TRANSPORT BY THE ELDERLY: COMPARING USE OF PRIVATE AND PUBLIC TRANSPORT TO ACCESS OUT-PATIENT SERVICES AT MATER DEI HOSPITAL (MALTA)

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Abstract. The main purpose of this study is to analyse modal choice amongst the elderly people in Luqa (Malta) travelling as outpatients to Malta's general hospital, Mater Dei, and to compare the generalised cost between private and public transport. Modal choice was primarily analysed through questionnaires addressed to a sample of the elderly living in Luqa. As the study dealt with elderly people the value of non-working time was used. The study shows that elderly prefer to use private transport and the main factors affecting their modal choice are car availability, health status, age and some constraints that they encounter when using public transport. The study concludes that with a projected increase in the elderly population in Malta the need for further improvements in the public transport is becoming more pressing.

Introduction

Population ageing is a global demographic trend which is forecasted to increase. Although there is no general agreement on when a person becomes old, the United Nations refers to elderly people as those who are 60 years or more (WHO, 2013). From the year 2000 to 2050, the proportion of the world's population over 60 years will double from 11 to 22 per cent. Consequently, for the first time in history, by 2050, seniors over the age of

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60 will outnumber children under the age of 15 (WHO, 2012). The population structure of the Maltese Islands is also changing rapidly as a result of the ageing population, and is bound to further accelerate in the future in an irreversible process. There was an increase of 2.6 per cent in people above 65 years of age between just 2005 and 2011 (NSO, 2012). From 2010 to 2060, the 65+ will increase from 16.2 per cent (98,786) to 24.8 per cent (111,700) of Malta's total population (European Commission, 2011).

The main aim of this paper is to analyse the main factors that affect the choice between private and public transport by elderly people travelling as outpatients from Luqa to Mater Dei Hospital (and vice-versa) using data from a survey among the elderly population in Luqa and also the generalised cost of travelling by car or public transport.

The paper provides a detailed overview of the main factors that lead the elderly to prefer one mode of transport over the other and determines a value for the generalised cost of non-working time for the elderly travelling between the origin and destination. This gives a better understanding of the choice made by elderly people living in Luqa as to why they opt for one mode of transport and not the other. In arriving at the generalised cost, the modal penalty which incorporates factors which affect modal choice such as reliability, convenience, comfort and accessibility, is taken into account. The estimates were determined through different data collection methods mainly questionnaires, travel time surveys and mathematical formulation.

The relevance of this paper lies in the fact that the determinants for elderly modal behaviour are quite complex and therefore require thorough analysis. Moreover, the generalised cost reflects the opportunity cost of travel time. This is a fundamental issue in an ageing society as elderly need to be aware of the resource cost of travelling. As generalised costs are based on the notion of time, such study helps policy makers to understand how elderly travel behaviour may be affected by travel costs. Also, this paper supports conclusions in other studies such as that of Kennedy (2002) which contains comparisons between private and public transport. Yet, it is an important contribution to the existing scientific literature as although the elderly population is on a continuous increase, studies focusing on comparisons between the two modes of transport in relation to the demographic group under study are particularly lacking, especially in Malta.

The paper is structured as follows. The next section presents brief information about the location of Luqa and Mater Dei Hospital and about the ratio of elderly persons residing at Luqa. This is followed by a literature review on the elderly mobility trends, a discussion on factors that affect modal choice amongst the elderly and the estimation of generalised costs.

The paper also focuses on the relevance of travel time and time use for older people. The study then determines the probability of using one mode of transport as against the other, comparing travel time cost differences for the two modes of transport, valuing the non-working time and based on the generalised cost for private and public transport between Luqa and Mater Dei Hospital. Finally, conclusions and comparisons between the two modes of transport are made.

Location of and the Ratio of Elderly Persons in Luqa

Luqa is a town in the southeast of Malta, 6.4 kilometres away from the capital city, Valletta (Guillaumier, 2002). Mater Dei Hospital, which is the only state general hospital in Malta, is located in Msida (both localities are shown in Figure 1).

Figure 1
The Location of Luqa and Mater Dei Hospital (Msida)

According to the 2005 census, Luqa was amongst the first five localities with the highest elderly population. Indeed, the elderly people (60+) amounted to 1,922, which represented 31.6 per cent of the entire locality population (NSO, 2007). Yet, such a figure includes elderly persons living in the state residential home of St. Vincent de Paule (which hosts around 1,000 residents). Projections also show that Luqa is one of the localities that will have a high increase in the elderly population in the future (MEPA, 2006).

