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Funding for Roads in South Africa: Understanding the principles of fair and efficient road user charges

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Abstract

Roads support economic development and is one of the key economic infrastructures of South Africa. Funding for roads has been, and continues to be, controversial and faced with a multitude of challenges. The fuel levy, for instance, has for decades been the basis of road funding, but in recent years it has experienced declining effectiveness and efficiency. Both South African and international policy documents frequently propose the so-called user-pay principle to be adopted to fund land transport. It is frequently understood that the user-pay will imply sufficient income to sustain the road user, however this assumption is not entirely correct. In this paper the importance of roads to the economy is introduced which underscores the importance of an adequate and stable income source for road construction, maintenance and upgrade. The paper does emphasize that sufficient and adequate roads and hence funding is, however, not sufficient to support economic development. The paper defines and discuss the user-pay principle and the importance of charging road users efficient prices for road use. In transport, the term marginal social costs, sometimes also referred to as the principle of short run marginal social costs (SMSC) describes efficient road use prices. The paper discuss this concept as a road use charge. The technical difficulties of implementing SMSC is presented which are often the reason why alternative pricing regimes, such as average cost or long run marginal costs are adopted in practice. The paper concludes with a discussion on the way forward for South Africa.

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Keywords: User pay principle; funding; road infrastructure; efficient road user charging; marginal social cost

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1. Introduction

Road infrastructure, and all the transport services that use roads, such as private vehicle owners, public transport operators and goods transporters, improve the standard of living for the public and businesses; provide a social service; and generally contribute to a government's developmental goal of supporting its country's economy. Policy-makers have always responded positively to this relationship between roads and prosperity, and as a result have invested heavily in roads. This was and remains the case in South Africa.

Funding for roads is controversial, faces many conflicting viewpoints and is notoriously complex. This situation is amplified in a developing country facing numerous developmental needs, limited revenue opportunities and a relatively small road user base. Governments cannot realistically always ensure that funds are indeed spent on roads given other urgent developmental requirements, or that the spending on roads is done in an economic efficient manner. Given the nature of roads infrastructure, indivisible, chunky and public nature, funding for roads is nearly always under pressure. To compound the problem, road users seldom, if ever, know the full usage price of their road use (cost observation) and mostly under-estimate the cost of their use of the scares resource.

A general theme in government, and state owned entities, policy documents and statements seems to indicate their preference to adopt the so-called user-pay principle to fund roads. Other than these general statements, no documents elaborate on the principle and what it entails. The popular press, on the contrary, seems to favour a more 'equitable' allocation of the fuel levy, assuming that the fuel levy is sufficient if fully allocated to the road sector. Non-government civil action organisations typically support this viewpoint, often calling for the ring-fencing of the fuel levy for road infrastructure spending. The public is sceptical of government taxes and, if the recent experience with tolls is anything to go by, will be very reluctant to accept a new road tax or any form of toll. Civilian action organisations actively engage in this debate under the banner of fighting tax abuse, with the various conflicting groups arguing for or against toll roads, ring-fencing the fuel levy, lessening the financial load on motorists and stopping the subsidising of other economic sectors by the road sector. Near weekly revelations about 'state capture', corruption and the squandering of tax money seems to increase the unease of people to continue financing government spending (Visser 2017). How roads should be funded (who should pay), and how much they should pay, seems to be the main points of contention.

Despite all these conflicting views, there is surprisingly little research in South Africa on road funding. In fact, there have been very little research on road funding since Peter Freeman conducted his seminal work, The Road User Cost Recovery Study, in the 1980s (Freeman 1982). The limited studies that have been undertaken in South Africa have focused the how to fund roads (as a non-pure public good) (Mirrilees 1989; Naude 1996) and on the issues of how much users should pay and who should fund roads (Stander & Pienaar 2006; Brits 2010). What is evident from the very limited number of studies undertaken in South Africa is that (i) the fuel levy may not be a viable long term solution given technological developments, (ii) road user charges based on weight distance charges may accurately reflect road users costs, and (iii) that South Africans may be paying more road use tax than what their fair share of road use demand.

Compounding this lack of research is the unavailability of data such as the size, composition and growth projections of the South African vehicle fleet, income from road use and expenditure on the road network, costs caused by road users including maintenance, social and environmental unit costs, the allocation of costs to road user types, information on administration of road funding, the value of the road network and an understanding of road user charging principles. The road industry, broadly including road users, infrastructure service providers, transport operators, and the government and state-owned entities, seems saturated with distrust, suspicion and with untruths about road funding, specifically the who should pay, the how to pay and need for road funding.

The purpose of this research was not to present a solution to road funding, but instead to explain the road-funding dilemma in general; to clarify the user-pay principle; and finally to recommend a way forward to address the current policy vacuum and stimulate objective public debate on road funding. Investigating these issues can provide the foundation to establish a road funding policy that is (i) sensitive to the specific circumstances of the road sector in

South Africa, (ii) based on fair, equitable and efficient road user charges and (iii) adopts an inclusive institutional framework in road fund administration that can foster general consent of road user charging.

