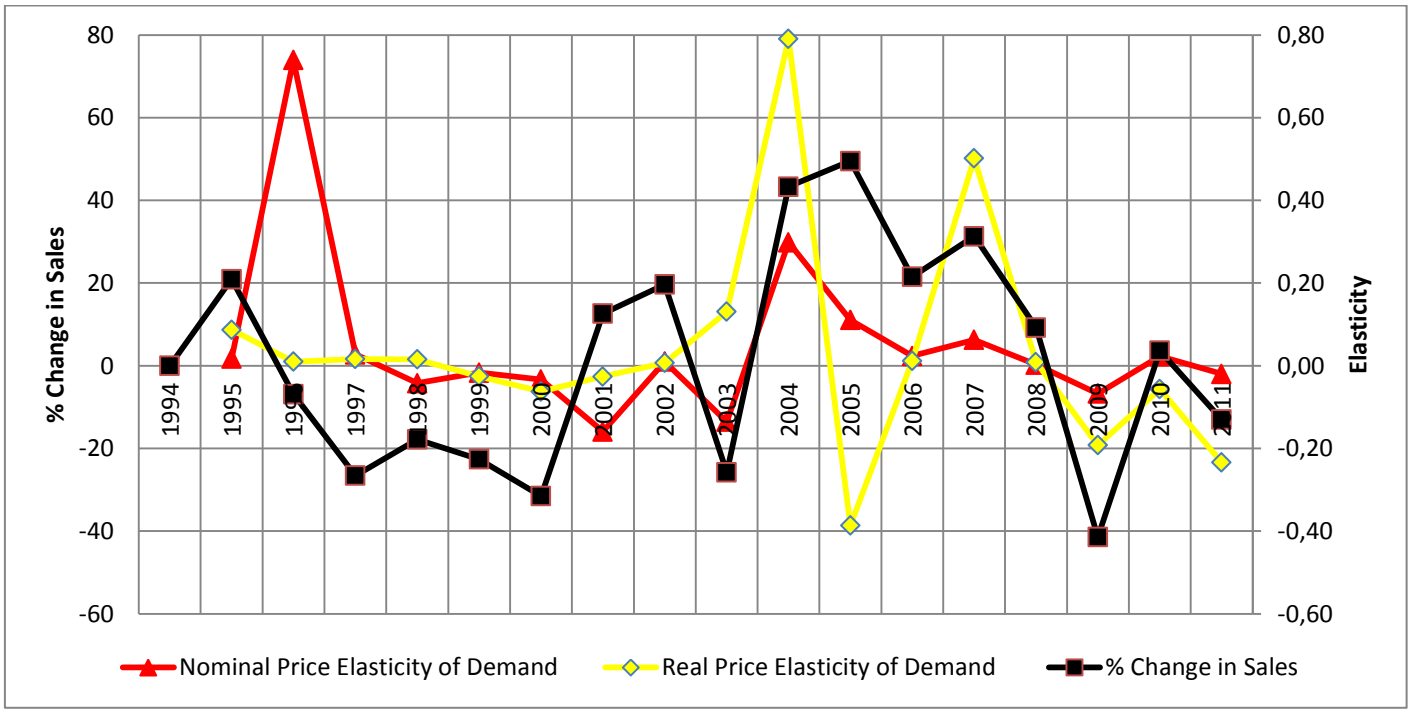

Figure 6: Minibus Taxi Vehicle Responsiveness Trajectory in Nominal and Real Economy

A much clearer image of market elasticities is shown in Figure 7. The greatest levels of volitilty in real and nominal sales prices lies between R5 000 and R10 00 per seat. In is within this range that evidence of hysterisis is found. Which implies that vehicles priced as such attract a varying range of market responses: both positive and negative responses in demand.

The most response inducive price per seat is the R10 000 price. As prices increase, the range of responsiveness narrows from the 0.3 peak to < 0.1 where the market becomes more inelastic at high prices. This is intuitively correct. The real economy thus, is the inflation/deflation reflective layer of the economy minibus vehicle consumers interact with. It also appears to reveal a vividly complex reflection of market trends over time, and their responsiveness in line with the axioms in macroeconomic theory: (a) as income increases, consumption (i.e. sales) follow suite as in Figure 5; (b) real and nominal price elasticities over time vary significantly in relation to a change in sales; and (c) nominal or real price elasticity contracts as prices increase. Do these effects translate into the travel demand market?

