

Money well spent? Assessing the effectiveness of expenditure on road accident prevention programmes in South Africa

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(Work-in-Progress: Please do not copy or circulate)

Abstract

Road traffic injuries and fatalities and the promotion of road safety are important policy issues worldwide, in part because road accidents are such a big contributor to injury mortality. South Africa's road traffic injury fatality rate is 33.2 per 100 000 of the population, which is much higher than the World Health Organization's estimate of 19.5 for all middle income countries. For the period April 2010 to March 2011, 13 800 people lost their lives in South Africa in 10 800 road accidents. The reality of such high road traffic fatality rates suggests that mechanisms to ensure road safety require serious attention. The current policy framework in South Africa includes various institutions, including formal ones (traffic laws and enforcement, e.g. AARTO) and others aimed at influencing the norms and habits that determine road user behaviour (e.g. the Arrive Alive campaign). In 2005 the Road Traffic Management Corporation (RTMC), an agency established to coordinate these institutions, commenced its operations. This paper investigates the efficacy of such policy interventions by evaluating road fatalities before and after the RTMC became functional. For this purpose we forecast road fatalities beyond 2004 for twenty years based on historical data from 1935, and compare the number of fatalities with and without the formal institutional intervention of the RTMC. We also attempt a crude cost benefit analysis by determining the number of fatalities that should have been prevented to warrant the RTMC expenditure.

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1 Introduction

Road traffic injuries and fatalities and the promotion of road safety are important policy issues worldwide, in part because road accidents are such a big contributor to injury mortality. South Africa has a road traffic fatality rate that is higher than the average for all regions reported by the World Health Organization. It is therefore not surprising that road safety is a priority for the government and large sums of money are expended on a yearly basis to reduce traffic crash crashes. The current policy framework in South Africa includes various institutions, including formal ones (traffic laws and enforcement, e.g. AARTO) and others aimed at influencing the norms and habits that determine road user behaviour (e.g. the Arrive Alive campaign).. In 2005 the Road Traffic Management Corporation (RTMC), an agency responsible for the registration of vehicles, traffic information systems, public communication and traffic law enforcement, commenced its duties (Arrive Alive, 2013).

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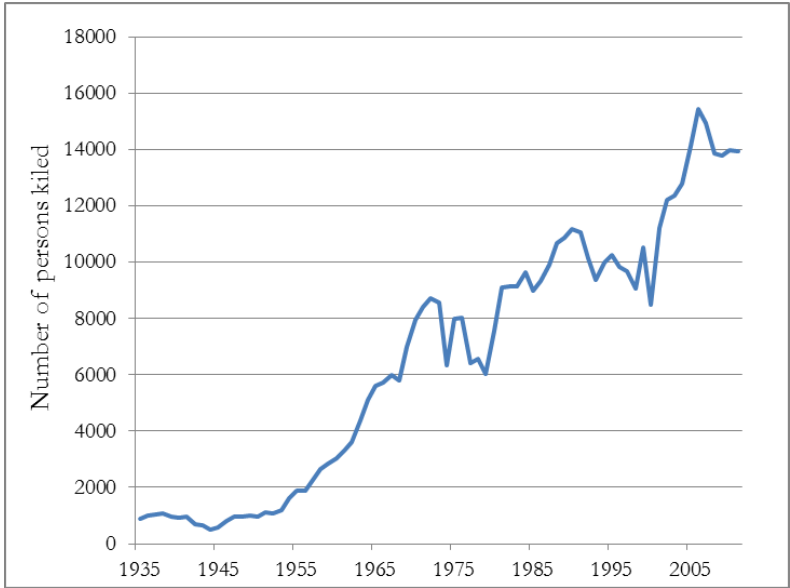
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This paper investigates the efficacy of policy interventions by evaluating road fatalities before and after the RTMC became functional. For this purpose we forecast road fatalities beyond 2004 for twenty years based on historical data from 1935 onwards, and compare the number of persons killed with and without the formal institutional intervention of the RTMC. We also attempt a cost benefit analysis of policy interventions by determining the number of road accidents they should have prevented in order to warrant their cost. Using estimates of the unit costs of traffic accidents published by the National Department of Transport, we determine the average cost of a road fatality. Programme expenditures are then divided by this cost to establish how many road fatalities a cost-effective intervention should have prevented. We use insights from the literature on the relationship between formal and informal institutions to comment on the effectiveness of the interventions and suggest policy recommendations.