2. Roads and economic and social development

A basic conviction supporting the viewpoint of an infrastructure-led growth policy is the theory that transport, and particularly transport infrastructure, is growth-enhancing (European Conference of Ministers of Transport 2001). Empirical support for this viewpoint is often provided by referring to the statistical link between growth in Gross Domestic Product (GDP) or Gross National Product (GNP) and growth in road traffic (goods and passengers) or road network density. The National Planning Commission for South Africa even suggests that transport is a pillar for economic development and growth (National Planning Commission 2009). While there is no doubt that the transport network and transport operations can support economic development, the issue is exactly how this would come about.

Transport investments, such as roads, public transport networks and intermodal transfer facilities, lower the costs of moving people and goods. This decrease in costs may increase the productivity of companies, organisations and individuals in that more time and money is made available, leading to increased output. Productivity, measured in terms of increased output per unit of investment, is a key element of economic growth. Economic growth, when measured in terms of the expansion of the GDP, may lead to a higher standard of living. Whether or not the growth resulting from an increase in productivity is equally shared among the citizens is not considered here. Seen from this perspective transport (infrastructure) investments such as building new roads or upgrading existing roads may improve economic wellbeing through enhancing productivity. Central to this argument, however, is that the cost of the road investment be less than the savings generated by the new road. This implies, of course, that it is possible to overinvest, specifically with regards to (i) providing too much capacity too soon (ii) or too expensive road infrastructure or (iii) that the demand remains too low to support the road infrastructure.

While transport investment, and road investment in specific, may in fact support economic development, there are some important qualifications for development to occur (Banister & Berechman 2001). Positive economic externalities should be present which include agglomeration and labour market economies and the availability of a well trained workforce, among other. Investment factors are present which relate to the availability of funds for investment, the scale of investment and location, network effects (no missing links in the network), etc. Political factors are conducive to support economic development which includes sources of finance, the level of investment and supporting legal, organisational and institutional policies and processes.

If these requirements are not present, any transport investment to support economic development will be severely hindered and may even have counter development effects as adequately illustrated by Banister and Berechman (2001).

The savings offered by transport infrastructure can be measured by the rate of return produced by the transport investment. Governments at all levels use public funds to invest in transport projects such as roads. These public funds are the result of collected taxes, including the fuel levy or toll fees. To be worthwhile investments, the roads projects selected should deliver a high rate of return in order to ultimately support the goal of increasing productivity and generating economic growth. It therefore follows that transport investments should be sound and be in response to a need, as opposed to being supply-driven.

Measuring the impact of transport infrastructure investments on the economy can be assessed at micro- and macro-level with various analytical techniques. Roads support economic development by bringing on direct savings. Micro-economic techniques capture the direct time and cost savings from transport improvements (such as vehicle operating costs), but not the indirect impact of these savings in the form of lower production costs and possible benefits from the reorganisation of logistical activities. These benefits are then compared to the costs, including external costs, associated with the investment. If these benefits, termed first order or primary benefits, exceed the costs, the transport (road) investment is worthwhile. While these techniques are widely used, they do not consider the network or general equilibrium effects of transport investments on the transport-using sectors of the economy or the indirect effects induced by road investment. These network benefits may in fact be dramatic in terms of the growth in total factor

productivity. Macro-economic modelling techniques are used to capture these economy-wide cost reductions and the output expansion derived from transport infrastructure investments (Lakshmanan 2011). Two other benefits ascribed to transport infrastructure are spatial agglomeration in larger urban areas, and innovation and commercialisation of new knowledge in connected areas. That is, good transport connections create productive and efficient cities which stimulate innovation and economy of scale.

Transport, and more specifically road infrastructure investments can undeniably contribute to improved accessibility (or reduced costs of accessibility), which are key to creating an improved standard of living for citizens by giving them access to job opportunities and cheaper basic services.

The second caveat relates to funding. If roads are financed by public borrowing, the impact of debt servicing will be felt by other investments, including education and social services. Given South Africa's current fiscal position, public borrowing may not be feasible. Funding from the fuel levy, as a partial substitute for a road user charge, may lead to one of two outcomes. Unconstrained spending from a well-stocked fuel fund, especially spending that is not related to actual road use, can lead to inflationary pressure. By contrast, insufficient spending on the network, including on the necessary maintenance and upkeep, would lead to a rapidly deteriorating road network, increasing transport costs and placing time and financial pressure on businesses and citizens. The costs of poor road management and inadequate road financing are, after all, borne primarily by road users through increased vehicle operating costs.

Shifting road investments from the government to the private sector, including public/private partnerships, toll road concessions, etc. may be useful to secure much-needed funds. Although these initiatives are becoming more popular globally, they are associated with political inertia, an aversion from road users and enterprise regulation voids with regard to setting road use charges which hamper their roll-out and permanent use. Yet they do offer the possibility of cutting project implementation time significantly and securing funding for much needed projects.

