Tax(i)ing the poor? Commuting costs in South Africa

Andrew Kerr

Abstract

In this paper I describe the monetary and time costs of commuting to work in South Africa. I find that these costs are high and that monetary costs of commuting have increased faster than inflation, mainly through a shift away from walking and towards minibus taxis and driving. Journey times are substantially higher than the OECD country average. Using a method suggested by Hausmann (2013) I estimate the effective tax on hourly earnings that the time and monetary costs of commuting impose. I find high effective tax rates, which are a disincentive to working far from home. This only deepens the puzzle of why South Africa's informal sector is so small, since more than half of the informally self-employed work at home and pay no transport costs. I show that whilst minibus taxis conveyed around 71% of commuters that used public transport in 2013, the industry receives less than 1% of the direct public transport subsidy provided by the South African government. I find that the subsidy accrues mainly to bus and train users in the lower middle part of the labour income distribution.

For a short article based on this paper, see the online forum *Econ3x3*, October 2015.

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Andrew Kerr [*]

(DataFirst, University of Cape Town)

1 Introduction

According to data from the 2003 National Travel Survey black South Africans spent an average of 88 minutes per day commuting to work. This was just less than double the average commute time both in the United States in 2002, a country known for its long commuting times, and Hungary, the European Union country with the longest commute times (Stutzer and Frey 2008). White South Africans spent less time commuting than black South Africans, 54 mins per day, but still spent more time commuting on average than in the US and all 23 EU countries listed by Stutzer and Frey (2008). Ten years later, the 2013 South African National Travel Survey suggested that average commuting times had increased by a further 14 minutes for both black and white South Africans. Growing commuting costs mean that any economic growth may not be as inclusive as it would otherwise have been, since workers are spending larger fractions of their incomes getting to and from work.

South African cities have been shaped to a large extent by policies of segregation from before and during the Apartheid era. This has meant that wage work opportunities are often located far from home, particularly for black South Africans, and this creates high commuting costs, both monetary and time costs. In this paper I document how large these commuting costs are and how they have changed during the post-Apartheid period using nationally representative survey data. I use descriptive statistics and regression analysis to document the size and correlates of commuting costs. High commuting costs are an indication that search frictions may be severe and may play a role in raising unemployment rates if they mean that job seekers are located a long way from employment opportunities and thus cannot easily access information about these opportunities, as the spatial mismatch literature has emphasised (Kain (1968), Zenou (2008)). Inspired by Hausmann (2013) I also investigate whether low income formal sector workers pay large effective tax rates on their hourly wages due to long and costly

[*] I acknowledge funding from an incentive grant from REDI3x3. The paper has benefitted from the comments of participants at SALDRU and CSSR (University of Cape Town) and RESEP (Stellenbosch University) seminars. In the interests of transparency: I am the co-owner of a website that assists commuters to use minibus taxis in Cape Town and Durban, see: www.taximap.co.za. Author email: andrew.kerr@uct.ac.za

commutes. Long commutes to formal sector employment should make working in informal self-employment (predominantly an activity carried out near or at home) much more attractive, only adding to the puzzle of why South Africa has a very small informal sector (Kingdon and Knight 2004, Magruder 2012).

Finally, I document the disconnection between the direct public transport subsidies paid by the state and the use of public transport by commuters. 71% of public transport users use minibus taxis to get to work but despite this minubus taxis receive only about 1% of the total public transport subsidy. I also show that any indirect subsidy to bus and train service providers would accrue mainly to commuters in the middle of the labour income distribution.

2 Literature review

2.1 Comparative data on transport times and costs

A number of studies have identified South Africa as having very high time costs of commuting relative to other countries. The 2011 OECD study "How's life" used data from time use surveys in 24 countries to compare commuting times. South Africa had the highest average commute times, of 56 minutes per day, compared to the average for OECD members and partners of 38 minutes per day.

The times reported for South Africa in the introduction are much higher than those in the OECD study using time-use survey data. The same thing is true for a number of other countries when comparing the results from Stutzer and Frey (2008) and OECD (2011). We show below that four nationally representative South African surveys across a 20 year period also suggest that average commuting times in South Africa are actually higher than the times calculated from the Time Use Survey, between 68-94 minutes per day on average. Rospabe and Selod (2006) also report much higher commute times in Cape Town than the time use survey using data from 1998. The authors' results imply mean two-way commute times of 78 minutes per day for blacks living in Cape Town, the source being the 1998 Migration and Settlement in the Cape Metropolitan Area survey.

Zeljko and Fedderke (2006) report an average of 35 minutes for a one way commute time in South Africa but this is only slightly higher than averages reported for other regions and the world average of 31 minutes. The source of the data is listed as Estache and Goicoechea (2005), who in turn cite "UN Habitat-1998" as the source of the data. This seems to be the Global Urban Indicators database II. Given the coverage of only Durban, Port Elizabeth and the "East Rand" in this database[1] and the lack of clarity on the source of the data this data is likely to be less reliable than other sources. Nevertheless it is one source of data that indicates

[1] This can be seen at http://ww2.unhabitat.org/programmes/guo/guocityprofiles.asp and by clicking on South Africa; these 3 cities are then possible options. The database was not working when accessed on 14 April 2015.

that South African travel times may not be as much of an outlier as suggested by a number of other sources.

2.2 Explanations for and consequences of long commuting times and high costs

In South Africa high transport costs and large distances between work and home have been driven by the country's history of forced removals and the restriction of movement through the pass laws and other measures that have shaped the country's cities and rural areas. A policy of racial segregation and forced removals has led to black, coloured and Indian South Africans often living far from economic centres (Selod and Zenou 2001). Turok (2001) notes that segregation has led to high levels of mobility within cities that is costly both for individuals and the state to sustain.

Researchers have long been aware that the location of individuals and households can have important impacts on employment outcomes. Kain (1968) described what later became known as the spatial mismatch hypothesis, that minority workers in the US had lower employment prospects as a result of living far from employment opportunities. He also argued that these opportunities were increasingly located in the suburbs, away from minority workers who resided mainly in city centres. The term "spatial mismatch" has broadened to incorporate many situations in which certain groups of workers are located far from employment (Zenou 2009) and the negative impact this has on employment prospects. I do not attempt to explore the existence of mismatch or its impact in this paper. However the spatial mismatch literature provides a strong motivation for this paper as high transport costs, both time and monetary, are possible indicators of spatial mismatch.

