

THE SPATIAL TREND ASSOCIATIONS BETWEEN SOCIO-ECONOMIC FACTORS AND HOUSEHOLDS' TRAVEL PATTERN IN GAUTENG

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ABSTRACT

It is widely believed that public transport alternatives, income levels and employment influence households' travel patterns and modal choice. In particular, the level of employment and disposable income influences trip generation rates as well as the type of trips that are undertaken. The dual nature of Gauteng's and South Africa's economy creates a diverse socio-economic landscape and it is expected that this has varying effects on household travel patterns and modal choice. However, not enough is known about the relationship between socio-economic factors and households' travel patterns in South Africa. The aim of this study is to describe the spatial trend associations between socio-economic factors and households' travel patterns in Gauteng by analyzing data from the Gauteng Household Travel Survey. The results revealed trend associations between 1) income, employment, possession of a driver's license and car ownership 2) income, employment and trip generation rates 3) income, employment and mode choice and 4) income, employment and type of trip. The results suggest that private cars are the preferred mode above a certain income threshold and that public transport alternatives are limited and not preferred. This study highlights that improvements in public transport alternatives can significantly influence households' travel patterns.

Key words: spatial analysis, travel patterns, Gauteng, car access, public transport

INTRODUCTION

Socio-economic factors influence households' mobility and travel patterns. As a result, households can be classified as transport disadvantaged and social disadvantaged. Social disadvantage entails lack of participation in economic, political and social activities and is attributed to unemployment, low incomes, low skills, ill-health and poor housing (Lucas, 2012). Low skills result in high difficulty in finding jobs or if employed the low skilled workers earn low incomes. Transport disadvantage is a result of not owning a car, poor formal and informal public transport services, high cost of fares, lack of information and fear of crime (Lucas, 2012). Due to low incomes, transport disadvantaged households cannot afford to own a car and usually stay in the cities' periphery where access to modes of transport is poor. The dual nature of Gauteng's and South Africa's economy creates a diverse socio-economic landscape and it is expected that this has varying effects on household travel

patterns and modal choice. However, not enough is known about the relationship between socio-economic factors and households' travel patterns in South Africa. The aim of this study is to describe the travel patterns of Gauteng households. In particular, the study aims to determine spatial trend associations between socio-economic factors and households' travel patterns in Gauteng. The paper begins with a review of the literature on factors that affect travel patterns, it continues with descriptions of the data and methods used. Results include trend associations between travel patterns such as trip generation rates, mode choice etc of households in relation to household income and employment. It concludes with policy implications and areas of future research.

LITERATURE REVIEW

Mobility, particularly between work and home is a major consideration for transport planners as it results in economic, social, and environmental benefits and externalities (Mercado *et al.*, 2012). Consequently, it is vital to explore the factors that influence travel patterns of households, as it is an avenue through which socio-economic development can be improved.

Income and employment

Low incomes impose restrictions on the number of trips generated by households as limited income is at the disposal of these households. As a result, low-income households' travel less, tend to travel shorter distances and have difficulty accessing shops, leisure, work, education and cultural activities as they have limited incomes to spend on travel (Hurni, 2006, Lucas, 2012, Pa'ez *et al.*, 2010). In addition, no-car and low income households have been found to experience more difficulty in accessing jobs, owing to limited access to public transport (Cervero, 2004). In terms of annual journey distances travelled, non-car households were found to travel 50% less than car-owners (Kenyon *et al.*, 2003). This implies low-income households are transport disadvantaged.

Drivers' license

Obtaining a driver's license enables one to derive the benefits of private car use. A household's travel patterns are enhanced when one or more members of the household obtain a driver's license (Priya, & Uteng, 2009). In Europe and the USA government programmes in the form of loans and assistance to obtain drivers' licenses were implemented to increase car ownership, mobility and access to employment (Fol *et al.* 2007). The 2003 South African National Household Travel Survey showed disparity across ethnicities in having driving license. Of the black population only 10% had a driving license, whilst for colored it was 21%, for Indians it was 56% and for whites it was 83% (National Household Travel Survey, 2005). Additionally, buying and maintaining a car is expensive for large proportion of South African households resulting in car ownership being not easily accessible.