Road infrastructure, and indeed all transport infrastructure, can support economic growth and development, but this can only be achieved with sufficient, stable modes of funding based on efficient road user charges. Funds must be spent judiciously and focused on bottlenecks where a deficient road network inhibits growth. Finally, if supporting conditions are not present, investment in road infrastructure to support economic development is not likely to occur.

3. The South African road funding framework

During 2014 – 2015, R99.9 billion was directly collected from the road network and road users through various charges, levies and taxes by all levels of government. This income was collected from a vehicle fleet of 10 350 835 travelling a distance of 162 405 499 396 kilometres using the 746 835 kilometres or roads in South Africa. Road users charges resulted in R0.62 of direct income collected per vehicle kilometre.

R49.2 billion was spent on road infrastructure (planning and design for road upgrade, maintenance and new construction) by SANRAL, provincial and municipal governments. All authorities spent R70.2 billion on road operations and regulation resulting in R119.5 billion being spent on road infrastructure, regulation and operations. This investment was spent on 746 835 kilometres of roads as well as the supporting operational and regulatory agencies in South Africa, used by a vehicle fleet of 10 350 835 travelling a distance of 162 405 499 396 resulting in an investment of R0.74 per vehicle kilometre.

The fuel levy remains the main income source from road users that may be used to support road construction and maintenance. It is also a significant component of the direct road-generated revenue (47%), and currently the only nationally levied road use tax that charges users, more or less, in proportion to their amount of road use. To satisfy the theoretical principles of user-pay, it seems that the fuel levy is currently the only tax available to serve as a road user

charge. The question remains, however, as to what extent the fuel levy can be increased, if required or whether the current fuel levy represent an appropriate user-pay charge?

Bloomberg (2016) ranked 61 countries by three economic measures to compare the affordability of fuel, or as the publication put it, 'who feels the most pain at the pump'. The comparison included countries from North and South America, the Middle East, Africa, Europe and Asia-Pacific. South Africa was ranked with selected BRICS and OECD nations in this paper to simplify the figures.

In 2014, the average price of a litre of fuel in South Africa was R13.41. South Africa ranked 16th cheapest of the 61 countries compared, and ranked relatively low among the other BRICS and OECD nations (Figure 1).

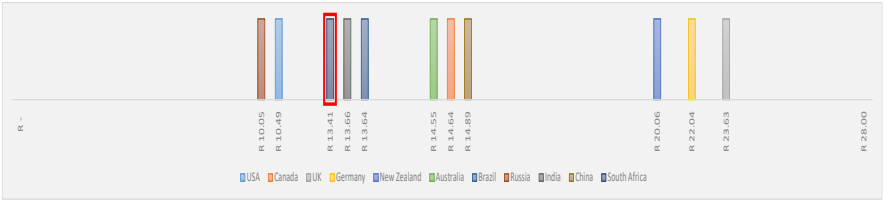

Figure 1: Fuel price (in Rand)

Affordability is measured as a commodity's cost relative to the amount that the purchaser is able to pay. Using data from the 2014 Income and Expenditure survey (STATs-SA, 2011) the average daily income in South Africa was R192.64. It would therefore have taken 6.96% of a day's income to afford a litre of fuel. This placed the country 53rd, out of 61 countries, in terms of affordability with only India being less affordable of the BRICS and OECD nations (see Figure 2).

Figure 2: Affordability

South Africans face a lot of 'pain at the pump', which is further exacerbated by how much fuel the country consumes. In no other country do people spend more of their salary filling up. The average driver in South Africa uses 216.6 litres of fuel per year, which consumes 4.13% of the typical salary. South Africa is ranked 61st out of all the countries, as well as the worst among the BRICS and OECD nations (Figure 3). This may in fact also be an indication of the inefficiency of land use patterns in South Africa with sprawling cities and low income residents located on the outskirts

of towns and cities. Such spatial patterns lead to a mismatch between housing and employment resulting in long commutes, mostly with private vehicles.

Measuring the price of fuel in South Africa in terms of the share of personal income absorbed by fuel for travel illustrates the true cost to road users. Given the regressive nature of fuel levies, any increase in the price of fuel would therefore also impact poorer communities severely.

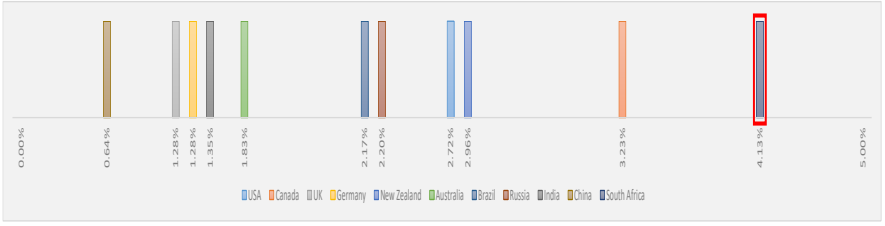

Figure 3: Percentage of annual income spent on fuel

Using income and expenditure data from Statistics South Africa (2011), it is possible to empirically determine the magnitude of transport costs, and the fuel levy in particular, on an individual and household budget. For comparative purposes the expenditure of the average South African was compared against that of the average vehicle user, and to a hypothetical motorist operating an electric vehicle (see Figure 4).

