Social Value of Time for Investment Appraisal in Mozambique

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Development Discussion Paper: 2019-05

ABSTRACT

This study aims to estimate social value of time for investment appraisal in Mozambique. In doing so, we estimate the social value of time for three categories of project that result in time savings. These include transportation sector (road), water supply and sanitation projects and social value of time for people using public services. The estimated social value of time savings in this study, reflects the average magnitude of the welfare improvement of passengers travelling by type of vehicles, welfare improvement of women and children hauling for water and sanitation project and welfare improvement of visiting public offices for commercial and non-commercial purposes in Mozambique. This welfare improvement comes about either through increased productivity of the individuals or through the increase in utility an individual would enjoy if waiting time is reduced by an hour in the Mozambique for immediate or future projects.

Key words: Mozambique, SVT, Time, Social Value of Time, Time saved, Households’

Jel Classification: D46, D61, I31.
Introduction

Many public sector interventions are designed to save the time of individuals and also in some circumstances lead to a better utilization of the existing capital stock. Common examples of such interventions that lead to time savings are road improvements in the transportation sector, improvements in the accessibility of potable water supply and provision of sanitation services. There are many other examples where public sector investments and policies are designed to reduce waiting time.

An important outcome of such projects is that households may no longer need to spend as much time to accomplish a specific activity and can thus devote these “time savings” to other welfare-enhancing activities. For example, a health clinic may be located closer to a household’s community, and thus members of the household will have to spend less time traveling to receive both routine and emergency health services. An improved water source may be located closer to a household, and thus women and children who collect water will need to spend less time to collect a given quantity of water. In both examples, households experience a reduction in travel times.

The social value of time in terms of the time saved by a public intervention is made up of two components, the value of working time saved and the value in terms of the utility derived from time that now can be spent on other non-working activities. The first component corresponds to the value of time saved by those individuals who will work more in their occupation if the public sector intervention is made. The second reflects the value that individuals place on the diverse market and non-market activities that they will be able to undertake if the time savings intervention were implemented.

The changes in a households’ time allocation caused by a public sector intervention may also be negative (a cost to the household). For example, a hydro dam may displace some households, forcing them to relocate farther away from their work or school. As a consequence, they may spend more time commuting. In this case the change in time allocation would decrease individuals’ well-being and should be counted as a cost of the intervention.

For almost all public sector time saving interventions, some of the time saved will result in a direct increase in the working time in the occupations of the people affected. For example, taxi drivers, truck drivers and travelling sales personnel will be more productive over the normal working days if they can travel at a higher average speed on the road. It may be that people without the intervention may be spending hours queuing up to pay their annual road tax or to carry out banking activities. Public sector broadband initiatives allow for quicker processing of communications during the day or allow for transactions can be made over the internet outside of working hours. The net impact will be that the individual involved will be able to spend more time working. On the opposite extreme, there are those whose supply price of time in a given activity is essentially zero. For example, children on a road trip, infants accompanying their parents or retired people enjoying the opportunity to go for a drive or to socialize with friends while waiting in a queue. In each case, the supply price of time for such

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1 The theoretical framework for evaluation of business time was initially developed by D. Hensher (1977).
activities might be very low or zero. Between these two extremes there will be a distribution of values for the social value of time for individuals facing an array of opportunity costs.

Figure 1: Social value of time saved per average hour associated with an activity.

Let us consider Figure 1 which illustrates how a weighted average of the social value of time per hour that is derived from a time saving intervention. If a project or a policy intervention saves time, then it may allow certain people to work more. The proportion of time saved of this type is shown by the distance ($\alpha$) in Figure 1. For these people their opportunity cost of time will be approximately equal to their wage rates. There will also be a proportion of the time saved by the intervention where the opportunity cost of the time of the people affected is less than the wage rate ($w$) of those whose working hours are directly changed by the intervention. It is also expected that the value of time for this group will be greater than zero. The proportion of this group is denoted as the distance ($\beta$) in Figure 1. Lastly there is likely to be a proportion of time saved, (perhaps a small proportion) where the opportunity of their time is equal to zero. We denote this proportion as the distance ($\mu$) in Figure 1.

This expected valuation of time saved will be specific to the type of activity and the types of people whose time is saved. If the distribution of the social value of time between $w$ and zero is linear, as shown by the line AB, then ($\delta$) will be equal to ($\beta \times 0.5w$), otherwise it will take a value according to the distribution of values assigned to the people affected; a higher expected value will arise if the curve AB is concave to the origin and will have a lower expected value if the curve is convex. The expected or average social value of an hour saved or lost by an intervention is shown as the area 0WABC in Figure 1.

Lastly, it is important to note that, these three components that make up the expected social value of time saved will likely be present in the estimation of the value of time saved for most of the public sector interventions that will have an impact on the use of time.

Based on the above analysis, the social value of a unit of time is reflected in following Eq. (1).

$$SVT = \alpha \times w + \beta (SVT_1 = \delta) + \mu (SVT_2 = 0) \quad (1)$$

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2 This formulation of the value of business time is the simplified Hensher formula (Wardman et al, 2015).
Where, SVT is the social value of a unit of time and $w$ is the average wage rate per unit of
time of those who are directly affected and work either more or less because of the intervention,
while $\alpha$, $\beta$ and $\mu$ are as discussed above.

**Transportation**

The determination of the opportunity cost of time is an important parameter in the evaluation
of transport systems, particularly passenger transport systems. Time saving is a key benefit
when comparing the efficiency of alternative transport modes. Moreover, it is possible to assign
a monetary value of the time savings by linking it to the opportunity cost of the time that
individuals have to face in order to accomplish their transport activities. In this respect, the
value of travel time saved is a major determinant of people’s willingness to pay for new or
improved transportation services. Hence, it is an important parameter when designing pricing
policies for both public and private transport services.

In the case of a road improvement, the value of time savings will be a function of the number
of people who are using the road as part of their normal workday such as bus, truck and taxi
drivers, and travelling sales people, as well as the opportunity cost of others using the road.
This opportunity cost of time saved will be different for traffic which is made up of a truck
whose only occupant is a truck driver, for buses that carry a driver and many passengers, and
for a car with a driver and one or more passengers.

For those people where travel time is a clear component of their work time the opportunity cost
of time will be approximately equal to their wage rates. For some the opportunity cost of time
may be close to this wage rate, but for others, the value of time may be significantly less. In
the absence of carrying out a survey to ascertain the distribution of the valuation of the time
across individuals, we initially assume a linear relationship between the average wage rate of
the people whose work is directly affected, i.e. the drivers with the value of time equal to the
wage rate and people that place zero value on the time spent on a road. As shown in equation
1, for some users of a transport facility the value of time will be close to zero (Richardson,
2003).

To estimate the average social value of time in Mozambique associated for each type of vehicle
whose occupants have a change in the use of time, we begin with the information available on
car, truck and bus ownership. In Table 1, we report the units of motor vehicles that are licensed
to use the roads such as passenger cars, buses and trucks. Out of the total vehicles on the road
(735,954) for 2017, 71% are cars (522,527) and 24% and 5% of this total are buses (176,629)
and trucks (36,798) in Table 1, col. 1, rows 2; 3 and 4 respectively.