2 Road fatalities in South Africa

South Africa has a road traffic injury fatality rate of 33.2 per 100 000 of the population, which exceeds the World Health Organization’s estimate of 19.5 for all middle income countries (World Health Organization, 2009: vii, 244-245). From April 2010 to March 2011, 13 800 people lost their lives in South Africa in 10 800 road accidents. Figure 1 shows the number of persons killed over the period 1935 to 2011. It is evident that there has been an upward trend in the number of persons killed in road accidents, albeit not an uninterrupted one, although these numbers do not take population growth into account.

Figure 1: Number of persons killed (1930 – 2011)

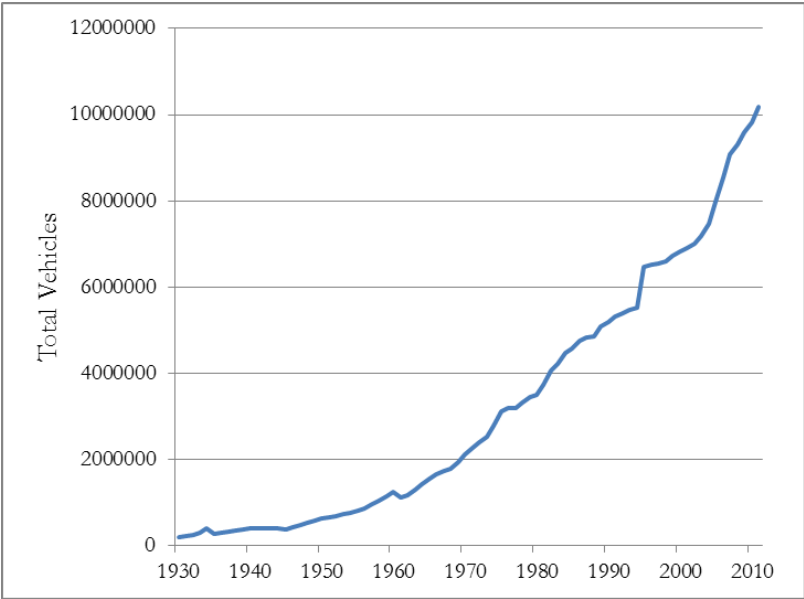


Source: RTMC (various years)

Various factors contribute to changes in road traffic deaths over time. According to Naumann et al (2010), these include factors such as demographics, kilometres driven, the distribution of types of road users, and the type of road safety policies and interventions applied. Bester (2001) alludes to speed, vehicle ownership, conditions of infrastructure and the attitude of the driver population as possible explanatory factors for a country's fatality rate.

In recent years South Africa has experienced an increase in the number of vehicles utilising its roads. For the period 2000 to 2011, Figure 2 indicates a continuous increase in the number of vehicles on South Africa roads.

Figure 2: Total vehicles registered (1930 – 2011)