Literature Review

Trends in elderly mobility

Carr (2003) shows that though individuals travel less when they become older and retire, they tend to substitute their work trips with other trips mainly of a social, recreational and medical in nature. Metz (2003) claims that the car is the ideal vehicle for older people to sustain their quality of life by providing door-to-door transport at moderate operating cost. It is estimated that within the next two decades almost 100 per cent of the older men and around 60 to 90 per cent of older women in the developed countries will be using a car at some stage (Rosenbloom, 2001; Rosenbloom and Stahl, 2002). Liddle *et al.*, (2004) comment that today's generation of older people is so attached to the private car as the main mode of transport that they do not plan well for when they have to cease driving due to health limitations. This means that often they do not consider alternative options to the car, and when they stop driving a substantial reduction in mobility occurs, leaving them often transport disadvantaged.

In the Maltese Islands, the situation is very similar. It is relevant to note that in 2010, the number of driving license holders aged 60+ amounted to 42,359 representing 19 per cent of the total driving license holders (NSO, 2011b). Also, in 2010 the number of non-public transport users aged 60 and over exceeded the number of regular bus users (TM, 2010).

Factors that affect modal choice amongst the elderly

Travel behaviour is affected by various factors and several studies have attempted to identify the main determinants for older people mobility.

Beimborn *et al.,* (2003) outline that the most important factor that determines whether users choose between the car and the bus, is not the difference in travel time but the accessibility available to the public transport system.

In contrast, Ibrahim and McGoldrick (2003) state that the most important attributes for older shoppers when choosing between public and private transport are the 'absence of waiting time' and 'shortness of walking distance'. The frequency of the bus service and for how long the users are willing to wait, are also indispensable considerations to attract people to use public transport (Polzin *et al*., 2002).

Cheng (2008) asserts that travel time is one of the most important factors determining whether or not people will use public transport. Moreover, Krizek (2003) as well as Kim and Ulfarsson (2004), point out that household and land use variables are important determinants for older peoples' modal choices. Schmöcker *et al.,* (2008) discuss that the higher the bus stop density the more older people tend to use public transport rather than the private car.

On the other hand, Chen *et al.,* (2004) argue that vehicle ownership is the key factor affecting modal choice. They consider car availability and public transport fare as the main factors that make people choose between private and public transport services.

Correspondingly, Wilds and Talley (1984) conclude that in the United States, older passengers' perception of the reliability and accessibility of public transport are primary factors that affect their mode of transport. In fact, elderly people encounter several barriers when using public transport. Most commonly these are related to lack of accessibility (e.g. absence of low floor buses, dangerous busy roads and high curbs), fear of falling, safety issues, bus design, unreliability of services, bus driver behaviour, and orientation towards commuting hours (Wixey *et al*., 2005; Marsden *et al*.,, 2007). Hence, together with the physical and functional limitations of elderly, all these difficulties further increases elderly people's preference for private transport. Yet, such studies also show that if public transport is absolutely accessible and reliable it will attract many more users (Schmöcker *et al.,* 2005).

Elderly and accessibility to health care services

Equal access to healthcare services, especially for disadvantaged groups, is one of the main requirements for social inclusion and social justice (Department of Health, 2002). Penchansky and Thomas (1981) explain that two important dimensions of access to health services are availability and accessibility. Such concepts represent the geographic dimensions of access and mainly refer to the supply and travel time to reach the health service respectively.

It is an undisputed fact that health care is of paramount importance to the elderly. The aged have always been disproportionately the largest users of medical services (Rice and Feldman, 1983; Kovar, 1986; Fuchs, 1999). Zhang *et al.,* (2007) show that 5.4 per cent of the elderly over 60 years travels to obtain health care compared to only 1.2 per cent of those between 19 and 60 years who do so. Moreover, Mifsud (2013) shows that medical care is the second most popular travel purpose after shopping for elderly in Luqa, Malta.

Thus, as the old-age population is on a continuous increase, better accessibility to health services will be further required in the future. Statistics show that, the 'oldest old' has the highest projected global increase. Hence, demand for health care services is even higher because as Roos *et al.,* (1984) indicate, the older old require about ten times as many hospital days as any of the age groups under 65.

Travel time and time use for elderly

Travel time is one major external transport cost and subsequently one of the most important modal choice determinants. Kwan and Weber (2003) as well as Tribby and Zandbergen (2012) argue that determining changes in travel times is one measure of assessing transport's accessibility equity. Moreover, in a region attempting to foster a modal shift to public transport, evidence suggests that faster public transport travel times are essential (Newman and Kenworthy 1999). A decrease in travel time by public transport, helps to increase accessibility in areas that have most social needs, which hence alleviate social exclusion due to poor transport options (Preston and Rajé, 2007).