Modal choice and travel patterns

Modal choice affects accessibility and travel patterns. Private car use has been shown to increase accessibility compared to public transport use (Mercado *et al.*, 2012). Gao and Johnston (2009) as well as Grengs (2009) found that the right mix of transport modes available to residents was a more important factor to accessibility than geographic proximity. Access to efficient public transport was found to be positively associated with labour participation rates. In particular, Hess (2005) suggested that governments should improve public transport in areas with a high density of low wage earners as this would improve access to employment and household incomes.

Empirical evidence suggests that private car ownership and private mobility reduces the geographical barriers and the resultant poor labour outcomes such as unemployment, underemployment and low labour productivity. Several studies have shown that improved car access results in improved employment opportunities (Cervero *et al.* 2002, Ong 2002, Garasky *et al.* 2006, Rogalsky, 2010).

METHODOLOGY

Although some research has been done within the South African context, there is little research that seeks to identify relationships between the socio-economic variables and mobility and accessibility, considered for the purposes of this paper to be the efficient movement of people and the ability to reach opportunities respectively. Gauteng was chosen for this study as it is the economic hub of the country and, whilst being the smallest province, it represents approximately one quarter of the country's population. It also has a mix of area types (ranging from metropolitan to rural), income levels and ethnicities.

The main source of data was the Gauteng Province Household Travel Survey 2014 (Gauteng Province Roads and Transport, 2016). The survey was distributed to a random stratified sample of 29 779 households. Additional sources of data were obtained from Statistics South Africa (Statistics South Africa, 2016). Data was sought from the databases on population and population density, as well as national and provincial gross domestic product (GDP).

PRESENTATION AND DISCUSSION OF RESULTS

The Gauteng province consists of five municipalities, three of which are metropolitan municipalities, i.e. Johannesburg, Tshwane and Ekurhuleni, and two of which are district municipalities, i.e. Sedibeng and the West Rand. The latter are in turn divided into three local municipalities each. Economic activity varies considerably across the province ranging from agriculture and mining to areas dominated by services. The population densities for the five municipalities vary considerably, providing a possible indication of the variation in the human settlement types across the province. These are shown in Figure 1.

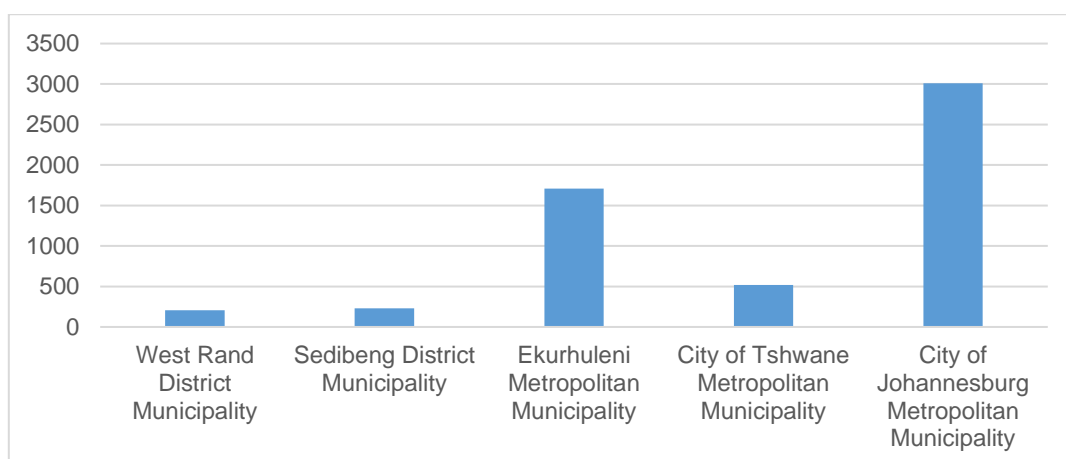


Figure 1: Population density per Gauteng municipality (Data sources: South African Market Insights, 2017; StatsSA, n.d.)

Average incomes also vary considerably across the municipalities. Figure 2 below provides an indication of the average income, with Johannesburg being the highest and the Westrand the lowest. There are however considerable disparities in the distribution of income. The figure depicts the areas within each municipality with the lowest and highest average area income. Tshwane shows the highest differences in area income and Westrand shows the least. Ekurhuleni houses the area with the lowest average household income.