The search and matching literature in labour economics has highlighted the importance of search frictions for the performance of the labour market (cf Mortensen and Pissarides (1994)). The extremely high commute times described above are an indication that search frictions caused by long distances between job seekers and employment opportunities may be large.

There is work in economics that explicitly incorporates land markets and distance into a search and matching framework (cf Zenou (2009)). In this work search efficacy can be modeled as being a function of distance to employment. Interestingly for the South African case, some of these models generate rates of unemployment close to 25%, with those furthest from the city centre, where jobs are assumed to be located, having the highest unemployment rates.

There has been one paper that investigates spatial mismatch in South Africa. Rospabe and Selod (2006) investigate the possibility that Cape Town's spatial structure contributes to raising unemployment due to the disconnect between workplaces and homes. The authors use population census and RSC levy firm location data to show that workers are located extremely far from jobs, and quantify commuting costs for workers, but only for the City of

Cape Town, using the Migration and Settlement in the Cape Metropolitan Area survey from 1998.

Researchers have also begun tackling aspects of spatial dimensions of urban economic development in South Africa and the impact this could have on inclusive growth. Sinclair-Smith and Turok (2012) draw attention to spatial inequalities in firm location. The authors show that nearly 25% of formal sector turnover in the City of Cape Town was in firms located in the centre of the city, whilst the Cape Flats area contributed just 0.5% of total formal sector business turnover in the city, despite being home to around one third of the city's population. These authors also argue that growth in business turnover in Cape Town was skewed towards new areas with weaker public transport links. This means that workers in firms located in these newer areas are likely to have to rely on minibus taxis rather than subsidised trains or buses and are therefore likely to spend more on transport costs.

3 Data on transport modes, times and costs

The four survey data sources I use are all nationally representative surveys, conducted by Statistics South Africa (the 2003 and 2013 National Travel Surveys or NTS) and SALDRU (the 1993 PSLSD and NIDS 2010)[2]. However each one differs in how information on commuting was collected and other ways. Here I document important differences between the surveys (see table A1 below).

The 1993 PSLSD only collected data on transport for regular and casual workers. The informally self-employed were not asked transport-related questions and this group was 14.4% of the total weighted number of employed residents in the PSLSD. Data from four of the Surveys of Employers and Self-Employed (SESE) between 2001 and 2013 suggest that between 50-60 % of businesses run by the informally self-employed are based at the owner's home. This means that the 1993 PSLSD survey is likely to overestimate transport times and costs compared to later surveys that asked information about all workers, since a group with a large fraction of members who have zero times and costs to work were excluded.

The 2003 and 2013 National Travel Surveys (NTS) were comprehensive in their coverage of all workers. They were also fairly similar to each other. Unfortunately they asked little information about each worker's job and place of work. The 2003 survey did not ask drivers their cost of getting to work whilst the 2013 survey did.

NIDS 2010 is the second wave of the NIDS panel. It is thus unlike the other three surveys in that it is not a nationally representative cross-sectional sample. Nevertheless the weights that correct for attrition allow it to be considered nationally representative, if one believes that

[2] The PSLSD, NIDS wave 2 and the 2013 NTS are all publicly available through DataFirst. The 2003 NTS micro data is not currently being made publicly available, although a super cross descriptive data displayer was made available.

attrition is based on observable characteristics. However, NIDS did not ask information about costs to casual or self-employed workers. Thus only regular workers were included, or 80% of the employed identified from the adult questionnaire. Again, because the self-employed were excluded and we know this group has a large fraction of members with zero times and costs from other surveys this means we are excluding a group with low travel times and costs. However, we cannot know the impact of excluding casual workers. If these individuals are working in informal businesses their transport costs might also be low but if they are working in large/formal firms or in suburbs as casual workers they may have high travel costs. NIDS also had a proxy respondent questionnaire which was different from the questionnaire asked to responding adults. The proxy questionnaire did not include questions on travel time. The other three surveys allowed proxy respondents but asked all the questions asked to a proxy respondent who was present. Thus whilst the proxy respondent data is likely to be lower quality than data from actual individuals, it is perhaps better than no data, which is what we get from NIDS wave 2 for anyone who was not available to be interviewed.

Table A1: Details on questions and respondents across the four surveys

Questions	PSLSD 1993	NTS 2003	NIDS 2010	NTS 2013
Mode and time questions	Regular, Casual, Not self-employed	All	Regular workers only	All
Costs questions	Regular, Casual, Not self-employed	Not drivers	Regular workers only	All
Were proxy respondents asked commuting questions?	Yes	Yes	No	Yes

To be able to undertake analysis of commuting trends over time the key issue is comparability of the data across the surveys used. The 2003 and 2013 National Travel Surveys asked the time and modes of all workers, and costs for all commuters except drivers in 2003. They are the two surveys that are most similar. The 1993 PSLSD excluded the informally self-employed from transport questions. NIDS 2010 is not directly comparable to the other surveys because informally self-employed and casual workers are excluded from transport questions, as are those who did not respond themselves in NIDS and for whom information was collected through a proxy respondent. This means that about 25% of the employed were not asked commuting questions in NIDS. Table A1 shows the main differences between surveys. Unfortunately there is not enough labour market information collected in the 2003 and 2013 surveys to then limit the sample to the restricted groups of individuals who were asked questions about commuting costs in either 1993 or 2010.

These limitations mean that NIDS 2010 should not be used when looking at trends over time. When comparing 1993 to either 2003 or 2013 we are likely to underestimate changes in costs or times since 1993 costs and times were overestimated due to excluding the informally self-

employed, a majority of whom are working at home and thus incurring no time or money costs of commuting.

Data quality

I noted above that there are differences between the surveys in which commuters were asked questions about their transport times and costs. There are also other differences that are worth highlighting. In the 2003 NTS drivers were not asked about their costs of commuting to work but they were in the other three surveys. This is an important disadvantage of the 2003 NTS data and means that 2003 costs are not comparable with other years. 2013 NTS is thus really the only survey in which all types of workers (the self-employed, casual workers and drivers) were asked about the costs of getting to work. Walkers and cyclists were not asked about their commuting costs in the 2003, 2010 and 2013 surveys and I assume these are zero throughout the paper.

