

Lund University

Lund University Master's Programme in International Environmental Science



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**Changing Transport Behaviours in South-Western Skåne: a
Challenge for Sustainability**

Master Thesis

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November 22, 2004

Motto

”Human beings, by changing the inner attitudes of their minds, can change the outer aspects of their lives.”

William James (1842-1913)

Acknowledgements

First of all, I would like to thank Anna-Lisa Lindén, my supervisor, for her constant support, for guiding me while writing my thesis, for helping me distinguish right from wrong, white from black, and necessary from unnecessary, and for always being there when I turned to her for advice.

I am particularly indebted to Bengt-Åke Leijon, David Eldman, and Päivi Elmqvist from Lunds Kommun, for their promptitude and precision in providing me with the statistics I needed for my study.

Special thanks to all the teachers and researchers at LUMES and MICLU, especially to Lennart Olsson, Ingegerd Ehn, Mats Svensson, Harald Sverdrup, Göran Ewald, and Barry Ness. They created the pattern of what I am now, by teaching, tutoring, guiding, and criticizing...so often. They gave me a chance that has probably changed my life, even if I have not realized yet, and helped me build upon it, so it does not get lost.

To Åsa Grunning and Ola Dahlback, for being “the first-aid stations” at LUMES. Without you, confusion and maybe too much System Analysis would have long time ago created typhoons in my brain. Thank you for answering both banal and important questions and for searching the solutions for my real CLDs.

My love to all my colleagues at LUMES and to my friends from Romania. Thank you for being close to me in both happy and sometimes gloomy times. Thank you for I can call you my friends.

I wish I could find words to express my gratitude to my family. There are no such words, however, as my love for them is beyond any meaning that can be expressed through writing or saying... I am grateful to you for putting so much effort in educating me and raising me as an upright person. This work, as one of the best I have ever written, is dedicated to you.

Last, but not least, this thesis is also dedicated to the one that has filled in the empty half of my heart. Thank you, Mihai, for giving me so much happiness and so many beautiful moments, for loving me, caring, and supporting me in every way and every minute.

Abstract

At the end of the 20th and the beginning of the 21st century, South-Western Sweden is characterized by the development of small residential satellite localities surrounding the bigger cities. Because of the lack of workplaces in these localities, their inhabitants are forced to commute to the bigger cities for work. A mixture of variables – land planning, bad planning of bus traffic, few travel alternatives, bad weather for a long period of the year – determine the inhabitants of these localities to choose car over bus when traveling to work. This is a problem since the extensive use of cars in the area increases the negative dimension of many environmental issues, amongst which energy consumption and air pollution. However, apart of the determinant variables enumerated above, there have also been identified other items that influence transport behaviours, which are connected to the individual characteristics of the inhabitants of these small localities.

This thesis identifies and discusses the demographic and socio-economic variables that determine the daily commuters for work to choose between traveling by car and traveling by bus. To reach this aim, system analysis, secondary analysis of already existing statistics, and primary analysis of recently collected data have been used. The particular case of Dalby, a small locality situated in South-Western Sweden, close to the city of Lund, has been chosen for discussion. Firstly, system analysis is used in order to define the problem. Further, considering the general demographic and socio-economic characteristics of Dalby's inhabitants, as well as their car ownership and housing situation, it is shown that Dalby is one of the satellite residential localities whose inhabitants have the tendency to prefer car over bus when commuting for work-related purposes. The results of the primary analysis show that income is a major determinant for travel behaviours, but other variables also play an important role – gender, the number of children younger than 15 years old in the household, workplace, owning a personal car, and the number of rooms of the house. Two different profiles have been identified on the basis of this analysis – the profile of the commuter with sustainable travel behaviours, oriented towards bus travel, and the unsustainable commuter, oriented only partially towards bus travel and more towards car travel. The commuters manifesting sustainable travel behaviours – who always commute by bus – are mostly women, not working in international companies, with lower incomes, not having children younger than 15 years, not owning personal cars, who may live in rented or cooperative houses with a lower number of rooms than the second group, and traveling by bus because it is cheap, it fits the working hours, because they have no car, and/or because it is good for the environment. The “unsustainable” commuters travel only sometimes by bus and are mostly men, working in international companies, earning high incomes, who may have children younger than 15 years, who live in owned houses with at least 3 rooms and kitchen, owning their personal cars, and mostly traveling by bus because the partner uses the car and for other reasons.

The objective of this analysis is to show the policy makers that they have to implement different policies for different groups of people, in order for these policies to be effective. However, this subject is only briefly approached in the end of the thesis, once again with the aid of system analysis, and it is seen as a necessary future work in this domain.

Keywords: transport behaviours, income, gender, socio-economic characteristics, demographic characteristics, commuters.

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List of acronyms and abbreviations

<i>a.n.</i>	author's note
<i>CLD</i>	Causal Loop Diagram
C_nH_m	hydrocarbons
<i>CO</i>	carbon oxide
CO_2	carbon dioxide
<i>et al</i>	et alii
<i>EURO II</i>	European Emission Standards II
<i>EURO III</i>	European Emission Standards III
<i>GB</i>	Great Britain
N_2	nitrogen
<i>g</i>	gram
H_2O	water
<i>i.e.</i>	in exemplum
<i>IPCC</i>	Intergovernmental Panel on Climate Change
<i>MJ</i>	mega joules
<i>km</i>	kilometer
<i>KMO</i>	Kaiser-Meyer-Olkin coefficient
<i>LUMES</i>	Lund University Master's Programme in International Environmental Science
<i>MICLU</i>	Miljövetenskapligt Centrum vid Lunds Universitet (Centre for Environmental Studies at Lund University)
<i>no.</i>	number
NO_x	nitrogen oxides
<i>p</i>	the significance level
<i>RBP</i>	Reference Behaviour Pattern
<i>SEK</i>	Swedish Crown
<i>SIKA</i>	Statens Institut for Kommunikationsanalys (Swedish Institute for Transport and Communications Analysis)
SO_x	sulfur oxides
<i>SPSS</i>	Statistical Package for Social Sciences
<i>sqkm</i>	square kilometer
<i>the US</i>	the United States
<i>UNDP</i>	United Nations Development Programme
<i>VAT</i>	value added tax
λ_3	Guttman's lambda 3 coefficient

Chapter 1. Introduction

Transportation is one of the major sources for both air pollution and extensive energy consumption, two of the most acute problems of nowadays society. As Carlsson-Kanyama and Lindén show, in 1990 “the transportation sector was responsible for about 25% of the world’s primary energy use and for 22% of CO₂ emissions from fossil fuel use” (IPCC, 1996: 681 in Carlsson-Kanyama and Lindén, 1999: 406). When reducing the general to particular, one of the generating sources for both these problems is identified in the daily commuters for work, school, and leisure activities (including shopping), between residential suburban areas (“satellites” (Miller, 2004: 682)) and cities.

The number of these daily commuters has significantly increased with the migration of the population from the big cities to suburbs or satellite residential small cities. According to Smith and Sylvestre (2001: 396), “[t]he process of suburbanization and spatial dispersal of urban populations has [...] encouraged a heavy dependence on automobile travel in order to overcome substantial distance separation between the place of residence and many service opportunities”. However, people commute on a regular basis not only to service facilities, but also to workplaces, as well as to places where educational and leisure activities are carried on.

South-Western Sweden is characterized by an increased number of daily commuters. Big cities as Malmö or Lund are surrounded by a constellation of small residential localities from where people commute on a daily basis in order to fulfill their needs of education and leisure, to access a diversity of facilities, and, most of all, to work. However, the problem is not the commuting phenomenon in itself, but the fact that regardless the warnings from the end of the 20th century concerning the increased levels of air pollution and energy consumption, cars are still proved to be the dominant transportation mode for all population groups (Carlsson-Kanyama and Lindén, 1999: 405). This would be regarded by many as surprising, considering the fact that Sweden is known as one of the pioneers in environmental protection and especially considering the already implemented programs for reduction of car travel (see for example Lunds Kommun, 2004b). Dalby, a small locality in South-Western Sweden, has been part of these programs for reducing car travel and changing peoples’ travel behaviours towards more sustainable ones. However, many of the Dalby’s inhabitants still commute by car in their daily trips to work, education, shopping or leisure related activities. This is an example of a still low response of the population to these programs for the reduction of car travel.

These programs must take into account commuter’s individual characteristics in order to achieve the desired result. If car is the main transportation mode it does not mean that all commuters travel by car. The available means of transportation are differently used by individuals, according to their various personal characteristics: income, gender, age, family type and the number of children of non-working age in the family, and so on. For example, according to Carlsson-Kanyama and Lindén (1999: 405), “[p]ublic transportation is used especially by young people and women”. Thus, lifestyles and individual travel behaviours must become central items in the process of changing travel patterns.

One of the most important variables that need to be analyzed in this context is income, since it was argued that income varies with gender and is a major determinant for lifestyle and also for the behaviour of a series of other variables, at a more particular level. These variables – i.e. the probability of owning and using a car – can subsequently determine the travel behaviour. Lifestyles are essential, for there is not only transport technology that must be improved for achieving sustainability in this sector, but also humans’ travel patterns that must be changed. “Sustainability can only be reached when both travel patterns and vehicle technology have changed radically”, says Carlsson-Kanyama and Lindén (1999: 405). Furthermore, Hinterberger et al affirm that “the overall environmental effects of current lifestyles must decrease by a factor of 10 over the next 40-50 years” (Hinterberger et al, 1997 in Carlsson-Kanyama and Lindén, 1999: 405). The aim of this thesis is to identify and discuss the variables that determine the daily commuters for work to choose between traveling by car and traveling by bus. On the basis of this discussion and by also considering the Swedish context, the present study discusses if Dalby’s commuters are likely to choose car over bus when traveling for work. It differentiates between two different commuter profiles for Dalby’s inhabitants, profiles that favor different work oriented

commuting behaviours. Finally, the role of income for the individual choice of the travel mode is discussed as well and differentiated measures for different groups of commuters are proposed.

Chapter 2. An Analytical Framework for the Investigation of Individual Transport Behaviours

2.1. From car travel to bus travel: different solutions for different commuters

2.1.1. Energy savings and emissions reduction when replacing car travel with bus travel

Determining people to change their travel behaviours, thus to commute by bus and not by car, have proved to bring significant improvements for the environment. These improvements can be measured as savings in the consumed energy for transportation and in lowering the amounts of harmful emissions from the exhaust pipes of different transportation means, for example the amounts of carbon dioxide (CO₂). Table 1 shows the differences between car, bus, commuter train, and tram car use, for these two variables, measured in mega joules (MJ) per person-kilometer (km) and, respectively, grams (g) CO₂ per person-km, which makes comparable the numbers for the different transportation means.

Table 1. The amount of energy requested by different transportation means and the amount of harmful emissions (CO₂) from different transportation means when used for short and long distance trips.

Transportation Means	Type	MJ/person-km		g CO ₂ /person-km	
		short distance	long distance	short distance	long distance
Car	Fleet of cars ¹ , 1993	3.19	1.15	238.00	87.00
Bus	Peak hours, 80% capacity	0.25	0.29	19.00	22.00
	Average capacity	0.79	0.47	58.00	34.00
	Off-peak hours, 10% capacity	1.66	0.94	122.00	68.00
Commuter train	Peak hours, 80% capacity	0.17	-	1.50	-
	Off-peak hours, 10% capacity	0.50	-	4.50	-
Tram car		0.68	-	6.10	-

Data source: Lenner, 1993: 12-13².

Commuting for work is usually considered short-distance travel. Table 1 shows that energy consumption is two times higher for short-distance travel when using cars than when using bus at off-peak hours, at only 10% of the capacity. The proportion is similar when considering CO₂ emissions. Commuting by car and by bus at off-peak hours are the most unsustainable choices when considering car, bus, commuter train and tram car, from the two points of view considered above – energy consumption and CO₂ emissions. Bus is however, as shown above, a more sustainable alternative than car, and is to be considered when tram car or train lines do not exist, at least until the local council decides to build such lines, if they decide that they are viable and environmentally friendly when considering all points of view (other pollutants, the possibility to disrupt the ecosystems when building new lines, and so on).

However, some could argue that regional buses pollute more when it comes to certain substances (SO_x (sulfur oxides), soot and other particulates, NO_x (nitrogen oxides), CO (carbon oxide), C_nH_m (hydrocarbons)) (Van Beckhoven et al, 1985; Lies et al, 1988 in Neeft et al, 1996), because they are still equipped with diesel engines (Skånetrafiken, 2004b). Only buses running inside Skåne's cities use environmentally friendly fuels. Nevertheless, most and more of the buses running in Skåne are equipped with catalysts that observe at least

¹ Data for “fleet of cars” represent the average numbers for the total Swedish fleet of cars for several years in the last two decades.

² Cars during short distances are assumed to carry 1.2 persons, and during long distances 2 persons.

EURO II, but many even EURO III norms (Skånetrafiken, 2004c; Anonymous Author, 2002). These catalysts (or catalytic converters) transform the polluting substances in other substances: N₂ (nitrogen), H₂O (water), and CO₂ (carbon dioxide)³ and reduce most of the polluting exhaust gases to similar levels as for car engines (petrol engines) (Băţaga et al, 1995). Meanwhile, the sulfur content of fuels has been considerably reduced (Neeft et al, 1996). Thus, since Table 1 shows that the amount of CO₂ per person-km produced by buses is lower than that produced by cars and that the amount of energy per person-km consumed by buses is lower than that consumed by cars, it can be further considered that buses running in Skåne are a more sustainable and environmental friendly transportation mode than personal cars.

2.1.2. Different solutions for different commuters

According to Carlsson-Kanyama and Lindén (1999) it is important to identify different groups of travelers when seeking for sustainable transportation patterns. Kölbl and Helbing (2003: 2) indirectly support this affirmation. They argue that travel behaviours are characterized by a “constant travel time budget”, meaning that “on average, humans use to travel about 75 minutes per day since many decades (or even centuries)”. Thus, if the travel time is said to be constant, it is important nowadays that people use the most environmentally-friendly transportation means available in a given context.