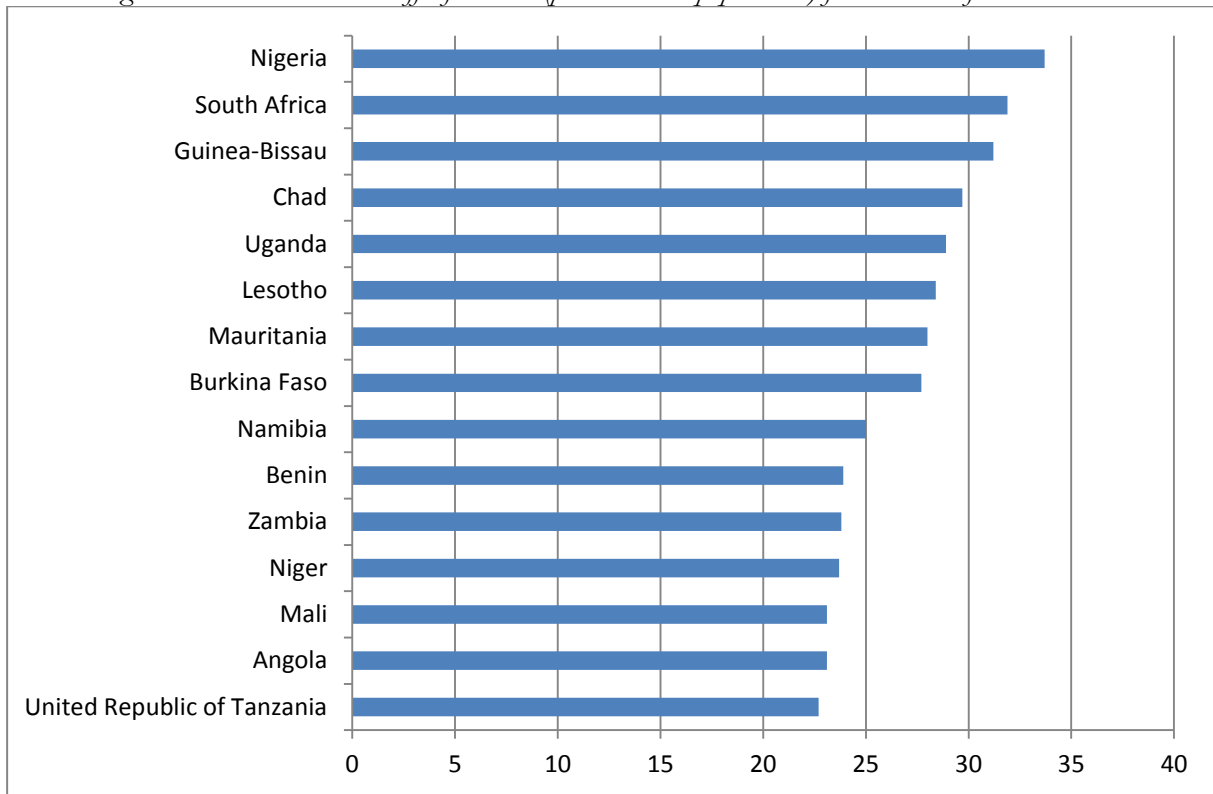
Source: RTMC (various years)

In 2000 the Transport Research Laboratory in London published a report entitled *Estimating Global Road Fatalities* (Jacobs, Aeron-Thomas and Astrop, 2000). It shows that the highest fatality rates (deaths per 10 000 motor vehicles) occurred in African countries, namely Ethiopia, Uganda and Malawi. The fatality risk (deaths per 100 000 people) is highest in countries such as Thailand, Malaysia, South Africa and Saudi Arabia. The report also emphasise that the groups at highest risk throughout Africa and Asia are pedestrians and cyclists.

Without taking other considerations into account, one would expect road accident fatalities to be high on the health agenda in Africa. This is unfortunately not the case, because diseases such as malaria, HIV/AIDS and tuberculosis pose a much greater threat to the regional population and rightfully take precedence on the health agenda (Jacobs, Aeron-Thomas and Astrop, 2000).