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3 [https://clubofmozambique.com/news/mozambique-road-deaths-declining-but-still-above-1300-last-year-ine/](https://clubofmozambique.com/news/mozambique-road-deaths-declining-but-still-above-1300-last-year-ine/). Because we do not have data on the breakdown of the number of vehicles by type for 2017, we estimate the number of vehicles by categories in 2017 by multiplying the total number of registered vehicle with the share of vehicles of different types for which we have information for in 2012.
Table 1: All Vehicles, Drivers and Kilometers Traveled by Category of Vehicles (million kilometers per annum in 2017)

<table>
<thead>
<tr>
<th>Categories</th>
<th>Numbers of Vehicles</th>
<th>Millions of kms traveled by Vehicle class</th>
<th>Millions of km traveled by vehicle occupants by</th>
<th>Millions of km travelled by those directly engaged in driving for work</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cars</td>
<td>522,527</td>
<td>5,418</td>
<td>10,836</td>
<td>2,709</td>
</tr>
<tr>
<td>2. Motor Coaches and Buses.</td>
<td>176,629</td>
<td>4,890</td>
<td>132,030</td>
<td>4,890</td>
</tr>
<tr>
<td>3. Trucks (Light + Heavy)</td>
<td>36,798</td>
<td>942</td>
<td>942</td>
<td>942</td>
</tr>
<tr>
<td>4. Total</td>
<td>735,954</td>
<td>11,250</td>
<td>143,808</td>
<td>8,541</td>
</tr>
</tbody>
</table>

To estimate the total km driven in Mozambique, we begin with the information on the total annual fuel consumption in Mozambique. In 2017 the total automobile fuel consumption of gasoline and diesel amounted to 1,125 million litres. If an average fuel efficiency of the fleet of cars, trucks and buses in Mozambique is 10km per litre then, approximately 11,250 million km were driven by all vehicles combined during 2017 (Table 1, row 4 column 2). Information available from the World Bank indicates that in developing countries a bus is driven on average approximately 2.67 times as many km a year as an average car. Trucks on average are driven 2.47 times as many miles as the average car (World Bank HDM-4). Given our estimate the total km driven in 2017 in Mozambique and the relationships on km driven by vehicle type per year and the actual composition of the fleet of vehicles in vehicles (Table 1, column 4) then the average km driven by each type of vehicle can be estimated. In 2017 the average km driven per car (e.g., X) in Mozambique would be:

\[(522,527) \times (X) + 176,629 \times (2.67X) + 36,798 \times (2.47X) = 11,250,000,000 \text{ km.}\]

Then \(X=10,368\text{km.}\) For buses the average would be \(2.67(10,368) = 27,682\text{ km}\) and for trucks the average is \(2.43(10,368) = 25,608\text{ km.}\)

Using these values, the number of km traveled by each component of the fleet can be estimated by multiplying the number of vehicles in each row in Table 1 by the corresponding estimates of the average km. driven by vehicle type per year in Mozambique. Table 1 column 2 reports the number km traveled by each type of vehicle driven over a year. To estimate the number of passengers associated with the utilization of these vehicles we use the World Bank estimate that on average two people (a driver plus one person) are carried in a car, buses on average carry 27 people (1 driver and 26 passengers) and trucks only have a driver. The next step is to estimate the relative intensity of the different types of passengers that are using the road.

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4 The million-vehicle kilometer traveled per year (Table 1 column 2) was derived based on the numbers of vehicles reported in Table 1 column 1. According to the statistics available, there are many more cars than buses and trucks in Mozambique. The number of km traveled by each component of the fleet was estimated by multiplying the number of vehicles in each row in Table 1 column 1 by the corresponding estimates of the average km. driven by vehicle type per year in Mozambique. For cars \(522,527 \times (10,368) = 5,418\), for buses \(176,629 \times (27,682) = 4,890\), for trucks \(36,798 \times (25,608) = 942\) respectively.
transportation system. This is done by multiplying the average number of passengers associated by the numbers of km travelled by each types of vehicle.

In Table 1, column 3 these estimates are presented for passenger usage of the vehicles in terms of km travelled in a year. The results indicate that a total of 143,808 million passenger (including drivers) kms were travelled on the roads in Mozambique in 2018. This is made up of 10,836 million km, 132,030 million km and 942 million km for people travelling in cars, buses and trucks, respectively.

It is expected that 25 percent of the people travelling in a car are travelling for the purpose of work e.g. taxi drivers, sales persons that would have an opportunity cost at least equal to the average wage rate in the region for drivers of motor vehicles. In total the number of vehicle kilometers travelled (Table 1, column 4) that involve people whose opportunity cost is equal to the average wage rate of bus (4,890 million), truck (942 million) and cars (2,709 million) is equal to 8,541 million km per year (Table 1 col., row 4). By dividing this value by the total number of kilometers travelled by all drivers and passengers in Mozambique per year of 143,808 million km (Table 1, col. 3, row 4), an estimate is made of the proportion of travel time of people who travel on the road and have their opportunity cost of time equal to the average wage rate of drivers. This proportion is equal to 6 percent (α = 0.06) of the total km traveled on roads by all people in Mozambique. Suppose that 10% of the travel time is made by people who value their travel time at zero\(^5\), then the proportion of the people who their opportunity cost of time is less than the wage rate but greater than zero (β) is equal to 0.84.

Assuming a linear distribution for the opportunity cost of travel time from w to 0 for the proportion of the travel time travelled by passengers (β) the average social value of travel time per hour can be estimated by summing up these 3 weighted components as shown in equation 2;

\[
SVT = 0.06w + 0.84(0.5w) + 0.1(0) = 0.48w
\]

where, w is the average wage rate per hour of a motor vehicle driver.

*Figure 2: Proportion of time saved considering all components.*

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\(^5\) Alger et al (1998) found that 11% of the travelers in Sweden had a value of time of zero. Also, Richardson (2003) found that 14% of traveler in Singapore had a value of time of zero. The population of people with a zero value of time is negatively related to their level of income and lower for those who are retired, children under 18 or unemployed.
On the other hand, if proportion of travelers in Mozambique that had a zero value of time (μ) saved is assumed to be 20%, then the total value of time savings will be as follow:

\[ SVT = 0.06w + 0.74(0.5w) = 0.43w \quad (3) \]

Figure 3: Illustrate the proportion of time saved considering 2 components.

Then the average of these two estimates of the value of travel time savings would be 0.455w, where w is the average wage rate per hour of a motor vehicle driver.

This estimation of the social value of time has been done for an “average” traveler without distinction of whether the person is a truck driver, a bus driver or a passenger in cars. As most road improvement projects measure both initial traffic volumes by type of vehicle and make projections of the traffic for each type of vehicle, this average estimate needs to be broken down for each type of vehicle.

We report the parameter values for (α), (β), (μ), average social value of time per hour by vehicle type, and total road traffic for urban travellers (Table 2) and rural travellers (Table 3) in Mozambique, based on the information presented in Table 1 in 2018 prices. Table 2 and Table 3 show the analysis of the SVT for passenger’s in different types of vehicle, such as cars, buses and trucks in the urban and rural regions of Mozambique, respectively.
The proportion (α) representing the share of total travel time associated with people who have an opportunity cost equal to the average urban wage. Its value is 0.25 for automobile travelers, 0.037 for bus users and 1.0 for truck travel (Table 2, column 2). If it is assumed that 10% of the people travelling on buses and cars value their travel time at zero (μ) (Table 2, column 4). Given these parameter values, then the proportion (β) of the people who their opportunity cost of time is less than the wage rate but greater than zero is equal to (0.65), (0.863) and (0) for car and bus passengers and truck drivers respectively (Table 2, column 3).

Travel time savings is often a significant benefit of a transportation project. Road development projects are justified partially by the value of the reduction in travel time they will bring about. These average social values of travel time savings estimates reported in Table 2 and Table 3 for urban and rural region of Mozambique reflect the average magnitude of the welfare improvement through either increased productivity of the individuals or the increase in utility an individual would enjoy if the waiting time in road transport is reduced by an hour in the respective regions.
### Table 2: Parameter Value and Estimation of Average SVT for Urban Traveller Per Driver and Passenger and by Vehicle Type.

<table>
<thead>
<tr>
<th>People travelling by type of vehicle</th>
<th>Proportion of road km. travelled by occupants of vehicle type.</th>
<th>(α) Proportion of business travel time by vehicle type.</th>
<th>(β) Proportion of travelled time for non-business but with positive SVT by vehicle type.</th>
<th>(μ) Proportion of travelled time by those with zero value of time.</th>
<th>SVT = Kw</th>
<th>Average SVT/hr. (MZN) Per Driver &amp; Passenger</th>
<th>Average SVT/hr. ($) Per Driver &amp; Passenger</th>
<th>Average SVT/hr. (MZN) By Vehicle Type</th>
<th>Average SVT/hr. ($) By Vehicle Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cars</td>
<td>0.075</td>
<td>0.25</td>
<td>0.65</td>
<td>0.10</td>
<td>0.575w</td>
<td>69.69</td>
<td>1.16</td>
<td>139.38</td>
<td>2.32</td>
</tr>
<tr>
<td>2. Buses</td>
<td>0.919</td>
<td>0.037</td>
<td>0.863</td>
<td>0.10</td>
<td>0.469w</td>
<td>56.78</td>
<td>0.94</td>
<td>1,533.06</td>
<td>25.38</td>
</tr>
<tr>
<td>3. Trucks</td>
<td>0.006</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td>W</td>
<td>121.20</td>
<td>2.02</td>
<td>121.20</td>
<td>2.02</td>
</tr>
<tr>
<td>4. Total road traffic</td>
<td>1.00</td>
<td>0.06</td>
<td>0.84</td>
<td>0.10</td>
<td>0.48w</td>
<td>58.18</td>
<td>0.96</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average wage rate for vehicle drivers in Mozambique⁶ is estimated to be 21,331MZN per month or 121.20MZN per hour. SVT/hr. = K (121.20)

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⁶ Average wage rate data for Mozambique is sourced from [https://meusalario.org/mocambique/salario/salarycheck#/](https://meusalario.org/mocambique/salario/salarycheck#/)
Using equation 2 the social value of travel time savings per hour can be estimated by multiplying the factor (Table 2, column 5) by the average wage rate (w) for the urban regions of Mozambique for each vehicle type.