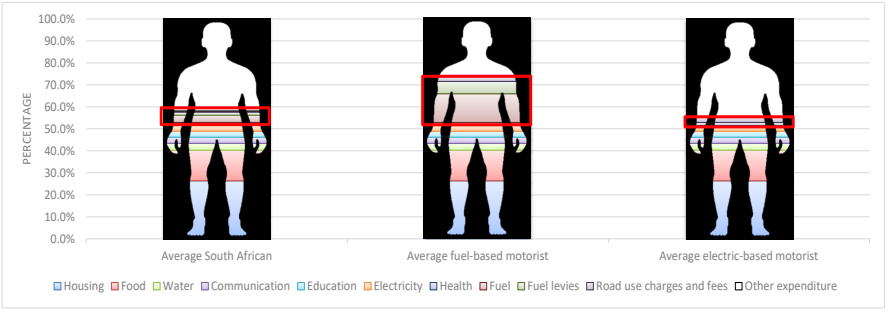

Figure 4: Income and expenditure of average user

The average South African household incurred an average annual household consumption expenditure of R116 381 in 2014 (projected using 2011 Income and Expenditure Survey data using an average inflation rate of 5.4%). Of this amount the three biggest expenditure items was housing (26.3%), transport (17.1%) and food (13.9%). Transport expenditure includes the purchase of vehicles such as motorcars, motorcycles and bicycles; the purchase of transport services which mainly relates to the fares of public transport and lastly the operation of personal transport equipment. The latter comprised of spare parts and accessories, maintenance and repairs of the personal transport equipment as well as expenditure on fuels and lubricants. Expenditure on fuel was 4.6% of the average annual household consumption expenditure. Of this 4.6% the general fuel levy comprised 0.9%, Road Accident Fund levy, demand-side management levy, IP marker levy and petroleum products levy constituted and further 0.5% resulting in 1.4% spent on fuel levies and taxes (thus 4.6 – 1,4 = 3.2% is therefore the expenses on the base cost of transport). Additionally 0.6% was spent on selected road user charges and fees.

Assuming this expenditure and an average fuel price of R12.06 and vehicle fuel efficiency of 12 l / 100 km, the average South African travelled 3 726 kilometres while using 458 litres of fuel in 2014. This discussion relates to the average South Africa as characterised by a specific income and expenditure profile. A private vehicle owner, however, is more likely to travel approximately 15 000 kilometres per year and use 1 800 litres of fuel. Assuming the same income and expenditure levels as the average South African, expenditure on fuel (excluding fuel levies) would increase to 13.1%.

The motorist would also pay 5.6% towards fuel taxes, and 2.4% on road user charges and fees such as speeding fines, parking costs, etc. The fuel levy alone would account for 3.8% of the annual expenditure. Expenditure on fuel and vehicle use related taxes would comprise 21.1%, a rather worrisome and unsustainable tax burden. This illustrates the pecuniary financial position of the 'average' South African with regard to road user charges and taxes. Coupled with long travel distances, the affordability of private vehicles is a significant financial undertaking for the majority of South Africans.

A hypothetical motorist operating an electrical vehicle, travelling on average 15 000 kilometres and assuming the same annual expenditure, would use no fuel and spend 0% on fuel taxes including the fuel levy. He/she would spend 2.4% on road user charges and fees as part of operating the vehicle on the road network.

While this section address the issue of what government collect and what is spent on roads, both in aggregate terms and per vehicle kilometre, it does not address what road users should be paying based on equitable and efficient road pricing principles. The following section discuss the issue of road user charges based on the principle of marginal social costs.

4. The user-pay principle

A widely accepted economic principle is that the users of scarce resources should pay the full cost of their consumption of these resources. Adopting this approach, it is argued, will avoid a misallocation of resources, such as spending too much on certain sectors, and the possible distortion of economic processes. In this scenario, the principle would imply that the users of the road, the scare resource, should pay for their use for every kilometre of road they consume. This principle is commonly referred to by the umbrella term of the 'user-pay principle'. The concept of user pay, however, is neither simple nor is there consensus regarding what the user should pay, or even what users are already paying.

Three issues problematise this principle. Firstly, the so-called 'service of roads' is not delivered to users in the way that other services (e.g. water and electricity) are. Measuring individual use is therefore difficult, for example because roads are not equally accessible everywhere. Secondly, even non-road users benefit from the presence of roads. In fact, few economic or even social activities do not require roads in some form or other. Thirdly, the identification, measurement and inclusion/exclusion of costs, and the allocation of these costs to specific types of users, are not trivial exercises.