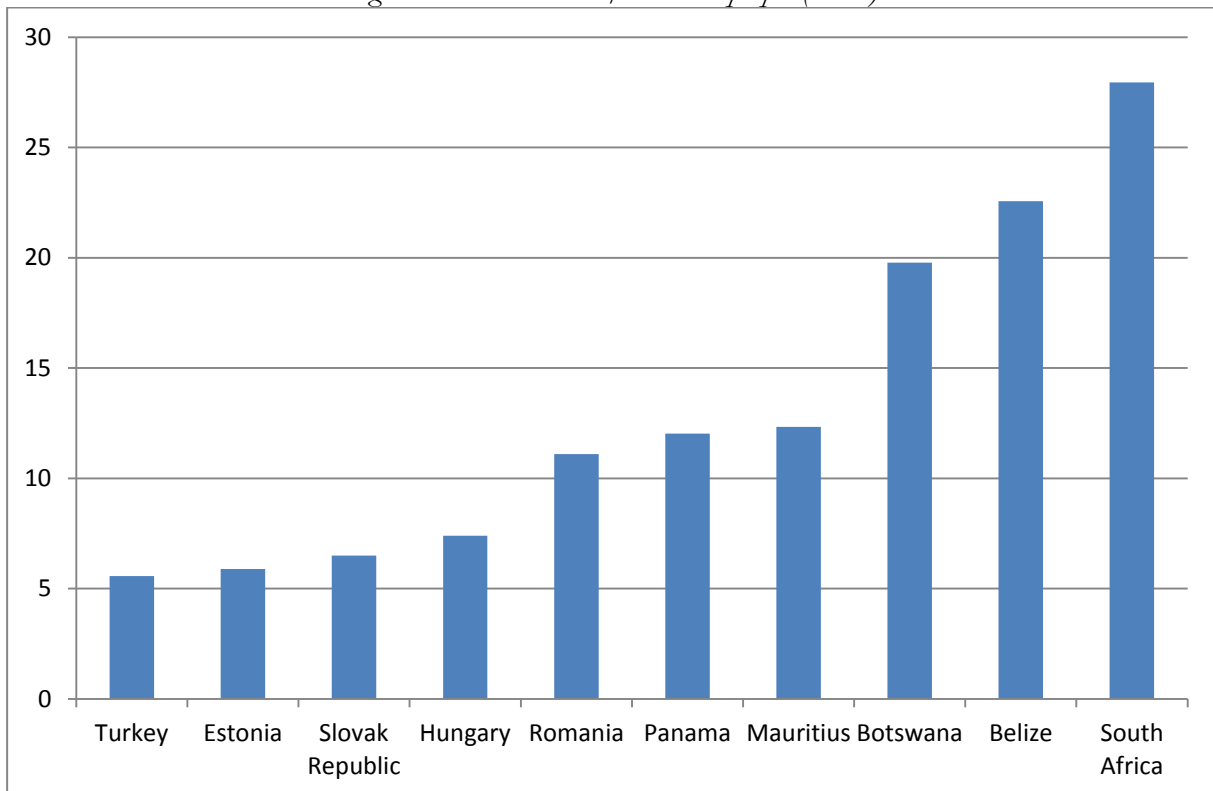
Figure 3 compares the incidence of road traffic fatalities in South Africa and fourteen other African countries with relatively high levels of such fatalities. Furthermore, Figure 4 shows how the number of persons killed in traffic accidents (per 100 000 of the population) in South Africa compares with those in other upper-middle-income countries with available data on road accidents. It transpires that road traffic fatalities are relatively high in South Africa, especially in comparison to other upper-middle-income countries.

Figure 3: Estimated road traffic fatalities (per 100 000 population) for selected African countries



Source: World Health Organization, 2013

Figure 4: Persons killed / 100 000 people (2010)



Source: World Road Statistics, 2012

In Table 1 South Africa is compared to countries that exhibit similar road densities (the road density is the ratio of the length of a country's total road network to its land area. In this comparison, road traffic fatalities in South Africa seem very high. If the total network of roads is taken into account, South Africa can be compared to Indonesia, Pakistan, Thailand, and the Ukraine (all being developing countries as well), but again, road fatalities in South Africa are markedly higher.