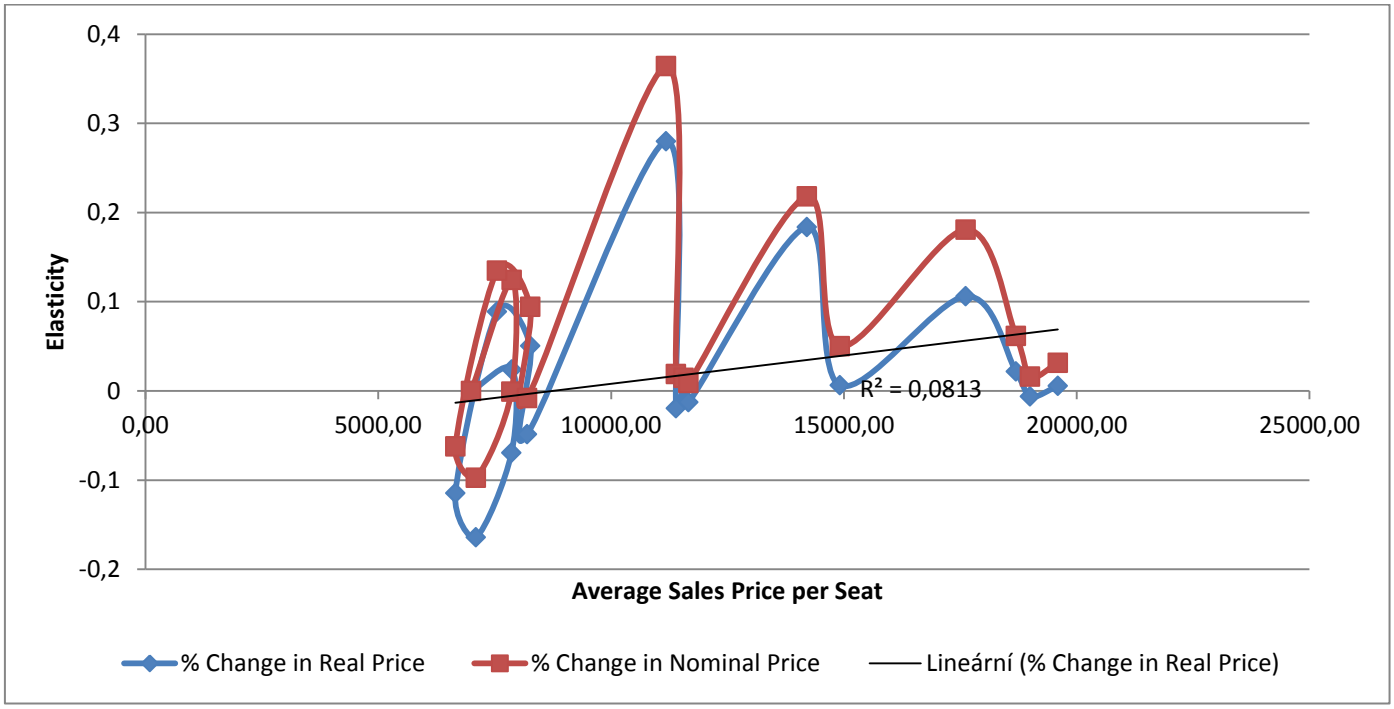

Figure 7: Price Elasticity in Relation to Nominal and Real Price Per Seat Changes

5.1.4 The Travel Economy

To conclude the temporal analysis, Figure 8 suggests that the minibus taxi market and the travel market (measured in average vehicle kilometers travelled (AVKT)) appear to take an interactive form. There appears to be some sequential lag effects between the AVKT and the nominal GDP over time, spaced over two years. For instance, in the 2000 decline in AVKT is followed by a 2002 decline in nominal GDP. A spike in nominal GDP in 2007 is preceded by peak increases in 2004 AVKT—nearly at a 1994 rate of growth. Unlike Figure 6, there is an evident lag effect between the two trends. It is also possible that other factors related to AVKT apply downward pressure on the nominal rate of change in income in the short-term. The relationship between the macroeconomy and the travel market may be an underlying one—that is better estimated statistically.