Peoples’ travel behaviours are various. Consequently, it is essential that the programs that are to be implemented in order to determine people to use environmentally-friendly transportation means are not general, but targeted towards particular groups of travelers (especially towards the groups with the most unsustainable travel behaviours); otherwise, their effectiveness is likely to be very low. For example, as Carlsson-Kanyama and Lindén explain, it is less efficient to introduce programs to determine elderly women to travel less than to accentuate those policies aimed at changing the travel patterns of the middle-aged population and of high-income earners, whose unsustainable travel patterns are forecasted not to change too much without determined intervention. In Sweden, for example, “men with high incomes consume the most energy, with 94,000 MJ during one year, while elderly consume 12,000 MJ” (Carlsson-Kanyama and Lindén, 1999: 405). In this case, the programs should be oriented towards the group of men with high incomes, on whose travel behaviour a low reduction in bus ticket prices could have no effect. “Individual lifestyles are dependent on the availability of transportation and the related aspects of time schedules, technical efficiency of vehicles and mode of transport. Individual factors such as attitudes, income and subjectively defined needs for travel and transport are also important” (Carlsson-Kanyama and Lindén, 1999: 416). Thus, before implementing programs aimed at changing travel behaviours, it is important to know who are the commuters, how can they be characterized.

Considering the individual characteristics in formulating policies aimed at changing travel behaviours is not only acknowledged by Swedish authors, but globally recognized as a necessity. As Litman affirms (2003), standard transport statistics indicate that in North America more than 90 percent of households own an automobile and more than 90 percent of trips are made by automobile. “This suggests that private vehicle travel is the most important form of transport and that improving other modes can do little to address transport problems” (Litman, 2003: 30). Thus, as the author suggests, it is necessary to target the measures to reduce car travel towards specific groups of people, i.e. car users with various individual characteristics. O’Fallon et al (2004) set a hierarchy of the transport behaviours, from the most environmentally harmful to the most environmentally friendly⁴ and tests the openness of different commuter groups for changing their transport behaviours to more sustainable ones. The most negative result they have obtained is expressed in the rigidity of the males, self-employed respondents, driving a company or a business vehicle, who affirmed that they will always choose to drive a car, regardless any scenario that may be presented to them (i.e. doubling the frequency of the bus transport, halving the price of the bus ticket, increasing parking fees and so on). Nevertheless, their

³ CO₂ is not considered an air pollutant, but is harmful because it contributes to the greenhouse effect (Miller, 2004).

⁴ In the stated order: drive a car; become a passenger in a car; arrange carpooling; walk and catch public transport; drive, park and ride public transport; cycle; other, including walk, taxi, change time of trip, work from home for some or all of the day (O’Fallon et al, 2004: 19-20).

research showed different responses to different scenarios from different groups of people, which underlines the necessity of applying different measures to different commuters as a solution for changing travel behaviours (see also Marshall, 2000). Other authors also support this idea. Already in the 1980s, Odland (1981) considers different households when analyzing travel behaviour. He shows that “labour force participation, location of residence with respect to potential destinations, the availability of automobiles, and the involvement of household members in locationally restrictive activities such as childcare” (Odland, 1981: 263) would be the most important variables to describe commuters’ profiles. “There is a need for individual household advice about how to find more energy efficient spending patterns” (Carlsson-Kanyama et al, 2002: 4; see also Heggie, 1978; Ibrahim, 2003). Rodriguez and Joo (2004) show that people respond differently to various policies, according to their age, sex and employment status. Klintman (1998) argues that age, formal education, gender and income are the major variables influencing the adherence to a carsharing organization. However, he points out that the groups of people adhering to carsharing organizations are different in profiles, when considering different countries; for example, in Norway the most open group seems to consist of men aged 30-40, owning a college or university degree, while in Austria a big part of the carsharers are 25-43 years old, have a lower average number of children aged 18 or below as compared to the mean for the whole country, and have a much higher formal education level than the rest of the Austrian population.

However, there are studies (Brännlund and Nordström, 2004) that show less variation between groups. Brännlund and Nordström (2004) included in their model variables connected to the demography of the household: the number of children of different ages, the number of adults, age of the head of the household, and so on. They have investigated the response of different households to two scenarios; the first one consists of a 100% increase of the CO₂ tax, with a tax replacement in the form of general Value Added Tax (VAT). The second scenario includes a 100% increase of the CO₂ tax, with a tax replacement in the form of lower VAT on public transport. The results show that low-income households will suffer a lower welfare loss than high income households in the first scenario; however, transport behaviours seem to generally change in the same directions for all households. Nevertheless, there are studies that argue that general policies can obtain the desired effect (DeCorla-Souza, 1994), or that targeted policies may have no effect (Anonymous Author, 1999).

Finally, other researchers exclude both general and targeted measures for changing travel behaviours, insisting on “cleaning” the fuels and introducing technical solutions to save energy and reduce emissions (Morris and Cherrett, 2001; Åhman, 2003; Jin and Lam, 2003). This must of course be an important part of the final solution. However, as Carlsson-Kanyama and Lindén state, an interdisciplinary approach is needed. “Our results indicate that changing travel patterns and energy consumption for travel is not just a matter of lifestyle changes, vehicle technology or transportation policy and infrastructure. A multifactorial effort is needed” (Carlsson-Kanyama and Lindén, 1999: 415; see also Ibrahim, 2003). All the variables that belong to these domains must be intercorrelated in a systemic approach, where changing commuter’s travel behaviours is only a sub-system.

2.2. Commuter’s profiles in the literature

As already shown, many authors have characterized the commuters between residential areas and industrial and/or academic centers by taking into consideration the different demographic and socio-economic variables, some already mentioned, but also many more: gender, age, marital status, number of children in the household, employment, income and other⁵ (Hanson and Hanson, 1980; Vilhelmsson, 1988; Turner and Niemeier, 1997; Carlsson-Kanyama and Lindén, 1999; Carlsson-Kanyama et al, 1999; Crane, 2000; Johansson-Stenman, 2002; Ibrahim, 2003; O’Fallon, 2004; and so on). Nevertheless income is, for most of them, a determinant variable, having a major role to play in the choice of the travel mode.

O’Fallon et al (2004) explain that employment status is one of the variables that influence the choice of the travel mode. This seems to be however determinant only when differentiating between people belonging to the

⁵ Nevertheless, it was surprisingly argued that being a member of an environmental organization is a variable that do not play any role in changing the travel behaviours to more sustainable ones (Johansson-Stenman, 2002).

same gender, since Carlsson-Kanyama et al (1999; see also Carlsson-Kanyama, 1999) argue that it is not the difference in employment rate that creates particular travel behaviours for men and women, but a series of other socio-economic factors: differences in the sectors of employment, holding a driving license, income, car ownership, as well as other social and cultural aspects. In their study is shown that men have the most unsustainable travel behaviours in Sweden. During all days of the week, men traveled longer distances than women (Figure 1).

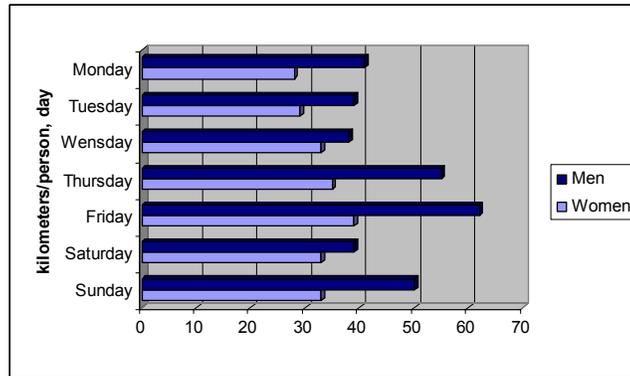


Figure 1. Gender differences in distances traveled in Sweden during 1996, in kilometers per person, according to the days of the week (Statistiska Centralbyrån och SIKÅ, 1996 in Carlsson-Kanyama et al, 1999: 359). Reproduced with author’s permission.

During 1996, men aged 6-64 traveled 18,900 kilometers (km) while women in the same age-group traveled only 13,300 km. This is consistent with Johansson-Stenman’s results (2002), which also show that men have a much larger average driving distance than women, a difference depending both on the average driving distance for those who drive and on a larger fraction of non-drivers amongst women. Furthermore, men traveled longer distances by car than women, who traveled longer distances by public transportation means and also walked longer distances than men, while there was no significant difference between the two genders concerning the distances traveled by bicycle, mopeds or motorcycles (Figure 2) (Carlsson-Kanyama et al, 1999: 358). However, car was the dominant transport mode for both men and women. Furthermore, Hanson and Hanson (1980 in Turner and Niemeier, 1997) argue that the only trip purposes for which men undertook significantly more travel than women were work and recreation⁶.

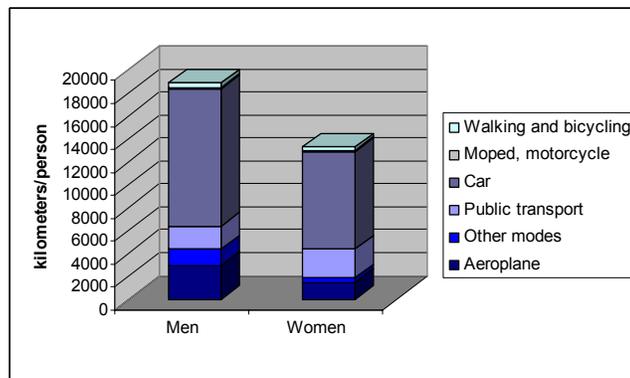


Figure 2. Gender differences in distances traveled in Sweden during 1996, in kilometers per person, according to the mode of transport (Statistiska Centralbyrån och SIKÅ, 1996 in Carlsson-Kanyama et al, 1999: 360)⁷. Reproduced with author’s permission.

⁶ A review of the literature on commuter’s profiles is done by Turner and Niemeier (1997). The most important variables taken into consideration are gender and the number of children in the household, as well as the purpose of the trips.

⁷ “Other modes” include driving a car and being passenger in a car or in a taxi. Public transport includes trains, commuter trains, trams, and buses (Carlsson-Kanyama et al, 1999: 360).

As already stated above, Carlsson-Kanyama et al (1999) argue that gender differences in travel behaviours are the result of the interconnection between a series of variables:

- Holding a driving license. The proportion of the Swedish population aged 18 and above who hold a driving license increased from 78% to 82% from 1990 to 1995, however following a decreasing trend lately particularly amongst young people and women with lower incomes.
- Having access to a car. More people have nowadays access to a car. However, men have higher access to a car because their incomes are higher than women's incomes.
- Income. As pointed above, women have on average lower incomes than men and only a very small proportion of women belong to the high income categories.
- The geographical location of workplaces. Women work more frequently in locations close to the city centers while men work more frequently in locations situated outside city centers, because women work more in care and service sectors, while men work more in industry.
- Other social and cultural aspects – i.e. men more often than women spend their leisure time outside home.

What is also interesting is that, as Johansson-Stenman affirms (2002), it is more likely for people living in the countryside to drive than for the ones living in big cities. As Sweden has not so many big cities, it can be said that it is a country where the rural population represent an important part of the total population⁸. Thus, it is likely that car oriented travel behaviours are preferred in Sweden, according to the above enounced theory.

According to Vilhelmsson (1988 in Carlsson-Kanyama and Lindén, 1999), women more often than men work in places located in or near the city centres, while men's workplaces are often located far away from the city centres. This allows women to use public transport to a greater extent than men, both because the transport system is more developed in city centres and because when trips become shorter, people choose not to drive as far (Crane, 2000). Furthermore, women are the ones that perform the majority of the carrying activities, which keeps them home or very close to the home. Data show that globally women spend on average one-third of their total work time on paid work and the rest on 'unpaid' activities, while men spend three-fourths in paid work and the rest in 'unpaid' activities (UNDP, 1995 in Pietilä, 1997). Women also have part-time jobs or irregular working schedules to a large extent (Carlsson-Kanyama et al, 1999: 362). Furthermore, other authors suggest that men have the tendency of choosing car over public transport "because they consider individualistic values to be important [...] and have a more individualistically oriented lifestyle as well" (Thelander, 1997; Berge, 1996 in Carlsson-Kanyama et al, 1999: 364). Cars are individualistic modes of transportation, because the individual can decide when, where, and with whom to travel. Public transport means are collectivistic means of transport because the individual is dependant on timetables and lines, and cannot choose whom to travel with.

Heggie (1978; also O'Fallon et al, 2004) affirms that it is the stage in the family life-cycle that determines distinct travel characteristics. Thus, six groups are differentiated: young adults, married or not, without children; families with dependent children, the youngest aged 7 years or less; families with dependent children, the youngest aged 8-12 years; families with dependent children, the youngest aged 13 years or more; families of adults; and elderly. Except for the last group, all have members engaged in transport to work; however, their choice of transportation modes for traveling to work – as well as for traveling for other activities – differs, as the author says, according to these stages in the family cycle. For instance, children's activities can stimulate car sharing. O'Fallon et al (2004) also argue that the presence of children younger than 18 years old affects the mode choice, and can determine the preference for traveling by car when transport alternatives are not sufficiently developed. Heggie (1978) appreciates that, in this context, the stage in the family cycle becomes more important than household's income in determining the travel behaviour.