Table 1: Road density, fatalities and network

	km of road per 100 sq. km of land area	Road fatalities/ 100 000 people	Roads, total network (km)
South Africa	0.3	27.94	364 131
China	0.4	4.88	4 008 229
Cote d Ivory	0.25	3.27	81 996
El Salvador	0.33	16.95	6 018
Indonesia	0.25	8.28	476 337
Malaysia	0.44	24.2	144 403
New Zealand	0.35	8.59	94 277
Norway	0.29	4.25	93 509
Pakistan	0.33	2.93	262 256
Portugal	0.24	8.81	21 912
Romania	0.34	11.09	82 718
Thailand	0.35	10.46	180 053
Uganda	0.29	8.84	70 746
Ukraine	0.28	10.63	169 496
Zimbabwe	0.25	8.32	97 267

Source: World Road Statistics, 2012

This section shows that the South African government needs to focus more attention on road accidents. The comparisons presented here all suggest that South Africa remains an outlier as far as road accident statistics are concerned.

3 Institutional responses to road traffic problems

Traffic rules are formal institutions and part of what North (1990) calls 'humanly devised constraints that shape human interaction'. The aim of traffic rules is to create safety on the roads through a set of incentives (Polinsky and Shavell, 2005). The effectiveness of formal rules depends on the extent to which they are enforced and supported by informal rules (e.g. habits and norms of behaviour). Put differently, high levels of compliance with formal rules result from a combination of effective enforcement and the extent to which the prevailing social norms complement such rules. Law enforcement might influence social norms, but the effect may only be seen after many years, because 'social norms are mainly the result of early childhood experiences and the messages conveyed by parents and other authority figures, such as educators' (Polinsky and Shavell, 2005). As Bergström (2005) observes, 'rules are not effective unless they

are accepted, observed and maintained by the people and Organizations concerned – hence what matters is that rules are actually applied in practice’. In all likelihood, it will take many years before compliance with traffic rules becomes part of society’s institutional framework.

The Road Traffic Management Corporation (RTMC) is a national agency that was established as a formal institution responsible for road traffic management in South Africa. It was enacted in Section 3 of the Road Traffic Management Corporation Act, No. 20 of 1999 to coordinate all aspects of road traffic management and started its operations in April 2005 (RTMC, 2013). The task of the RTMC is to ensure road safety and promote responsible usage of roads. Its objectives include improvement of the overall quality of the provision of road traffic services by ensuring safety, discipline, order and security on roads, and thereby reducing road fatalities (Adams, 2009). In fact, it has set specific fatality reduction targets: it was reported for example, that the RTMC planned to reduce the number of road fatalities by 25% during the festive period in December 2012 (Lancaster, 2012). The RTMC also published its progress in achieving the target to reduce fatalities by 50% by 2015 (RTMC, 2010).

The question whether the prevailing informal institutions support this drive towards road safety is one of the aspects that will be addressed in the remainder of the paper.

4 The efficacy of institutional interventions

4.1 Data

We use annual data for the period 1930 to 2011 that were obtained from the RTMC databases. The variables we use in our analyses are the number of persons killed (road accident fatalities), total vehicles registered and the number of kilometres driven.