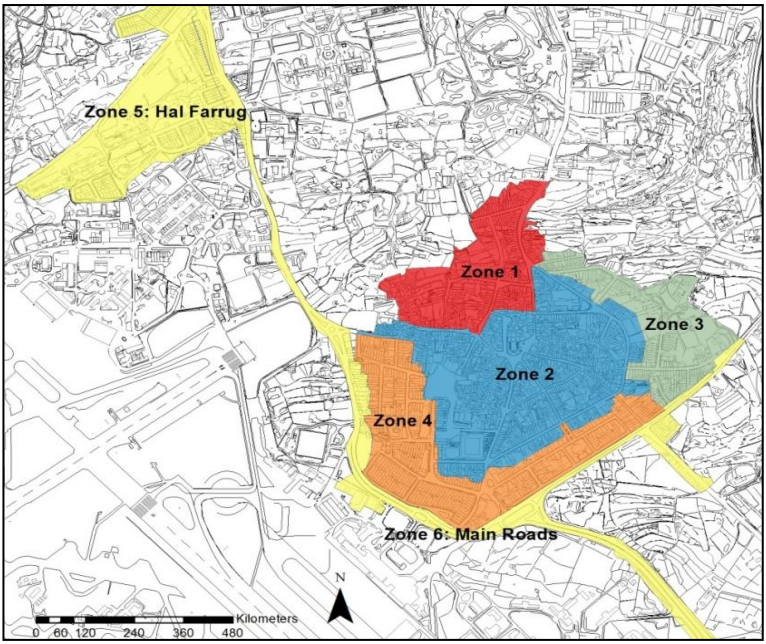
Yet, literature on travel time for elderly is quite limited. Yang *et al.,* (2013) using the Netherlands as a case study, analyse heterogeneity among older people's travel time by dividing their activities in compulsory vs. maintenance and leisure. The study shows that for all transport modes travel time for elderly is shorter than that of the rest of the population and reduces with age. Zhang *et al.,* (2007) similarly show that the mean travel time of elderly in Beijing is of 27 minutes whilst that of the rest of the population is of 35 minutes. This represents a 20 per cent less travel time for elderly than that of the contrastive population. Also, being non-working the elderly's travel time in compulsory activities is shorter than that of younger adults. It is more shifted towards maintenance and leisure. Yet, due to age limitations, the total amount of travel time spent on these activities decreases once again as old people grow older. Zhang *et al.,* (2007) show that the mean travel time for elderly aged 61-63 years is 28.3 minutes whilst that of elderly aged 84 years and more is 24.1 minutes.

Methodology for Data Collection

Telephone questionnaires were the main source of data that the study used to analyse mobility patterns, determinants affecting modal choice as well as problems that elderly encounter when using public transport. The questionnaire was divided into two sections: one for the frequent bus users and the other for the non-public transport users (see Appendix A). A sample of ten per cent of the whole population in Luqa was collected, which resulted in 192 questionnaires. For a more rounded figure, 200 questionnaires were carried out. The stratified sampling technique was used. Age groups were divided into three: 60-70, 71-80, and 81+. Luqa was also divided into six zones for an equal distribution of the respondents.

Such divisions were chosen in order to create as much as possible a representative sample in terms of spatial distribution between the different elderly age groups. This helped to understand the dynamics within each group and to give a representative picture of all the elderly population in Luqa (Figure2). Several correlations and cross tabulations were analysed statistically using the Pearson Chi Square in IBM SPSS 20 with a 95 per cent Confidence Interval. These tests were very useful to check associations and determine the factors that lead to modal choices.

Figure 2
Luqa Divided in 6 Zones for an Equal Spatial Distribution of Elderly Persons Surveyed



The shaded areas were identified by Deborah Mifsud (co-author)

The average walking time to the nearest bus stop for every route going to Mater Dei Hospital from Luqa was calculated through Geographic Information System (GIS), using closest facility analysis. Eventually, time was also analysed cumulatively along the route. The travel time surveys were carried out between the 10th and 19th July 2012.[1]

[1] The telephone and travel time surveys were conducted as part of the Ms Deborah Mifsud's Master of Science (Sustainable Development) dissertation within the Institute for Climate Change and Sustainable Development at the University of Malta.

Estimating Generalised Costs

For private transport, travel time was calculated through conversion from the shortest distance between Luqa and Mater Dei whereas the generalised cost was worked out using the following equation:

$$G^k_{ij} = a_1 t^k_{ij} + a_2 e^k_{ij} + a_3 d^k_{ij} + p^k_j + m^k$$

where:
G^k_{ij} is the generalized cost of travelling either by public transport or private car;
t^k_{ij} represents the travel time from i, Luqa, to j, Mater Dei Hospital;
e^k_{ij} is the excess time or the time spent waiting for public transport if public transport is the chosen mode of transport;
d^k_{ij} represents the distance travelled either by car or public transport;
p^k_j is the terminal cost or parking fee at Mater Dei Hospital applicable for an elderly person using his or her private car; and
m^k represents the modal penalty of travelling by public transport, that is the discomfort and lesser convenience of travelling by public transport for an elderly person.

See Appendix B for a detailed explanation of the above equation and how estimates were derived.