In dealing with hours spent commuting I set those persons reporting more than four-hour one-way journey times to 'missing'. This affects 96 observations out of close to 83 000 observations with a positive journey time across the four waves of data. In looking at the fraction of income spent on commuting I set this to 'missing' only if it was greater than 1. This affected about 700 commuters out of roughly 65 000 with positive earnings and commuting costs data. Most of these appear to be cases where the period of costs is mismeasured – for example a person reports what looks like a monthly value for transport costs but this is listed as a per day or per single trip amount in the data. I have not attempted to fix these issues – I have simply set it to missing and excluded these from the analysis.

There are other sources of nationally representative household survey data on transport times or costs that I have not used. The OECD study mentioned in the literature review used the 2000 Time Use Survey. This survey has some indicators of fieldworker fraud (Finn and Ranchhod 2013) so it has not been included in this study. The 2013 Time Use survey had not been released by Stats SA at the time of this research so was also not included. I have also not considered the four Income and Expenditure Surveys undertaken by Statistics South Africa in the post-Apartheid period.

4 Descriptive analysis

4.1 Trends in commuting modes

To begin I look at trends in mode of transport used by commuters to get to work over the last 20 years. A large fraction of workers walk to work – more than 20% in 3 of the 4 surveys, although the data suggests the trend is towards less walking. Driving and using minibus taxis are the two most important forms of commuting by 2013 – taxis overtook walking in 2013.

Together these two forms of transport account for just less than 50% of commuting – and around 57% of commuting when including car passengers. In 1993 roughly 60% of those using multiple modes reporting using taxis whilst this was about 75% in 2013. Taxi operational expenses are not subsidised by the state and are thus are a form of private transport. Thus private motorised transport is by far the dominant form of transport to work, either as a taxi passenger, a car passenger or a car driver.

Table 1: Work travel mode by year (%)

Work travel mode	PSLSD 1993	NTS 2003	NIDS 2010	NTS 2013	Total
1. Walk	27.8	21.4	16.7	20.1	21.2
2. Cycle	1.1	0.8	1.1	1.0	1.0
3. Drive	30.7	23.7	28.1	27.7	27.3
4. Train	3.3	2.5	2.4	2.8	2.7
5. Bus	8.7	6.2	5.6	6.1	6.5
6. Minibus taxi	18.9	17.3	26.0	21.8	21.0
7. Car passenger	0.0	6.8	0.0	7.2	4.2
8. Company transport	0.0	1.8	9.0	1.7	2.9
9. Other	0.4	0.7	0.6	0.4	0.5
10. Multiple modes	9.0	9.8	9.2	6.5	8.4
11. Works at home	0.0	8.9	1.3	4.7	4.2
Total	100.0	100.0	100.0	100.0	100.0

The data from Table 1 suggests that state-subsidised public transport (train and bus[3]) is used by a small fraction of the working population to get to work. Around 12% of the working population used subsidised public transport in 1993 and only 8.9% used it in 2013. In the rest of the paper, when I use the term public transport I refer to taxis, trains or buses. In the 2013 NTS Gautrain and BRT were listed as possible options for commuters. In table 1 I have included these in the train and bus categories respectively. 0.4% of commuters reported using BRT in 2013 and only 0.02% reported using Gautrain.

Table 2 shows absolute numbers carried by mode and year. According to the survey data presented in the table, between 1993 and 2013 the South African population was estimated to have grown from about 38 to 52 million people and the number of employed from 9.5 million to 15 million, growth of about 58% percent in total employment. The number of commuters using cars to get to work (either as passengers or drivers) increased from about 2.5 million to 5 million between 1993 and 2013. The number of commuters who used taxis also doubled from about 1.5 to 3 million people over the same period. This does not include the nearly 1

[3] There are some private buses that do not receive state subsidies. I do not know a reliable figure for what fraction these are of total buses but my sense is that it is small. For an example of non-subsidised buses see Medley (2012). Khan (2014) states that in eThekwini/Durban municipality about 900 of 1564 buses operating in Durban belong to subsidised operators, information that was obtained from interviews with officials from the old Durban Transport Department.

million multiple mode users, 75% of whom used taxis in 2013. The absolute number of bus and train users increased, but the percentage increases were smaller compared to taxis and driving. The number of commuters who walked to work increased from 2.2 to 2.9 million people.

Table 2: Mode numbers by year

Mode	PSLSD 1993	NTS 2003	NIDS 2010	NTS 2013
Walk	2249969	2310128	1447434	2925134
	(235132)	(73663)	(186802)	(60796)
Cycle	92689	89810	94651	148760
	(19355)	(7370)	(32677)	(9485)
Drive	2483106	2558901	2433444	4026494
	(286769)	(76734)	(308224)	(115430)
Train	266313	267368	203728	403008
	(56889)	(23260)	(49030)	(28557)
Bus	700009	669350	483927	893439
	(86281)	(30323)	(69427)	(36053)
Minibus	1529857	1866635	2248507	3171789
	(143170)	(60930)	(256247)	(81764)
Car passenger	0	728467	0	1048854
	(.)	(25261)	(.)	(32140)
Company transport	0	199312	781481	244764
	(.)	(14674)	(92462)	(13411)
Other	35149	72071	52328	55850
	(7600)	(7174)	(20355)	(6102)
Multiple modes	725741	1056753	800101	942424
	(82954)	(47062)	(111337)	(35772)
Works at home	0	958580	108620	682731
	(.)	(31551)	(22420)	(26552)

Standard errors in parentheses.

In the introduction I noted large differences between blacks and whites in commuting times, which I discuss further in the next section. Here I show part of the explanation for these differences – very different rates of car usage and public transport usage. Table 3 shows the fraction of commuters by race that either drive to work or use public transport. A much lower fraction of black South Africans drive to work than other races and especially whites. Only 8% of black workers drove to work compared to 80% of whites in 1993. By 2003 the fraction of black South Africans that drove to work was 14% and still around 80% for whites, whilst it had climbed to 21% for blacks and 86% for whites by 2013. There has not been much change in the percentage of black South Africans taking public transport. The fraction of white workers who used public transport was very small and stable, whilst the fraction of coloured and Indian workers who used public transport declined.