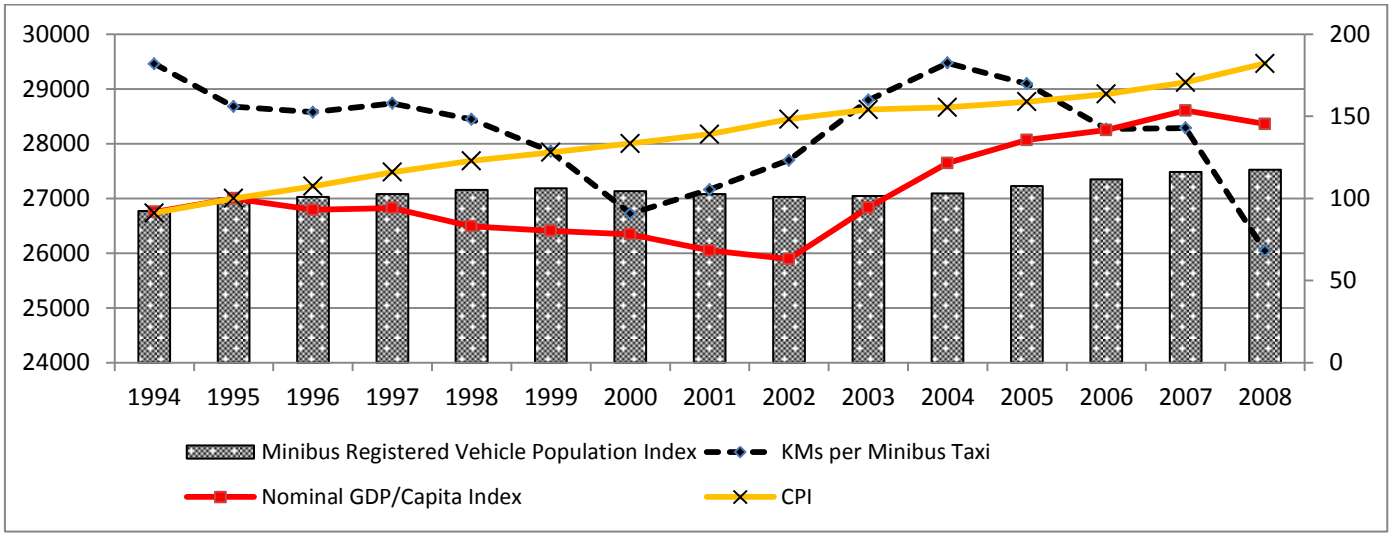

Figure 8: Average Minibus Vehicle Kilometres Travelled and Selected Indicators

5.2 Statistical Analysis

The statistical observation in this study considers the Pearson-correlation coefficient for the sample, the subsequent coefficient of determination (R^2), and the t-statistic assessing whether the mean falls within the null hypotheses. Relationships between SMIs and minibus economy variables are considered only correlations where $r \geq 0.5$; $R^2 \geq 0.5$, and t-crit $\geq +2.145$ at 95% significance. For a concise discussion on principles of statistics see Wegner, (2012). The path dependencies demonstrate the link between SMIs and market specific variables in the dataset. Such paths are in the tradition of macroeconomics, tools for understanding the chain effects of changes in specific variables, ceteris paribus. For the purposes of this study, observations considered are separated in to two parts: (1) statistical paths that exclude the total population index in South Africa (Consumer Price Index (CPI) centered) and (2) statistical paths that are specific to the total population index (TPI). Although they are presented separately, these relations take place simultaneously because the correlation between CPI and TPI is high (0.989), R^2 is 0.979 and a t-statistic of 25 is highly significant.

5.2.1 Paths Excluding the Total Population Index

In Figure 9 CPI has the highest number of links and thus directly affects CMEV, RSPS/S, CS, MRVP and NSP/S. The real economy shows to be responsive to CPI. RSP/S affects CS and CMEV to similar degrees but only explains 30% of the sale trend of minibus taxis (MTS) whilst correlating at a much lower threshold than its other paths (r = 0.55). The real sales price is the only indicator to relate significantly to the number of minibuses sold. However, stronger relationships are found between CMEV, CS in the nominal economy than in the real economy. 69% of the number of minibuses registered (MRVP) seem to be explained by the nominal price—which is the price that is communicated to consumers. The MRVP is also related to the CPI and the average nominal income per person (NGDP), suggesting that changes in inflation indirectly influence minibus vehicle consumption relative to average incomes.