Considering similar variables, Turner and Niemeier (1997) differentiate the commuters between single, married, married with children and not married with children. The results of their research show that both single

⁸ Only 2,252,400 of Sweden's inhabitants live in the 5 "big cities" (cities with more than 100,000 inhabitants): Stockholm, Göteborg, Malmö, Uppsala, and Västerås. Fourteen other cities have between 50,000 and 100,000 inhabitants (Anonymous Author, 2004a). As it can be seen, the majority of the people live in small and medium cities. However, Lund is also to become a big city in the years to come, while Dalby is still a small city, with less than 10,000 inhabitants.

men and single women travel the shortest distances to work; married men with children commute more than married men without children, and men who are not married but have children commute the longest distances to work. Married women who do not have children commute more than married women with children and these commute more than women who are not married but have children. However, women in all categories tend to travel shorter distances to work than men in the respective categories (Turner and Niemeier, 1997: 413). The authors explain this phenomenon by “the household responsibility hypothesis”, which states that “women shoulder greater household responsibility than men and, as a result, choose shorter journey-to-work commutes” (Turner and Niemeier, 1997: 399). Most of the studies (including their own) agree with this hypothesis and indicate that marital status and the presence of children in the household affect women’s work trips by determining women to choose shorter commutes. However, this might also be influenced by the fact that women earn less, have different educational backgrounds, and work in different occupations than men (Blau and Ferber, 1992; Madden, 1981 in Turner and Niemeier, 1997).

O’Fallon et al (2004) show that age is also important, as the tendency to keep using a car is at its maximum around 40 years old. Age is important also because it was determined that the expected annual driving distance reaches a peak at about the age 50. However, the probability of using public transport reaches a peak at about the same age (Johansson-Stenman, 2002).

Ibrahim (2003; see also Heggie, 1978) tests the differences between car owners’ and non-car owners’ perceptions of the transport modes and show that they are significant in many respects. For example, it was found that non-car owners recognize the effects of the car on the environment, while car owners do not. Furthermore, non-car owners have higher perceptions of the public transport modes than those who own a car. However, they also have significantly higher perceptions of the car than car owners, when it comes to certain variables – i.e. waiting time in travel, absence of traffic congestions, or suitability of the car for short distance travel (Ibrahim, 2003: 452); these variables are, however, few.

Thus, car ownership is an important variable that determines the choice of the travel mode; however, household’s income play a decisive role in car ownership; it was said that in Sweden “a 1% increase in household income (per equivalent adult) would increase the probability of having a car by about 0.034%” (Johansson-Stenman, 2002: 962). If applying Ibrahim’s results, this would further increase the positive perceptions and attitudes towards car travel and subsequently will determine the choice for car travel behaviours. Nevertheless, the other variables also positively influence this decision – i.e. gender, age, having a partner with income, and having children (Johansson-Stenman, 2002: 963).

2.3. Why is income so important?

As discussed in the previous section, income⁹ is one of the most important variables when generally discussing environmentally friendly travel choices because it plays a determinant role in the decision upon the travel mode to be used. Johansson-Stenman (2002; see also Levinson, 1999) argues that driving varies with income. Smith and Sylvestre (2001) have shown that income is associated with trip frequency to certain categories of service or activity sites. Carlsson-Kanyama and Lindén also argue that in Sweden “income is highly determinant for travel patterns, as distance traveled seems to be almost proportional to income for both genders” (Carlsson-Kanyama and Lindén, 1999: 408); furthermore, they show that traveled distances connected to work become longer with a higher income (Carlsson-Kanyama and Lindén, 1999: 410; Carlsson-Kanyama et al, 1999: 366). They also explain that, as there is a trend for women to increase their participation in the labour market, the differences in incomes as compared to men are likely to decrease; consequently, the differences in travel patterns are likely to decrease. Their study proved that women’s travel patterns resemble men’s travel patterns in higher income groups, and are dominated by personal car use (Figure 3).

⁹ Individual income was considered for analysis, because in relations where partners’ incomes differ, the one with larger income will most probably use a car, while the one with the lower income will use public transport means (Johansson-Stenman, 2002).

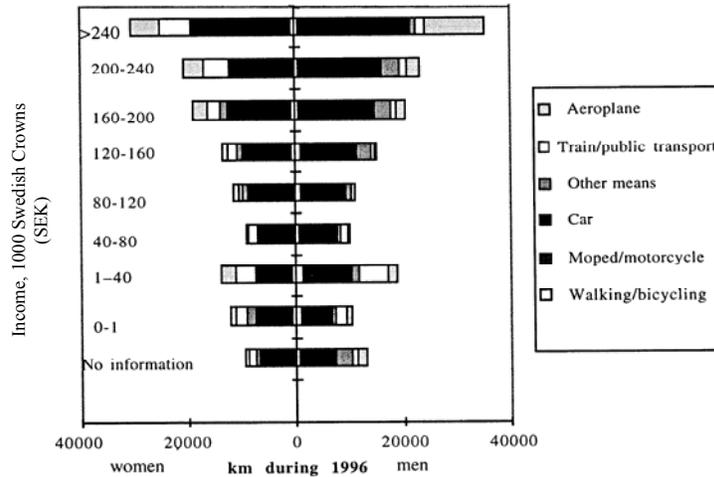


Figure 3. Distances traveled in Sweden during 1996, according to income, gender, and transportation mode (Statistiska Centralbyrån och SIKÅ, 1996 in Carlsson-Kanyama and Lindén, 1999: 409)¹⁰. Reproduced with author’s permission.

Other very interesting findings of Carlsson-Kanyama and Lindén (1999) were that men travel further than women, regardless of income, but men with higher incomes travel further than those with lower incomes. When we consider only car use, the situation is similar. The richest people are the ones who travel the most by car, and the numbers decrease when scrolling down to persons with lower incomes. However, when only considering car use, gender differences seem to be more attenuated. When only considering public transport means, it can be noticed that they are more often used by women than by men, even in the high income groups (Carlsson-Kanyama and Lindén, 1999).

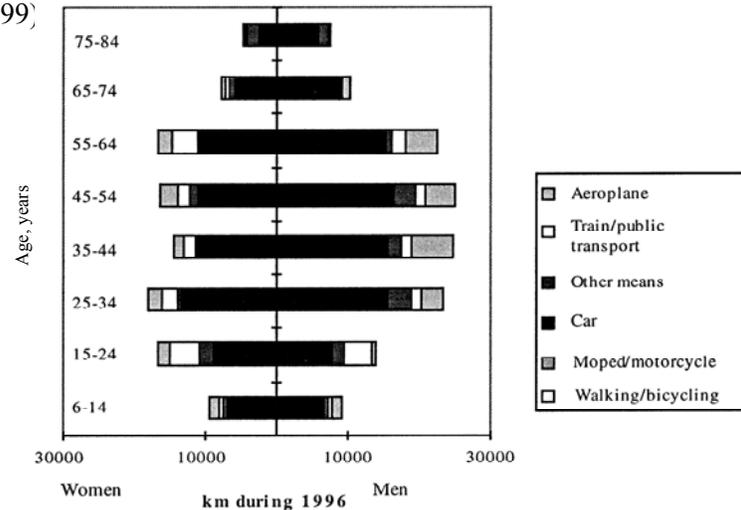


Figure 4. Distances traveled in Sweden during 1996, according to age, gender, and transportation mode (Statistiska Centralbyrån och SIKÅ, 1996 in Carlsson-Kanyama and Lindén, 1999: 408). Reproduced with author’s permission.

Carlsson-Kanyama and Lindén (1999) also show that there is a connection between age, gender, and the traveled distances. Not all age-groups include daily commuters for work. The commuters are to a great extent 25-64 years old adults, even if sometimes young persons, aged 15-24, can also be active on the labour market. It is obvious however that the persons included in the sub-categories comprised in the 25-64 years old age-group

¹⁰ As Carlsson-Kanyama and Lindén explain, the differences for the lower income classes are not very accentuated because the income group up to 40,000 SEK per year mostly comprises children and students who may travel with, or at the expense of, their parents (Carlsson-Kanyama and Lindén, 1999).

make extensive use of cars as compared to the other age-groups (Figure 4). Thus, when considering only the travel for work, age is indirectly a determinant for the distances traveled and its action is mediated by another variable: employment.

Income is also important because it can be considered a stimulus for changing travel patterns. Travel costs, as Kölbl and Helbing affirm (2003) are assumed to be determinant for modal choice. When considering the available travel choices between Dalby and any close big city, it seems that changing travel behaviours from using personal cars to using public transport could also contribute to an increase in peoples' savings. A return ticket from Dalby to Lund, for example, was 22 Swedish Crowns (SEK) in 2003 (17.6 SEK when using the discount card) and 24 SEK in 2004 (19.20 SEK with the discount card) – which is equivalent to 528 SEK per month for 22 days of traveling to work. However, it is possible to use a monthly card which reduces the costs to only 430 SEK for 30 days (450 SEK in 2004) (Skånetrafiken, 2003: 7; Skånetrafiken, 2004a: 11). When using the personal car, however, the costs are much higher. There are approximately 12 km from Lund's center to Dalby (Lunds Kommun, 2004a). A car consumes roughly 1 liter of petrol for 10 km (Anonymous Author, 2004b), which means that a person who commutes every day from Lund to Dalby for work needs 2.4 liters of petrol per day, meaning 52.8 liters of petrol per month (when only considering work trips) – equivalent to 535.9 SEK in monthly spending, as a liter of petrol costs 10.15 SEK (Taubert, 2004). When adding car price, maintenance costs¹¹ and the costs for other trips (i.e. leisure trips), this number is likely to be much higher. In Sweden, leisure trips account for more than 50% of all travel, while only about 25% of all travel is to and from work; furthermore, travel by car is often used for leisure-time activities, as many destinations may not be easy reachable by public transportation (Carlsson-Kanyama and Lindén, 1999: 409). If this problem is overcome, bus travel could become more attractive because it would allow consistent savings for a family, as with a monthly card a person could travel for both work and other activities, and also save the money otherwise spent to buy and maintain a car. However, there are other variables that determine the choice of the transport means, as accessibility, frequency of bus travel, duration of the trip, comfort, and so on, as it will be further shown.

2.4. Public transport as a service product. A model of car and bus travel determinants

As Lindén and Kanyama argue, public travel is a service product that aims “to serve as many people as possible with the same service standard irrespective of gender, age or income” (Lindén and Kanyama, 2004: 2), and is composed of a series of qualities that the customer desires to be fulfilled. There are five aspects of this product that the customer checks upon before making a decision, denominated as “added qualities” (Lindén and Kanyama, 2004: 14; see also Recker and Stevens, 1976 in Ibrahim, 2003): the timetable (perceived as the scheduled frequency of the bus trips); the quality of the bus stand; the characteristics of the vehicle (the standard of the vehicle, safety aspects, crowdedness, price, driver and/or conductor behaviour); direct route to the final destination or possibilities to change vehicle; and timetable for the return trip. Other authors have added supplementary qualities to these, as for example accessibility, perceived as the closeness of the bus stops from the departure and arrival points (home and work) (Litman, 2003). “Car added qualities” refer to similar characteristics for cars, as for example the possibility to travel at any time, to any place, to have privacy, and do different activities while driving (i.e. listen loudly to music). There are not only these added qualities that determine the attractiveness of traveling by bus or by car, but other variables, the most important being gender and income, as it will be shown. System analysis (Causal Loop Diagrams (CLDs) and Reference Behaviour Patterns (RBPs)) will be used to describe the network of variables that determine the individual to choose between traveling by car and traveling by bus.

Figure 5 shows the initial situation, previous to the occurrence of the problem. As only persons of working-age have been considered, it can be argued that age varies in the same direction with income. Income's initial value is assumed zero. When income increases, travel by bus becomes firstly more affordable. This increases the positive perceptions and attitudes towards traveling by bus, which subsequently increases traveling by bus. As

¹¹ For more details, see Carlsson-Kanyama et al, 2002.

Ibrahim argues (2003), travelers’ attitudes are correlated in a significant positive way with their behaviours. Many other authors also argue that, even if not in all cases, generally there is a strong connection between intentions/attitudes and behaviour, in the sense that the former determines the latter (Tischer and Dobsen, 1979; Tischer and Phillips, 1979 in Baldassare et al, 1998).

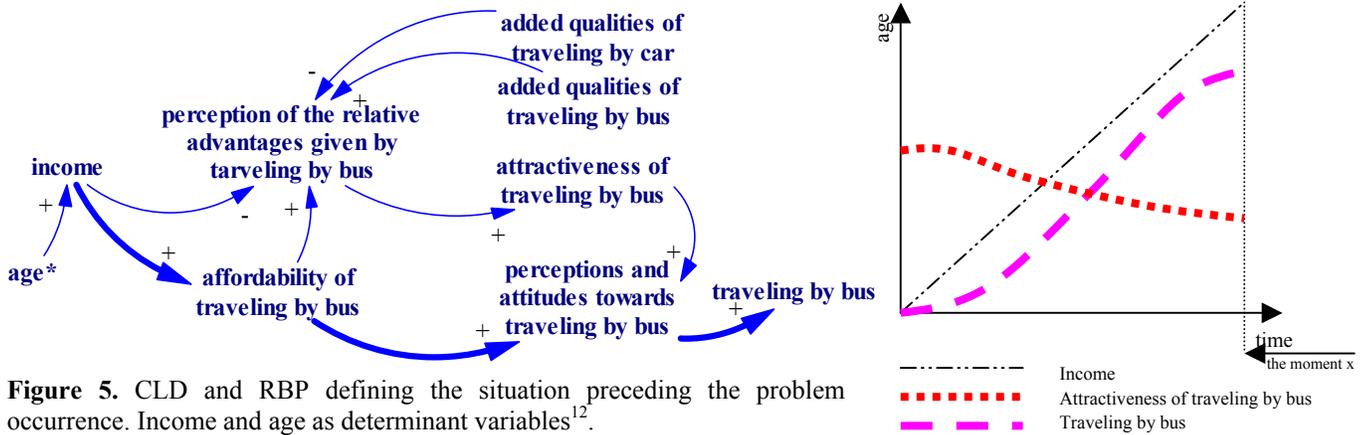


Figure 5. CLD and RBP defining the situation preceding the problem occurrence. Income and age as determinant variables¹².

* As only persons of working-age are considered (20-64 years old), the relation between age and income is assumed to be of direct proportionality.