Table 3: Proportions using public transport and driving by race

	PSLSD 1993		NTS 2003		NIDS 2010		NTS 2013	
Race	*Drive*	*P T*	*Drive*	*P T*	*Drive*	*P T*	*Drive*	*P T*
Black	0.08	0.53	0.14	0.473	0.14	0.54	0.21	0.468
	(0.01)	(0.03)	(0.00)	(0.01)	(0.01)	(0.02)	(0.00)	(0.01)
Coloured	0.27	0.43	0.32	0.291	0.29	0.35	0.38	0.318
	(0.03)	(0.05)	(0.01)	(0.01)	(0.04)	(0.07)	(0.01)	(0.02)
Indian	0.68	0.24	0.67	0.239	0.76	0.06	0.76	0.127
	(0.05)	(0.06)	(0.02)	(0.02)	(0.08)	(0.03)	(0.02)	(0.02)
White	0.82	0.08	0.81	0.02	0.79	0.07	0.86	0.016
	(0.03)	(0.01)	(0.01)	(0.00)	(0.03)	(0.02)	(0.01)	(0.00)

Standard Errors in Parentheses. PT is Public Transport and includes all those reporting that they used bus, train, taxi or multiple modes to get to work.

Table 4: Mode proportions by geography and year

	PSLSD 1993			NTS 2013		
Mode	*Rural*	*Urban*	*Metro*	*Rural*	*Urban*	*Metro*
Walk	0.53	0.23	0.10	0.38	0.25	0.10
	(0.04)	(0.03)	(0.02)	(0.01)	(0.01)	(0.00)
Cycle	0.02	0.02	0.00	0.01	0.02	0.01
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Drive	0.11	0.35	0.45	0.11	0.27	0.35
	(0.02)	(0.05)	(0.04)	(0.00)	(0.01)	(0.01)
Train	0.01	0.01	0.07	0.00	0.00	0.05
	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
Bus	0.13	0.06	0.07	0.12	0.05	0.05
	(0.02)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)
Minibus	0.16	0.23	0.19	0.18	0.21	0.24
	(0.02)	(0.03)	(0.03)	(0.01)	(0.01)	(0.01)
Car passenger	.	.	.	0.07	0.09	0.06
	(.)	(.)	(.)	(0.00)	(0.00)	(0.00)
Company transport	.	.	.	0.02	0.03	0.01
	(.)	(.)	(.)	(0.00)	(0.00)	(0.00)
Other	0.00	0.00	0.01	0.00	0.01	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Multiple modes	0.06	0.10	0.11	0.04	0.03	0.09
	(0.01)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)
Works at home	.	.	.	0.06	0.04	0.05
	(.)	(.)	(.)	(0.00)	(0.00)	(0.00)
Proportion by area	0.34	0.24	0.41	0.20	0.29	0.51

Standard errors in parentheses.

Table 4 shows the proportion of users by mode for each of three geography types – rural, urban non-metro and urban metro – in both 1993 and 2013. As noted above there are some differences in which commuters are included – in 1993 the self-employed are excluded, as were several mode options. The self-employed would predominantly be working at home.

Because each column sums to 1 they are not showing the shift to urban and particularly metro areas that has occurred in the 20 years between the two surveys (some of this shift is likely to be artificial since East London/Buffalo city and Mangaung/Bloemfontein were declared metro areas between the two surveys) but this shift is shown in the last row of the table. It shows that rural commuters constituted 34% of total commuters in 1993 but only 20% in 2013. The share of commuters living in metro areas increased from 41% to 51% whilst the share of urban non-metro commuters increased from 24% to 29%.

Walking is the most common form of commuting transport in rural areas both in 1993 and 2013, although its predominance has declined substantially. The car passenger numbers in 2013 should be added to the driver numbers to obtain a comparable fraction to the 1993 number. These suggest that driving has become more common in rural areas, increased slightly in urban areas and declined slightly in metro areas, although this difference is not statistically significant. Out of the public transport modes commuting by bus is more prevalent in rural areas whereas the train network is mostly confined to metro areas. Minibus taxi is prevalent across all geography types. Use of multiple modes is more common in metro areas, and in 2013 also in urban non-metro areas.

4.2 Trends in commuting times

From a discussion of how South African commuters get to work and how this has changed in the last twenty years I now move on to a description of the extremely long commuting times mentioned in the introduction. Table 5 below shows average one way commute times by year and travel mode. The overall trend is one of rising commute times, except for NIDS 2010, which shows lower average commuting times than the other surveys. Those taking trains, buses, taxis and particularly those using multiple modes to get work have the longest commute times. Walkers and drivers have shorter commute times.

These increases probably understate the true increase in commuting times over the 20 year period covered by the data. This is because the 1993 PSLSD survey did not ask commuting time and cost questions to a group of workers likely to have very low commuting times – the self-employed running informal businesses. As noted above data from four of the Survey of Employers and Self-Employed between 2001 and 2013 suggest that between 50-60 % of these businesses are based at the owner's home. This implies that 1993 overstates the average commute time for all the employed by excluding the self-employed.[4] Both casual workers and the informal self-employed are excluded in 2010. It is unclear whether this is responsible for the drop in average commute times in 2010 compared to other years. The increase in com-

[4] Obviously we do not know how long the other 40%-50% of the informal self-employed take to work but since there is such a large fraction with zero commuting times the exclusion of the self-employed is unlikely to lower average commuting times.

mute times between 2003 and 2013 across very similar surveys suggests that the trend is towards longer commute times.

Table 5: Mean travel time by mode and year

Mode	PSLSD 1993	NTS 2003	NIDS 2010	NTS 2013
Walk	21.81	26.16	23.99	33.90
	(1.06)	(0.50)	(2.46)	(0.45)
Cycle	37.26	43.09	34.43	48.14
	(6.56)	(2.25)	(2.21)	(2.08)
Drive	28.85	33.68	29.60	41.77
	(1.31)	(0.48)	(1.97)	(0.47)
Train	61.22	75.36	51.13	83.33
	(2.82)	(2.16)	(4.58)	(1.95)
Bus	55.90	62.28	51.77	76.51
	(4.15)	(1.35)	(4.03)	(1.32)
Minibus	45.03	44.92	38.77	53.49
	(1.54)	(0.54)	(1.50)	(0.53)
Car passenger	.	37.21	.	45.02
	(.)	(0.72)	(.)	(0.81)
Company transport	.	40.69	41.79	48.07
	(.)	(1.56)	(6.61)	(1.60)
Other	28.79	40.72	15.43	40.90
	(15.70)	(2.57)	(6.54)	(3.62)
Multiple modes	53.35	80.37	74.56	85.16
	(2.32)	(1.31)	(22.72)	(1.28)
Works at home	35.73	39.02	37.17	47.27
	(1.17)	(0.46)	(2.64)	(0.36)

Standard errors in parentheses.