Furthermore cumulative sales (CS) are strongly related (r = 0.79) to the average nominal income partly because nominal income per capita data takes a cumulative trend as economies and populations grow and the number of Rand increase to account for increases in average prices (inflation). The direction of each effect is inconclusive because it is unlikely that price increases encourage more sales, ceteris paribus. Or that increases in CPI place upward pressure on the cumulative sales (not the rate at which sales change over time). Hence the temporal analysis' role in interpreting the results in the concluding section. However, from the above discussion it is evident that significant relationships exist between price related indicators (RSP/S, NSP/S and CPI) and immediate sales estimates (MRVP, CMEV, CS). Price related indicators have indirect influence on a seemingly exogenous force (determinants of demand) such as NGDP.

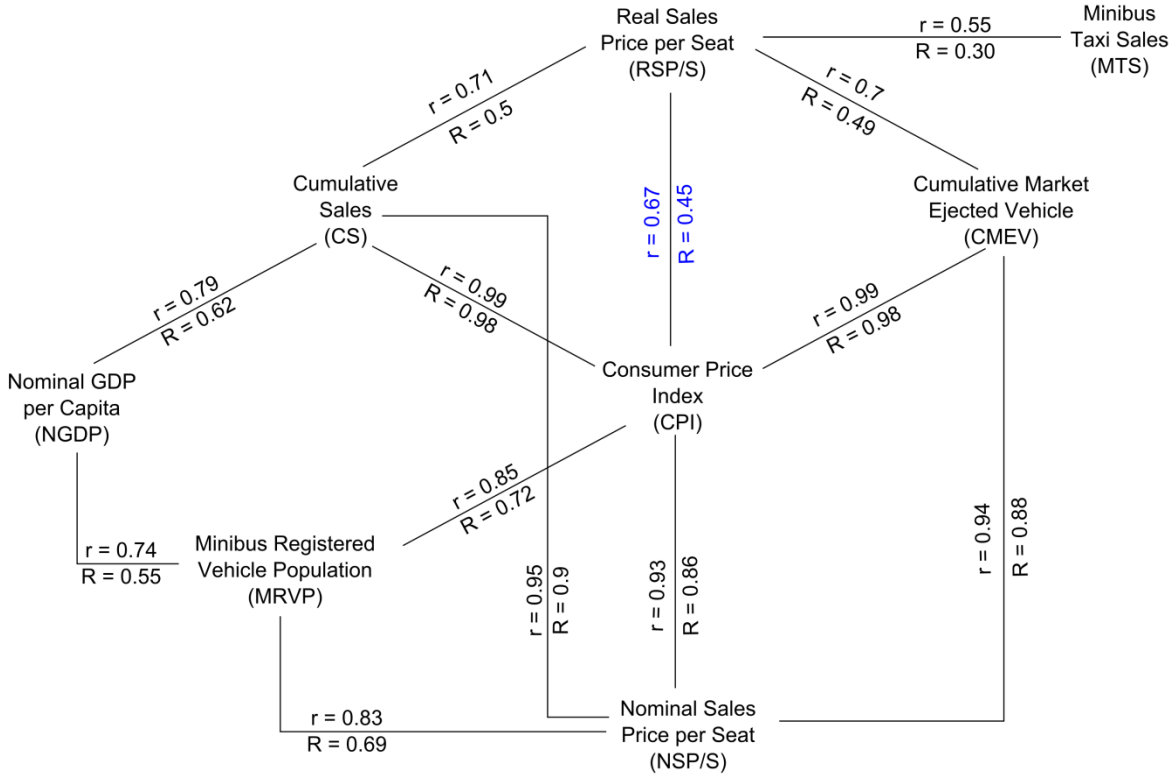

Figure 9: CPI Oriented Path Dependencies

5.2.2 Paths Including Total Population Index

Turning to Figure 10, the nominal economy relates more to the total population index (TPI) than to the real price per seat, as with CPI. In terms of immediate demand path dependencies the TPI is strongly related to CS and CMEV (*r* and *R* > 0.9) and less so to the number of minibuses registered (*r* = 0.81, and *R* = 0.66). Which implies intuitively that sales cumulate in relation to the number of people, and that as this occurs the number of vehicles ejected also follow suit—thus emphasizing the notion that the market renews its fleet over time (at a certain rate). As the average nominal income relates to the number of vehicles ejected from the market well (*r* = 0.76) but

only explains part of the trend (R = 0.58). Minibus operators consume minibus vehicles on the basis of their income and the conditions in the overall economy, not only the travel economy. In order for the market to renew its fleet, through ejecting vehicles, average income seems to be an enabler—even though it is indirectly affected by the population.