The social value of time for the average total road traffic for the country, Table 2 row 4 column 6 is found as the weighted average of the results for each of the traffic types. The weights are the proportions (Table 2 column 1) of the total km traveled by the passengers using each of the three types of vehicle. These weighted coefficients are consistent with the social value of time savings function of equation 2.

The average social value of time for the people travelling by cars in the urban region is estimated to be 69.69MZN per person per hour, for bus travellers 56.78MZN per person per hour and for trucks 121.20MZN per person per hour, respectively. The weighted average of the SVT per person for those travelling in these three types of vehicles in the urban region is 58.18MZN per hour. The average SVTs shown in Table 2 (columns 6 and 7) is a per person averages for all passengers in the vehicles including the driver.

As traffic is forecasted by vehicle type, and not necessary on a per person basis, it would be better if the reported SVTs/hour were based on the SVT associated with the time of the individuals travelling within each type of vehicle. In this vein, the SVT/hour for cars is 69.69*2=139.38 MNZ/hour. For buses it is 56.78*27=1,533 MNZ/hour and for trucks it is 121.20 MNZ per hour\(^7\).

The estimated average SVT per hour for the urban region of 58.18MZN is equivalent to $0.96 per hour. This value is slightly less than the Comprehensive Urban Transport Master Plan Executive Summary report and the Japan International Cooperation Agency (JICA) 2018 forecasted social value of travel time savings of $1.07 per hour for Mozambique\(^8\). However, the JICA estimate of the SVT is substantially larger than the values suggested by the World Bank of $0.50 on average for such low-income countries.

\(^7\) As we described earlier, the number of passengers in each type of vehicles are in line with the assumptions made in the World Bank (2010) HDM-4 estimate, such that for car the number is the driver plus one passenger. For bus users the is the 26 passengers plus the bus driver and for truck is the driver alone.

\(^8\) For more details see [http://open_jicareport.jica.go.jp/pdf/12152609.pdf](http://open_jicareport.jica.go.jp/pdf/12152609.pdf)
Table 3: Estimation of Average SVT for Rural Traveler Per Driver and Passenger and Vehicle Type.

<table>
<thead>
<tr>
<th>People travelling by type of vehicle.</th>
<th>Proportion of road km. travelled by occupants of vehicle type</th>
<th>(α) Proportion of business travel time by vehicle type.</th>
<th>(β) Proportion of travelled time for non-business but with positive SVT by vehicle type.</th>
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</tr>
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<tbody>
<tr>
<td>1. Cars</td>
<td>0.075</td>
<td>0.25</td>
<td>0.65</td>
<td>0.10</td>
<td>0.575w</td>
<td>45.39</td>
<td>0.76</td>
<td>90.78</td>
<td>1.52</td>
</tr>
<tr>
<td>2. Buses</td>
<td>0.919</td>
<td>0.037</td>
<td>0.863</td>
<td>0.10</td>
<td>0.469w</td>
<td>37.02</td>
<td>0.617</td>
<td>999.54</td>
<td>16.65</td>
</tr>
<tr>
<td>3. Trucks</td>
<td>0.006</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td>W</td>
<td>78.94</td>
<td>1.32</td>
<td>78.94</td>
<td>1.32</td>
</tr>
<tr>
<td>4. Rural total road traffic.</td>
<td>1.00</td>
<td>0.06</td>
<td>0.84</td>
<td>0.10</td>
<td>0.48w</td>
<td><strong>37.89</strong></td>
<td><strong>0.63</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average wage rate for vehicle drivers in Mozambique\(^9\) is estimated to be 13,894MZN per month or 78.94MZN per hour. SVT/hr. = K (78.94).

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\(^9\) Average wage rate data for Mozambique is sourced from [https://meusalario.org/mocambique/salario/salarycheck#](https://meusalario.org/mocambique/salario/salarycheck#)
Similarly, for the rural case, an estimate is made of the proportion of travel time made by people who have an opportunity cost of time equal to the average rural wage rate ($\alpha$) for cars, buses and truck drivers the proportions are equal to (0.25), (0.037) and (1.0), respectively (Table 3, column 2). We also assume that 10\% of the travel time consist of people travelling on buses and cars who value their travel time at zero ($\mu$) (Table 3, column 4). Given these variable values the proportion of the people who have an opportunity cost of time that is less than the wage rate but greater than zero ($\beta$) for car, bus and truck drivers is equal to (0.65), (0.863) and (0), respectively (Table 3, column 3).

Using equation 2 the social value of travel time savings per hour were estimated by multiplying the factor (Table 3, column 5) by the average wage rate ($w$) for the rural regions of Mozambique for each vehicle type.

The social value of time for those travelling by cars in the rural region is estimated to be 45.39MZN per hour, for bus travellers 37.02MZN per hour and for trucks 78.94MZN per hour, while those in the urban region is estimated to be 69.69MZN per hour, for bus travellers 56.78MZN per hour and for trucks 121.20MZN per hour, while the weighted average of these three vehicles in the rural region is 37.89MZN per hour and 58.18 per hour for the urban region respectively. Our estimated average SVT per hour for the rural of 37.89MZN is equivalent to $0.63 per hour, while the estimated average SVT per hour for the urban of 58.18MZN is equivalent to $0.96 per hour. Expressing the SVT for time saved in travel by all the occupants of a vehicle combined, we find that in the rural areas it is 90.78 MZN/hour for cars, 999.54 MZN/hour for buses and 78.94 MNZ/hour for trucks. Expressed in US$ these values are $1.52/hour, $16.65/hour, and $1.32/hour, respectively.

**Projecting the Social Value of Time over the Lifetime of a Project.**

In an economic appraisal of an investment project, it is necessary to make a projection of prices in real values over the project’s life. An important set of prices that need to be projected over the life of a project are the real values for the social value of time. It is important to note that, the expected growth rate in real wages will also need to be reflected in the social value of time. When the appraisal of such a project is done over a series of years it is necessary to determine the real value of time in every particular year. The adjustment for the real value of time is carried out based on the real growth in per capita income.

In our analysis, we make forecast in real terms as shown in equation 4.

$$SVT_{At} = SVT_{n} \left(1 + gw \right)^{-n}$$

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10 The data is sourced from the World Bank (2010) HDM-4 vehicle fleet data report. We use their assumptions that that a truck carries no passengers other than the driver, hence the proportion of business travel time by trucks is 1. Table 2 row 3 col 2. For a bus there is one driver out of a total of 27 travelers. As we attribute the full wage rate to just the driver this proportion is $1/27 = 0.037$. Based on the assumption that 25\% of people travelling by automobile have an opportunity cost equal to the average wage in the region (which is approximately that of a driver) this coefficient in the case of cars is 0.25.
where, $SVT_{At}$ is the inflation adjusted future value of travel time per hour $t$, $SVT_{n}$ is the estimated real social value of time per hour for the base period whose price level is used to express the real value for a project, $gw$ is the real growth rate of wages (estimated by the real growth of per capital income) for the country.

To use the estimated social value of time in the appraisal of transport projects, a projection of those values must be made for many future periods, for example, 10 to 30 years. The projection of the social value of time starts at the year the project comes into service. It is reasonable to expect that the growth in real wages ($gw$) in Mozambique will grow at approximately the same rate as the growth in real GDP per capita of the country (Jenkins, Kuo & Harberger, 2014). Forecasts of the social value of travel time savings can be estimated in real prices, by multiplying the social value of time saved in the base year (2018) by the growth rate in real GDP per capita index. Over the years, the real GDP per capita has grown on average, at a rate of 0.08% in Mozambique (World Bank Database).