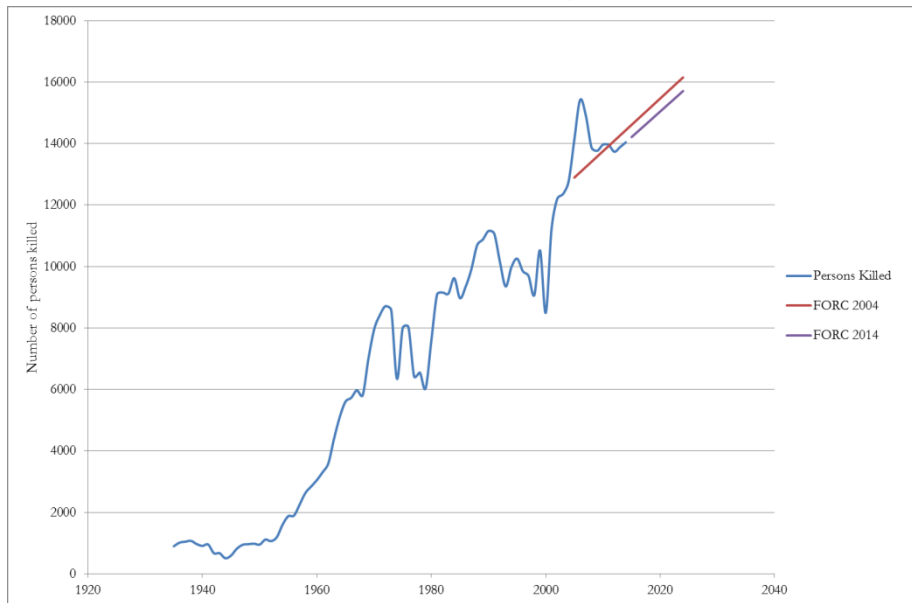
4.2 Method and results

To evaluate the efficacy of institutional interventions, we want to estimate the number of road accidents that should have been prevented to warrant their costs, that is, the budgeted allocations to the RTMC since 2005. Using estimates of the unit costs of traffic accidents published by the National Department of Transport, we determine the average cost of a road fatality over a period of five years. The budgeted expenditures of the RTMC are then divided by this cost to establish how many road fatalities cost-effective interventions should have prevented.

Forecasting fatalities

As a first step in costing the road fatalities, we forecast what the number of persons killed would have been had there been no institutional interventions such as the RTMC after 2004. Using the actual data observations from 1935 to 2004, we estimate observations for the years 2012 to 2014 using moving averages. This is necessary to allow a forecast on the number of persons killed beyond 2004 (actual fatalities are available until 2011, but at least 10 data observations points are required to apply time series forecasting). The results of the forecasting models (using IMA(1,1)) provide estimates for the period 2004 to 2014, as well as estimated forecasts from 2014 to 2024 (still on the assumption that no interventions take place). These results are shown in Figure 5.

Figure 5: Forecasts of number of persons killed



Source: Own calculations, Data from RTMC (various years)

Both forecasted periods show a continuing upward trend in the number of persons killed. We then calculate the difference between the actual observations and the forecasted fatalities – see Table 2 below. The values in the "Difference" column suggest that the actual values exceeded the forecasts in all seven years since the RTMC has commenced its operations (recall that the forecasts are based on the assumption that no institutional intervention, i.e. the RTMC, was operational). The difference decreases over time, however, and is negative from 2012 onwards. It should be kept in mind that the fatality numbers from 2012 onwards are estimates, rather than actual numbers. Nonetheless, these results are consistent with the possibility that the activities of the RTMC initially did not but are now reducing road traffic accidents.

Table 2: Difference between actual observations and forecasted values of the number of persons killed, 2005 to 2014

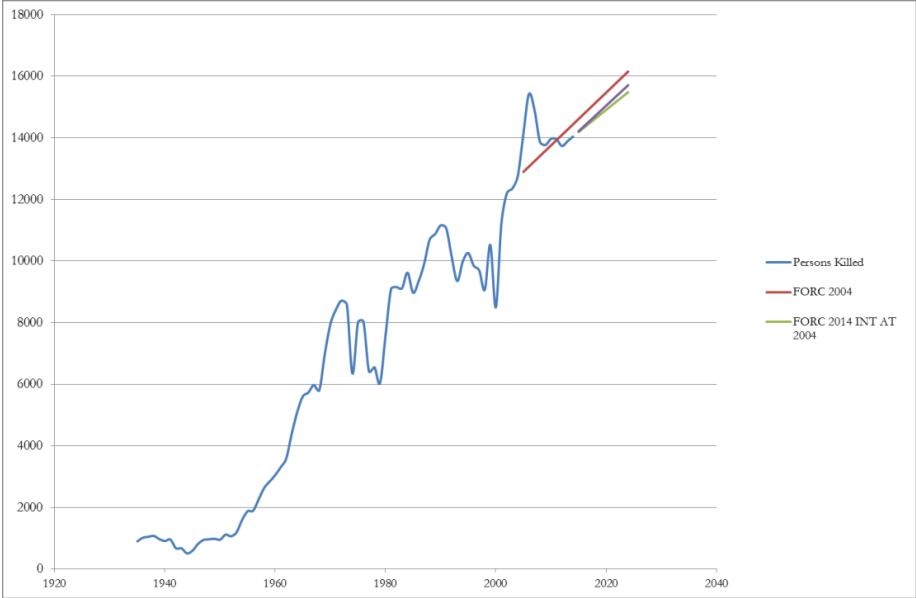
Year	Actual values	Forecasted values	Difference
2005	14 135	12 895	1 240
2006	15 419	13 066	2 353
2007	14 920	13 238	1 682
2008	13 875	13 409	466
2009	13 768	13 581	187
2010	13 967	13 753	214
2011	13 954	13 924	30
2012*	13 736	14 096	-360
2013*	13 890	14 267	-377
2014*	14 044	14 439	-395