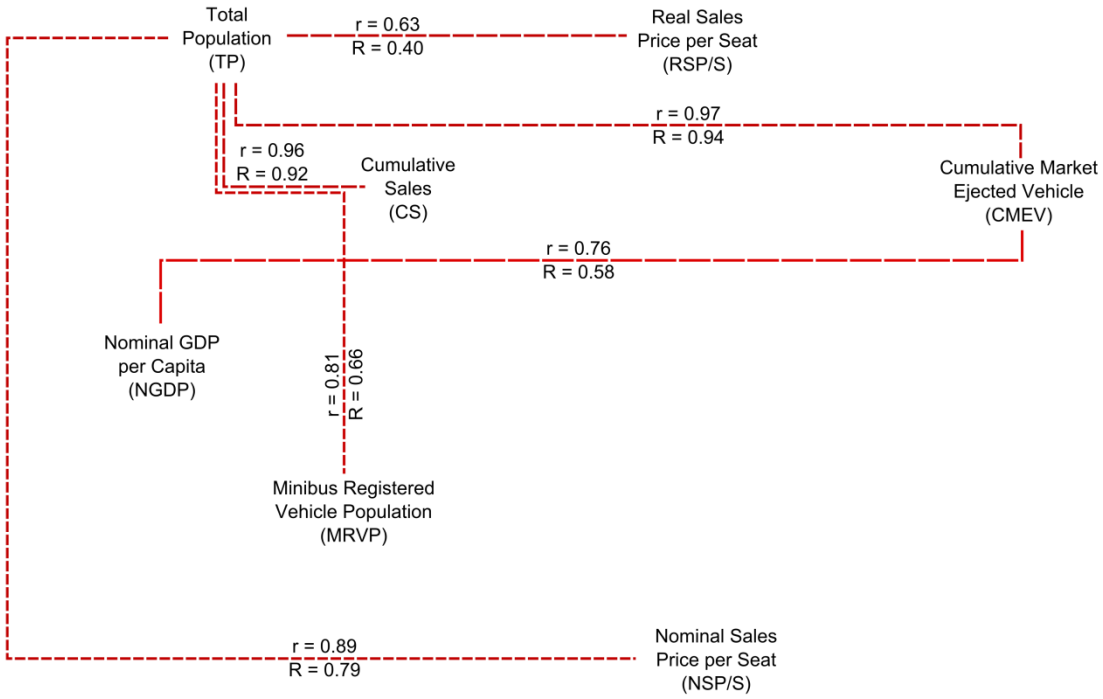

Figure 10: Total Population Index Oriented Path Dependencies

6 DISCUSSION AND CONCLUSION

This paper is an experimental exploration of statistical relationships between selected macroeconomic indicators (SMIs) and the national minibus economy. It is argued that regulations and interventions in the travel economy (i.e. reducing the number of minibuses) do not tally well with interventions in the transportation economy (i.e. minibus vehicle production incentives). Conceptually this purports that there is a policy mismatch between the minibus travel economy and the minibus transportation economy. The minibus market indicators seem to show lag effects, greater volatility to certain price ranges over others and follow, in some cases, macroeconomic indicators. Thus, macroeconomic indicators are shown to relate significantly with the minibus transportation economy, and travel economy at large. The relationships are found to be path dependent and dynamic over time—making it an interesting avenue of research in the mesoeconomic domain.

This paper, however, lacks a structured and consistent dataset for an accurate estimation of travel economies over the same period. Similarly, the effect of interest rates on the minibus travel and transportation economy is unaccounted for in this

study. Interest rates are important because most consumers of minibuses borrow money to purchase the vehicle.

From a policy making point of view, setting a mesoeconomic agenda to identify and address industrial policy and travel policy mismatches is crucial if effective implementation is sought. Industrial policies that inform the supply of vehicles in the transportation economy need to be reinforced by the policies related to the travel economy of any transport mode. In a similar vein, another recommendation for further research is that the treatment of public transport related industries should be treated holistically accounting for the entire supply chain of activities that make the travel system work. Finally, macroeconomic indicators seem to flow through the transportation economy influencing the demand for transit vehicles, and thus the supply of travel services in the travel economy. Future requires more rigorous quantitative models to predict the effect of changes in the indicators over time along the path dependencies, and the implications of such changes for transit supply and demand on a national, regional and local level.

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