Table 4 row 2 and 3 show the real SVT per hour for the average of rural and urban road travellers of Mozambique. These projections are made for the periods 2019-2025, using the real growth rate index $(1 + gw)^t$.

### Table 4: Projecting SVT/hr. by vehicle occupant for Urban and Rural Mozambique by Total Road Traffic, using 2018 as base year.

<table>
<thead>
<tr>
<th>Year</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Real Wage Index</td>
<td>1.00</td>
<td>1.01</td>
<td>1.02</td>
<td>1.02</td>
<td>1.03</td>
<td>1.04</td>
<td>1.05</td>
</tr>
<tr>
<td>Urban</td>
<td>Real SVT/hr.</td>
<td>58.18</td>
<td>58.65</td>
<td>59.11</td>
<td>59.59</td>
<td>60.06</td>
<td>60.54</td>
<td>61.03</td>
</tr>
<tr>
<td>Rural</td>
<td>Real SVT/hr.</td>
<td>37.89</td>
<td>38.19</td>
<td>38.50</td>
<td>38.81</td>
<td>39.12</td>
<td>39.43</td>
<td>39.75</td>
</tr>
</tbody>
</table>

**Note:** The projected real SVT/hr. for the rural and urban region is calculated by multiplying the SVT at the base year (2018) by the real wage index (row 1) for the consecutive years.

In Table 5, we make projections of the real (2018 price level) social value of time savings and the current values for urban and rural Mozambique for the passengers using different types of vehicles. As most road improvement projects measure initial traffic volumes by type of vehicle and make projections of the traffic for each type of vehicle. Hence, estimates of SVT are calculated for passengers by type of vehicle.

These average social values of travel time savings estimates reported in Table 5 for urban and rural region by type of vehicle also reflect the average magnitude of welfare improvement an individual would enjoy if the waiting time in road transport is reduced by an hour in the Mozambique for a project that is coming into service in 2018.
Table 5: Projection SVT/hr. for Urban and Rural Mozambique by Vehicle Type, using 2018 as base year.

<table>
<thead>
<tr>
<th>Year</th>
<th>Real Wage Index</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban (Real)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Cars</td>
<td>139.38</td>
<td>140.50</td>
<td>141.62</td>
<td>142.75</td>
<td>143.89</td>
<td>145.05</td>
<td>146.21</td>
<td>147.38</td>
</tr>
<tr>
<td>3</td>
<td>Buses</td>
<td>1,533.06</td>
<td>1,545.32</td>
<td>1,557.69</td>
<td>1,570.15</td>
<td>1,582.71</td>
<td>1,595.37</td>
<td>1,608.13</td>
<td>1,621.00</td>
</tr>
<tr>
<td>4</td>
<td>Trucks</td>
<td>121.20</td>
<td>122.17</td>
<td>123.15</td>
<td>124.13</td>
<td>125.13</td>
<td>126.13</td>
<td>127.14</td>
<td>128.15</td>
</tr>
<tr>
<td>Rural (Real)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Cars</td>
<td>90.78</td>
<td>91.51</td>
<td>92.24</td>
<td>92.98</td>
<td>93.72</td>
<td>94.47</td>
<td>95.23</td>
<td>95.99</td>
</tr>
<tr>
<td>6</td>
<td>Buses</td>
<td>999.54</td>
<td>1,007.54</td>
<td>1,015.60</td>
<td>1,023.72</td>
<td>1,031.91</td>
<td>1,040.17</td>
<td>1,048.49</td>
<td>1,056.88</td>
</tr>
<tr>
<td>7</td>
<td>Trucks</td>
<td>78.94</td>
<td>79.57</td>
<td>80.21</td>
<td>80.85</td>
<td>81.50</td>
<td>82.15</td>
<td>82.81</td>
<td>83.47</td>
</tr>
</tbody>
</table>

Note: The projected real SVT/hr. for the rural and urban region is calculated by multiplying the SVT at the base year (2018) by the real wage index for the consecutive years for types of vehicle.

Estimation of the Social Value of Time for Projects Starting in a Future Period.

In the application of this analysis in the appraisal of future transportation projects, there is a need to rebase the estimated social value of time estimate to the price level of the period that is used to express the real values of the future project. The social value of time savings expressed in a future year’s price level (n) is done by taking the value estimated for 2018 and then multiply this value by the ratio of nominal GDP per capita of that future period (n) by nominal GDP per capita of 2018. This is depicted in equation 5;

\[
SVT_n = SVT_{2018} \left( \frac{No\ min\ al\ _per\ capita\ _GDP_n}{No\ min\ al\ _per\ capita\ _GDP_{2018}} \right)
\]

where, \(SVT_n\) is social value of travel time savings of the future base period, \(SVT_{2018}\) is the social value of travel time estimate provided in the document, \(No\ min\ al\ _per\ capita\ _GDP_n\) of the period (2018) is \(GDP_{2018}\) and \(No\ min\ al\ _per\ capita\ _GDP_{2018}\) is the nominal GDP per capita for the future base period for expressing real price of the future project.

For example, the nominal GDP per capita for 2018 is 29, 091MZN and the assumed nominal GDP per capita for 2028 is 80,000MZN. Hence using the ratio of the \(GDP / capita_{2028} / GDP / capita_{2018}\), the \(SVT_{2028}\) is estimated using the formula below;

\[
SVT_{2028} = SVT_{2018} \left( \frac{No\ min\ al\ _per\ capita\ _GDP_{2028}}{No\ min\ al\ _per\ capita\ _GDP_{2018}} \right)
\]
For example, the social value of time per person for cars at 2028 for both urban and rural regions can be derived as:

**Urban**

\[ SVT_{2028} = 69.69 \times \left( \frac{80,000}{29,091} \right) = 191.65/\text{hr} \]

And the SVT per vehicle is equal to SVT per person * 2 that is 191.65*2= 383.30/hr.

**Rural**

\[ SVT_{2028} = 45.39 \times \left( \frac{80,000}{29,091} \right) = 124.82/\text{hr} \]

And similar to the urban, the SVT per vehicle is equal to SVT per person * 2 that is 124.82*2= 249.65/hr.

Using this same method, we estimate average social value of time savings per hour (MZN) for people travelling by different type of vehicle for urban and rural region. In this hypothetical example the estimated \( SVT_{2028} \) for people travelling by different types of vehicles are reported in Table 6.
Table 6: Estimated SVT for Urban and Rural Region by Vehicle Type.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cars</td>
<td>139.38</td>
<td>383.30</td>
<td>90.78</td>
<td>249.65</td>
</tr>
<tr>
<td>2. Buses</td>
<td>1,533.06</td>
<td>4,215.90</td>
<td>999.54</td>
<td>2,748.73</td>
</tr>
<tr>
<td>3. Trucks</td>
<td>121.20</td>
<td>333.30</td>
<td>78.94</td>
<td>217.09</td>
</tr>
</tbody>
</table>

Evaluating SVT in such a manner would give us the starting real and nominal SVT expressed in MZN per hour in that particular year. Consequently, based on the estimated SVT for 2028, we can make a forecast of the real value of SVT into the future. To make forecast, we need to consider using equation 4 the growth in the real wages estimated as the growth in GDP per capita.

Similarly, for a project that would come into service in year 2028, we can make projections based on the estimated 2028 SVT value for total traffic and vehicle type for urban and rural regions. Table 7 shows the real SVT per hour total road traffic for urban and rural region of Mozambique projected for the periods 2029-2035 using the real growth rate index $(1 + gw)^t$.

Table 7: Projecting SVT/hr. for Urban and Rural Mozambique by Total Road Traffic using 2028 as base year.

<table>
<thead>
<tr>
<th>Year</th>
<th>Real Wage Index</th>
<th>2028</th>
<th>2029</th>
<th>2030</th>
<th>2031</th>
<th>2032</th>
<th>2033</th>
<th>2034</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Urban Real SVT/hr.</td>
<td>160.00</td>
<td>161.28</td>
<td>163.87</td>
<td>167.84</td>
<td>173.27</td>
<td>180.31</td>
<td>189.14</td>
<td>199.99</td>
</tr>
<tr>
<td>2</td>
<td>Rural Real SVT/hr.</td>
<td>104.00</td>
<td>104.83</td>
<td>105.67</td>
<td>106.52</td>
<td>107.37</td>
<td>108.23</td>
<td>109.09</td>
<td>109.97</td>
</tr>
</tbody>
</table>

Note: The projected real SVT/hr. per person for the rural and urban region is calculated by multiplying the SVT at the base year (2018) by the real wage index (row 1) for the consecutive years.