Meanwhile, affordability of traveling by bus increases the perceptions of the relative advantages given by traveling by bus as compared to the car. People always evaluate comparatively the advantages of traveling by bus with the advantages of traveling by car. When the income is low, this comparative evaluation is in favor of bus travel, because the perceived costs of traveling by bus, especially when none of the members of the household owns a car, are lower than those of traveling by car. This perception of the advantages increases the attractiveness of traveling by bus, which varies in the beginning in the same direction with the perceptions and attitudes towards bus travel. It can be noticed however that there is an inverted relation between income and the perception of the relative advantages of bus travel. This link indicates that traveling by bus should decrease. However, in this phase, when income is low, the other connection, already discussed (and emphasized in the CLD in Figure 5) is dominant, leading to the preference for bus travel. Nevertheless, when income is high enough, the attractiveness of bus travel begins to decrease slowly to the moment x.

“The moment x” is defined as the moment when this situation changes in favor of traveling by car (Figure 6). The situation described in the CLD in Figure 5 is now added for the preference for car travel (see the CLD in Figure 6). After the moment x (which can be identified with the moment when the potential expenditures brought up by car travel become lower than a certain level of the income, i.e. 10% of the personal gross income), the inverted relation between income and the perception of the relative advantages given by traveling by bus is converted into a dominant one, leading to a fast decrease of the attractiveness of bus travel and subsequently a decrease in traveling by bus. Dominant becomes also the connection between income and car travel behaviours, which is eventually expressed in an increase of car travel behaviours, defining the problem taken in consideration by this thesis. As it can be noticed in the RBP below, car travel increases short after the attractiveness of car travel increases. Meanwhile, between traveling by car and traveling by bus a reinforcing

¹² The variables in the CLDs are connected by arrows; the arrows signify a relation of determination between two variables.

A positive arrow signifies a variation in the same direction. A negative arrow signifies an inverted variation. **B** signifies that the indicated loop is a balancing one, meaning that the variables change their behaviours after going through the entire loop. **R** signifies that the indicated loop is a reinforcing one, meaning that the variables do not change their behaviours after going through the entire loop. The RBPs represent the predicted behaviours of certain variables, in accordance to the CLDs.

loop is formed, of mutual exclusion: when one increases, the other decreases. Even if a similar loop could be formed between the perception of the relative advantages of traveling by bus and by car, this relation has not been indicated in the CLD, because it is not generally applicable and it is still questionable.

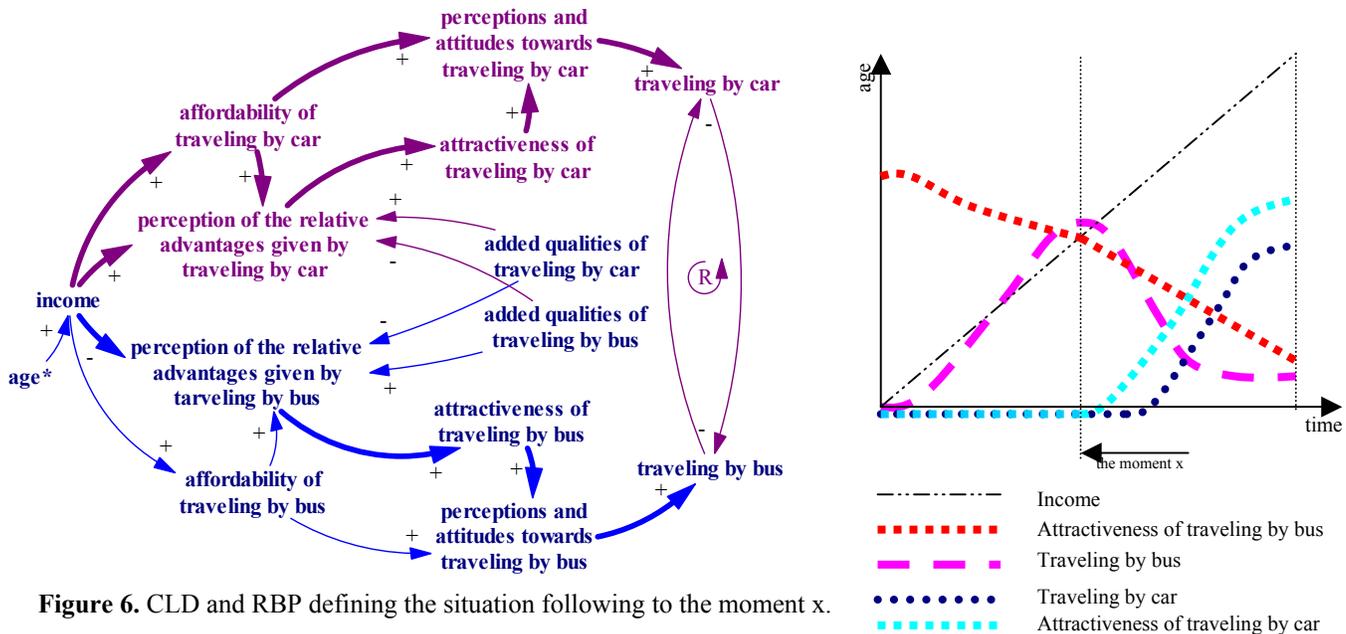


Figure 6. CLD and RBP defining the situation following to the moment x.

As shown by many authors (see subchapters 2.2., 2.3.), income has one major determinant: gender. As it was discussed, females’ incomes are generally lower than males’. Consequently, up to a certain income level, males are more likely to travel by car than females, who are more likely to travel by bus. If we consider that the RBP in Figure 6 represents males’ behaviour, the one for females’ behaviour would have the same trend, but increasing/decreasing later (moved to the right) and slower as compared to the one for males’ behaviour. However, for higher incomes the behaviour for the two genders is almost similar.

Gender is also a determinant for the probability that a person works in the city center or outside city center, as usually women belong to the former category and men to the latter. Working outside the city center determines traveling by car to appear as more attractive. Thus, owning a car becomes “a must”. Developing outside home leisure activities, another characteristic of the masculine behaviour, has the same effect (Figure 7). Meanwhile, together with the increase of the income also occurs the necessity of having a car as a symbol of the personal status. The perceptions and attitudes towards car and bus travel increase and, respectively, decrease when acquiring a car. Thus, gender indirectly determines travel behaviours by also following a path separate from income. The trends in the RBP for this scenario are similar to the one in Figure 6, with the difference that the increasing trends increase faster and the decreasing trends decrease faster after the moment x.

Other variables could also enter the scene when discussing a scenario for the female gender. The number of children in the household varies in direct proportionality with the probability for the mother to work in city centers, to travel less or not at all for leisure activities, but also with the probability of owning a driving license and a car, as the presence of children of non-working age in the household can determine driving-oriented travel behaviours. Age also influences the number of children of nonworking age in the family, because when the parents grow old, the children naturally become mature and enter the labour market.

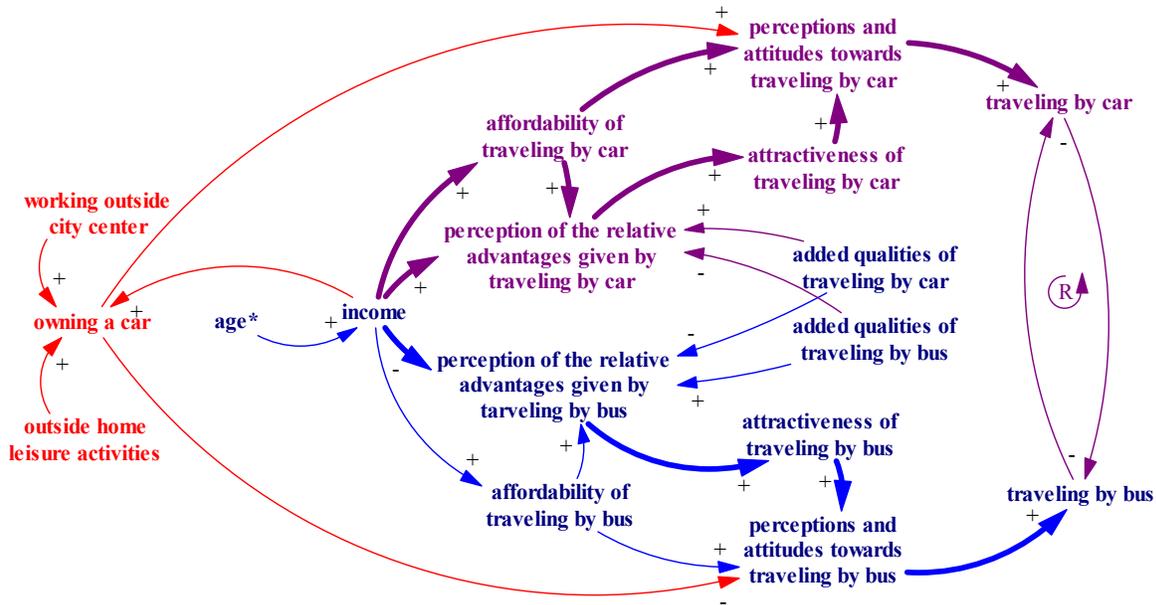


Figure 7. CLD for the situation when new variables are introduced in the model.

To show how the predicted behaviour is influenced by income, a situation of unemployment is introduced at the moment t_1 (Figure 8).

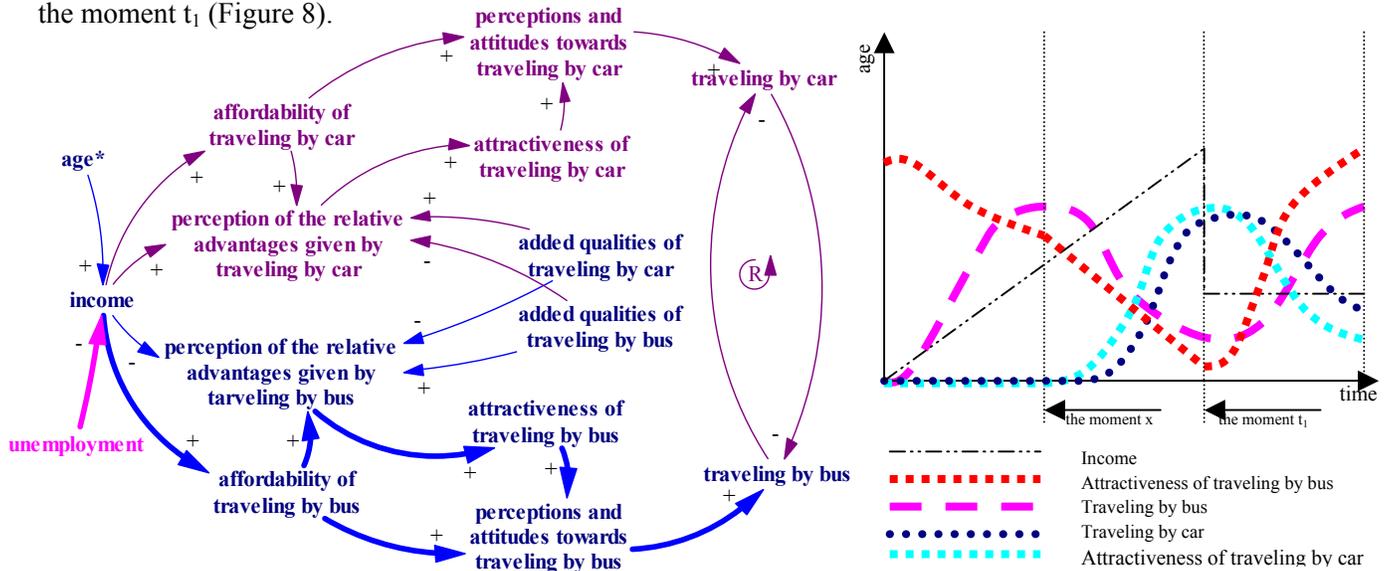
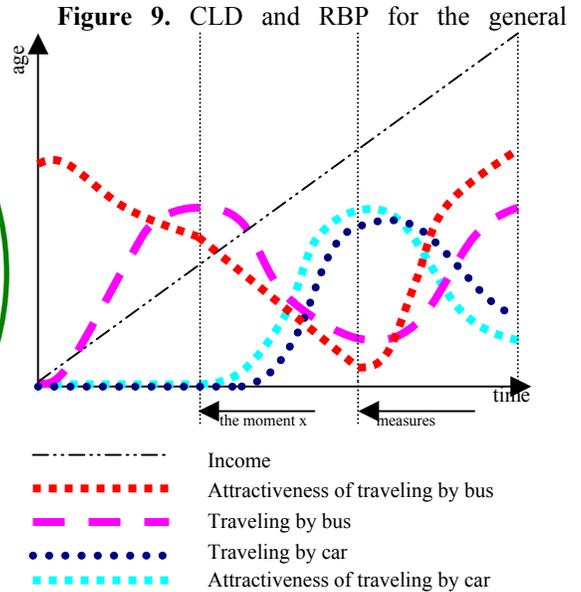
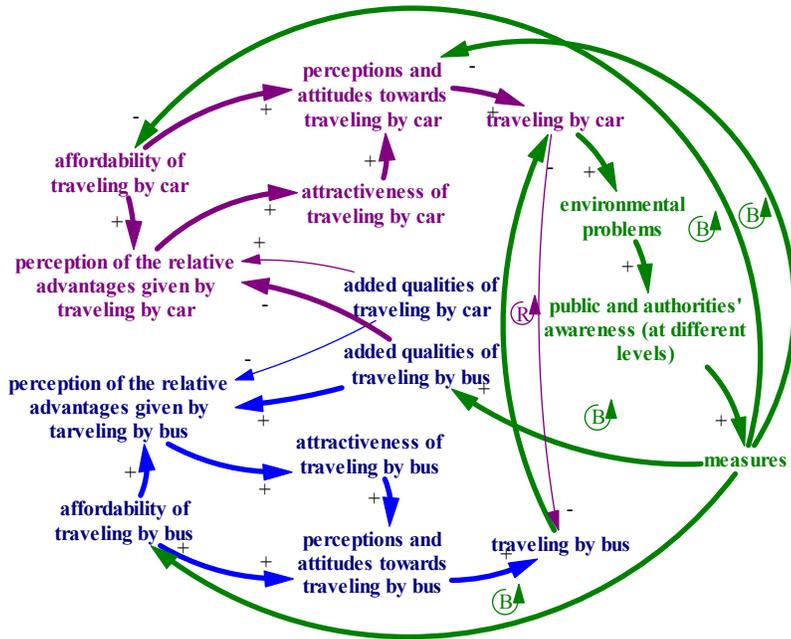


Figure 8. CLD and RBP for the situation when unemployment intervenes at the moment t_1 .