The costs used for private transport included the cost of travel time together with the proportional costs of road tax, services, insurance, maintenance, fuel consumption and parking charges at the hospital. The costs used for public transport included the cost of total travel time (i.e. walking time to the bus stop, waiting time and travelling time), the modal penalty cost and the bus ticket price.

Based on the above equation, time costs would depend on the mode of travel and include walking time from home to bus stop, waiting at the bus stop which is considered as excess time, and time spent in the vehicle between Luqa to Mater Dei or on public transport if the elderly person opts to travel by bus. The latter will of course depend on the time of day given the volume of traffic on the roads especially at peak hours. The money costs of travel either by public transport or by private car includes bus ticket or fuel costs and all other relevant costs proportional to the distance

travelled. The terminal cost, which generally refers to parking charges, in the case of use of private car was also included. Of relevance to public transport use is the modal penalty that is the lesser convenience and possible discomfort for an elderly person of using public transport. A monetary value was set for the modal penalty whereas a value was also set for travel time, walking and waiting time for public transport.

It should be noted also that in the short-term a person may not consider or perceive the full range of costs incurred in either mode of transport. Part of these non-perceived costs are external costs caused by both modes of transport, especially if the vehicle being used is non-compliant with the strict new capping on pollutant emissions from diesel and petrol cars, limiting in particular nitrogen oxides (NOx) and particulate matter (PM) which pose the most serious health and environmental problems.

The costs of travelling by private car which individuals may ignore or misperceive are likely to include cost of depreciation and vehicle maintenance such as replacement of tyres; and the additional cost of waiting at traffic lights and in traffic congestion unless the vehicle has a start stop system that cuts engine power and helps to reduce emissions. A car owner using his or her car for regular visits to Out-patients at Mater Dei may also ignore changing cost conditions such as additional charges on fuel excise duties.

What is relevant for our analysis, however, is that we consider the generalised costs or the actual resource costs reflecting the opportunity costs of travel time. This is of particular relevance for transport economists since individuals need to be fully aware of the resource costs of travelling from Luqa Centre to Mater Dei Hospital. One should note, however, that the notion of generalised costs is not without its critics, and one would be wrong, for instance, to apply estimates (including the ones obtained in this study) as a 'universal' index that may be applied for other routes in the Maltese Islands. The advantage of using generalised costs is that it is based on the notion of time. Since there are 24 hours in a day, this facilitates the use of money values for estimating travel costs. The approach of generalised costs, therefore, helps us to understand how travel behaviour (that is choosing to travel by public transport or private car) may be affected by travel costs, as defined in this study. An important component

of this is the relevant value of time (see Appendix C for a detailed explanation of value of non-working time and how it was derived).

The generalised cost for an elderly person travelling by public transport was estimated at €12.07 and exceeds the generalised cost for travelling by car by €1.36. Though the difference is marginal, one should not underestimate the modal penalty reflecting the discomfort and lesser convenience associated with travelling by public transport including the waiting time inconvenience. This discomfort or lesser convenience is among a number of factors that are likely to affect modal choice for elderly people.

Factors determining Modal Choice for Elderly People in Luqa

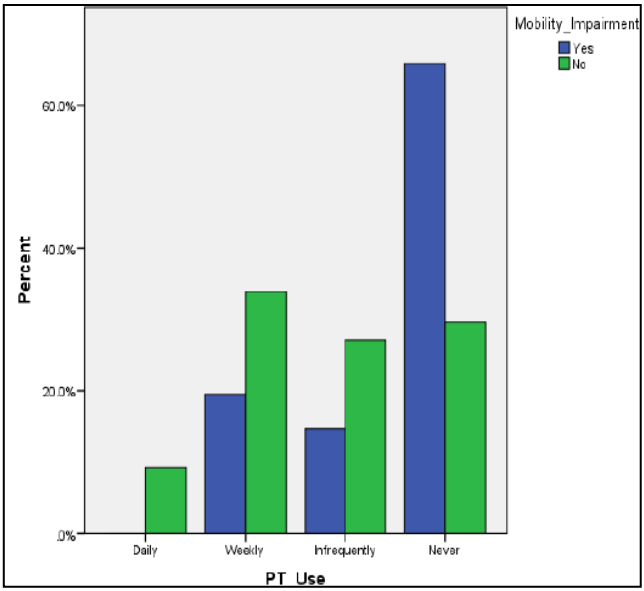
The time travel surveys results referred to earlier were relevant in determining modal choice and revealed that the car was the mode of transport used by the majority of the elderly population for visits to Mater Dei Hospital. Although only 35.5 per cent of the respondents held a valid driving licence, only 33 per cent used public transport often (daily or weekly) when compared with a total of 67 per cent of infrequent and non-public transport users. This implies that there may be several factors which affect the infrequent use of this mode of transport. Although gender, age, health status, marital status, household type, car availability and proximity to bus stop were analysed, only three of them resulted to be statistically significant.