The different types of road users, from motorcycle and car users to heavy goods vehicle operators, are seldom aware of either the type or the magnitude of all the costs they impose on society and other users of the facility. Being unaware, or not paying the correct price, has consequences and may lead to a misallocation in the economic sector. The user-pay principle implies that the road user is aware of their road user costs, both private and social, and pays the correct price for road use. Only then will they make the correct decision(s) in terms of their road use and travel behaviour, leading to a more equitable allocation of resources. Of course, if prices are not set correctly in other sectors (for example, if rail tariffs are too high, or the transport infrastructure is not available, or there are no public transport options), setting the correct road user tariff holds very little benefit, and may even have unintended outcomes, such as promoting inequality.

When the prices that are charged to road users are equal to the resource costs, those prices are referred to as efficient prices, as they will result in the economically efficient use of transport resources (Delucchi 2000). In transport, the term marginal social cost (MSC) describes this efficient price (Macario 2010). Marginal refers to the cost of each incremental unit, or each additional unit of traffic. Marginal costs are therefore the costs that can be causally attributed to a specific vehicle at a specific time and a specific place. Marginal user cost differs from average user cost, which refers simply to the total cost of road use for all the users, divided among all of the users. Social refers to the cost to

society as a whole, as opposed to the cost to the individual. Social therefore includes costs such as congestion, road damage, environmental pollution, accidents, and other costs that are traditionally external to the pricing mechanisms.

Marginal social cost is equal to marginal private cost (fuel, travel time, depreciation etc.) plus marginal external cost. Only when marginal social costs equal margin social benefits, will an economic efficient price be achieved leading to an efficient equilibrium.

Note that MSC does not involve the user of the road paying sunk costs for past infrastructure expansion (i.e. the capital cost of the road), but only for the damage caused to the pavement of the road, thus some maintenance and some road admonition and operational costs. Marginal costs look to the future and not to the past. Only future costs that can be causally linked to road use are considered in marginal cost estimation (Kahn 1970).

MSC stands in contrast to the approach where users are paying an amount for road use that bears no relationship to their actual road use. In such a case, the amount can be either above or below the actual resource cost. In the latter case, users are directly or indirectly subsidised to use the resource, while in the former case they are paying more than the resource case. Both of these outcomes are said to be inefficient. In the case where the user cost exceeds the optimal price, i.e. the MSC, users (notably poorer sections of the community) are discouraged from using the infrastructure, thereby reducing the social benefit provided by roads. A road user cost that is below the optimal resource price, on the other hand, will lead to excessive resource consumption, generating higher costs than benefits, and individual users will have less incentive to reduce the costs that they impose on society. An efficient price results in users paying their correct share and adapting their use to an optimal level (where their benefit of use equates to the cost of their use).

While the user-pay principle, as formulated above, seems conceptually sound, MSC holds numerous problems and the concept is often considered more theoretical than practical as it presents some serious shortcomings (Rothengatter 2003). Among these are the fact that its measurement is complex; that it ignores equity; that financing issues (i.e. the need to cover costs) and price distortions elsewhere in the economy are not considered; and that its implementation may involve substantial administrative costs. Probably the biggest concern with MSC pricing is that does it not guarantee that all costs are covered, or that fiscal neutrality is achieved. All of this implies that MSC may not always be justified by the benefits it brings – or, in fact, be a realistic option at all.

While some of the shortcomings can be addressed, it must be emphasised that MSC pricing is not a straightforward, practical solution, and that it remains for the most part a theoretical approach to pricing policy. In fact, there is no country in the world where the approach is fully implemented. Yet this does not mean that the approach should be disregarded. It is generally accepted that MSC pricing should be used as a starting point (i.e. a base price), and that the shortcomings of the system should be accommodated by some optimal departures from the theory (Commission of European Communities 1998). Moreover, the optimality of MSC pricing has to deal with the marginal opportunity cost of public funds.

Implementing the user-pay principle according to theoretical principles is not always an option, as the necessary conditions are not always met. The measurement of road use is difficult, and road use also varies enormously between users, making individual-user pricing challenging. The strict implementation of the user-pay principle may therefore not be feasible in South Africa at this stage.

Marginal social cost also does not explicitly consider capacity expansion (the long-term expansion of a network due to increased traffic). When supply exceeds demand, resulting in congestion on roads, MSC pricing will generate ‘profits’, which can be used to expand the network. Unfortunately, as noted before, short-run MSC (SRMC) fluctuates continuously, which makes implementing the principle difficult.