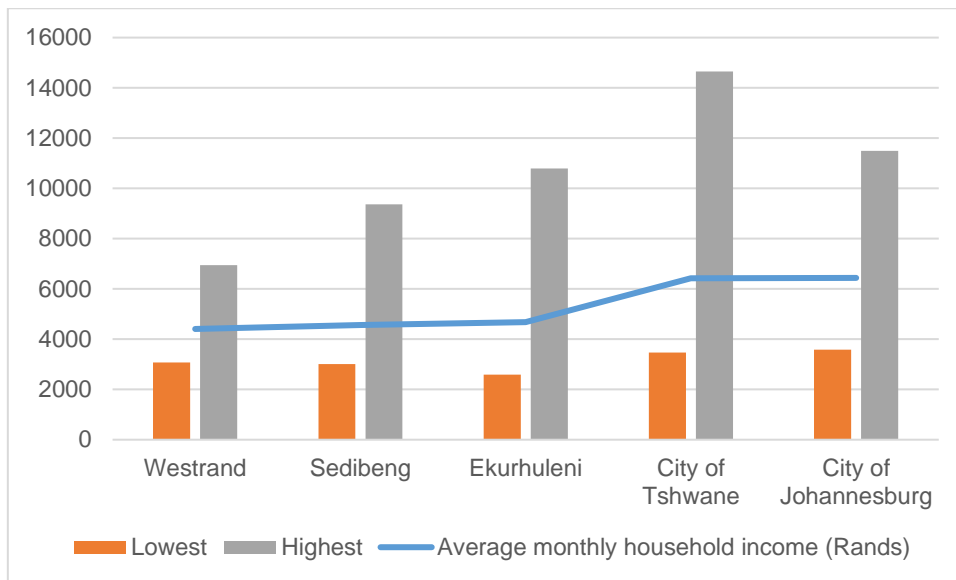


Figure 2: Average income per municipality (Data source: GHTS)

Figure 2 provides a clear indication of the vast differences that exist in income levels across the province, thereby evidencing the dual economy in the province. This is also shown in the Gini coefficient, which measures income equality, indicates that, in 2014, the level in Johannesburg was the highest in the province, at 0.65 and the lowest was the Westrand at approximately 0.61 (Gauteng Provincial Government, 2016, p. 63). The varying levels of economic wellbeing is also illustrated by the employment levels across the province, which vary considerably. These are illustrated in Figure 3 below.

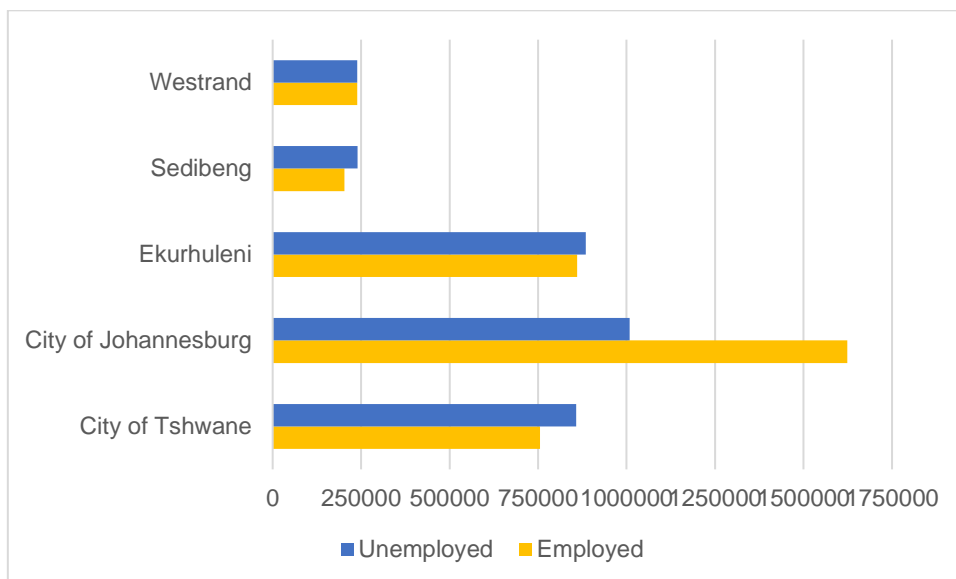


Figure 3: Employment and unemployment in Gauteng (Data source: GHTS)