The younger old (particularly women) were those who used public transport the most. Correspondingly, the older old were in their highest numbers for the infrequent and non-public transport users. One possible reason for this is that as age increases elderly people tend to travel much less. Actually, public transport usage was highly correlated with the age of the elderly people. The Pearson Chi Square Statistical Test's p-value indicated that there was a statistically significant relationship between these two variables.

In addition, highly related to the age of the elderly respondents was their health status. Forty-one per cent of all the elderly people suffered from some kind of disability or physical impairment. The level of physical

impairments increased with age, with more than 90 per cent of the males and 86 per cent of the females with physical impairments being over the age of 70. The absolute majority (65.9 per cent) of elderly persons with physical impairments did not make use of public transport, corresponding with the fact that all the daily users did not have any disability or impairment (Figure 3).

Figure 3
Public Transport Usage According to Health Status of Elderly People in Luqa



The Pearson Chi Square Test p-value of 0.002 did not exceed the 0.05 level of significance. This indicates that there was a significant relationship between public transport use and health of the elderly population.

A very important contributing factor determining public transport use was car availability. The absolute majority of the infrequent public transport users (97.7 per cent) and the non-public transport users (97.8 per cent) had a car available, which was a crucial reason why they did not make use of public transport (often or never). Correspondingly, 63.6 per cent of the daily public transport users did not have a car available. The Pearson Chi

Square p-value between these two variables resulted in 0.000, which being less than the 0.05 level of significance implies that there was a significant relationship between car availability and public transport use for the elderly population.

The study also analysed several difficulties that elderly encounter when using public transport. The two dominant problems were long waiting times and inappropriate bus stops' infrastructure with lack of comfort. Other issues as inappropriate frequency of buses, unsafe pavements, high traffic volume, inaccessible travel information, lack of safety, fear to travel alone and inappropriate driver behaviour were also referred to by the elderly.

Modelling the Mode of Transport Choice

We have seen that for an elderly traveller, making a trip from Luqa Centre to Mater Dei Hospital and back, is affected by a number of factors. The costs involved in either public transport use or private car are equally as important in determining modal choice.

This study employs a mode choice model (logit model) in order to determine the transport mode choice that elderly people make from Luqa Centre to Mater Dei Hospital. The logit mode choice relationship states that the probability of choosing a particular mode for a given trip is based on the relative values of a number of factors such as cost, level of service, and travel time. Put differently, the aim is to estimate utility and therefore the probability of using a car as against public transport based on data derived from the survey as well data on costs such as fuel, parking, bus fare, and other considerations.

It should be noted that the concept of utility assumes that there is a method of combining the various attributes of all the alternatives including their price, to give one measure of utility which is consistent across all the alternatives within the choice set available to an elderly person living in Luqa. The utility for each mode (public transport and use of private car) therefore would consist of the attributes of each mode which are considered relevant to the elderly person.

The attributes relevant to this case include:
C = the cost of each mode e.g. fare, parking cost, petrol cost of private car;
IVT = the amount of time spent travelling on each mode of transport;
WAIT = the amount of time spent waiting for the bus to arrive;
WALK = the amount of time spent walking to, from or between buses.

The utility for each mode can be formed from the weighted sum of the attributes of choice. In fact, the utility for mode p (public transport) can be shown as:

$$U(p) = \beta_0(p) + \beta_1 IVT(p) + b\,\beta_2 C(p) + \beta_3 WALK(p) + \beta_4 WAIT(p)$$

where the variable attributes are:
$U(p)$ = the utility of travel by mode p
$\beta_0(p)$ = the perception of mode p (or mode constant)
$IVT(p)$ = the accumulated time spent in vehicles while travelling by mode p
$C(p)$ = the accumulated fare for travelling by mode p(or in the case of travelling by car the pertinent costs such as fuel)
$WALK(p)$ = the accumulated time spent walking while travelling by mode p (this would not apply in the case of travelling by car)
$WAIT(p)$ = the accumulated time spent waiting while travelling by mode p (this would not apply in the case of travelling by car).

The coefficients β_1, β_2, β_3, and β_4 are the respective weights of each attribute.

Based on the choice between alternative modes of transport available for the sample population, we have attempted to find out the value and weight of each attribute. The combination of attributes and weights were then used to calculate the utility for each mode of transport. We then compared the utility of each mode of transport to determine the mode with the highest utility. The procedure used is explained in detail in Appendix D. The main results of this estimation procedure shows that in the case of public transport the exponentiated utilities were estimated at 40 per cent whereas using a car has a probability of 60 per cent.

Conclusion

Through a logit mode choice model based on survey findings as well as through results derived from generalised costs of travel by car and public

transport, the study clearly shows that the preferred mode of transport amongst the elderly people in Luqa is the private car with a probability of 60 per cent. The main reasons for such a modal choice were found to be car availability, health and age issues, as well as several downsides in the public transport system, including long travel time and inappropriate bus stop infrastructure. The results are in line with evidence found in the literature which highlighted health, car availability, time and accessibility as important factors affecting elderly mobility.