4.1. What should users be paying

Vehicle use impose four main costs on society, (i) accident costs, (ii) environmental pollution, (iii) road damage and (iv) congestion (Newbery 1994). In the absence of road use taxes, society generally absorbs these costs and not the

individual road user. The magnitude and type of cost absorbed by society depends on individual's classification as a road or non-road user. While the benefits of road use, such as fast and cheap access to employment, social and cultural activities are enjoyed by the individual, these external costs of the road provision and use are not always borne by everyone (Korzhenevych et al. 2014). Road users do not consider these 'external' costs in their travel and transport decisions, such as what route to take, when to travel, how many trips to make or even what mode to use. These costs are external to the individual's decision-making framework. Not considering these costs has an impact on society, such as additional (excessive) road capacity demands which leads to further congestion, noise and air pollution, and increased accident risk. Internalising these external costs in road user charges would therefore be more fair and efficient. MSC represents such a fair and efficient price.

While the concept seems straightforward, the methodology behind the concept, the costs categories to include, the calculation, the costs allocation and ultimately the implementation are far from simple. External costs or marginal social costs, as defined here, also differ between various road types (urban roads, rural, intra-urban and other), vehicle technologies (vehicle engine size and vehicle weight) and traffic conditions (free flow, nearing capacity and fully congested). It also differs between urban, sub-urban and rural areas. There is thus not one road user charge, but multiple road user charges differentiated to reflect the different circumstances.

While it is difficult to determine or calculate a road user charge for South Africa, it is possible to illustrate the concept using international values and approximations. The values so derived should only be seen as an illustration of, firstly, how to determine a road user charge, and secondly, what are the important cost components that make up a road user charge.

4.2. Deriving an MSC-based road user charge

While some costs are available, such the annual maintenance costs (from audited accounts), most road use costs are not, preventing the exact estimation of an accurate road user charge. In other instances, aggregate costs estimates are available, such as the cost of accidents to the South African economy (R147 billion per annum in 2016), but these estimates should be treated with circumspection, as they do not reflect the external costs associated with road users, and because the calculation of the specific cost has not been ratified against the accepted methodology. Finally, an often wrongly understood concept is the inclusion of capital infrastructure costs in road user charges. As discussed above, the existing capital asset base is not considered in the setting of road user charges. Only the cost attributable to the road user, i.e. direct maintenance and some upgrade costs and other external costs, is included in road user charges. Historical investment costs are not included in road user charges, or if they are, they are often negligible. Historical cost may, however, provide an indication of how a private entity will set tariffs, and provide an indication of what revenue is required to maintain the current asset in an agreed state (Newbery 1998).

South Africa has an estimated 750 000 kilometres of roads, with a potential value of R2 trillion in 2014 (National Treasury 2015). This represents the sunk costs (road capital costs). The existing maintenance backlog is projected to be roughly R200 billion. With the historical cost method of pricing, sunk costs are spread over time between successive generations of users using a representative discount rate. Using a discount rate of 8%, the total annual road cost (2014) was R206 093 313 914 (assuming the backlog is first addressed). Accepting the estimated total distance travelled in 2014 as 162 405 499 396 km, this results in a per kilometre cost of R1.27 for the average vehicle. This amount is necessary to maintain the road network in its current state. Allocating revenue to the road sector of less than this amount will lead to a gradual decline in condition of the service and / or the network. It does not represent the amount the user should pay but rather the average amount that the state and the user should contribute to roads.

As shown before, the total direct revenue (R0.62 per vehicle kilometre) collected in 2014 amounted to R99.9 billion. Additionally indirect revenue (revenue not relating to actual road use, but vehicle ownership) to the amount of R66.5 billion was collected in the same year (R0.40 per vehicle kilometre). This amounted to a total of R166 414 285 000, or R1.02 per kilometre. If the historical costs is assumed, users (i.e. all vehicle types on average) are contributing R0.25 per kilometre less than the required R1.27 per km to maintain the road network asset without considering the operational costs. While not all operational costs should be attributable to the road user, assuming a 10% allocation

or R0.05 per kilometre for operational costs, result in a road user cost of R1, 32 per kilometre and a deficit of R0.30 per kilometre.

It is a complex and time-consuming task to derive the MSC of road use, and estimates of MSC are scarce. Probably the best source of reference values was produced by the European Union (European Commission) based on extensive and comprehensive research and consultation between all EU countries (see Doll and van Essen, 2008; van Essen et al., 2011; Korzhenevych et al., 2014 for an overview). It is therefore not possible, within the scope of this paper to determine MSC for South Africa. What is possible is to consider international values of MSC and based on these derive corresponding estimates for South Africa based on local data.

4.3. Marginal infrastructure cost

Road maintenance costs in South Africa amount to roughly R49 billion. This entry in the national accounts, however, also includes new construction and road upgrades. Assuming that 45% of the annual road maintenance cost is spent on maintenance, the marginal infrastructure cost is roughly R0.14 cents per kilometre. Furthermore, the operational cost of R70 billion cannot all be attributable to users and included in MSC. Assuming that 10% of these costs can be attributed to use by an individual user, it will result in a road user cost of R0.04 per vehicle kilometre. Marginal (or additional) infrastructure costs are therefore roughly R0.18 per vehicle kilometre.