Table 6 shows mean and median one way commute times by income quintile. The general picture is lower commute times for the poorest and richest quintiles with those in the middle more likely to have longer commute times across all the surveys. The low commute times for the bottom quintile are due to walking and working at home being much more prevalent in the bottom income quintile than in other quintiles, with close to 50% of commuters in the bottom quintile either walking to work or working at home. This is a different situation from the top quintile, where lower commute times relative to the middle quintiles are mainly due to the extensive use of private cars rather than public transport. This is also likely to be as a result of the layout of South African cities and towns where Apartheid planners forced black, coloured and Indian South Africans to live far from work opportunities. About 65% of commuters in the top income quintile use private vehicles to get to work across the four surveys (not shown).

Table 6: Mean and median travel time by labour income quintile

	1993	2003	2010	2013
Quintile 1: Median	25	30	30	30
Mean	30.8	33.2	33.1	43.5
	(1.7)	(0.6)	(2.1)	(0.6)
Quintile 2: Median	30	30	30	45
Mean	33.4	42.8	41.5	50.0
	(1.7)	(1.1)	(3.9)	(0.7)
Quintile 3: Median	30	40	30	45
Mean	41.8	45.7	37.1	49.9
	(1.9)	(0.8)	(2.4)	(0.7)
Quintile 4: Median	30	30	20	35
Mean	38.9	42.3	31.6	45.2
	(1.8)	(0.7)	(3.2)	(0.6)
Quintile 5: Median	25	30	30	31
Mean	31.8	34.3	44.4	44.3
	(1.5)	(0.6)	(13.5)	(0.7)

Standard errors in parentheses.

4.3 Trends in monetary costs of commuting

The very long commute times shown in the previous section, as well as the shift away from walking suggest that South African commuters might also be paying large amounts to commute long distances and that these amounts may have increased since 1993. All four surveys asked commuters about the cost of getting to work. Table 7 shows the 25th, 50th, mean and 75th percentile monthly rand amounts spent by mode across the 4 surveys. The CPI increased from 30.9 to 101.3 over the 20 year period between 1993 and 2013. The 50th percentile increased by 5 times, the mean by 8 times and the 75th percentile by 7 times. The 25th percentile was unchanged because of the large number of walkers and those who worked at home and who incurred no commuting costs. Transport costs thus increased at around twice the rate of inflation.

Table 7: Percentile and mean cost by year

	PSLSD 1993	NTS 2003	NIDS 2010	NTS 2013
25th percentile	0	0	0	0
Median	65	70	280	344
Mean	85	172	424	673
75th percentile	110	200	500	800
Std error of mean	5	11	30	14

Note: these are nominal costs.

The large increases between 1993 and 2013 actually understate the increases in transport costs because 1993 excluded those in informal self-employment, of whom roughly 50-60% work at home and thus have zero costs of commuting. This means commute costs for all workers would be lower in 1993, and thus the increase between 1993 and 2013 would be larger. Results not reported suggest this raises the 2013 and 2003 mean and median by around 10%. It should be noted that the 2003 costs are lower than in other years because drivers were not asked about their costs.

Given the data limitations and differences in who was asked questions on costs, which modes of transport were included and also who was asked any questions about transport a detailed comparison of costs by mode over the years would not be useful. However we can compare costs of public transport (buses, trains and taxis) across the surveys, bearing in mind the caveats discussed above. Table 8 shows the means of the three types of public transport. The increase for trains has been about 200% since 1993, whereas the means for bus and taxi have increased by 5 times. The CPI increased by about 4 times over the period. Thus both bus and taxi mean spending increased by more than inflation, whilst the increase in costs for train travel was lower than inflation. The lower increase for train travel cost is borne out by the 2010 annual report of PRASA, the parastatal that runs intracity trains in South Africa, in which it is noted that 2009 was the 6th year in a row in which there were no approved increases for Metrorail fares (Metrorail 2010).

Table 8: Median and mean cost for public transport by year

Mode	PSLSD 1993	NTS 2003	NIDS 2010	NTS 2013
Train median	66	82	120	155
Train mean	82	114	188	242
SE of mean	5	7	24	16
Bus median	88	175	280	387
Bus mean	81	238	314	404
SE of mean	7	16	23	10
Taxi median	88	170	300	430
Taxi mean	101	244	393	526

Note: these are nominal costs.

Overall increases on spending on transport were quite a lot higher than the increases for bus, train and taxi. Partly this was because of shifting towards higher cost forms of transport and the decline of cheaper modes of transport. For example the prevalence of walking to work decreased from 28% to 21% over the 20 year period under review and driving prevalence increased from 31% in 1993 to 35% in 2013 (both car drivers and passengers are included in this calculation since they were not separated in 1993).

Table 9 shows the mean of monthly commuting costs as a fraction of gross income by transport mode. The fraction of earnings spent getting to and from work is substantial for taxi and bus users over all waves and is roughly 15%. Spending is lower for car users, who generally have higher incomes, although Table 9 suggests the fraction of income spent on driving more than doubled compared to 1993 and 2010. Those who use multiple modes spend the largest fraction of income on commuting to work in both 2003 and 2013, although 2010 suggests lower spending for those using multiple modes. Those who walk or cycle are assumed to not incur any costs of commuting (shoe wear and tear and depreciation and repair costs of bicycles were not asked about in any of the surveys).

Table 9: Transport costs as a percentage of income by mode

Mode	PSLSD 1993	NTS 2003	NIDS 2010	NTS 2013
Walk	0.00	0.00	0.00	0.00
Cycle	0.00	0.00	0.00	0.00
Drive	0.07	.	0.08	0.17
Train	0.11	0.08	0.08	0.08
Bus	0.12	0.16	0.16	0.14
Minibus taxi	0.14	0.16	0.15	0.17
Car passenger	.	0.13	.	0.05
Company transport	.	0.07	0.06	0.01
Other	0.00	0.12	0.06	0.12
Multiple modes	0.16	0.22	0.10	0.21
All modes	0.08	0.09	0.09	0.11

By 2013 the mean fraction of income spent on transport by users of cars, taxis, buses and multiple mode users was more than 10% , and in 1993 all of these except car users were also spending more than 10% of their incomes on transport. The 1996 white paper on Transport set as a target that commuters should not pay more than 10% of disposable income on transport (Department of Transport 1996). South Africa does not seem to be making any progress on achieving this goal when looking at the data from the four surveys considered in this paper. Venter and Behrens (2005) note that this specific goal was modified in the National Land Transport Strategic Framework so that households should not spend more than 10% of their disposable income on public transport.