Source: Own calculations, Data from RTMC (various years)

* Note: the actual values are estimated moving averages.

A further forecasting exercise is undertaken to distinguish between the forecasted number of persons killed with and without the commencement of operations of the RTMC in 2005. The goal of this exercise is to ascertain the effect of the intervention in a long-run setting, namely from 2014 to 2024. The results are illustrated in Figure 6 and Table 3.

Figure 6: Forecasts of number of persons killed (2014 to 2024, with and without intervention)



Source: Own calculations, Data from RTMC (various years)

Figure 6 shows that the forecasted fatalities for the period 2015 to 2024 are higher without the intervention in 2004 than with it. The positive difference between the two series (shown in Table 3 above) also becomes larger over time. This indicates an increase in the forecasted decrease in the number of fatalities associated with the intervention. It must be emphasised, though, that we do not claim to have shown a causal relationship between the number of fatalities and the commencement of the activities of the RTMC.

Table 3: Difference between forecasted values of the number of persons killed with and without intervention, 2015 to 2024

Year	Forecasted values (without intervention)	Forecasted values (with intervention)	Difference
2015	14 212	14 188	24
2016	14 379	14 332	46
2017	14 545	14 476	69
2018	14 712	14 620	91
2019	14 878	14 764	114
2020	15 045	14 908	137
2021	15 211	15 052	159
2022	15 378	15 196	182
2023	15 544	15 340	204
2024	15 711	15 484	227

Source: Own calculations, Data from RTMC (various years)

Cost benefit analysis

In this section, we attempt a costing exercise of road fatalities in order to provide a crude cost-benefit analysis of the institutional interventions. We estimate the number of road fatalities that would have had to be prevented given the annual budgeted expenditure of the RTMC.

The costs of road crashes include various components. Harris and Olukoga (2005) point out that the human cost entails the fatality cost (such as lost output), and provide an estimate of R331 000 (in 1998 values). The National Department of Transport (2004) provides estimates of the unit costs (in 2000 values) for urban and rural fatalities, by age group – see Table 4 below. These estimates are based on the methodology of calculating the value of lost productivity (based upon the average life expectancy, rate of employment and the income of the population).

Table 4: Estimated unit costs for rural and urban fatalities, by age group

Age group	Urban fatality (killed)	Rural fatality (killed)
0-1	R 479 927	R 482 132
1-4	R 506 457	R 508 662
5-9	R 553 648	R 555 853
10-14	R 590 536	R 592 741
15-19	R 627 581	R 629 786
20-24	R 663 318	R 665 124
25-29	R 686 248	R 688 054
30-34	R 685 154	R 686 960
35-39	R 667 400	R 669 206
40-44	R 633 881	R 635 687
45-49	R 588 077	R 589 883
50-54	R 539 920	R 541 726
55-59	R 480 748	R 482 554
60-64	R 427 700	R 429 906
65-69	R 385 299	R 387 504
70-74	R 353 554	R 355 759
75-79	R 321 039	R 323 244
80 and older	R 273 091	R 275 296
Unknown age	R 624 405	R 629 777

Source: National Department of Transport, 2004

The first step in our analysis is to convert all expenditure estimates and unit costs to 2012 values. Using the number of fatalities per age group for 2004 – 2006, we calculate a weighted average for the unit cost, shown in Table 5.