Another conclusion of the study is the difference in generalised cost between private and public transport for elderly persons travelling from Luqa to Mater Dei Hospital and back. Though marginal, together with other factors, it affects the modal choice made by elderly people living in Luqa. This too supports the survey results that the car is the most popular mode of transport for elderly people.

This has significant policy implications given that elderly people are often termed 'transport disadvantaged' because when they stop using their car, public transport becomes an almost obligatory travel option. Yet, as mentioned in this study, quite apart from the generalised cost, there are other issues related to socio-economic aspects (e.g. health status) that result in increasing number of elderly people using private transport.

Assuming visits to Mater Dei Hospital (for outpatient services) become more regular then discomfort and lesser convenience will become more important than any cost consideration. With a projected increase in the elderly population in Malta, one would expect a higher demand among the elderly population for private transport and the implication of this becomes obvious: the public transport service needs major improvements to cater for the needs of our ageing population.

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APPENDIX A
The Survey Questionnaire

Section 1: Household and Personal Characteristics

Select the relevant box using (x) and complete where necessary

1. Gender: ☐ Male ☐ Female

2. Age: ☐ 60-65 ☐ 66-70 ☐ 71-75 ☐ 76-80 ☐ 81-85 ☐ 86+

3. Status: ☐ Single ☐ Married ☐ Separated ☐ Widow/er

4. What type of household do you live in
   ☐ Single household ☐ Multi-member household

5. Do you have any physical disability/mobility impairment that makes it more difficult for you to travel without any difficulties or support
   ☐ Yes ☐ No

Section 2: Access and Mobility Characteristics

6a. Do you have a driving licence ☐ Yes ☐ No

6b. Are you a car owner ☐ Yes ☐ No

6c. If no, is a car available ☐ Yes ☐ No

7. How often do you use public transport
   ☐ Daily ☐ Weekly ☐ Infrequently ☐ Never

8. How far is your home from the nearest bus stop? _____ minutes.

9. Which is your most common journey(s), and by which mode of transport?

Purpose	**Mode of Transport**
Shopping	
Medical Care	
Visit Relatives	
Recreation	
All of the above	
I do not go out	
Others	

10. What is the maximum time budget you think is affordable to travel to Mater Dei Hospital by bus? _____

Section 3: Daily and Weekly Public Transport Users

11. For what purpose do you use public transport most for?

Medical care	
Shopping	
Recreation/ leisure	
Visit relatives	
Errands	
Others	

12a. Are there any unmet travel needs or difficulties when using public transport? ☐ Yes ☐ No

12b. If yes, what are the main barriers encountered and/ or what would you like to do more? Despite the barriers do you acknowledge any positive issues in the public transport system? If yes, list them.

12c. If no, rate your satisfaction level (from 1 to 5 maximum) and list the positive aspects related to the current public transport system.

13. What are the neighbourhood barriers encountered when walking to the closest bus stops?

Bus stops are not well distributed to cater for users from different areas	
Lot of traffic passing by and/or lack of crossings	
Bad infrastructure (e.g. narrow streets, bad pavements, slopes, too many steps)	
There are no barriers	
Others	

14. What are the necessary improvements that you think are necessary in public transport to reach more travel needs (to reach equal mobility)?

Section 4: Infrequent and Non-Public Transport Users

15. What are the reason(s) for not using public transport (or not often)?

Prefer to travel by car (as a driver)	
Depend on relatives for wherever I need to go (passenger)	
Difficult to board/alight (Accessibility Problems)	
Bus stop is far away from home	
Long travel times/ lack of punctuality/long waiting times	
Poor personnel service/customer care	
No travel information is given	
Lack of comfort (e.g. difficult to get a seat)	
Ticket fare too expensive	
Unreliable bus schedules	
Has no need to travel	
Others:	

16. What are the positive aspects that you think have improved in public transport in Malta with the new operator (if any)?

17. What do you think are the main barriers encountered by elderly when using public transport?

Affordability	
Bus stops are unfavourably located (far away from home)	
Lack of safety and security	
Accessibility problems (e.g. to get on/off the bus)	
Unreliable schedules	
Long waiting and/or travel time	
Lack of Comfort (e.g. overcrowded vehicles)	
Too many interchanges	
There are no barriers	
Do not know	
Others	

18. What do you think are the necessary improvements needed in order to attract more public transport users?

Cheaper trips	
More bus stops	
More Safety e.g. accidents/crimes	
Improved comfort and access	
Shorter travel time and better frequency and punctuality	
More routes that satisfy more needs	
More information	
Less physical stress (e.g. less bus interchanges)	
There is no need for improvements	
Others	

APPENDIX B
Estimating Generalised Cost

The equation used to determine the cost of travelling is shown hereunder:

$$G^k_{ij} = a_1 t^k_{ij} + a_2 e^k_{ij} + a_3 d^k_{ij} + p^k_j + m^k$$

where the variables and coefficients have been explained in the main body of the text.