Johannesburg has the highest level of employment in the province at 61.69%, whereas Sedibeng has an average employment level of only 45.83%. The area with the lowest level of employment in the region is Temba, Winterveld, Mabopane, Ga-rankuwa in Tshwane at 27% and the area with the highest levels of employment at 89% is Randburg in Johannesburg.

As indicated in the literature review, there appears to be a strong correlation between income, employment and travel patterns. The considerable variation in income and

employment levels across the province would therefore also suggest that there are considerable differences in travel patterns across the province.

Figure 4 shows the relationship between income and car access, as well as the average number of licensed drivers. As expected, there is a strong relationship between the average number of licensed drivers and the average car access per household. The former is higher than the latter, suggesting that car ownership aspirations are high; even where there is no car access in the household, there may be a licensed driver, most likely indicating a desire to have access to a car. There is also a relationship between income and average car access/ licensed drivers. Generally, as income increases, so does car access per household. The exception to this is the City of Tshwane. Although the average car access level is higher than those in the lower income areas of Sedibeng and the Westrand, it is slightly lower than the lower income area of Ekurhuleni. This is possibly explained by the fact that, although Tshwane has a high average income, this may be distorted by some of the highest income areas in the province. In addition, the literature indicates that Tshwane also has the lowest income area in the province as well as a very high portion, i.e. 53.17%, of unemployed persons.

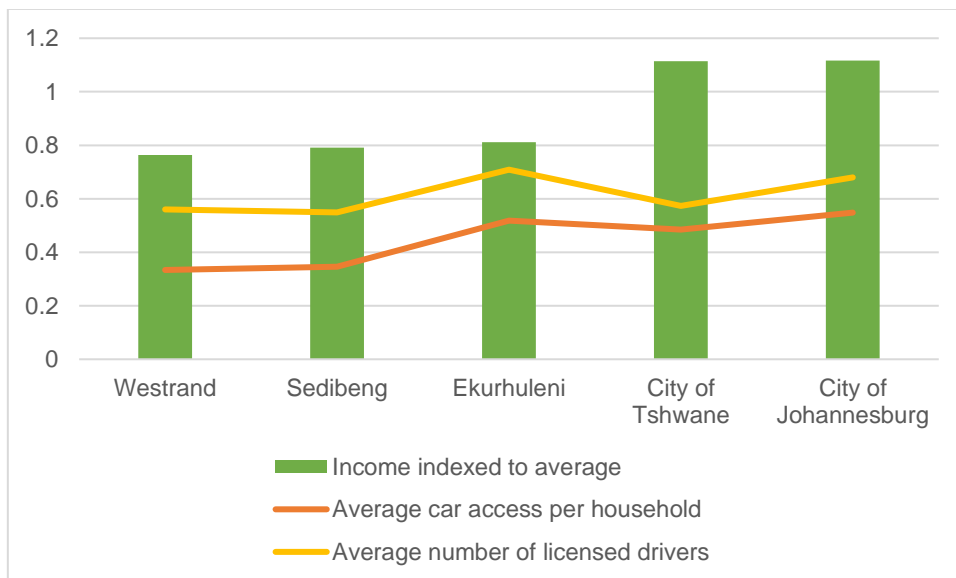


Figure 4: Income and car access/licensed drivers (Data source: GHTS)

Figure 5 shows the relationship between income and trip generation rates. The figure shows that there is a relationship between income and trip generation; i.e. areas with lower incomes tend to generate fewer trips than areas with higher income. It cannot however be stated that the higher the average income, the higher will be the trip generation rate. Ekurhuleni shows very high trip generation rates, despite its relatively low average income. Westrand also has higher trip generation rates than Sedibeng, despite having a slightly lower average income level. The reasons for these discrepancies are not immediately apparent and may relate to the level of public transport services, or the costs thereof. It is also likely that these are related to population densities and land surface areas, as well as average travel distances. Finally, it could be associated with the variation in employment and income levels within the municipality. This would require further investigation to clarify.