Table 8: Projection SVT/hr. for Urban and Rural Mozambique by Vehicle Type, using 2028 as base year.

<table>
<thead>
<tr>
<th>Year</th>
<th>Real Wage Index</th>
<th>2028</th>
<th>2029</th>
<th>2030</th>
<th>2031</th>
<th>2032</th>
<th>2033</th>
<th>2034</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Urban (Real) Cars</td>
<td>383.30</td>
<td>386.37</td>
<td>389.46</td>
<td>392.57</td>
<td>395.71</td>
<td>398.88</td>
<td>402.07</td>
<td>405.29</td>
</tr>
<tr>
<td></td>
<td>Urban (Real) Buses</td>
<td>4,216.05</td>
<td>4,249.78</td>
<td>4,283.78</td>
<td>4,318.05</td>
<td>4,352.59</td>
<td>4,387.41</td>
<td>4,422.51</td>
<td>4,457.89</td>
</tr>
<tr>
<td></td>
<td>Urban (Real) Trucks</td>
<td>333.30</td>
<td>335.97</td>
<td>338.65</td>
<td>341.36</td>
<td>344.09</td>
<td>346.85</td>
<td>349.62</td>
<td>352.42</td>
</tr>
<tr>
<td>5</td>
<td>Rural (Real) Cars</td>
<td>249.64</td>
<td>251.64</td>
<td>253.65</td>
<td>255.68</td>
<td>257.72</td>
<td>259.79</td>
<td>261.86</td>
<td>263.96</td>
</tr>
<tr>
<td>6</td>
<td>Rural (Real) Buses</td>
<td>2,748.87</td>
<td>2,770.86</td>
<td>2,793.03</td>
<td>2,815.37</td>
<td>2,837.90</td>
<td>2,860.60</td>
<td>2,883.48</td>
<td>2,906.55</td>
</tr>
<tr>
<td>7</td>
<td>Rural (Real) Trucks</td>
<td>217.09</td>
<td>218.83</td>
<td>220.58</td>
<td>222.34</td>
<td>224.12</td>
<td>225.91</td>
<td>227.72</td>
<td>229.54</td>
</tr>
</tbody>
</table>

Note: The projected real SVT/hr. per vehicle for the rural and urban region is calculated by multiplying the numbers of passengers assumed in each vehicle by the real SVT/hr per person.

In Table 8, we make projections of the real social value of time savings for urban (row 2-4) and rural (row 5-7) Mozambique by vehicle type based on the price level of 2018. As most road improvement projects measure initial traffic volumes by type of vehicle and make projections of the traffic for each type of vehicle, estimate is calculated for the time of passengers by type of vehicle.
These real social values of travel time savings estimates reported in Table 8 for urban and rural region by type of vehicle also reflect the average magnitude of the welfare improvement of passengers travelling by type of vehicles. This welfare improvement comes about either through increased productivity of the individuals or through the increase in utility an individual would enjoy if the travel time in road transport is reduced by an hour in the Mozambique for a project that is coming into service in 2028.

**Valuing Time Savings from Improved Water Supply and Sanitation**

Time savings often occurs due to the construction of a well or borehole that is nearer to where the people live. If piped water supply is provided to houses, people will also save time. Closer access to latrines and less waiting time for public latrines will also save the time of individuals. These time savings give either increased production or provision for more leisure time. Both have an economic welfare implication and therefore time savings carries with it an economic value. Women and children in developing countries spend a significant part of their day hauling water to their houses from outside sources. One of the principal benefits of improved water delivery systems is that the time that is spend carrying water is reduced (Churchill, Ferranti, Roche, Tager et al., 1987). The time saved by not having to haul water may now be put to other productive uses, such as child care, wage employment, agricultural labor and/or food preparation.

According to Hutton et al (2007) the economic value of convenience time savings is estimated by estimating a quantity of time saving per individual for water supply and sanitation services and multiply this quantity by the opportunity cost of individuals involved. In a situation where there is an absence of specific household data, a lower bound value has been proposed by the WHO, based on an IMF study (Senhadji, 2000). This study suggests that adults who spend time carrying water value on average their time at roughly 30% and children at 15% of the GDP per capita.

A recent study by Cook et al (2016) for Kenya, using a stated preference approach carried out an extensive survey-based analysis of the water hauling activity of individuals and households in a rural district of Kenya. This was done in order to place an economic value on the time these individuals and households spent hauling water. The study results were derived from a multinomial logit model that segmented the population into four (4) groups\(^\text{11}\). Their analysis followed a similar description of the distribution of the social value of time as was outlined in equation (1) above. In their analysis, the value of (α) was approximately 0.34, where these individuals valued their time at least equal to the real wages of 50 shillings per hour. In the same community of water haulers, there was a group that placed a zero value on the opportunity cost of their time. Hence, the value of (µ) in equation (1) had a value of 0.18. Between these two extremes, there were 48% (β = 0.48) of the people, who placed a positive value on their time that was substantially below the prevailing wage rate. From the survey it was found that

32% had an average SVT of 8.3 shilling per hour and 16% had an average SVT of 7.9 shilling per hour. The estimation of the average SVT is shown in Figure 4.

\[ SVT = 0.34(50) + 0.32(8.3) + 0.16(7.9) + 0.18(0) \]

\[ SVT = 21.003Ksh/hour. \]

The weighted average of these three groups came to 21Ksh per hour ($0.22 per hour). In order to check the veracity of their study result, they compared their results with the traditional estimate of the social value of time savings of 50% of the local wage. In Kenya, the local wage in the area of the study was 35 Ksh per hour, thus 50% of this hourly local wage gives the social value of time savings estimate of 17.5 Ksh per hour.

In this particular case, the stated preference methodology resulted in an estimate that was 20% higher than the traditional estimate of the social value of time savings of 50% of the local wage. Because of the difficulty of finding estimate in local wages in each community, we want to see how these values and compare with a readily available value of the GDP per capita. By taken 50% of the GDP per capita for Kenya that particular year (2013). The estimated social value of time saved in the transport of water would be 19.2 Ksh per hour for Kenya. Interestingly, this value falls almost exactly midway between the previous two estimates (lower value of 17.5Ksh obtained by taken 50% of local wage rate and an upper value of 21.003Ksh derived from stated preference approach).

For ease of measurement we employ this GDP/capita-based method to estimate the social value of time savings for hauling water and improved sanitation in Mozambique. For Mozambique, we propose to estimate the opportunity cost of time saved through water improvement projects as 50% of the GDP per capita per hour for adults and 25% for children in Mozambique. For a lower bound estimate for the social value of time we propose using Hutton (2012) approach of 30% of GDP per capita for adults and 15% GDP per capita for children. This approach can be adopted to provide a minimum social value of time savings estimate for Mozambique.

Table 9 presents an illustrative example of the quantities of time saved due to closer physical access and less waiting time for water sources and sanitation facilities at home or in the community. For water supply, two roundtrips are assumed per household to fulfill their needs for household water supply (min. 20 liters per person per day). Households gaining access to basic improved water supply reduces roundtrip times from 40 to 20 minutes in urban areas and
from 60 to 20 minutes in rural areas. The time saving is a combination of closer access and higher number of water points, leading to less queuing time. For sanitation, in the baseline only one trip per day is assumed for defecation. The quantities of time saved will vary depending on the circumstances without the project and the nature of the project that will ameliorate the situation.

Table 9: Variables and values for convenience time savings

<table>
<thead>
<tr>
<th>Variables</th>
<th>Access time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urban areas</strong></td>
<td><strong>Rural areas</strong></td>
</tr>
<tr>
<td>Water Supply (baseline = distant water source)</td>
<td></td>
</tr>
<tr>
<td>Unimproved source</td>
<td>40 minutes roundtrip</td>
</tr>
<tr>
<td>Improved source</td>
<td>20 minutes roundtrip</td>
</tr>
<tr>
<td>Household piped water</td>
<td>Less than 5 minutes roundtrip</td>
</tr>
<tr>
<td>Sanitation (baseline = open defecation)</td>
<td></td>
</tr>
<tr>
<td>Open defecation</td>
<td>15 minutes travel time roundtrip</td>
</tr>
<tr>
<td>Shared sanitation</td>
<td>5 minutes travel time roundtrip</td>
</tr>
</tbody>
</table>

See reviewed studies of Hutton and Haller (2004).