In measuring the generalised cost of travelling by car from Luqa Centre to Mater Dei Hospital and return, a number of assumptions have been made. The shortest distance by car between Luqa Centre and Mater Dei Hospital entrance is of 7.2 km and this would translate itself into 11 minutes driving time. However, this travel time is unrealistic due to volume of traffic and stoppages at traffic lights. A more realistic time is 20 minutes. With a value of non-working travel time of €5.45 per hour, the cost of travel time for an elderly person is €3.62 both ways.

It is also assumed that the vehicle used is a 2008-built B Segment car running on unleaded fuel. B Segment cars are considered as compact cars. These cars currently account for 22.4 per cent of European sales and they are very popular in the Maltese Islands as one would expect given the size of the Islands and the parking restrictions. The annual running costs are based on 3,000 kilometres; an annual road tax of €120; service costs of €150; an insurance premium (fully comprehensive) of €300 including breakdown insurance; and parking permits, fines, tyres and oils adding up to €80. The money costs of the trip from Luqa Centre to Mater Dei is based on the distance and is proportionate to the annual cost as determined from the above.

The fuel consumption for this B Segment car in urban road traffic is estimated at 6.94 litres per 100 km. Though the average consumption of a car depends strongly on traffic conditions and driving style, given the volume of traffic on Maltese roads and regular stops due to traffic lights and roundabouts, 6.94 km per 100 km appears more realistic for a B Segment car. For a return distance of 14.4 kilometres, the fuel consumption works out at 1 litre. The cost of unleaded petrol, €1.54 per litre, is taken as at 1st September 2012. The terminal costs consist of parking charges at

Mater Dei Hospital. It is assumed that the out-patient visit by the elderly person lasts 3 hours. The total charge is €2.45.

The above assumptions and data form the basis for measuring the generalized cost index for an out-patient elderly person visiting Mater Dei Hospital by private car. The generalized cost for travelling by car between Luqa and Mater Dei Hospital during peak time is estimated by adding the cost of travel time (€3.6) plus the proportionate cost of road tax (€0.576) plus the proportionate service cost (€0.72) plus the proportionate cost of insurance (€1.44) plus the proportionate cost of parking permits, tyres etc (€0.38) plus the fuel cost based on a consumption of 6.94 litres per 100 kilometre (€1.54) plus the parking charges at Mater Dei Hospital (€2.45). The generalized cost of travelling by car for an elderly person between Luqa and Mater Dei Hospital both ways is estimated at €10.71. This cost will of course vary depending on the vehicle's fuel consumption, the cost of fuel, and insurance cost.

If the elderly person opts to use public transport, the generalised cost index will need to factor in costs such as the modal penalty to reflect the discomfort and lesser convenience of travelling by public transport as well as the waiting time for public transport and time taken to walk to the nearest bus stop in the direction of Mater Dei Hospital. Money costs associated with the use of a private car and terminal costs are of course excluded. The time taken to the bus stop, the waiting time for public transport, and the travel time were derived from actual observations of public transport services to Mater Dei Hospital as explained earlier at on and off-peak time.

The modal penalty is in this case defined as the difference between the time taken to travel by public transport and the travel time if the elderly person travels by private vehicle. The travel time surveys determined that Route 117 had the shortest travel time in peak hours with 46 minutes (one way including walking and waiting time). This is highly comparable with the 20 minutes taken by private car. The modal penalty can be estimated on the basis of the value of non-working time (€5.45 per hour).

Therefore, in estimating the generalised cost of travelling by public transport, it is assumed that the elderly person opts for the discussed shortest route (Route 117 at peak time) taking a total travel time of 92

minutes both ways. This includes a walking time of 14 minutes (from bus stop to home and return) and 40 minutes waiting time (both ways) valued at €8.35. The cost of bus ticket is €0.50. In addition, there is the modal penalty or the difference between the time taken to travel by public transport and the travel time if the elderly person travels by car. This amounts to €4.72. The generalised cost for an elderly person travelling by public transport adds up to €12.07 and exceeds the generalised cost for travelling by car by €1.36.

The difference, though marginal, should not ignore given the discomfort and lesser convenience associated with travelling by public transport including the waiting time inconvenience.

Appendix C
Estimating the Value of Non-working Time

The case under consideration concerns elderly persons and the interest here, therefore, is the time value for a non-working person or put differently, the value of non-working time. The value of non-working time can be based on is drawn from the adjusted Harmonized European Approaches for Transport Costing and Project Assessment (HEATCO) (European Commission, 2006). The value of non-working time is in fact a proportion of value of working time. An explanation of how this is arrived at is warranted.