4.4 The implicit tax on commuting in time and money

The results above suggested that particularly those taking public transport spent a large share of their incomes on transport across all four surveys. Ricardo Hausmann (Hausmann 2013) has argued that transport costs and times represent a regressive tax that is a disincentive to working in the formal economy. In Hausmann's example low income formal sector workers commute for 3 hours per day and spend the equivalent of 2 hours of work on transport costs,

transforming an 8 hour work day into an 11 hour day for which pay net of monetary transport costs is the equivalent of 6 hours of work. Hausmann notes this example implies a 45% effective tax on low income workers in the formal sector and is one reason why workers may be inclined to take a lower paying job in the informal sector near where they live.

Clearly monetary costs of commuting reduce net income. But what of commuting times? Although commuting times do not reduce incomes they do reduce time available for other activities. There is also some evidence that commuting is viewed as one of the least enjoyable daily activities (cf. Stutzer and Frey (2008)).

In this section I estimate the implied tax rate by different modes of transport. To estimate these tax rates requires data on monetary costs of commuting, time costs of commuting and hours worked per week, as well as days worked per week if commuting costs and times are asked or given per day. The 1993 PSLSD asked only hours worked per week and only for regular and casual workers. The 2003 NTS asked days worked but not hours worked per week. The 2013 NTS did not ask hours or days worked per week. NIDS 2010 has perhaps the best data to look at effective tax rates – it asked hours worked per week and about monthly transport costs. The downside of using NIDS is that only regular workers were asked these questions and casual workers and self-employed were excluded. Also days per week were not asked so I assume all individuals work 5 days per week. This means we will overestimate commuting times (and thus tax rates) for those working less than 5 days per week and underestimate times and tax rates for those working more than 5 days per week.

To calculate the effective tax rate following Hausman's suggestion for NIDS 2010 I first multiply the daily two way commute time by five and add this to the reported weekly hours worked. This is then the adjusted weekly hours worked. I then subtract monthly transport costs from monthly net pay to obtain an income measure net of transport costs. I then calculate hourly wage and adjusted hourly wage and the effective tax is the percentage difference between these two.

To calculate the effective tax rate for 2003 NTS I multiply the daily two way commute time by five and add this to the reported number of days worked per week mutiplied by 8 hours per day. This is then the adjusted weekly hours worked – which will be overestimated for those who work less than 8 hours per day and underestimated for those working more. I then subtract monthly transport costs from monthly gross pay (whereas NIDS asked about net pay) to obtain an income measure net of transport costs. I then calculate hourly wage and adjusted hourly wage and the effective tax is the percentage difference between these two.

In Table 10 I report median hourly wage, median adjusted hourly wage and the median effective tax rate by mode of transport for NIDS wave 2 (2010) and in Table 11 I report the same for the 2003 NTS. Whilst not as high as Hausmann's example I still find high effective tax

rates for NIDS, particularly for public transport. The effective median tax rate for bus users is 40% whilst it is 29% for taxi users, 28% for those using multiple modes and 22% for train users. The median tax rate for drivers is 16%. This is likely to be underestimated if drivers do not report the full costs of driving (for example insurance, maintenance, depreciation). Walking and cycling have low tax rates because the reported monetary costs are zero and the mean and median commuting time is lower than for other modes.

Table 10: Implied tax rates of transport costs in NIDS 2010

Mode	Median hourly wage	Median adjusted hourly wage	Effective median tax rate
Walk	12.920	11.175	7.692
Cycle	11.370	10.551	11.111
Drive	51.680	40.310	15.907
Train	13.953	9.792	22.186
Bus	14.050	8.795	40.267
Minibus taxi	18.411	12.458	28.996
Company transport	18.088	14.688	17.241
Multiple modes	24.289	16.279	27.875

Table 11: Implied tax rates of transport costs by mode in NTS 2003

Mode	Hourly wage	Adjusted hourly wage	Effective tax rate
Walk	4.15	3.75	7.69
Cycle	5.81	5.17	12.73
Train	7.50	5.54	28.69
Bus	8.14	5.33	30.71
Minibus	7.50	5.69	25.75
Multiple modes	8.72	5.57	38.56

The median tax rates in the 2003 NTS are somewhat different than for NIDS because the NTS asked about gross income whereas I used net income above for the NIDS 2010 calculations. Drivers were not asked about their costs so implied tax rates cannot be calculated. The highest taxes are for those using multiple modes and these are higher than estimated using NIDS. Bus commuters have the second highest implied median tax rate but this is lower than when calculated using NIDS. The implied tax rate for train commuters is also higher than that estimated for NIDS at nearly 29% and for taxi users it is slightly lower than NIDS at nearly 26%.

Since a large fraction of those in the informal sector work close to home (recall that between 50-60% of informal business owners operate from home), transport costs are likely to be low for the informally self-employed. The high implied tax rates of transport costs for public transport commuters – and thus low incentives to commute to formal sector work – thus contributes to the puzzle of why South Africa's informal sector is so small (Kingdon and Knight 2004).

5 Descriptive regression analysis of commuting times

In this section I take the analysis of time costs further by examining the correlates of commuting times using Ordinary Least Squares Regression (OLS). OLS is helpful because it allows one to control for many factors and the explore the impact of one particular characteristic holding the others fixed. This analysis extends the descriptive work on commuting times in section 4.2 above.

Table 12 (below) shows the regression results from a regression of one way journey time on a number of individual characteristics in each of the four surveys that have been discussed thus far and some other characteristics. I control for mode of travel, race, income quintile, gender, age and geographical location. Mode of transport is an important determinant of journey times. Public transport users spend substantially more time commuting across all the surveys than walkers (the omitted category) but also compared to those driving their own cars. Missing coefficients are due to these options not being asked in some waves.