The values in Table 9 are for illustrative purposes only, as the actual quantities of time saved will vary from project to project. In calculating the opportunity cost of time savings for hauling water and improved sanitation, we use the fractions of 50% and 30% of GDP per capita to derive high and low values for the social value of time saved by water and sanitation projects for adult and 25% and 15% of GDP per capita to derive high and low values for the social value of time saved by water and sanitation projects for children respectively.

Table 10: Value of Travel Time Savings for improved Water Supply and Sanitation

<table>
<thead>
<tr>
<th></th>
<th>Adults</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monetary value of time savings</td>
<td>1.</td>
<td>2.</td>
</tr>
<tr>
<td>1. GDP per capita in 2018 prices</td>
<td>MZN29,091</td>
<td>MZN29,091</td>
</tr>
<tr>
<td>2. GDP per capita (monthly)</td>
<td>MZN2,424.25</td>
<td>MZN2,424.25</td>
</tr>
<tr>
<td>3. Working hours in a month</td>
<td>176 hours</td>
<td>176 hours</td>
</tr>
<tr>
<td>4. GDP/capita per hour</td>
<td>MZN13.77</td>
<td>MZN13.77</td>
</tr>
<tr>
<td>5. Monetary value of time savings per hour (Upper bound)</td>
<td>(0.5)13.77 = MZN6.89 per hour</td>
<td>(0.25)13.77 = MZN3.44 per hour</td>
</tr>
<tr>
<td>6. Monetary value of time savings per hour (Lower bound)</td>
<td>(0.3)13.77 = MZN4.13 per hour</td>
<td>(0.15)13.77 = MZN2.06 per hour</td>
</tr>
</tbody>
</table>

In Table 10, we estimate the opportunity cost of time, that is, the value of time savings due to closer physical access and less waiting time for improved water supply and sanitation (WSS) for the adults and children. Table 10, row 1, reports the annual GDP per capita in 2018 prices for Mozambique. In our analysis, the value of time is taken as the GDP per capita per hour (Table 10, row 4) as it reflects the average productivity of labor in a country. An upper bound on the valuation of the time savings from interventions that reduce the time spent in hauling

---

12 From a survey of >5,000 households conducted in six Southeast Asian studies, a single round trip to place of open defecation was found to require up to 15 minutes in urban areas and from up to 20 minutes in rural areas, varying by country (Hutton, Rodriguez et al. 2014).
water and sanitation activities is taken to be 50% and 25% of GDP per capita per hour for adult and children for transporting water and improved sanitation. For a lower estimate we use Hutton’s recommendation of 30% of per capita GDP for the SVT for adults and 15% of per capita GDP for children.

The results presented in Table 10 rows 5 show that, the estimated upper bound value of the social value of time saved in hauling water and improved sanitation is MZN6.89 per hour for an adult (Table 11, row 5, column 1) and MZN3.44 per hour for children (Table 11, row 5, column 2) in 2018 values. This indicate that the hourly benefit estimated per adult and child in Mozambique, in US dollar equivalent is about $0.11 and $0.06 per hour respectively.

Estimation of the Social Value of Time Spent Hauling Water and Sanitation for Projects Starting in a Future Period.

In the application of this analysis in the appraisal of future transportation projects, there is a need to rebase the estimated social value of time estimate to the price level of the future period that is being used to express the real values of a project started in some future period \((n)\). The social value of time savings expressed in a future year’s price level \((n)\) is done by taking the value estimated for 2018 and then multiply this value by the ratio of nominal GDP per capita of that future period \((n)\) by nominal GDP per capita of 2018. This is depicted in equation 6;

\[
SVT_n = SVT_{2018} \left(\frac{Nominal \ per \ capita \ GDP_n}{Nominal \ per \ capita \ GDP_{2018}}\right)
\]

where, \(SVT_n\) is social value of travel time savings of the future base period, \(SVT_{2018}\) is the social value of travel time estimate provided in the document, \(Nominal \ per \ capita\) of the period \((2018)\) is \(GDP_{2018}\) and \(Nominal \ per \ capita \ GDP_n\) is the nominal GDP per capita for the future base period for expressing real price of the future project.

For example, if the nominal GDP per capita for 2018 is 29,091MZN and the nominal GDP per capita for 2028 is 80,000MZN. Hence using the ratio of the \(GDP / capita_{2028} / GDP / capita_{2018}\), the \(SVT_{2028}\) is estimated using the formula below;

\[
SVT_{2028} = SVT_{2018} \left(\frac{Nominal \ per \ capita \ GDP_{2028}}{Nominal \ per \ capita \ GDP_{2018}}\right)
\]

The social value of time spent hauling water and sanitation project expressed in the price level for 2028 for adults and children in Mozambique are shown as;

**Adults (Upper bound estimate)**

\[
SVT_{2028} = 6.885 \times \left(\frac{80,000}{29,091}\right)
\]

\(SVT_{2028} = 6.885 \times 2.75\)

\(SVT_{2028} = 18.93 / hr.\)
Using this same method, we estimate average social value of time savings per hour (MZN) for people hauling water and sanitation project for Mozambique. In this hypothetical example the estimated SVT for people hauling water and sanitation project, using the upper and lower bound social value of time saved estimates as reported in Table 11.

### Table 11: Estimated SVT for Adults and Children in Mozambique.

<table>
<thead>
<tr>
<th>People hauling for water and sanitation project.</th>
<th>Adults average SVT/hr. in 2018 prices</th>
<th>Adults average SVT/hr. in 2028 prices</th>
<th>Children average SVT/hr. in 2018 prices</th>
<th>Children average SVT/hr. in 2028 prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Upper estimate</td>
<td>6.88</td>
<td>18.93</td>
<td>3.44</td>
<td>9.47</td>
</tr>
<tr>
<td>2. Lower estimate</td>
<td>4.13</td>
<td>11.36</td>
<td>2.06</td>
<td>5.66</td>
</tr>
</tbody>
</table>

As discussed earlier, evaluating SVT in such a manner would give us the starting real SVT expressed in MZN per hour in that particular year. Consequently, based on the estimated SVT for 2028, we can make forecast of real of SVT into the future using equation 7.

\[
SVT_{At} = SVT_n \left(1 + gw\right)^{t-n} \tag{7}
\]

Similarly, for a project that would come into service in year 2028, we can make projections from that year onward based on the estimated 2028 SVT value for hauling water and sanitation project. Table 12 shows the real SVT per hour for hauling water and sanitation project for Mozambique projected for the periods 2029-2035, using the real growth rate index for wages of \((1 + gw)^t\).
Table 12: Projecting SVT/hr. saved for Water and Sanitation for Adults and Children using 2028 as base year. (Upper bound estimates).

<table>
<thead>
<tr>
<th>Year</th>
<th>2028</th>
<th>2029</th>
<th>2030</th>
<th>2031</th>
<th>2032</th>
<th>2033</th>
<th>2034</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Real Wage Index</td>
<td>1.00</td>
<td>1.01</td>
<td>1.02</td>
<td>1.02</td>
<td>1.03</td>
<td>1.04</td>
<td>1.05</td>
</tr>
<tr>
<td>3</td>
<td>Real SVT/hr. Urban</td>
<td>18.93</td>
<td>19.08</td>
<td>19.23</td>
<td>19.39</td>
<td>19.54</td>
<td>19.70</td>
<td>19.86</td>
</tr>
</tbody>
</table>

Note: The projected real SVT/hr. for the rural and urban region is calculated by multiplying the SVT at the base year (2018) by the real wage index (row 1) for the consecutive years.

These real social values of time saved hauling water and sanitation project estimates reported in Table 12 reflect the average magnitude of the welfare improvement of women and children hauling for water and sanitation project in Mozambique. This welfare improvement comes about either through increased productivity of the individuals or through the increase in utility an individual would enjoy if waiting time for hauling water is reduced and improved sanitation by an hour in the Mozambique for a project that is coming into service in 2028.

The Social Value of Time Spent Obtaining Public Services

The time required to obtain services from governments is often unnecessarily time consuming. A number of interventions are taking place to reduce the time that the citizens need to obtain services from the government. For example, making applications for passports, paying taxes or renewing permits online greatly reduces the time that is required to obtain these services. In a similar manner, being able to make an appointment at a clinic or hospital by mobile telephone rather than simply coming and waiting in line, can save a great deal of time for the consumer of these services.