This scenario assumes that the monthly income drops after the moment t_1 and stays constant at a low level. Consequently, the connections dominant in the first case (the lowest income scenario) become again dominant after the moment t_1 . The attractiveness of traveling by car begins to decrease at the moment t_1 ; however, traveling by car as behaviour only begins to decrease a while after the moment t_1 because of the differences in phase (see the CLD in Figure 8) and also because the habits (traveling by car) are more difficult to change rapidly. Consequently, even if the attractiveness of car travel drops significantly, traveling by car does not follow the same drastic decrease. Similarly, the attractiveness of traveling by bus begins to increase at the moment t_1 (because of the financial situation); however, even if the attractiveness of bus travel increases (mainly

because of the financial situation), bus travel behaviours do not increase immediately and to the same extent because the same problem of the habits occurs.

The solution to the increase in car use is represented in Figure 9.



situation expected to occur when introducing different policies as measures to decrease car travel.

When traveling by car reaches a certain limit, many phenomena determined by this unsustainable behaviour begin to be perceived as problems requiring solutions. For example, when many people commute from Dalby to Lund by car, Lund becomes overcrowded because of the high number of cars in the city and air pollution level increases. This increases authorities' awareness for the necessity to take measures; consequently, Lund's municipality may decide to increase parking fees in Lund, in order to decongestion the city center. However, the measures differ according to the specific problem taken in consideration (see Chapter 7). Thus, the authorities involved in the process are also different. For example, the high energy consumption and the high levels of CO₂ emissions may be considered problems that request governmental intervention, through, for example, taxes on exhaust emissions.

As explained, these measures cannot be targeted to changing the demographic or socio-economic characteristics of a person – it is impossible to change peoples' genders and illogical to lower their incomes so to reduce car travel; moreover, as women's incomes tend to increase, their travel behaviours tend to resemble men's travel behaviours more and more. The measures must be targeted to other variables. The model in Figure 9 indicates as target variables for the transport policies: the affordability of traveling by bus; the affordability of traveling by car; the added qualities of traveling by bus (which subsequently influences the attractiveness of traveling by bus and the attractiveness of traveling by car); and the perceptions and attitudes towards traveling by car. Thus, the measures are targeted to variables that are both external (the costs of traveling by car) and internal (the perceptions and attitudes towards traveling by car) to the individual (see Chapter 7). However, the problem is that a certain measure will not affect traveling by car for all Dalby's car commuters, but only for the ones belonging to certain groups. It is the aim of this thesis to discuss which are these groups and which are the main variables that determine more sustainable or unsustainable travel behaviours for the particular case of Dalby, the locality chosen for analysis.

The presented model has a series of assumptions and limitations, some of them already described; the others are mentioned as it follows:

- The aim of the model, as also the aim of the thesis, is not to discuss in detail the impact of the various transport policies on the population, but to discuss which are the groups that may have different travel behaviours and that may be differently affected by various policies; this is the step before testing the effect of the policies on these groups and it is also important for the policy makers. This limitation is mostly determined by the space and time limitations requested for the thesis. However, a short discussion upon the viability of some of the policies is done in Chapter 7.
- The relation between perceptions/attitudes and behaviours is one of mutually dependence, more complex than represented here (Reibstein et al, 1980); nevertheless, for simplification the relation is considered as unidirectional; when also considering the reversed relation, a reinforcing loop would be created; however it would not significantly influence the other variables of the model.
- Only cars and buses have been considered as alternatives for daily transportation; other motorized alternatives do not exist yet in the analyzed area, and biking is difficult most of the year because of the considerable distance between Dalby and Lund (12 km) and the weather in Skåne. Furthermore, because of the need to narrow down the analysis, increasing the number of people traveling together in the same car and carpooling/carsharing have not been considered, remaining for a future work to also extend the discussion upon them.
- It was assumed that car travel added qualities and bus added qualities have the same value and do not change over time (without policy makers' intervention) and that in the beginning the attractiveness of bus travel is high as the income is low, and the attractiveness of car travel is zero. Traveling by car and traveling by bus are also zero in the beginning.
- Income has a linear increase during the years, starting from zero.
- Some of the variables are not mentioned in the CLDs (i.e. the number of children under 15 years old in the family); however, their influence on the other variables is explained in the text. Meanwhile, the CLDs presented represent only part of the general CLD describing the situation.
- Gender does not occur in the CLDs and RBPs not because it is not a main variable, but because it is a dichotomic variable that cannot vary with the time or with any other variable, thus not allowing the representation of a relation of variation.
- Other variables that could influence travel behaviours have been on purpose excluded from the model for different reasons – i.e. education or the role of the infrastructure (both excluded because of the need to narrow down the subject of analysis); however, the author is aware that the model represented above is only a subsystem of the system representing the possible solution for a sustainable transportation system in South-Western Sweden.
- Furthermore, only the significant connections have been represented, in order to avoid confusion; other connections can also be identified, but their influence has been considered as of lower importance.

2.5. Problem formulation

The model described in the CLDs in subchapter 2.4. expresses the empirical problem analyzed by this thesis. Dalby, a small locality in Skåne¹³, is situated in the vicinity of three big cities in Sweden (Malmö, Lund, and Trelleborg). It is a “satellite” locality, mostly residential – where most of the people only reside, but where they do not have many possibilities to work. As Levinson states, “the suburbanization of housing in absence of the concomitant suburbanization of jobs would surely have led to an increase in work travel duration” (Levinson, 1999: 143). This is the phenomenon that motivates this thesis: subsequently to the development of Dalby as a residential “satellite” city, the travel for work-related purposes from Dalby to other localities has increased.

The problem not only consists in the increase of the travel for work-related purposes, but in the preference for car travel. As shown before (subchapter 2.1.1.; see also subchapter 5.5.), car travel can be considered as

¹³ Skåne is the province situated in the very South of Sweden, in the close vicinity of Denmark, Germany, and Poland. Dalby can be considered a “satellite” (Miller, 2004: 682) of Lund, as it is situated in Lund's vicinity, at a 12 km distance.

unsustainable as compared to bus travel. However, it is not only the lack of workplaces in Dalby that determines this car-oriented travel behaviour, but also the fact that there is no other alternative to travel to Lund than bus, car or bike. Biking is not a viable choice for a long period of the year because of the distance and weather, while the timetable of the buses is frequently considered as unsuited (because of the long intervals between rides or because of extremely rare rides during evenings and weekends (Skånetrafiken, 2004a)); these are some of the determinants of the preference for car travel. However, they are not the only ones. As shown before, the demographic and socio-economic characteristics of the people are also important.

Thus, people traveling by car are expected to have specific demographic and socio-economic profiles. As already shown by other authors, men with high incomes show the strongest tendency towards car use. People owning driver's licenses and cars are more tempted to use them than people not owning driver's licenses and cars. Furthermore, members of families with children younger than 15 years are more inclined to buy and use a car for multiple purposes, including work. Traveling outside the residential locality for leisure activities is also connected to car driving, as shown above. All these variables are interconnected and they influence the preference for car travel or bus travel, together with the perception of the relative advantages given by traveling by bus and by car. But which are the most important determinants in South-Western Sweden? This is what this study aims to identify.

In attempting to explain the differences between commuters by car and commuters by bus, the questions to which the research will try to answer are focused on:

- Can it be identified a tendency for the commuters from Dalby to Lund to travel more by car than by bus for work related purposes, on the basis of their general demographic and socio-economic characteristics?
- Do the commuters by bus from Dalby to Lund, for work related purposes, have different demographic and socio-economic characteristics than the commuters by car?
- Is income a central variable that influences the choice of traveling by bus or by car to work?

A considerable part of Dalby's commuters are believed to manifest a tendency to travel by car for work related purposes. However, because of the lack of both human and financial resources, it is more difficult to analyze this part of the population. Therefore, this thesis will firstly discuss the general present demographic and socio-economic characteristics of Dalby's inhabitants in a regional context; secondly it will depict the specific characteristics of the commuters from Dalby to other localities, by bus, for work related purposes, through a field study. These characteristics are subsequently compared to the ones depicted for the total population residing in Dalby and in other regions in South-Western Sweden, in order to find and discuss similarities and differences and in trying to identify which of these characteristics can be connected with the preference for car or bus travel.

There are two hypotheses that the research will test. They both refer to the connection between commuter's profiles and their choice of transportation mode for work-related trips:

- Hypothesis 1: Car users and bus users have different demographic and socio-economic characteristics, and also different reasons for motivating their choice of traveling by bus to work.
- Hypothesis 2: Income is the one of the main variables that determines travel behaviours. The lower the income, the higher the probability for the commuters to always choose bus over car as transportation mode for traveling to work.

Thus, by taking the form of an explanatory analysis, this study will test if car users and bus users have different demographic and socio-economic profiles. In this way it can be checked if what other authors have already shown is also true for South-Western Sweden. If this proves true, the policies that should be implemented in order to change people's travel behaviours from using cars to using buses (or other environmentally friendly transportation modes) must be specially designed for the most unsustainable groups, because general policies have lower chances to conduct to the desired results. The policy makers must know which are commuters' profiles in order to apply these targeted measures and to obtain the desired results.

Chapter 3. Methods and Material of Research

The research phases followed by this study have been described by Sarantakos (1998). Table 2 presents them together with the positioning of the discussion upon these steps in the present thesis. This chapter will look upon the methodology of the research and the operationalisation of the concepts used in the hypotheses.

Table 2. The research phases of the present study.

Phase	Elements	Positioning and discussion in the thesis ¹⁴
Preparation	Selection of the research topic	Chapter 1, subchapters 2.1., 2.4., 2.5.
	Selection of the research methodology	Chapter 3
	Formal definition of the topic	Subchapters 2.2., 2.3., 2.4.
	Exploration	Subchapters 2.1., 2.2., 2.3.
	Operationalisation	Chapter 3
	Formulation of hypotheses	Subchapter 2.5.
Research design	Selection of sampling procedures	Chapter 4
	Selection of methods of data collection	Chapter 3
	Selection of methods of data analysis	Chapter 3, 5, 6
	Arrangement of administrative procedures	Chapter 4
Data collection	Data collection	Chapter 4
Data processing	Grouping and presentation of data	Chapter 5, 6
	Analysis and interpretation of data	Chapter 5, 6, 7
Reporting	Publication of findings	-

Data source: Sarantakos, 1998: 100.

Statistical data and survey data have been used as material for research in this study. The first set of data has been obtained from already existing documents and statistical databases (Lunds Kommun's Statistics, City of Malmö's Statistics, Trelleborgs Kommun, Statistics Sweden, and Skånetrafiken) and through e-mail interviews with key persons (Bengt-Åke Leijon, responsible with statistics on Lunds Kommun for Lunds Kommun and on Skåne for Statistics Sweden). These data have been used as empirical material for two purposes: firstly, for analyzing the present characteristics of Dalby in a regional context in order to show the presence of many factors that may increase the probability for Dalby's inhabitants to choose car over bus for their work related trips. Secondly, these data have been used for comparison when analyzing the results obtained through the survey. The field methods combine elements of quantitative and qualitative research, as both quantitative (i.e. demographic data, or data upon incomes, obtained through using questionnaires) and qualitative data (obtained through using interviews with the commuters) were collected. The data obtained supply information for testing the hypotheses already mentioned above. Table 3 provides the operationalisation of the concepts used in the hypotheses, on which the questionnaire is grounded.

Table 3. The operationalisation of the concepts used in testing the hypotheses.

Concept	Definition	Indicators	Indexes
Income	Personal gross income per year	Personal gross income per month*	- < 12,000 per month** - 12,001-16,000 per month - 16,001-20,000 per month - >20,001 per month
Main variable	The variable that influences the most the decision of choosing car	- gender	- woman - man

¹⁴ Some of the steps of the research are not presented in the thesis in the order specified by Sarantakos, because the author has considered that the present order of discussion would insure a better fluency of the thesis.

Concept	Definition	Indicators	Indexes
	variables (including income)	- age	- < 15 years old - 15-19 years old - 20-24 years old - 25-59 years old - 60-64 years old - > 65 years old
		- having children younger than 15 years	Dichotomic question (yes/no) Open question for the number of children
		- having driver's license	Dichotomic question (yes/no)
		- owning a car	- having own car - having car in the family - not owning a car
		- house's type of contract	- rental contract - cooperative housing contract - ownership/single family house
		- house's number of rooms (excluding the kitchen)	Open question
Transport behaviour	Using car/bus to commute for work related purposes	Using car/bus to commute for work related purposes	- traveling always by bus - traveling sometimes by bus - traveling always by car - traveling sometimes by car
Commuters	People aged 20-64 residing in Dalby, who commute for work-related purposes from Dalby to other localities (Lund)	-	-
The probability of always choosing bus over car as transportation mode	The percentage of people choosing to always travel by bus	The percentage of people choosing to always travel by bus	See Chapter 6
Bus users	People always commuting by bus	People always commuting by bus	See Chapter 6
Car users	People only sometimes commuting by bus	People only sometimes commuting by bus	See Chapter 6
Demographic characteristics	Demographic characteristics	Demographic indicators (see above)	- gender - age
Socio-economic characteristics	Socio-economic characteristics	Socio-economic indicators (see above)	- income - having children younger than 15 years - having driver's license - owning a car - house's type of contract - house's number of rooms (excluding the kitchen)
Reasons for traveling by bus	Why do people travel by bus to work	Different reasons for people to travel by bus to work	- it is comfortable - it is cheap - it fits with the working schedule (hours) - it is good for the environment - having no car - the husband uses the car Open question for other

Concept	Definition	Indicators	Indexes
			alternatives
Workplace***	Name of the workplace	Name of the workplace	Open question
The locality where commuting for work***	The name of the locality where the workplace is situated	The name of the locality where the workplace is situated	Open question

* The personal annual gross income is obtained from the monthly gross income multiplied by 12.