Table 5: Weighted average of unit cost of fatalities, by age group (R'000)

Age Group	2004	2005	2006	Average (3 years)
0-4	21	22	20	21
5-9	39	34	34	36
10-14	32	31	26	30
15-19	44	41	36	40
20-24	82	78	78	79
25-29	95	102	101	99
30-34	120	122	114	119
35-39	97	83	84	88
40-44	77	76	68	74
45-49	44	40	44	43
50-54	30	28	31	30
55-59	14	16	18	16
60-64	12	11	11	11
65-69	6	7	6	6
70-74	5	3	5	4
75-79	2	2	2	2
80+	2	2	2	2
Unknown	316	343	361	340
Total	1 039	1 040	1 039	1 039

Source: Own calculations, based on data from National Department of Transport (2004), RTMC (various years)

The weighted average unit cost of R1.039 million per fatality is used to calculate the number of fatalities that would have had to be prevented given the annual budget expenditure estimates of the RTMC. This is shown in Table 6.

Table 6 shows that in the initial years after the commencement of the operations of the RTMC, the difference between the actual and forecasted fatalities (assuming no intervention) was positive. This indicates that the intervention activities coincided with an increase in the number of fatalities. For example, in 2005 the actual number of fatalities was 14 135, whereas the forecasted estimate was 12 895, i.e. an increase of 1 240. Given the unit cost estimate of R1.039 million, the expenditures of R113.941 million (in 2012 prices) would have been cost-effective if they had prevented at least 110 fatalities. Hence, the increase in the actual fatalities given the forecasted estimates indicates no immediate intervention effect. As time passes, however, the difference between the actual and forecasted fatalities become smaller and for 2012 it is negative (indicating that the actual fatalities were lower than the forecasted estimate). The latter result (a shortfall of -360) shows a greater decline in the number of fatalities than what would have been required given the RTMC expenditure for 2012 (which requires a decline in fatality of 159). Clearly, this result does not establish a causal relationship. It suggests, however, that trends in road accident fatalities since the establishment of the RTMC do not prove that the intervention

has been ineffective. In fact, these trends are consistent with the view that it took time before the activities of the RTMC began to affect accident outcomes.

Table 6: Annual expenditure estimates of RTMC and number of required fatalities

Year	Total expenses in 2012 prices (R'000)	Required number of fatality reductions given RTMC expenditures	Difference between actual and forecasted fatalities (from Table 2)
2005	113 941	110	1 240
2006	74 940	72	2 353
2007	93 291	90	1 682
2008	207 968	200	466
2009	308 157	297	187
2010	177 365	171	214
2011	188 495	181	30
2012	165 612	159	-360

Source: Own calculations & data from National Treasury (2007, 2010, 2012, 2013)

5 Concluding remarks

The extent of road accidents is of great concern in South Africa, and the estimated cost of road fatalities (even when only considering the resultant loss in output) is relatively high. Institutional interventions are therefore a necessity, and South Africa's current policy framework allows for an dedicated agency (i.e. the RTMC) to consolidate efforts to address the problem.

This paper analyses the magnitude of road fatalities before and after the operational commencement of the RTMC. This was done by forecasting the number of persons killed assuming no intervention, and comparing this to the actual road fatalities. The results of this exercise revealed that immediately after the RTMC commenced its activities, the number of persons killed increased (i.e. the actual number of road fatalities was higher than the forecasted value). A costing exercise revealed that this by far exceeded the required decline in the number of road fatalities given the expenditure of the RTMC. Although we emphatically cannot prove any causal link between the operations of the intervention and the change in the road fatalities, we do observe that over a longer (forecasted) period the positive difference between the actual and the forecasted number of fatalities become smaller. The latter also implies that the required reduction in the number of persons killed (given the expenditure of the RTMC), decline. In fact, in 2012, this reduction was smaller than the difference between the actual and forecasted values (which now showed a negative difference). Beyond 2014, the forecasted values without an intervention exceed the forecasted values with an intervention. Although we have not established causality, there is an allusion to the efficacy of such an intervention programme over a longer time span.

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