For this analysis, we categorized the people that uses public services frequently into two groups; that visit for personal services such as visiting health clinics for treatments and those that visit public offices for commercial purposes such as to obtain licenses, passports and pay bills. In this section estimates are derived for the social value of time from reducing the waiting time for people visiting public offices or obtaining services from government run organizations. In Mozambique, there appears to be little information on the incomes or willingness to pay for time savings from these types of activities.

SVT for People obtaining Non-Commercial Services from Public Sector.

A large group of people that visit public institutions are patients that are in need of medical services. This group of people are usually biased towards elderly men and women, children and those who cannot afford private hospital and private health-care services. To access such facilities, it usually requires long time waits before receiving the service. People of this status will be broadly similar to the economic status of those that suffer from inadequate water supplies and also unimproved sanitation services. Thus, it seems appropriate that this group of
people would have an estimated SVT that on average is close to those who spend time hauling water.

Thus, for public service interventions that will save time for those people that visit government hospitals or other such service providers, it is recommended that the value of time should be taken as fractions of the per capita hourly GDP (Table 13, row 1) as it reflects the average productivity of labor in a country. Table 13 reports the suggested upper and lower estimate of the SVT saved by interventions that reduce waiting time by one hour for those using public services of a non-commercial nature in Mozambique.
Table 13: Value of Time Savings (Non-Commercial) Public Services) 2018 prices\textsuperscript{13}.

<table>
<thead>
<tr>
<th></th>
<th>GDP/capita per hour</th>
<th>MZN13.77</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Monetary value of time savings per hour (Upper bound)</td>
<td>((0.5) \times 13.77 = \text{MZN6.89 per hour})</td>
</tr>
<tr>
<td>2</td>
<td>Monetary value of time savings per hour (Lower bound)</td>
<td>((0.3) \times 13.77 = \text{MZN4.13 per hour})</td>
</tr>
</tbody>
</table>

Table 13, row 1, reports hourly GDP per capita in 2018 for Mozambique. An upper bound on the valuation of the time savings from interventions that reduce waiting time by one hour using public offices for non-commercial purposes is taken to be 50% of GDP per capita. For the lower bound estimate, we use Hutton’s recommendation of 30% of per capita GDP for the SVT.

The results presented in Table 13 rows 2 show that, the estimated upper bound value of the social value of time saved by reducing waiting time by one hour is MZN6.89 per hour and the lower bound estimate is MZN4.13 per hour. This indicates that the hourly benefit from time for non-commercial services in Mozambique would be equivalent to between $0.11 and $0.06 per hour.

**SVT for People obtaining Commercial Services from Public Sector.**

In order to have a comprehensive social value time savings estimate for public sector in Mozambique, we incorporate people that visit public offices for commercial purposes. For example, for people that visit public offices for business transactions of various types, such as tax payment or acquire/renew their driving licenses. We are of the opinion that the social value of time savings for public services intervention that reduce waiting time in queue should be valued at 100% of real GDP/capita per hour as it reflects the average productivity of labor in a country. It is assumed that users of these public services usually visit or make use of public services during active working time and tend to be better off. Table 14 report the social value of time saved for an individual visiting public office for commercial purposes.

\textsuperscript{13} For consistency sake and due to unavailability of 2019 GDP per capita, the social value of time for all categories was valued at 2018 GDP per capita.
Table 14: Value of Time Savings for (Commercial) Public Services 2018 prices

<table>
<thead>
<tr>
<th></th>
<th>GDP/capita per hour</th>
<th>MZN13.77</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Monetary value of reducing waiting time in public services.</td>
<td>(1) = MZN13.77 per hour</td>
</tr>
</tbody>
</table>

Table 14, row 1 reports hourly GDP per capita in 2018 for Mozambique. The valuation of the time savings from interventions that reduce waiting time by one hour using public offices for commercial purposes is taken to be 100% GDP/capita hour \( SVT_n = 1GDP/capita_{hr} \). Table 14 present the hourly benefit estimated for reducing waiting time on average for public sector commercial users as MZN13.77 per person. This indicates that the hourly benefit from time saved in obtaining commercial services from the public sector in Mozambique would be equivalent to USD$0.23 per hour.

Projecting the Social Value of Time over the Lifetime of a Project.

In a financial and/or economic appraisal of an investment project, it is necessary to make a projection of prices in both nominal and real values over the project’s life. These prices are influenced by movements in the real prices and the impact of inflation. This is because, the factors that affect real prices are different from the impacts of general inflation. An important set of prices that need to be projected over the life of a project are the real values for the social value of time and the inflation adjusted values for the social value of time. It is equally important to note that, the assumed growth rate in the price level index is only considered in appraisal of a project, when the appraisal of such a project is done in different years to determine the value of time in every particular year. However, the nominal values should not be included to adjust the SVT for every year of a particular project, if GDP forecast in real terms is available.

In our analysis, we make forecast in real terms as shown in equation 8.

\[
SVT_{At} = SVT_n \left(1 + gw\right)^{-n} \quad \text{.................................................................} \quad (8)
\]

where, \( SVT_{At} \) is the inflation adjusted future value of travel time per hour t, \( SVT_n \) is the estimated real social value of time per hour for the base period whose price level is used to express the real value for a project, \( gw \) is the real growth rate of wages of the country.

To use the estimated social value of time in the appraisal of public services projects, a projection of those values must be made for many future periods, for example, 10 to 30 years. The projection of the social value of time starts at the year the project comes into service. It is reasonable to expect that the growth in real wages (gw) in Mozambique will grow at approximately the same rate as growth in real GDP per capita (Jenkins, Kuo & Harberger, 2014). Forecasts of the social value of
time saved by reducing waiting time using public offices for services discussed above can be estimated in real prices, by multiplying the social value of time saved by reducing waiting time by one hour in the base year (2018) by the growth rate in real GDP per capita index$^{14}$.

**Estimation of the Social Value of Time Saved by Reducing Waiting Time for Public Service Projects Starting in a Future Period.**

In the application of this analysis to the appraisal of future time saving projects for the provision of government services, there is a need to rebase the estimated social value of time estimate to the price level of the period that is being used to express the real values of the future project. In most cases this is the price level of the initial year of the project life. The social value of time savings expressed in a future year’s price level \((n)\) is done by taking the SVT estimated for a specific type of individual for 2018 and then multiply this value by the ratio of nominal GDP per capita of that future period \((n)\) by nominal GDP per capita of 2018. This is depicted in equation 9;

\[
SVT_n = SVT_{2018} \left( \frac{\text{Nominal per capita GDP}_n}{\text{Nominal per capita GDP}_{2018}} \right) 
\]

where, \(SVT_n\) is social value of time saved by reducing waiting time by one hour of the future base period, \(SVT_{2018}\) is the social value of time saved by reducing waiting time by one hour provided in the document, \(\text{Nominal per capita of the period (2018)}\) is \(GDP_{2018}\) and \(\text{Nominal per capita GDP}_n\) is the nominal GDP per capita for the future base period for expressing real price of the future project.

For example, the nominal GDP per capita for 2018 is 29,091MZN and the assumed nominal GDP per capita for 2028 is 80,000MZN. Hence using the ratio of the \(GDP / \text{capita}_{2028} / GDP / \text{capita}_{2018}\), the \(SVT_{2028}\) is estimated using the formula below;

\[
SVT_{2028} = SVT_{2018} \left( \frac{\text{Nominal per capita GDP}_{2028}}{\text{Nominal per capita GDP}_{2018}} \right) 
\]

---

$^{14}$ Over the past 5 years, the real GDP per capita has grown on average, at a rate of 0.08% in Mozambique (World Bank Database).
The social value of time saved by reducing waiting time by one hour for public service projects expressed in the price level for 2028 for adults and children in Mozambique are shown as;

**SVT Non-Commercial (Upper bound estimate)**

\[ SVT_{2028} = 6.885 \times \left( \frac{80,000}{29,091} \right) \]
\[ SVT_{2028} = 6.885 \times 2.75 \]
\[ SVT_{2028} = 18.93 \text{ / hr.} \]

**SVT Non-Commercial (Lower bound estimate)**

\[ SVT_{2028} = 4.13 \times \left( \frac{80,000}{29,091} \right) \]
\[ SVT_{2028} = 4.13 \times 2.75 \]
\[ SVT_{2028} = 11.36 \text{ / hr.} \]

**SVT Commercial**

\[ SVT_{2028} = 13.77 \times \left( \frac{80,000}{29,091} \right) \]
\[ SVT_{2028} = 13.77 \times 2.75 \]
\[ SVT_{2028} = 37.87 \text{ / hr.} \]

Using this same method, we estimate average social value of time saved by reducing waiting time by one hour for public service projects in Mozambique. In this example, the estimates of the \( SVT_{2028} \) for people using public service for non-commercial and commercial purposes are reported in Table 15.
Table 15: Estimating the SVT saved by Public Service Project in Mozambique.