** The income is expressed in SEK. The limits for each group were approximated on the basis of the annual amounts per year: <150,000; 150,000-200,000; 200,000-250,000; >250,000 SEK.

*** Supplementary variables used in order to analyze the results.

The interview is the third method used for research in this study. Interviews with the commuters were considered important because, as Brieschke states, “reality cannot be defined objectively but subjectively: reality is interpreted social action” (Brieschke, 1992 in Sarantakos, 1998: 43). The interviews have been individual, personal, oral, unique, and semi-structured (Sarantakos, 1998; Chelcea, 2001) (see Appendix 1), and they have been used in order to catch the personal interpretations and variations of the data obtained through applying the questionnaires.

Chapter 4. The Fieldwork: Collecting the Data

As stated in the previous chapter, the second set of data has been obtained through a survey. The survey has been realized between 14 and 27 October 2004. The questionnaire/interview guide has been applied to commuters at all times of day, but especially in the morning and in the evening, when more commuting is more intense. They have been pre-tested on a number of 15 persons and then applied to a number of 117 respondents. As both human and financial resources did not allow, a representative survey could not be realized. The respondents have been chosen from the persons commuting by bus from Dalby to Lund for work; thus, a focused sample has been created.

By choosing a target group (the commuters from Dalby to Lund traveling by bus to work) and thus creating a focused sample, the survey has the advantage that it offers information specific for the members of the respective group (commuters by bus); when choosing a random sample, people that the study is not interested in could enter it. Meanwhile, sample’s size has been chosen big enough to allow a proper analysis of the data collected. According to Krejcie and Morgan (1970 in Sarantakos, 1998: 163) when the population is of approximately 2,600 persons the number of persons included in a sample must be of approximately 350. The number of commuters from Dalby to other localities for work is of 2,726 (see Table 4). But the number of commuters to Lund is lower, and furthermore the number of commuters by bus to Lund is even lower, as there are many people commuting by car. Thus, a number of approximately 120 persons has been considered as suited. Therefore, even if the conclusions cannot be extrapolated to the total population (Dalby’s commuting population), they can describe the profiles of the commuters by bus from Dalby to other localities for work-related purposes, and can even, as it will be seen, differentiate between commuters who travel always or only sometimes by bus.

Due to the limited time the respondents could allow to answering the questions, the most viable option has been to apply a short questionnaire in Dalby’s main bus station in the morning when working persons leave to Lund for work and in the afternoon in Lund’s main bus station where people can take the bus to Dalby. The questionnaire has been self-administrated by the respondents, as it mainly consists of identification questions, both with close and open answers (Appendix 2; see also Chapter 3).

The interviews have been realized with those commuters who showed that they had time and interest for further discussion. However, commuters belonging to both genders and to different age groups have been chosen. The interview questions have been applied by the interviewer, but as the interview guide (Appendix 1) is mainly composed of semi-structured questions, the discussion has been almost free, increasing the amount of information obtained through this method.

However, a series of difficulties have been encountered:

- In the beginning the commuters were approached in the bus stations. Because they used to come only shortly before their bus left, the time they could allow to answering the questions was very limited, sometimes not permitting them to fill in the questionnaire. Furthermore, this method could only provide a limited palette of data, since it allowed only short responses to the interview questions. More time has been allocated when switching to using the bus as the place to apply the questionnaires and interview the commuters.
- Weather was another impediment, which was also counteracted by using the bus as the place to apply the questionnaires.
- Most of the commuters leave for work between 6,30 and 8,30 in the morning and return to Dalby between 4,30 and 6,30 in the evening; outside these intervals more than 50% (sometimes 90%) are pupils going to school; furthermore, the buses for the three lines that connect Lund to Dalby come approximately in the same time and the commuters come shortly before their bus leaves. Thus, it was difficult to apply a high number of questionnaires/interviews in the same day; however, this impediment was also partially counteracted by using the bus as the place to apply the questionnaires; nevertheless, bus timetable seemed to represent a problem for both the author and the subjects of this study (as it will be discussed in Chapter 7).

The refusal rate has been of 10.25%, with 12 refusals and 117 completed questionnaires. Most of the persons who refused were women (8 persons). However, all the persons who refused were approximately 45-55 years old. Only one suggested the motive of refusal, by asking why is income important for the research. However, the refusal rate can be categorized as very good for this kind of research, as the sociological development today shows that the refusal rates tend to increase to 40-45% of the interviewed number of people (Lindén, 2004, personal communication).

The results of both the survey and the interviews are presented and analyzed in Chapter 6. Chapter 5 presents the discussion upon the statistics on Dalby and other regions in Skåne, in trying to identify if Dalby's inhabitants are likely to make extensive use of cars for work related purposes.

Chapter 5. Results and Discussion: Dalby. National, Regional, and Local Contexts

5.1. Demographic characteristics

The demographic characteristics of the population have an important influence on the travel behaviours. As Reddy (2000) states, an increase in population's number is important because it is likely to be accompanied by an increase in the number of cars in the respective region. As we have already seen, owning a car is positively correlated with positive perceptions towards car use; these lead further to car oriented travel behaviours (see subchapter 2.2.), which is subsequently likely to increase both local and regional car use.

Dalby, the locality that we considered for analysis, is characterized by an increase of the population number, as the other localities and regions in Sweden. As of 31 December 2003 Dalby had 7,180 inhabitants, a number predicted to increase to 7,595 until 2008 (Lunds Kommun, 2004c) since the internal migration from the big cities towards suburbs will continue in the following years and due to the further natural increase of the population (Reddy, 2000). Furthermore, an increase of the population has been registered in all Sweden's regions, and according to the predictions for the year 2050 this trend will continue (Statistiska Centralbyrån, 2004k). This increase in the total population also characterizes each age group, including the working-age group (20-64 years old) (Table 4).

The population of working age is of special importance because it constitutes the potential daily commuters for work purposes. Out of the total population, in Dalby there are 4,147 persons aged 20-64 years, a number that is foreseen to increase to 4,311 in 2008. The population of 20-30 years old is lower in relative numbers than the same age-group in Lunds Kommun, but the youngest group contains more people in relative terms and will soon add a significant number to the working-age group (Lunds Kommun, 2004c). Only from this rapid look at the

below table one could suggest that commuting behaviour should register a low occurrence in Dalby, as only 58% of Dalby's inhabitants are of working age, a lower number when compared other localities/regions. However, the phenomenon must be regarded from a systemic perspective; indeed the number of persons of working age is lower in relative terms than in other localities/regions in Sweden, but a bigger percent of these persons commute for work, determined by various factors (already mentioned above (subchapter 2.2.)). Out of the total population, 2,726 persons commute every day from Dalby to other localities for work. This number represents 66% of Dalby's population of working age (20-64 years old), as compared to only about 23-26% for Lund and Lunds Kommun (Lunds Kommun, 2003a). Dalby is a town big enough to live in for a short time, considering the supply of services, but when it comes to workplaces most of the inhabitants have to commute to other cities in the region. *I have chosen Dalby because it is big enough to have grocery, systembolaget and kindergarten, other localities don't have and you have to commute whatever you want to do. However, you cannot live in Dalby more than one day without having to commute. (Male commuter, 25-59 years old)* As there are many places like Dalby in the region, commuting for work seems to represent a phenomenon in South-Western Sweden.

Table 4. Demographic characteristics for the people living in Sweden, Skåne, as well as in other areas and cities in Skåne*.

Demographic Characteristics	Year	Dalby	Lund	Malmö	Trelleborgs Kommun	Lunds Kommun	Skåne	Sweden	
Population**	Total	2001	7,080	76,670	262,397	38,576	99,622	1,136,571	8,907,543
		2003	7,180	77,543	267,171	39,110	100,995	1,152,697	8,975,670
Population by gender**	Men	2001	3,525	37,698	126,475	19,106	49,144	557,733	4,406,455
		2003	3,577	38,181	129,307	19,359	49,867	566,871	4,446,656
	Women	2001	3,555	38,972	135,922	19,470	50,478	578,838	4,501,088
		2003	3,603	39,362	137,864	19,751	51,128	585,826	4,529,014
Population by age***	Total 20-64 years	2001	4,095 (58%)	51,280 (67%)	158,873 (61%)	22,179 (57%)	64,769 (65%)	666,131 (59%)	5,236,224 (59%)
		2003	4,147 (58%)	52,058 (67%)	162,681 (61%)	22,364 (57%)	65,729 (65%)	667,552 (59%)	5,282,126 (59%)
	Men 20-64 years	2001	2,031	26,003	79,918	11,081	32,755	335,430	2,656,814
		2003	2,066	26,399	81,397	11,318	33,231	341,169	2,680,288
	Women 20-64 years	2001	2,064	25,277	78,955	11,098	32,014	330,701	2,579,410
		2003	2,081	25,659	81,284	11,046	32,498	336,383	2,601,838
Daily commuters for work from the city/region****		2002	2,726 (66%)	13,707 (26%)	~	~	15,189 (23%)	~	-

~ Data not known.

* Almost all the percents in this study have been rounded off towards the closest whole number to increase the readability of the data.

** In parenthesis, the year, for the information for which the year differs from the other in the same category.

*** In parenthesis, the proportion of persons in the respective group, out of the total population.

**** In parenthesis, the approximate proportion of persons in the respective group, out of the population of working age.

Data sources: City of Malmö, 2004; Leijon, 2004, personal communication; Lunds Kommun, 2004c; Statistiska Centralbyrån, 2004a,c,d,e,f,l,m; Trelleborgs Kommun, 2004.

Thus, as shown in Table 4, commuting (especially commuting for work) is a phenomenon whose frequency is, generally speaking, in relation of inverted proportionality with the size of the considered locality/region; however, exceptions from this pattern do exist, but they are few (Lunds Kommun, 2003a).

The fact that Dalby is a residential satellite can also be underlined through the analysis of two important variables: dagbefolkning¹⁵ and nattbefolkning¹⁶. The numbers for dagbefolkning and nattbefolkning for Dalby show an inversion when compared to those for Lund or for the whole Lunds Kommun. While there are 3,383 nattbefolkning and 1,417 dagbefolkning registered for Dalby, for Lund the data report 33,979 and, respectively, 48,732, while for Lunds Kommun, 45,443 and, respectively, 56,353 (Lunds Kommun, 2003a; Lunds Kommun, 2004c). This suggests that the number of workplaces in Dalby is low and that people have to commute for work; the phenomenon is also registered for other small satellite localities around Lund and Malmö. Furthermore, statistical data show that while in Lund 60% and in Lunds Kommun 66% of the population have their workplace in the same locality as their residence, only 19% of the inhabitants have both the workplace and residence in Dalby (Lunds Kommun, 2004c).

When differentiating between genders, it can be said that generally speaking women of working age, who are believed to have more environmentally friendly travel behaviours than men, are more numerous than men in Sweden and in many of its localities/regions. This is an important factor, as gender influences not only income, but also the workplace, and the probability of owning a car and of having less/more travel oriented leisure activities, with subsequent influence on the choice of the travel mode (Figures 1-4; subchapter 2.2.). This proportion is also maintained in Dalby. However, the difference between the number of persons of the two genders is not very high and, as shown above, women's travel behaviours tends to resemble more and more men's, especially in the high income groups and if not implementing programs aimed at changing the unsustainable travel behaviours; thus, these programs must be considered a must in the present society.

5.2. Socio-economic characteristics

The socio-economic characteristics have also an important impact on travel behaviour. As shown above, many authors argued that the higher the income, the higher the probability of choosing car travel over bus travel. Income is mainly determined by gender, employment status, and age. As expected, Swedish women's salaries register considerably lower numbers than men's; on country average, women's incomes represent 84% of men's incomes (in 2003) (Statistiska Centralbyrån, 2004j). This is characteristic for all age-groups and for all educational levels and stands for the connection between male gender and the predominance of using car travel for work related purposes. The situation on the labour market shows an improvement as compared to the 1990s; however, a slight increase of the unemployment rate from the beginning of the 21st century is also noticeable (Statistiska Centralbyrån, 2004g). The unemployment rate is of 5.6% for the whole country (Table 5), with a certain variation between sexes (5.5% for women, 5.7% for men), however not so prominent. A more accentuated gender-based difference is registered in case of the employment rates. Age seems to also be a determinant for the income. Persons aged 50-54 years old have the highest salaries, irrespectively of gender; persons in adjacent age-groups (45-49, 55-59, and also 30-44 years old) also register higher incomes (Statistiska Centralbyrån, 2004j). Furthermore, blue collars' incomes are, as expected, lower than white collars' incomes (Statistiska Centralbyrån, 2004a), while the salaries in the public sector are lower than those in the private sector (Statistiska Centralbyrån, 2004j). However, because of the necessity of narrowing down the subject of analysis, only the first three determinants of income (gender, employment status, and age) will be considered.

Socio-economic statistics from Dalby show a very positive situation of its inhabitants. As shown in Table 5, the average income of Dalby's inhabitants is considerably higher as compared to the closest big cities, when considered for both men and women and separately for each gender, however not higher than the country's average. However, the mean income for women is much lower than for men, a general phenomenon, as already discussed. The employment rate is also higher for Dalby than for the other localities/regions discussed – 80%. In

¹⁵ Dagbefolkning are defined as those people aged 16 years and over working in a certain town, regardless if they live in the same town or they commute to that place from somewhere else (Lindén, 2004, personal communication).

¹⁶ Nattbefolkning are defined as those people aged 16 years and over who have their registered home in a town, regardless if they also work in the respective town or not (Lindén, 2004, personal communication).