4.4. Marginal congestion cost

Congestion costs, made up of travel time, vehicle operation costs and the inconvenience to all the road users who are impacted by the addition of one extra vehicle to the flow, can overshadow all other elements of marginal social costs, i.e. accident costs, noise and air pollution. This is subsequently the reason for the popularity of congestion charges, and their relative acceptance by the community, to curb congestion in urban areas.

The cost of congestion to the South African economy has seen wide ranges of speculative values ranging from R1 billion to R60 billion annually. The vast difference in these estimates may be based on the frequent mistake of the assumption that no congestion (i.e. free flow) is efficient, which in reality is not. No formal congestion studies have, however, been undertaken in South Africa. Data for the EU indicate that the cost of congestion, measured per vehicle kilometre, can vary significantly. Accepting R60 billion as the best guesstimate of congestion costs in South Africa, this would lead to an average cost of R0.37 per vehicle kilometre.

4.5. Marginal accident cost

Recent work for the Road Traffic Management Corporation in South Africa revealed the annual costs of road accidents to be R142.95 billion, equating 3.4 per cent of GDP. This translates into a per kilometre charge of R0.78 per kilometre (when discounted to 2014). This cost, however, cannot be assumed to be the external cost of accidents and is merely the average ‘cost’ per vehicle kilometre. The external costs will require an assessment of the degree of risk internalisation of accidents (i.e. own insurance), as well as the risk associated with each vehicle and driver. Such an exercise was not possible in the context of this paper. Assuming EU values for South Africa and combining this with research undertaken at Stellenbosch University, the per kilometre cost for accidents is likely to be in the range of R0.01 – R0.15 (we assumed a value of R0.09 per kilometre for calculation purposes).

4.6. Marginal environmental (Noise and pollution) cost

Only limited work has been done in South Africa with regard to the environmental costs (pollution and noise) associated with transport, and road transport in South Africa. Several environmental models such as COPERT 4 (Computer programme to calculate emission from road transport) developed by the European Environmental Agency Environmental have been applied to the sector in South Africa. Furthermore, the AA publishes vehicle emissions for all vehicles in South Africa (comparative passenger car fuel economy and CO2emissions data). Using the AA data, external costs were estimated for South Africa using distance travel per vehicle type and CO2 equivalency factors

(CO2e). A cost of R476.79 per tonne CO2e was used to derive a per kilometre cost of R0.13. Unfortunately no noise data was available.

4.7. Total marginal social cost

Summation of the cost components per vehicle kilometre, i.e. infrastructure operations and maintenance (18 cents), congestion (37 cents), accidents (9 cents) and pollution (13 cents) results in a cost of +/- R0.77 per vehicle kilometre. This should be compared to the R1.02 that road users in South Africa are already paying towards road use (both in indirect and direct charges) and the R1.27 - R1.32 to maintain the network. Note that these values have been averaged over different vehicles, times of the day, types of road, etc. It serves merely as an illustration of the concept.

If capacity is not optimally adjusted to demand, for example low demand with excess capacity, setting optimal road user charges will lead to deficits. South Africa has a large road network with a comparatively small vehicle population. Charging a road user fee that excludes the external cost component will clearly not deliver sufficient income. Implementing congestion charges, and other external costs, with road damage charges, however, may address part of this problem.

Using the data supplied for the EU, Table 1 illustrates the dramatic differences in marginal social costs between a car (engine < 1.4l) and heavy goods vehicle (HGV) that travel in and outside of the peak. Congestion cost is the main contributor to peak cost values. Equivalent values for South Africa were derived using an exchange rate of R14.59 to the Euro (Column 2) and using purchasing power parity (PPP) (Column 4).

Table 1: Marginal Social Costs (EU average values) (2014)

European Commission Marginal Social Costs: EU, US and SA	€ct per vkm	SA cent per vkm	US cent per vkm	SA cent (PPP) per vkm
Car: Motorway – Off Peak	0.77	11.20	1.05	5.61
Car: Motorway - Peak	29.17	425.64	39.75	213.4
Car: Urban road – Off Peak	2.29	33.39	3.12	16.74
Car: Urban road – Peak	54.54	795.74	74.30	398.94
HGV: Motorway – Off peak	3.94	57.45	5.36	28.80
HGV: Motorway – Peak	89.61	1307.46	122.09	655.50
HGV: Urban road – Off peak	9.66	140.96	13.16	70.67
HGV: Urban road - Peak	156.14	2278.08	212.72	1142.12

Table 1, column 4, does not indicate what MSC should be in South Africa. It is merely an illustration of the ranges of MSC for road use in the EU and the comparative South African values, based on Purchasing Power Parity (PPP). Note that while these values do not hold any relevance for South Africa, they do show how road user charges are impacted by location, time of day and vehicle characteristics, and specifically the importance of congestion on road user charges.

These results clearly indicate the very different outcomes that can be obtained using the different approaches, as well as the sensitivity of the final road user charge to the available cost data. However, the findings do seem to indicate, simply based on comparison with international data and road user charges, that South Africans are already paying a fair price for road use in rural areas but that urban and peak hour road user charges may not cover road user costs.