<table>
<thead>
<tr>
<th>People visiting hospital for health-care. (Non-commercial)</th>
<th>Average SVT/hr. in 2018 prices</th>
<th>Average SVT/hr. in 2028 prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Upper estimate</td>
<td>6.89</td>
<td>18.93</td>
</tr>
<tr>
<td>2. Lower estimate</td>
<td>4.13</td>
<td>11.36</td>
</tr>
<tr>
<td>3. People visiting public office for commercial purposes.</td>
<td>13.77</td>
<td>37.87</td>
</tr>
</tbody>
</table>

Evaluating SVT in such a manner would give us the starting real SVT expressed in MZN per hour in that particular year. Consequently, based on the estimated SVT for 2028, we can make forecast of real value of SVT into the future. To make forecast, we need to consider the growth in the real GDP per capita using equation 10.

$$SVT_{At} = SVT_{n} (1 + gw)^{-n}$$ ................................................................. (10)

For a project that would come into service in year 2028, we can make projections based on the estimated 2028 SVT value reducing waiting time using public service projects. Table 16 shows the real social value of time saved reducing waiting time by one hour in Mozambique projected for the periods 2029-2035, using the real growth rate index $$(1 + gw)^{t}$$. 


Table 16: Projecting SVT/hr. for individuals using non-commercial and commercial Public Services using 2028 as base year.

<table>
<thead>
<tr>
<th>Year</th>
<th>2028</th>
<th>2029</th>
<th>2030</th>
<th>2031</th>
<th>2032</th>
<th>2033</th>
<th>2034</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Real GDP/capita Index</td>
<td>1.00</td>
<td>1.01</td>
<td>1.02</td>
<td>1.02</td>
<td>1.03</td>
<td>1.04</td>
<td>1.05</td>
</tr>
</tbody>
</table>

Upper

| 2    | Real SVT/hr. | 18.93 | 19.08 | 19.23 | 19.39 | 19.54 | 19.70 | 19.86 | 20.02 |

Lower


Commercial Users

| 4    | Real SVT/hr. | 37.87 | 38.17 | 38.48 | 38.79 | 39.10 | 39.41 | 39.72 | 40.04 |

Note: The real SVT/hr. overtime is estimated by multiplying the SVT at the base year (2028) by the real GDP/capita index for the consecutive years.

For a project that would come into service in year 2028, we can make projections based on the estimated 2028 SVT saved by reducing waiting time using public sector for non-commercial (Table 16, row 3 upper bound estimates and Table 16, row 3 lower bound estimates) and commercial purposes (Table 16, row 4). Table 16 shows the real SVT by reducing waiting time using public sector for non-commercial and commercial purposes in of Mozambique projected for the periods 2029-2035, using the real growth rate index \((1 + gw)^t\). The real social values of time saved by reducing waiting time by one-hour estimates reported in Table 16 reflect the average magnitude of the welfare improvement of visiting public offices for commercial and non-commercial purposes in Mozambique. This welfare improvement comes about either through increased productivity of the individuals or through the increase in utility an individual would enjoy if waiting time for receiving health-care or getting a driving license among others is reduced by an hour in the Mozambique for a project that is coming into service in 2028.

Summary

In section 1 to section 3 of this manual, we estimate the social value of time for three (3) categories of project that result in time savings. These include transportation sector (road), water supply and sanitation projects and social value of time for people using public services. The social value of time as summarized in Table 17 covers people living within the urban and rural regions of Mozambique.
Table 17: Summary of Estimated SVT for Mozambique.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cars</td>
<td>139.38</td>
<td>90.78</td>
</tr>
<tr>
<td>A</td>
<td>Buses</td>
<td>1,533.06</td>
<td>999.54</td>
</tr>
<tr>
<td>A</td>
<td>Trucks</td>
<td>121.2</td>
<td>78.94</td>
</tr>
<tr>
<td>B</td>
<td>People hauling for water and sanitation project.</td>
<td>Adults average SVT/MZN/hr. in 2018 prices</td>
<td>Children average SVT/MZN/hr. in 2018 prices</td>
</tr>
<tr>
<td>B</td>
<td>Upper estimate</td>
<td>6.89</td>
<td>3.45</td>
</tr>
<tr>
<td>B</td>
<td>Lower estimate</td>
<td>4.13</td>
<td>2.06</td>
</tr>
<tr>
<td>C</td>
<td>People visiting Public Sector.</td>
<td>Average SVT/MZN/hr. (2018)</td>
<td></td>
</tr>
<tr>
<td>(i)</td>
<td>For non-commercial purpose.</td>
<td>Average SVT/MZN/hr. (2018)</td>
<td></td>
</tr>
<tr>
<td>(i)</td>
<td>Upper estimate</td>
<td>6.89</td>
<td></td>
</tr>
<tr>
<td>(i)</td>
<td>Lower estimate</td>
<td>4.13</td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td>For commercial purposes.</td>
<td>13.77</td>
<td></td>
</tr>
</tbody>
</table>

Table 17, Part A reports the estimated social values of time saved per hour for people travelling by type of vehicle in Mozambique. We report the average social value of time per hour by vehicle type, and total road traffic for urban travellers and rural travellers in Mozambique (Table 17 column 1 and 2).

In Table 17, Part B we report estimated social values of time saved per hour for interventions that provide better physical access and less waiting time for water services and sanitation facilities at home or in the community. Women and children in developing countries spend a significant part of their day hauling water from outside sources to their homes. One of the principal benefits of improved water delivery systems is that the time that is spent carrying water is reduced. The results presented in Table 17, Part B show the upper and lower bound estimates of the social value of time saved per hour in hauling water and improved sanitation for an adult and child. This indicates the hourly benefit estimated per adult and child in Mozambique.

In Table 17, Part C, we report estimated social value of time saved for people that visit public institutions into two; (i) people that visit public service for non-commercial purposes, such as patients that are in need of medical services, and (ii), people that visit for commercial purposes such as a range of people that visit public offices for business transactions such as to pay taxes of various types or to acquire or renew their driving licenses.

Lastly, Table 17, Part C (i) for non-commercial public service users, we are of the opinion that this group of people are more heavily weighted towards elderly men and women, children and those
who cannot afford private hospital and private health-care services. An upper bound on the valuation of the time savings from interventions that reduce waiting time by one hour using public offices for non-commercial purposes is taken to be 50% of GDP per capita. For the lower bound estimate, we use Hutton’s recommendation of 30% of per capita GDP for the SVT.

In Table 17, Part C (ii), we report the social value of time saved for people that visit public office for commercial purpose. We estimate SVT for these group of people based on the assumption that the social value of time savings for public services intervention that reduce waiting time in queue should be valued at 100% of real GDP/capita per hour as it reflects the average productivity of labor in a country. Since, users of these public services usually visit or make use of public services during active working time.

These estimated and projected social value of time savings reflects the average magnitude of the welfare improvement of passengers travelling by type of vehicles, welfare improvement of women and children hauling for water and sanitation project and welfare improvement of visiting public offices for commercial and non-commercial purposes in Mozambique. This welfare improvement comes about either through increased productivity of the individuals or through the increase in utility an individual would enjoy if waiting time is reduced by an hour in the Mozambique for immediate or future projects.
References


Teye, C., Porter, H. & Bell, H. MGH from the Institute of Transport and Logistics (ITLS) University of Sydney Business School Australia and Peter Davidson from the Peter Davidson Consultancy Limited, Suites 2, 3, 4. Audley House, Northbridge Road, Berkhamsted, Hertfordshire, HP4 1EH, United Kingdom.


World Health Organization 2012 report on Global costs and benefits of drinking-water supply and sanitation interventions to reach the MDG target and universal coverage