2003, 3,345 persons aged 16-64 and living in Dalby were employed. The 1,132 not employed were studying, liable for military service, early retired, and with other situations. However, in 2001 only 1,417 workplaces were detected in Dalby (Lunds Kommun, 2004c). Together with the relatively low number of shops and other facilities¹⁷, these statistics underline the fact that Dalby is a residential suburban area from where people must commute every day for work as well as for other activities.

Table 5. Socio-economic characteristics for the people living in Sweden, Skåne, as well as in other areas and cities in Skåne.

Socio-economic Characteristics		Year	Dalby	Lund	Malmö	Trelleborgs Kommun	Lunds Kommun	Skåne	Sweden
Average gross income per year	Total	2001	238,900	207,200	161,900	170,200	213,000	172,500	255,600
	Men	2001	285,900	238,100	190,400	202,700	247,800	206,000	279,600
	Women	2001	192,700	176,000	136,400	138,700	179,300	141,000	230,000
Employment rate**	Total*	2002	80%	65% (2001)	64% [‡]	76%	68% (2001)	72% [‡]	78%
	Men*	2002	82%	65% (2001)	65% (2000)	78%	69% (2001)	74%	80%
	Women*	2002	79%	64% (2001)	62% (2000)	73%	68% (2001)	69%	76%
Unemployment rate***	Total*	2004	3% (2001)	3% (2003)	6% (2002)	6%	3% (2001)	4.2%	5.6%
Persons receiving social service benefits**	Total*	2002	3% (2001)	4% (2001)	11% (2000)	5%	3%	6%	5%

~ Data not known.

[‡] Approximate computations from the data already known.

* In parenthesis, the year, for the information for which the year differs from the other in the same category.

** % of the population.

*** % of the labour force.

Data sources: City of Malmö, 2004; Leijon, 2004, personal communication; Lunds Kommun, 2004c; Statistiska Centralbyrån, 2004a,b,g,h,j; Trelleborgs Kommun, 2004.

The unemployment rate and the proportion of persons in need of social service benefits also support the idea of a very good situation of Dalby as compared to the other analyzed localities. In 2001, the unemployment rate in Dalby was of 3%, the same as in Lunds Kommun. In Malmö the unemployment rate was twice as much (City of Malmö, 2004), and the number of persons employed has decreased from 1990 by more than 10%; in Trelleborgs Kommun the unemployment rate was also double as compared to Dalby (Trelleborgs Kommun, 2004). The same numbers were registered for both Dalby and Lunds Kommun as regards persons receiving social benefits (3% of the population). An improvement has also been registered for the whole Sweden at the beginning of the 21st century, since the number of persons receiving social benefits decreased from 9% to only 5% of the population (Statistiska Centralbyrån, 2004a).

5.3. Housing

As it will be argued below, the housing situation also stands for the financial condition of the inhabitants. When considering housing, Dalby can be characterized as a wealthy locality. This is a fact supported by high number of houses with at least 3 rooms and kitchen and by the high number of owned houses and of single-family houses. In 2002 in Dalby there were 2,829 apartments, of which 2,265 had at least 3 rooms and kitchen

¹⁷ There are 5 grocery stores, 1 library, 2 pubs, no built playgrounds and only 47 square kilometers (sqkm) parks per inhabitant, as compared to 63 sqkm parks per inhabitant for the whole Lunds Kommun (Lunds Kommun, 2004c).

(representing 80% of all apartments). The similar relative numbers for the other localities taken into consideration are much lower – i.e. 56% for Lund, 57% for Malmö, and 61% for Lunds Kommun (Table 6).

Table 6. Housing in Sweden, Skåne, as well as in other areas and cities in Skåne.

Houses*		Year	Dalby	Lund	Malmö	Trelleborgs Kommun	Lunds Kommun	Skåne	Sweden
Houses	Total	2002	2,829	38,025	133,244	16,356 (1990)	47,140	377,480 (1990)	4,329,221
	Houses with at least 3 rooms and kitchen**	2002	2,265 (80%)	21,275 (56%)	75,949 (57%)	11,494 (70%) [£] (1990)	28,734 (61%)	237,497 (63%) [£] (1990)	2,553,807 (59%) [£] (1990)
Average number of rooms/house		2002	4.9	3.8	3.8	~	4.1	~	~
Type of contract***	Total	2002	2,829 (100%)	38,025 (100%)	133,244 (100%)	16,356 (100%) (1990)	47,140 (100%)	377,480 (100%) (1990)	4,329,221 (100%)
	Ownership	2002	1,970 (70%)	7,297 (19%)	19,987 (15%)	7,722 (47%) (1990)	14,178 (30%)	124,825 (33%) (1990)	1,301,000 (30%)
	Cooperative housing contract	2002	142 (5%)	12,190 (32%)	45,303 (34%)	3,104 (19%) (1990)	12,766 (27%)	75,830 (20%) (1990)	557,000 (13%)
	Rental contract	2002	676 (24%)	18,427 (48%)	67,954 (51%)	4,244 (26%) (1990)	19,778 (42%)	141,528 (37%) (1990)	1,318,000 (30%)
Type of house****	Single-family houses	2002	2,533 (90%)	9,581 (25%)	24,388 (18%)	9,079 (56%) (1990)	17,417 (37%)	155,814 (41%) (1990)	1,977,476****
	Houses in multi-family blocks of flats	2002	296 (10%)	28,444 (75%)	108,856 (82%)	7,277 (44%) (1990)	29,723 (63%)	221,666 (59%) (1990)	2,351,745 (54%)
Households with children < 15 years old*****		2002	36%	22%	~	~	25%	~	24% (1990)

~ Data not known.

£ Approximate computations out of the total number of houses in 2002.

* In parenthesis, the year, for the information for which the year differs from the other in the same category.

** In parenthesis, the percent represented by the houses with at least 3 rooms and kitchen out of all houses.

*** In parenthesis, the percent for the houses inhabited on the basis of each contract type out of the total number of houses. The difference to 100% is constituted by houses inhabited on the basis of other types of contract.

**** One- or two-dwelling buildings.

***** In parenthesis, the percent represented by each house type out of the total number of houses.

***** % of all households.

Data sources: City of Malmö, 2004; Leijon, 2004, personal communication; Lunds Kommun, 2003b; Statistiska Centralbyrån, 2004a,i,n,o.

Consequently to having many houses with a high number of rooms, Dalby have also registered a high average number of rooms per house – 4.9, as compared to 3.8 in Lund or 4.1 in Lunds Kommun (Lunds Kommun, 2003b; Lunds Kommun, 2004c). 90% of all apartments in Dalby are single-family houses. In the whole Lunds Kommun area only 37% of all houses are single-family houses, while in Malmö only 18%. Nevertheless, the number of single-family houses built has increased again in the whole kommun in the beginning of the 21st century, after a considerable decrease in the 1990s, while the number of houses built in

common blocks of flats has decreased. Dalby is to receive another 130 apartments in 2005 and 2006 (Lunds Kommun, 2003b), while Malmö will get 300-700 new apartments every year until 2006 (City of Malmö, 2004). However, the difference is that while Dalby receives single-family houses, Malmö receives mostly apartments in multi-family houses. Moreover, most of the houses in Dalby (70%) are owned by the inhabitants, a number considerably higher than in the other localities/regions considered for this study (Lunds Kommun, 2003b; Lunds Kommun, 2004c; City of Malmö, 2004).

As we have already seen, wealth seems to be correlated with unsustainable travel behaviours, and Dalby appears as a wealthy locality. Housing costs also support this idea. To hire a house with three rooms and kitchen in Sweden costs in average 56,112 SEK per year; the hire increases significantly to 69,315 SEK per year for 4 rooms and kitchen, and to 87,732 SEK per year for 5 rooms and kitchen or more. Furthermore, the yearly housing expenditure scores 60,100 SEK in average for owned houses, 47,200 SEK for houses with cooperative housing contract, and 48,900 SEK for rented houses. However, even if the most expensive to buy and to maintain, housing expenditures for the owned houses represent only 20% of their inhabitants' income; this number is lower than that for the houses occupied through other forms of contract and lower than that for the average for all tenure types (Statistiska Centralbyrån, 2004a). This suggests that there is the richest class that occupies them. Correlated with the information that in Dalby 70% of all houses are owned by their inhabitants (a number much higher than in the rest of the country (Table 6)), this may suggest that Dalby is inhabited by middle to upper class people who can afford to buy a house and a car, or even more. However, information from a local apartment's rental agency show that there is another reason for which people choose to live in Dalby instead of Lund: the price of buying the houses. A house in Dalby, similar to one in Lund, costs half as much. Some of the commuters from Dalby to Lund acknowledge the fact that there are few available houses in Lund as compared to the high demand (Anonymous Author, 2004d). *I would move to Lund, so I can be closer to my workplace. But unfortunately there are no available apartments in Lund. You know, there is a long queue, people waiting for apartments in Lund. It is really difficult to find an apartment. Thus, I decided to live in Dalby. It's ok. (Male commuter, 60-64 years old)*

Dalby also presents a tendency for car oriented travel behaviours from the household's structure point of view. In 2003 there were counted 2,579 households in Dalby. 36% of these households have had children below the age of 15, meaning children who do not work, a percentage that is higher than in other localities as for example Lund, or the whole Lunds Kommun. The presence of children of non-working age in the household usually affects women as it either decreases their participation in the labour force (Lunds Kommun, 2003a), and/or determines them to choose car oriented travel behaviours, especially in small cities where the public transport system is not very well developed. The situation of the personal cars in Dalby also sustains this idea.

5.4. Personal cars in traffic

In 2002 there were 3,325 personal cars owned by Dalby's inhabitants, representing 466 cars per 1,000 inhabitants (Lunds Kommun, 2004c). The number is higher than in Lunds Kommun, where for the same period there were registered 34,913 personal cars, but only 374 cars per 1,000 inhabitants. Actually, the number of cars per 1,000 inhabitants in Dalby was higher than in most of the considered localities/regions (Table 7). Furthermore, in 1994 there were registered 1.10 cars per household in Dalby, a number close to that for all the small localities surrounding Lund. The similar number for Lund was lower, of only 0.80 cars per household (Stadsarkitektkontoret i Lund, 1997) (Table 7). Moreover, the number of cars per household in Dalby has increased to 1.28 in 2002¹⁸.

Data in Table 7 show an increase of the number of cars owned by the Swedish population. The highest number of people with driver's license belongs to the 25-47 years age group; many people aged 48-66 years also detain a driver's license. Furthermore, there are considerably less women who own a driver's license than men

¹⁸ In 2002 there were registered 3,325 passenger cars in Dalby and 2,579 households (in 2003), as shown above. Thus, the approximate number of cars per household was of 1.28. This means that some of the households owned more than one car.

(Statistiska Centralbyrån, 2004a). This is consistent with many authors' description (subchapter 2.2.). Carlsson-Kanyama et al (1999) argue that after a considerable increase of the number of people holding driver's license at the end of the 20th century, a slight decrease is registered today especially amongst women and the young, because of a weaker economy that negatively influence particularly the lives of these groups. The same difference between middle aged and young persons has been registered when considering car ownership because, as the authors state, middle age persons have better opportunities than younger persons.

Table 7. Car situation in Sweden, Skåne, as well as in other areas and cities in Skåne.

		Year	Dalby	Lund	Malmö	Trelleborgs Kommun	Lunds Kommun	Skåne	Sweden
Passenger cars in use*	Total	1990	~	~	85,987	15,778	32,629	442,889	3,600,518
		2002	3,325	23,178	95,522	18,758**	37,518**	517,569**	4,042,792
	Owned by men	1990	~	~	~	~	19,524	~	2,122,593
		2002	1,816	13,409	69,863	13,365	26,322	365,209	2,182,326
	Owned by women	1990	~	~	~	~	11,341	~	877,833
		2002	1,033	7,801	25,629	5,393	11,196	152,360	1,078,847
People with driver's license	Total	2002	4,417	46,687	142,213	23,860	61,461	697,106	5,619,899
	Men	2002	2,308	24,169	77,632	12,786	31,914	369,959	3,029,315
	Women	2002	2,109	22,518	64,581	11,074	29,547	327,147	2,590,584
Number of cars per 1000 people		2002	466	300	364	484	374	452	452

* The difference between the sum of the number of cars owned by man and by women, and the total number of passenger cars in use consists of the number of cars owned by corporations.

** The number only includes the cars owned by private persons, not also by companies.

Data sources: City of Malmö, 2004; Leijon, 2004, personal communication; Lunds Kommun, 2004c; Statistiska Centralbyrån, 2004a.

However, a fact to be considered is that as the number of cars has increased considerably from 1990 until 2002, the number of buses has decreased from 15,000 to 14,000 for the whole country (Statistiska Centralbyrån, 2004a). This might be an indicator for a decrease in bus traveling and an increase in car use, which would represent a switch to more unsustainable travel behaviours, when considering energy consumption and the emissions of certain substances, as shown in the following subchapter.

The fact that Dalby has one of the highest number of cars per 1000 inhabitants is an indicator for the tendency of Dalby's inhabitants to prefer car use over bus travel for work-related purposes. The other variables discussed above also sustain this supposition – the demographic variables: the increasing population, a very high number of daily commuters from Dalby to other localities, a high number of nattbefolkning as compared to dagbefolkning, a low percent of people having both their residence and their workplace in Dalby; furthermore, the socio-economic variables also support this idea: a high employment and low unemployment rate, and a low relative number of persons receiving social service benefits, high average salaries, a low number of workplaces in Dalby, and a relative low number of facilities. People in Dalby also live in larger single-family houses, expensive to maintain, mainly owned, and own in average more than one car per household. However, since the initial cost of the houses is lower than in Lund, this may be still discussed if it is an argument for the tendency of Dalby's inhabitants to prefer car over bus for commuting. Another conclusion can be also derived from these results: there is obviously a difference between men and women regarding their incomes, employment rates or having a driving license. This suggests that men and women in Dalby have indeed different lifestyles and thus different transport behaviours. This supposition will be discussed in Chapter 6.