The value of working time can be estimated using the rate that employers are willing to pay or alternatively what users (employees) are willing to pay for time savings. The adjusted HEATCO value of working time for the Maltese Islands is based partly on the average cost of wage rates paid by employers.

The HEATCO estimates indicate a value of time in 2002 of €18.64 euro per hour for working time and 6.53 euro for non-working time. A growth factor of 1.204 has been referred to in the *Guidance Manual for Cost Benefit Analysis (CBAs) Appraisal in Malta* (2013) and therefore the value of working time converted to 2012 prices is €22.45 euro per hour. It is acknowledged, however, that the estimate is considered high when compared with the average wage per hour in the Maltese Islands.

The *Guidance Manual for Cost Benefit Analysis (CBAs) Appraisal in Malta* recommends an ad hoc estimate for working time with the value being applicable for both use of private cars and commercial vehicles. The Manual estimates this time value from the total cost of employees divided by the average hours worked per employee. On this basis the value of working time is estimated at €11.59 euro per hour.

This estimate, however, is deemed low when one considers that low income earners (this should include most elderly people) are more likely to use public transport. In fact, persons with higher incomes tend to spend more on transport than persons with low income. The value of €11.59 euro per hour had to be adjusted to account for this. An income factor of 1.3, derived from a London Economics analysis of HEATCO (European

Commission, 2006) by London Economics in 2006 and referred to in London Economics (2011) was used for this adjustment. This was arrived at by dividing the average income per household by the weighted average income obtained from the average transport spending. A more realistic estimate of the value of working time (at factor cost) was derived as a result. The value of working time for transport purposes should was therefore taken to be read €15.07 euro.

Given that this paper's focus of attention is elderly people, it is assumed that the individual using either public or private transport is receiving a retirement pension (in Malta this is most likely to be a state pension). Non-working time value can be estimated as two and half times smaller than the working time value. However, a further adjustment to the €15.07 euro per hour should also be made since this should not include the incremental or additional cost to the employer of hiring an additional employee.

According to the *Guidance Manual for Cost Benefit Analysis (CBAs) Appraisal in Malta* (2013), the adjusted value for working time should read be €10.47 euro and therefore the value for non-working time based on 40 per cent of €10.47 euro is €4.19 euro. Multiplying this by the applicable income factor or 1.3 produces a value for non-working time at market prices of €5.45 euro. This can converted to factor cost using 18 per cent (Value Added Tax as the indirect tax percentage) results in €4.62 euro.

However, the value of non-working time as applied in this paper should read €5.45 euro. This is in line with the thinking in Cost Benefit Analysis literature whereby non-working time values can be determined by revealed or stated preference approaches based on the 'willingness to pay' concept.

People implicitly put a value on their own time in that they will trade a less expensive mode of journey as against a faster more expensive mode. In the case of an elderly person who can afford to use his or her car would therefore opt to use a private car despite the additional cost incurred if convenience is a foremost consideration.

Another consideration that may be factored in is that the 'willingness to pay' will differ depending on the elderly person's income, the urgency or regularity of the journey and the value the individual may give to

convenience and comfort when he or she considers the differences in time travelled on different modes of transport that is the difference between travelling by private car or public transport from Luqa to Mater Dei Hospital.

Appendix D
Multinomial Logit Model

The mode choice model was framed as a multinomial logit model which derives the proportion of elderly persons who would use mode *p* as shown hereunder:

Pp = [*Exp(Up)*] / [Sum of *Exp(Up)* over both modes of transport]
where:
Pp = the proportion of trips (or the probability of) travelling on mode *p*
Up = the utility of travel by mode *p* (as shown above)
Exp(Up) = e, about 2.17, raised to the power of *Up*

The logit model estimates the ratio of the exponentiated utility to their sum. Given that we have two modes of transport, this exercise determines the probability of an elderly person living in Luqa using either a car or public transport. In terms of probability and in the case of public transport the exponentiated utilities were estimated at 40 per cent whereas the car has a probability of 60 per cent.

In determining the probability of an elderly person's modal choice it was necessary to measure the generalised cost (as explained in Appendix B) of travelling by car or by public transport. Data on travelling time, waiting and walking time is referred to in Appendix B whereas the attributes, in the case of public transport, were determined after setting a euro value for time spent travelling, bus fare, walking time, and waiting time. Each weight was based on the proportion of total cost relevant to each mode.

As for travelling by car, two weights were considered relevant: β_1 with respect to *IVT(p)* and β_2 with respect to *C(p),* representing the cost of travelling by car. Again euro values were set for *IVT(p)* and *C(p)* and their respective weights were estimated using the same method as explained above. As regards the perception of both modes of transport $\beta(p)$ this was inferred from the survey result referred to earlier where it was found that 33 per cent used public transport regularly when compared with 67 per cent of infrequent and non-public transport users.