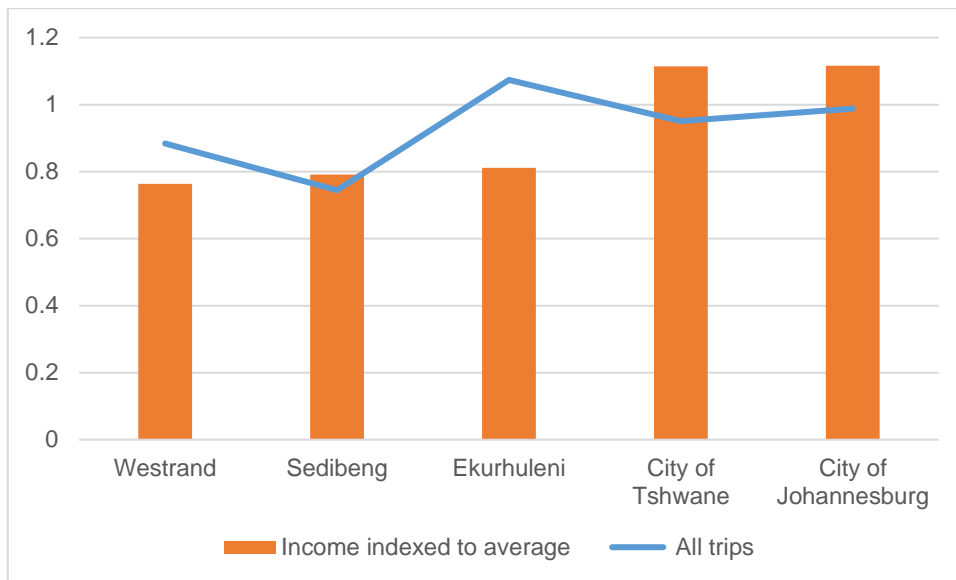


Figure 5: Income and trip generation (Data source: GHTS)

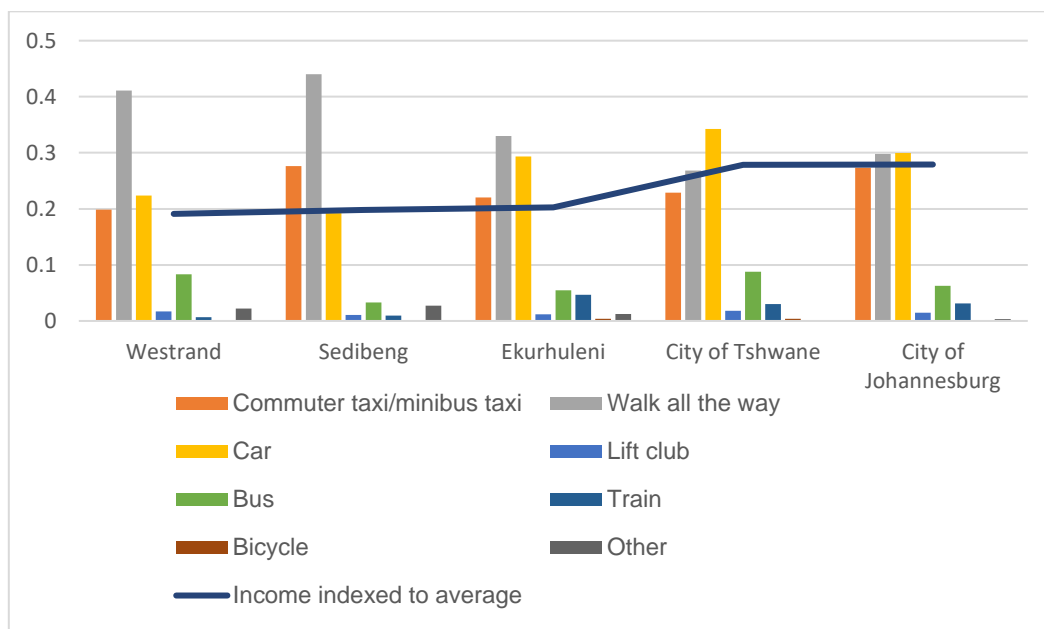


Figure 6: Income and modal choice (Data source: GHTS)