Implementing such a road user charge would make road users aware of their congestion costs and it may entice more sustainable driving behaviour, such as choosing public transport in urban areas. It may also shift trips to the off-peak, thereby reducing congestion. The problem in South Africa may be less a question of additional or increasing road user

charges and more an issue of differentiated charges between urban and rural areas, between congested and non-congested roads and the allocation of road funds. In congested urban environments and the main metropolitan highways the situation may be different and current road user charges may not adequately reflect the congestion caused by vehicles. An important caveat for implementing road user charges based on marginal social costs is that the pricing principle should be followed by all modes and services. Implementing the user pay approach based on the principle of MSC also does not guarantee that costs will be covered (or in fact that it should be covered).

The user pay approach, if equated to the internationally accepted term of social marginal costs as a road user charge will cover road user costs, but the principle does not guarantee sufficient income or budget neutrality. In fact, applying the road user pay approach may lead to a decrease in revenue from road users in some areas, notable rural areas and off-peak travel, while it may lead to an increase of revenue in urban areas and on the main highways experiencing congestion. At a minimum, road use tariffs should not be set lower than the variable cost of road used, i.e. the marginal costs. Local taxes and charges can be used to support lightly travelled local access roads and cover all the road use cost of providing these roads. Congestion costs should be included in road use charges in congested cities and high volume roads (Heggie & Vickers 1998).

Finally, South Africa is not unique in its road funding dilemma. Few countries manage to balance revenue form road users with demands for road funding. While there is no clear recipe for success, it seems that countries that do implement the road user pay approach, based on the concept of marginal social costs seem to be more successful in getting the prices right, i.e. fair and efficient road user pricing.

The above discussion should not be seen as an accurate representation of MSC-based road user charges in South Africa. It is merely an attempt to illustrate how MSC can be derived in South Africa, the data requirements that will be required to establish the approach and the possible impact of the approach on existing road user charges. Implementing road user charges based on the MSC-pricing approach is dependent on; an understanding of the concept by all the relevant parties; an appropriate policy framework; data supporting the calculation of the various external cost; accurate costs accounting procedures and accurate vehicle fleet and road use information

MSC as presented in this section will lead to fair and efficient prices or road use charges for road users. While the principle is quite clear, the current road user charging institutional framework in South Africa is not receptive for such an approach. Road use charges and road ownership taxes are collected at various levels of Government and has very little, in fact no relationship with the actual costs imposed by road users on society. Any relationship between efficient road user charges and the current road user taxes and levies are merely spurious.

5. Discussion and recommendation

Transport infrastructure, roads in particular, impacts on economic growth by lowering transaction costs and ultimately improving productivity. In addition to the direct and even some indirect effects such as employment creation, transport infrastructure also supports trade, competitiveness, regional integration and tourism, which are all important developmental objectives that are part of the National Development Plan of South Africa.

South Africa appears to spend a lot of funds on roads, particularly administration and regulation, but also on road maintenance and construction. Despite this, the country is faced with a rapidly deteriorating road network, increasing congestion in the urban areas, and an insubstantial national road funding policy. The country cannot rely on the current national road funding framework to finance or manage its roads. In place of the current approach, a policy is proposed founded on the principles of (1) efficient road user charging to regulate the demand for road capacity based on MSC, (2) efficient investment to minimise the total public and private investment in road capacity, and (3) efficient road management to coordinate road user charging and investment. An effective road funding policy is dependent on close

cooperation between these three elements. Implementing one without the other will not deliver any results and may in fact be counterproductive.

While state-owned enterprises have been in the news for all the wrong reasons, reforming the roads sector in South Africa will probably result in some additional (although functioning independent) parastatals such as a Road Users Authority, Road Fund Administration and Road Fund. The National Treasury and the Department of Transport should transfer to them the responsibility for managing, financing, and maintaining the roads. These entities should establish a system of road user charges based on the marginal social cost principle. Heavy vehicle (> 3500 kg) weight-distance charges and congestion charges are well-known and practical cost recovery mechanisms that can be effectively implemented. Shortfalls should be covered by transfers from the National Revenue Fund and not imposed on existing users.

South Africa seems to have reached a critical point with regard to road funding. It is unclear whether roads are currently allocated sufficient funds. All indications are that the country allocates a comparable amount of funds to the roads sector. What did become glaringly clear during the research is the absolute lack of general knowledge about how much money is spent on roads, the need for funding, how much users are spending, and how the funding cycle works. In South Africa, the responsibility for establishing a road funding policy, setting road user tariffs, managing the road funding budget, collecting data and disseminating reports to the public, and even simply stating the case for roads seems disjointed. No single authority seems to take responsibility for these tasks. The solution to road funding in South Africa is therefore not only a monetary problem but also a knowledge problem. It is firmly recommended that the institutional and policy framework be addressed before any funding issues are considered.

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