The results suggest that income is not a significant correlate of commuting time. Those more towards the middle of the income distribution seem to have slightly shorter commutes in 2003 and 2013, relative to those in the bottom income quintile. The results for those in the top income quintile are mixed – only in 2003 is there a statistically significant difference in commuting times compared to the bottom quintile. And even here the effect is fairly small – it is only 4 minutes shorter. It is likely that incomes have important effects on journey times but indirectly, for example by allowing commuters to purchase cars that lower journey times.

Race is strongly correlated with commuting times. Coloured and white commuters spend less time commuting than black commuters in all the surveys, although in 2010 these differences are not statistically significant. The results for Indians are more ambiguous – in 2003 and 2013 Indians spend less time commuting than blacks but in 1993 they spent more time commuting than blacks, holding all else constant. These results confirm that black South Africans live further away from jobs than other race groups and that whites live closer to jobs than blacks, controlling for income and travel mode. This is true even in 2013, nearly 20 years after the advent of democratic rule and implies that blacks are still disadvantaged as a result of Apartheid era policies to remove black (and coloured and Indian) people from urban centres where many jobs were and continue to be located. Men spent slightly longer commuting than women in 2003 and 2013 but this was only by 1.5-3 minutes. There is also a positive association between age and commute time, with younger people having shorter commutes than older people, although the effect is not large – a 20 year old commutes 6 minutes less than a 60 year old holding all else constant in 1993, and only 3 minutes less in 2013.Type of location is also correlated with journey time. Living in a metropolitan area meant slightly longer commute times than those living in rural areas, whilst living in a non-metro urban area was correlated with lower commute times than those living in rural areas.

Table 12: One-way journey time regressions

	1993	2003	2010	2013
	(1)	(2)	(3)	(4)
Cycle	17.496 (3.401)***	17.621 (2.165)***	14.622 (3.873)***	15.355 (1.799)***
Drive	12.026 (0.991)***	14.742 (0.888)***	7.612 (2.682)***	10.584 (0.721)***
Train	34.195 (2.242)***	49.829 (1.875)***	32.764 (4.749)***	46.294 (2.059)***
Bus	32.401 (1.408)***	36.156 (1.127)***	33.043 (3.390)***	39.960 (1.092)***
Minibus taxi	20.276 (0.962)***	18.516 (0.595)***	18.407 (2.149)***	16.965 (0.622)***
Car passenger		15.602 (0.799)***		13.301 (0.828)***
Company transport		16.013 (1.305)***	15.629 (3.669)***	15.018 (1.492)***
Other	4.742 (12.222)	18.208 (2.751)***	-6.367 (6.395)	9.122 (3.344)***
Multiple modes	28.623 (1.381)***	54.752 (1.115)***	27.713 (3.371)***	48.686 (1.261)***
Coloured	-7.400 (0.96)***	-9.628 (0.523)***	-.159 (2.679)	-9.769 (0.6)***
Indian	8.066 (1.999)***	-7.434 (0.936)***	1.576 (6.649)	-6.799 (1.281)***
White	-16.489 (1.095)***	-9.643 (0.842)***	-4.911 (3.963)	-11.784 (0.76)***
Income quintile 2	0.893 (1.098)	0.383 (0.738)	-.587 (2.068)	-1.793 (0.713)**
Income quintile 3	1.188 (1.061)	-1.767 (0.748)**	-.772 (2.309)	-2.383 (0.775)***
Income quintile 4	-2.404 (1.014)**	-2.874 (0.751)***	-.064 (2.635)	-3.735 (0.734)***
Income quintile 5	0.457 (0.954)	-3.944 (0.814)***	2.780 (3.165)	-1.173 (0.845)
Male dummy	0.084 (0.614)	1.484 (0.474)***	-.355 (1.644)	2.945 (0.447)***
Age	0.148 (0.027)***	0.061 (0.022)***	0.137 (0.083)*	0.079 (0.019)***
Metro area dummy	8.359 (0.943)***			3.405 (0.661)***
Urban, non-metro area dummy	-.919 (0.916)			-6.326 (0.591)***
Urban or metro area dummy			-3.426 (1.963)*	
Constant	17.315 (1.382)***	25.711 (0.967)***	18.821 (3.816)***	33.620 (0.962)***
Observations	7894	31143	3105	30390
R^2	0.23	0.283	0.118	0.21

Notes: *, **, *** denote significance at 10%, 5% and 1% levels. Dependent variable is one way journey time to work expressed in minutes. Standard errors are in parentheses and adjusted for intra-cluster correlation.

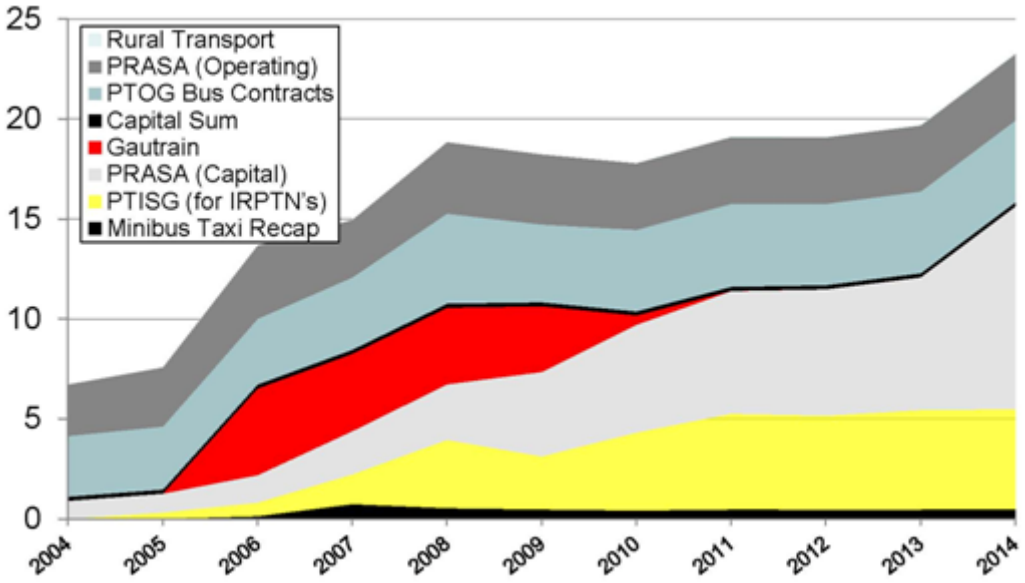
6 Financing and targeting of public transport

Public transport spending by the state is premised partly on the notion that it provides positive externalities and is "socially necessary" (Department of Transport 1996). Venter and Behrens (2005) also note that the National Land Transport Transition Act of 2000 states that public transport subsidies should be targeted at "currently marginalised users and those who have poor access to social and economic activity."