Figure 6 depicts the relationship between income and mode selection. Again, although the relationships are not absolute, the data indicates that, as expected, walking is far more prevalent in lower income areas. Taxis and cars are important modes of transport, regardless of the level of income in the area. This is largely explained by the high levels of availability of taxis as the dominant mode of public transport in Gauteng (Statistics South Africa, 2014) as well as the high levels of car ownership in the province (Luke, 2018). The relatively low levels of bus and train patronage may however be more of an indicator of availability rather than being related to income levels. Availability levels of various forms of public transport would be required to further investigate these patterns.

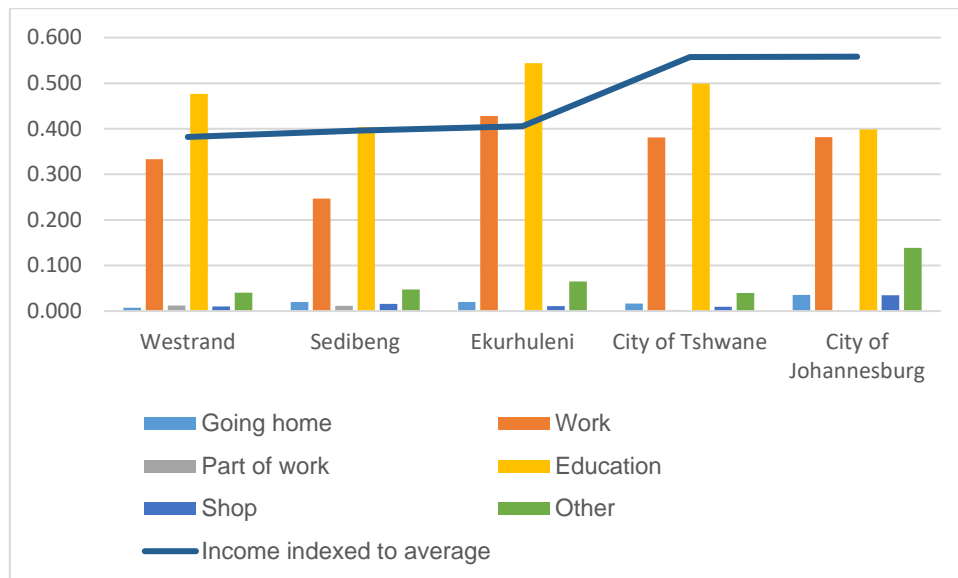


Figure 7: Income and trip purpose (Data source: GHTS)¹

Figure 7 shows the trip generation rate per group of activities per household. The data reflects that that education and work trips are essential and are undertaken regardless of income levels. Less work trips tend to be associated with lower income level areas, as would be expected, particularly where there are higher levels of unemployment. Ekurhuleni shows the highest work and education trips of all the municipalities. Again, the reason for these anomalies are not immediately apparent, particularly as unemployment levels are higher than employment levels in the municipality. Similarly, Johannesburg work trips seem low, particularly given the generally higher rate on employment. These could be related to household structures, or discrepancies in the application of the survey instrument and would have to be considered in conjunction with these socio-economic factors in order to gain appropriate insight into the reasons underlying these differences. There are also anomalies in the results regarding shopping trips. It is expected that these rates would increase significantly as income levels increase. This is true in Johannesburg, but not Tshwane. This may be explained by the high levels of unemployment in Tshwane and the possible distortion of average income by pockets of high income earners. The shopping trip generation rate is however high in Sedibeng (higher than all other municipalities bar Johannesburg). Again, this could not be explained by the data, but may be explained either by an aspect such as the proximity of shops, or application of the survey instrument.

CONCLUSION

The purpose of this study was to describe the spatial trend associations between socio-economic factors and households' travel patterns in Gauteng. The Gauteng Province consists of five municipalities with considerable variations in socio-economic characteristics. Whilst Johannesburg, Tshwane and Ekurhuleni are functioning cities, Sedibeng and the West Rand largely considered to be a mixed area of either rural or mining activities and dormitory townships. In general, the municipalities tend to be very mixed with an area such as Tshwane containing both the highest and lowest average income areas in the province. Employment levels in areas within municipalities range from a low of 27% to a high of 89%. As expected, there tends to be strong associations between employment and income levels and travel patterns. As income increases, so does the number of trips generated. Although this is reflected across the region in individual areas, there are anomalies. Tshwane, for

¹ A return trip from work is assumed to be a work trip and counted in this category, thus resulting in a low count for "going home"

example, although considered a higher income area than Ekurhuleni, has a lower trip generation rate. It is probable that this can be explained by the vast socio-economic disparities in the Tshwane municipality – although the average income is high, the municipality also contains some of the poorest areas in the province. Trip generation rates also tend to be higher in the Ekurhuleni municipality. This should however be considered in conjunction with other factors such as the high population density and the low surface area of the municipality, thereby providing similar trip generation rates as Johannesburg. There is also a clear relationship between income/ employment and car ownership. In broad terms, the higher the household income level, the more likely that the household has access to a private motor vehicle. The number of licenced drivers per household is considerably higher than the number of households with access to a car, which likely indicates a strong intention or aspiration to car ownership. This is of concern, as it clearly indicates that households tend to car ownership as soon as the financial means become available to them. This latter point is also illustrated by the indication that, as income increases, there are more trips made by private motor vehicle and less by other means. The modal selection indicates that, at low income levels, walking is the dominant mode of transport. As income increases, more taxis are used. Further increases in income/employment show high levels of car use. Finally, the results also show that, although education and work trips dominate all areas, as income increases, so does less essential trips such as shopping. There are also variations in these results, largely explained by high levels of income/employment variation across the municipalities.

The results show, as expected, clear associations between income/ employment and travel patterns, with higher incomes associated with more trips, more non-essential trips, higher levels of car access and lower levels of non-motorised transport and public transport. From a policy perspective, this provides a clear indication of the mobility needs in each area, and therefore of the areas in which focused transport interventions are required.

It should however be noted that there are some anomalies in the results, with some areas showing lower than expected trip generation rates or higher than expected car access levels. This is largely explained by the use of averages in the analysis. Further research would require that the individual areas within the municipalities are considered, rather than the municipalities as a whole. There are also other factors that could impact the results, notably the current public transport offerings, the population densities, the size of the area under review and the variations in income and employment levels across the areas making up the municipality as a whole. Given these limitations and areas for future research, this study has nonetheless provided an overview of the associations between socio-economic characteristics and travel patterns in the Gauteng Province, as well as highlighted those geographical areas that are most disadvantaged and therefore most in need of mobility interventions. Future research should consider expanding the analysis on a national level. Given that Gauteng is the economic hub of the country, with the highest level of transport density, this expansion of the research will highlight the geographical areas where policy interventions are most urgent. It would also be of interest to analyse the results in conjunction with previous policy interventions, as well as with the next household travel survey, to determine whether policy interventions are effective over time and achieving their stated aims. This will however be dependent on the release of newer household travel data.