Public subsidies are distributed to private bus operators, to the new Bus Rapid Transport systems in larger cities, to PRASA, the provider of intracity train services, and to Gautrain, the new train service in Gauteng targeted at middle class users. Minibus taxi operations are not subsidised but there is a taxi recapitalisation programme that provides an incentive to scrap older, smaller taxis and a grant to purchase newer taxis. Taxis and buses also benefit from spending on the road network.

Table 1 above implies that minibus taxis carried around 71% of all commuters travelling by bus, train or taxi in 2013. Despite this, figures from the Department of Transport shown in Figure 1 indicate that the vast majority of spending on public transport goes to the bus and train network (these figures exclude spending on the road network that benefits taxis and buses) and that minibus taxis receive about 1% of the total direct public transport spending by the South African state, in the form of the scrapping allowance for old taxis.

Figure 1: Public transport subsidies from Dept. of Transport (DOT)



Source: DOT, 2013. *Notes*: PRASA is the operator of inter and intra-city trains. PTOG is the provincial operating grants to private bus operators contracted by provincial governments. Gautrain is the train in Gauteng Province targeted at high income commuters. PTISG is the grant for Bus Rapid Transport (BRT) Systems operating in some cities [Johannesburg (Rea Vaya), Cape Town (MyCiti) and Pretoria (Areyeng)].

Targeting of public transport spending

Given the goal of the South African state to subsidise public transport for marginalised users it is of interested to explore the extent to which public transport spending is targeted at low income individuals. Table 13 shows the distribution of modes by quintile of earnings from employment in 2013.

Table 13: Work travel mode by income quintile in 2013

Income quintile:	1	2	3	4	5	Total
Mode	%	%	%	%	%	%
1. Walk	44.5	24.9	17.0	14.8	7.2	21.8
2. Cycle	1.5	1.6	0.8	0.9	0.5	1.1
3. Drive	5.6	8.0	18.8	34.7	61.6	25.5
4. Train	1.8	4.5	3.4	2.5	1.5	2.8
5. Bus	5.5	8.2	8.0	5.8	2.8	6.1
6. Minibus taxi	19.6	30.0	28.5	20.3	11.3	22.0
7. Car passenger	6.4	7.3	8.2	8.9	5.6	7.3
8. Company transport	1.7	2.3	2.2	1.9	0.9	1.8
9. Other	0.4	0.5	0.5	0.4	0.3	0.4
10. Multiple modes	4.8	8.5	9.3	6.6	4.0	6.6
11. Works at home	8.3	4.3	3.4	3.0	4.2	4.6
Total	100.0	100.0	100.0	100.0	100.0	100.0

It is clear that a majority of those in the lowest income quintile either walk to work or work at home. Only 7.3% of those commuters in the lowest quintile use buses or trains that are likely to be subsidised by the state, this is 12.7% in quintile 2, 11.4% in quintile 3, 8.3% in quintile 4 and 4.3% in the top quintile. Thus the benefits of transport subsidies seem to accrue more to those towards the middle of the income distribution.

7 Conclusion

In this paper I have presented household survey data on commuting transport from 4 surveys covering the period 1993-2013. There are some important differences between the coverage of workers across the surveys, particularly rendering NIDS wave 2 less comparable with the other 3 surveys. The PSLSD excluded the informally self-employed, a group of commuters known to include a group of employed with zero costs and times. I have shown that the surveys nevertheless allow for a comparison between 1993 and both 2003 and 2013 in commuting modes and costs, both time and monetary costs. I have shown that the time costs of commuting in South Africa are dramatically higher than in a number of other countries and that they have increased over the last 20 years. Monetary costs are also high – higher than the target of 10% of commuter income suggested by the first post-Apartheid Department of Transport's white paper (Department of Transport 1996). These

findings confirm other work suggesting that Apartheid era segregation has had negative consequences on the extent to which particularly black South Africans are required to travel long distances to get to work.

The descriptive regression analysis showed the impact on commuting times of legislation from the Apartheid and pre-Apartheid period such as the Natives (Urban Areas) Act of 1923 and the Group Areas Act that spatially segregated South Africans mainly by moving black South Africans out of central urban locations. Even after controlling for incomes, white South Africans still had the lowest commuting times and black South Africans the highest times. The regression analysis also showed that bus and train users spend a much longer time commuting, on average, than users of other modes, holding a number of other factors constant. It also showed that mode of transport is an important determinant of time spent commuting and I argued that this is highly correlated with income – which was not an important predictors of journey times by itself but which allows the purchase of private cars and thus decreases commuting times indirectly.

The high costs I have described place a large burden on individuals and on the state, which has a responsibility to mitigate some of these costs. However, transport costs are high despite public subsidies for train and bus users. Despite a stated commitment from the South African state to target marginalised users I find that the commuters who benefit from public transport subsidisation are not mostly at the lower end of the income distribution but rather those in the middle. A majority of those in the lowest income quintile walked to work or worked at home in 2013 and the descriptive analysis suggests these modes have lower times than public transport modes. This suggests that transport costs are borne not by the poorest but those in the middle of the income distribution. However it is possible that the poorest would be able to access better employment if costs were lower – this issue has not been tackled in this paper.

Following up a suggestion by Hausmann (2013) I calculated the implied tax rates from time and monetary costs of public transport. I find median tax rates as high as 40% for some public transport modes, a result of long commute times and expensive commuting costs. These high implied tax rates only add to the puzzle of South Africa's small informal sector – as informal sector workers often work at home their transport costs are much lower and thus one might expect more individuals to work in this sector.

The high and increasing commuting costs I have shown place a significant burden both on individuals and their household members, the state, as well as firms that employ commuters who are likely to be less productive after early morning starts, long commuting times and late returns to home. Policies that improve the targeting of public transport spending as well as those that lead to denser cities and to the poor being located closer to job opportunities would help to mitigate these costs.

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