REFERENCES

- Barry, B., 2002. Social exclusion, social isolation and the distribution of income. In: J. Hills, J. Le Grand and D. Piachaud, eds. *Understanding social exclusion*. Oxford: Oxford University Press, 13–29.
- Cervero, R. 2004. Job isolation in the US: Narrowing the gap through job access and reverse commute programmes. In: LUCAS, K. (ed.) *Running on Empty: Transport social exclusion and environmental justice*. Bristol, United Kingdom: PolicyPress.
- Cervero, R., Sandoval, O., and Landis, J., 2002. Transportation as a stimulus of welfare-to-work: private versus public mobility. *Journal of Planning Education and Research*, 22, 50–63.
- Davidov, E., 2007. Explaining habits in a new context: the case of travel-mode choice. *Rationality and Society*, 19 (3), 315–334.
- De Witte, A., Macharis, C., and Mairesse, O., 2008. How persuasive is 'free' public transport? A survey among commuters in the Brussels capital region. *Transport Policy*, 15 (4), 216–224.
- Delbosc, A. & CURRIE, G. 2012. Choice and disadvantage in low-car ownership households. *Transport Policy*, 23, 8–14.
- Department for Transport. 2007. *Transport trends 2008 Edition*.
- Efthymiou, D. and Antoniou, C. 2017. Understanding the effects of economic crisis on public transport users' satisfaction and demand. *Transport Policy*, 53, 89-97.
- European Commission, 2000. *Communication from the commission: building an inclusive Europe*. Brussels: European Commission.
- Fol, S., Dupuy, G., and Coutard, O., 2007. Transport policy and the car divide in the UK, the US and France: beyond the environmental debate. *International Journal of Urban and Regional Research*, 31 (4), 802–818.
- Gao, S. and Johnston, R.A., 2009. Public vs. private mobility for low-income households: transit improvements vs. increased car ownership in the Sacramento region. In: *Compendium of papers CD-ROM, the 88th annual meeting of the transportation research board*, 11–15 January, Washington, DC
- Garasky, S., Fletcher, C.N., and Jensen, H.H., 2006. Transiting to work: the role of private transportation for low-income households. *Journal of Consumer Affairs*, 40 (1), 64–89.
- Gauteng Province Roads and Transport, 2016. *Gauteng Province Household Travel Survey*, Johannesburg: Gauteng Province Roads and Transport.
- Grengs, J., 2009. Job accessibility and the modal mismatch in Detroit. *Journal of Transport Geography*, 18 (1), 332-345.
- Hess, D.B., 2005. Access to employment for adults in poverty in the Buffalo-Niagara region. *Urban Studies*, 42 (7), 1177–1200.

- Hurni, A., 2006. Transport and Social Exclusion in Western Sydney. University of Western Sydney and Western Sydney Community Forum, Australia.
- Kain, J.F., 1968. Housing segregation, negro employment, and metropolitan decentralization. *Quarterly Journal of Economics*, 82 (2), 175–197.
- Kenyon, K., Lyons, G. and Rafferty, J. 2003. Transport and social exclusion: Investigating the possibility of promoting social exclusion through virtual mobility. *Journal of Transport Geography*, 10: 207–219.
- Lucas, K., 2012. Transport and social exclusion: Where are we now? *Transport Policy*, 20: 105-111.
- Mercado, R.G., Paez, A., Farber, S., Roorda, M.J. and Morency, C. 2012. Explaining transport mode use of low-income persons for journey to work in urban areas: a case study of Ontario and Quebec, *Transportmetrica*, 8:3, 157-179.
- Ong, P., 2002. Car ownership and welfare-to-work. *Journal of Policy Analysis and Management*, 21 (2), 239–252.
- Paez, A., Mercado, R.G., Farber, S., Morency, C., Roorda, M., 2010. Relative accessibility deprivation indicators for urban settings: Definitions and application to food deserts in Montreal. *Urban Studies*, 47(7): 1415–1438.
- Priya, T. & Uteng, A. 2009. Dynamics of transport and social exclusion: Effects of expensive driver's license *Transport Policy*. 16(3): 130-139.
- Rogalsky, J., 2010. The working poor and what GIS reveals about the possibilities of public transit. *Journal of Transport Geography*, 18 (2), 226–237.
- Schwanen, T., Dijst, M., and Dieleman, F.M., 2001. Leisure trips of senior citizens: determinants of modal choice. *Tiidschrift voor Economische en Sociale Geografie*, 92 (3), 347–360.
- Sheller, M. and Urry, J., 2000. The city and the car. *International Journal for Urban and Regional Research*, 24 (4), 737–757.
- South African Market Insights, 2017. Blog: 27 March 2017 (Provincial Analysis). [Online]. Available at: <https://www.southafricanmi.com/blog-27mar2017.html>. [Accessed 12 December 2017].
- Statistics South Africa, 2014. National Household Travel Survey 2013, Pretoria, South Africa: Statistics South Africa.
- Statistics South Africa, 2016. Databases. [Online]. Available at: <http://interactive2.statssa.gov.za/webapi/jsf/dataCatalogueExplorer.xhtml>. [Accessed 19 December 2017].
- Tsakoglou, P. and Papadopolous, F., 2002. Aggregate level and determining factors of social exclusion in twelve European countries. *Journal of European Social Policy*, 12, 211–225.