5.5. An example of emissions reduction and energy savings by changing travel behaviours

Dalby is a good example to show how changing transport behaviours can save energy and reduce CO₂ emissions¹⁹. It will be assumed that all the people who commute daily from Dalby for work (2,726 (Lunds Kommun, 2003a)), have as destination the city of Lund and would change their travel behaviour from initially traveling by car to traveling by bus. Considering the numbers from Table 1 for short distance trips, as well as the distance between Dalby and Lund (12 km) (Lunds Kommun, 2004a), energy consumption for one commuter in one month, and energy consumption for all commuters in one month is computed. Meanwhile, the levels of CO₂ emissions from work trips for one commuter in one month and for all commuters in one month are also interesting (Table 8, Figure 9 and Figure 10).

Table 8. Energy consumption and CO₂ emissions from one commuter and all commuters’ work trips from Dalby to Lund*.

Mean of transportation	Type	MJ/person-km	MJ/person-month	MJ/all commuters-month	g CO ₂ /person-km	g CO ₂ /person-month	g CO ₂ /all commuters-month
Car	Fleet of cars, 1993	3.19	1,684.30	4,591,456.30	238.00	125,664.00	342,560,064.00
Bus	Peak hours, 80% capacity	0.25	132.00	359,832.00	19.00	10,032.00	27,347,232.00
	Average capacity	0.79	417.12	1,137,062.10	58.00	30,624.00	83,481,024.00
	Off-peak hours, 10% capacity	1.66	876.48	2,389,284.48	122.00	64,416.00	175,598,016.00
Commuter train	Peak hours, 80% capacity	0.17	89.76	244,685.76	1.50	792.00	2,158,992.00
	Off-peak hours, 10% capacity	0.50	264.00	719,664.00	4.50	2,376.00	6,476,976.00
Tram car		0.68	359.04	978,743.04	6.10	3220.80	8,779,900.80

* Data for MJ/person-km and g CO₂/person-km have been taken from Table 1.

The quantity of energy consumed by a person per month is computed as the quantity of energy consumed by a person per km multiplied by the number of km between Lund and Dalby (24, for a return trip) and by the number of working days in a month (approximately 22). The quantity of energy consumed by all commuters per month is computed by multiplying the quantity of energy consumed by one commuter per month with the total number of commuters. The same operations have been applied for the levels of CO₂ emissions.

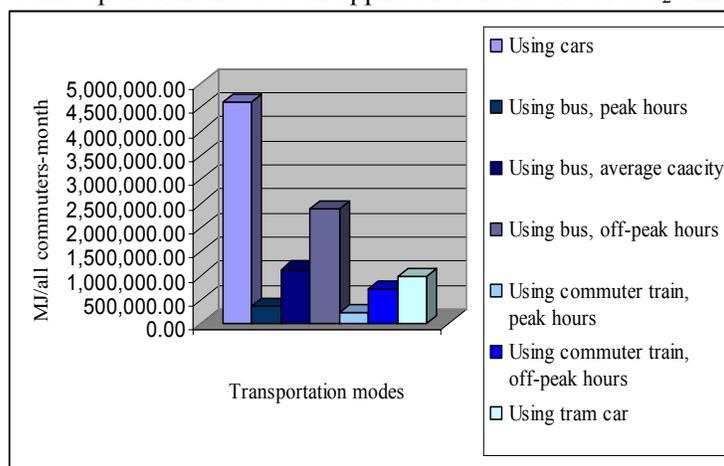


Figure 10. Energy consumption for all the daily commuters for work between Dalby and Lund, when using different transportation means.

¹⁹ However, when computing the levels of emissions, all emissions must be taken into consideration (see subchapter 2.1.1.).

As data in Table 8 and the graphs show, car travel consumes large quantities of energy as compared to the other travel means considered, and also pollutes the most (when considering CO₂ emissions). Using commuter train at peak hours seems to be the most environmentally friendly solution. However, there is no train rail or tram rail between Dalby and Lund, thus another viable alternative is bus travel. Even if considering buses running at only 10% of their capacity (off peak-hours), it can be noticed that both energy consumption and CO₂ emissions would be reduced by half. However, if using telephone tours – when buses only run if the commuter orders the trip by telephone (Skånetrafiken, 2003; Skånetrafiken, 2004a) – empty running could be much reduced. Furthermore, it is likely that people who change their behaviours and renounce at using cars for work related trips will also reduce their desire to own a car – or at least a second car²⁰ – and, further, will multiply their habits of using other means of transportation than car also for other purposes (i.e. leisure trips, shopping, and so on).

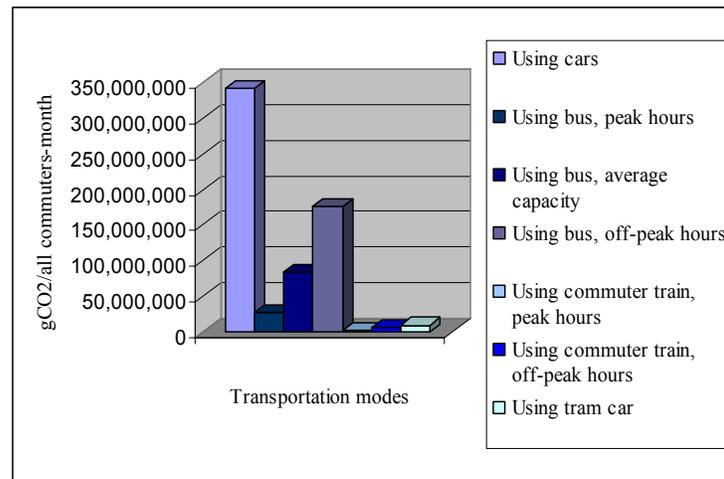


Figure 11. CO₂ emissions from all the daily commuters for work between Dalby and Lund, when using different transportation means.

Thus it is obvious that, from the points of view considered above, commuting by bus is more environmentally friendly than commuting by car (when traveling alone). Of course other solutions may be considered, as switching to bicycling or walking, or to carpooling/carsharing. These behavioural changes may be attained through the use of policies affecting the attractiveness of car travel, increasing VAT (Value Added Tax) for cars, road tolls, exhaust taxes and other fees, decreasing bus travel prices, implementing information programs, and so on. However, it is not the aim of this paper to discuss and evaluate these policies, but only to consider the differences between car and bus users and to discuss the profiles of the commuters, profiles that must be taken into consideration by the policy makers in the decision-making process upon these policies.

Chapter 6. Results and Discussion: Commuters from Dalby. Individual Profiles

6.1. The validity and reliability of the research instrument

While in Chapter 5 data analysis has shown that Dalby is one of the localities whose inhabitants are likely to use cars because of their socio-economic and demographic profiles, but also because of other variables (i.e. land-use characteristics – the development of Dalby as a satellite locality), Chapter 6 will describe the profile of the commuters by bus from Dalby to Lund. This description will be further used in trying to make the difference between bus and car users, because the lack of both human and financial resources did not allow a more

²⁰ As shown in subchapter 5.4., the number of cars per household in Dalby increased to 1.28 in 2002, meaning that some of the households own more than one car.

extensive survey. However, before proceeding with the description of the profiles, the validity and reliability of the main instrument (the questionnaire) is verified.

The Statistical Package for Social Sciences (SPSS) is used for analyzing the results, because it is built to allow the most suited interpretation of the data obtained when applying a questionnaire. The validity and reliability of the questionnaire is firstly checked. Validity analysis establishes “if the working method, or the working instrument, analyzes what was defined to be analyzed” (Mărginean, 2000, p.82 – my translation). Construct validity is frequently verified through a factorial analysis over the data. Kaiser-Meyer-Olkin (KMO) is one of the coefficients computed with the aim of confirming that in these data there are a series of “common factors”, meaning that the validity of the instrument is high. The closer to 1 it is, the higher homogeneity we have between the information obtained about the measured indicators. KMO is 0.571 for the present study, which indicates that the instrument is valid. The validity is also verified through the computation of the “communalities”, the coefficients that indicate how accurate are the initial data represented by the “common” factors. The minimum accepted value is 0.5. By studying the communalities for the present study, it can be seen that all the items have values over 0.5. The only exception is constituted by the variable defined as “the city of work”, for which the communality is 0.389. However, as it is not an essential variable, but only used to test if the sample obtained is focused (if all people in the sample work in Lund), not much importance has been given to this.

Reliability measures “the degree of stability for the measurement instruments” (Mărginean, 2000, p.85 – my translation), “the degree of consistency and repeatability of the instrument, meaning the degree to which the obtained results are not affected by measurement errors” (Pitariu and Albu, 1997: 65 – my translation). The fidelity coefficient is maxim (1) when the real values are obtained. In reality, this number is difficult to reach. Researchers suggest that the reliability coefficient ought to be at least 0.70-0.94 (Guilford, 1965, in Pitariu and Albu, 1997: 88). This number can be reached when the questionnaire is answered by a high number of respondents. Because the present study uses only a limited number of responses and because of the lack of a large sample for pre-testing the instrument, the Guttman’s reliability coefficient λ_3 (Lambda 3) is 0.2721. This value shows that the items comprised in the questionnaire are not “internal consistent”, meaning that they can be improved in an enlarged questionnaire.

6.2. Analyzing the results: the characteristics of the commuters by bus from Dalby to Lund for work related purposes

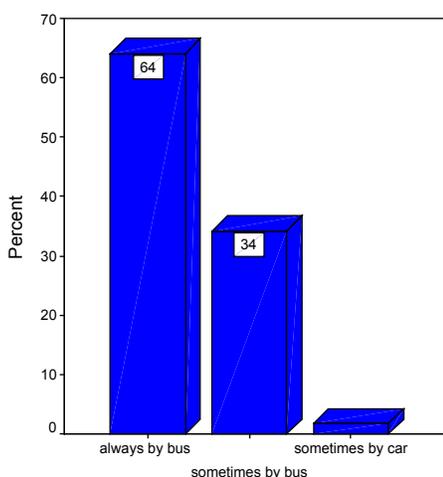


Figure 12. How do the commuters use to travel to work.

The results of the primary analysis show that most of the interviewed people use to travel by bus for work-related purposes (Figure 12). This has been expected because of the way the sample was built, and shows that the aim of choosing a focused sampling method has been reached – a targeted sample has been created, which can offer enough information to characterize the respective group. However, some of the respondents included in the sample answered that they only sometimes travel by bus; they also travel by other means, more sustainable (bicycle) or unsustainable (car). However, because of the weather and distance between Lund and Dalby (12 km) it is assumed that the last variant is more viable, at least for the cold seasons.

The various reasons motivating commuters’ travel choice can be depicted from Figure 13. Most of the commuters (55.6%) see bus travel as comfortable, but many also take the bus because it is good for the environment and because it is cheap. *If I had a car, I would have used it, but only because of the frequency of the buses. Otherwise, no. It is comfortable to go by bus; you can relax, read a*

book. However, if you only travel for 20-30 minutes you can only read a newspaper. (Male commuter, 25-59

years old) I wouldn't travel by car. I have a car, but it is more comfortable to go by bus. You have nothing to worry about. I think more people would go by bus if they would come more frequently. Now they come once every half of an hour. To Malmö, for example, they go every fifteen minutes. It is also cheaper to go by bus; if you travel by car you have to pay high parking fees in Lund. (Female commuter, 25-59 years old) Fewer commuters take the bus because the husband/wife/partner uses the only car in the family, because they have no car, or for other reasons, as bad weather (thus being difficult to bike), parking costs or problems in finding a parking place in Lund. These answers concerning the parking places in Lund show that the already applied policies have been effective for some of the commuters. However, as people still make extensive use of cars, it can be said that they are not enough.

Almost all the chi-square coefficients for the crosstabulation between the travel behaviour and the reasons for traveling by bus are all significant (as the significance level (p) is lower than 0.05). This shows that there are differences between the commuters. Thus, the commuters who always travel by bus motivate their choice by saying that that is cheap, it fits their working schedule, and it is good for the environment. *Why go by car when it is so comfortable for me to take the bus? I have regular work hours, I know exactly when the bus comes and goes, I live closely to the bus stop and my workplace is also close to the bus stop. Yes, if I had irregular work hours maybe I would have needed a car. Or if I had to travel long distances to the bus stop, to take another bus or the bike. I am not stressed when I travel by bus. I can read, listen to music and, the most important, meet people. Look around! There are so many people you can talk to!* (Male commuter, 60-64 years old) It is very uncommon for a commuter to go by bus when it has irregular working hours (Lindén, 2004, personal communication). The flexibility of the schedule must be considerable, especially because of the big intervals between bus departures from/to Dalby (Skånetrafiken, 2004a). They are usually regarded as a reason for preferring car over bus for commuting; together with very rare rides during evenings and weekends they contributed to creating the problem – the preference of car travel over bus travel for work related purposes. However, some commuters see bus timetable as fitting with their flexible schedule and thus as suited for commuting. *For me going by bus is very good, because I can arrange my working hours in accordance to bus' timetable. I have flexible working hours. So there's no point in using the car. I also use the car, but not when I go to work. When I have to go in many places in the same day, for example to different shops and in different places, then I take the car; bus is useless then.* (Female, 25-59 years old) The commuters who only sometimes use the car say that they do so because the wife uses the car in the family. There is no difference between people with different travel behaviours as regards the other reasons – “I have no car”, “my husband/partner uses the car” or other motives.

The persons referring to reasons connected to any incapacity of using the car are the ones that would develop unsustainable travel behaviours if they had the chance (i.e. if they had the possibility to buy a car/a second car in the household). This is a category of people upon which informational programs about the harmful effects of unsustainable travel habits may have the desired effects. They are already used to travel by bus, and these policies would be likely to determine them not to buy a car/a second car for the household. However, their response would also depend on other variables, i.e. education.

The statistical analysis shows that it is not important where people work for choosing the transportation mean – the significance level (p) for the chi-square coefficient is higher than 0.05, which indicates a non-significant relation between the two variables. However, Figure 14 indicates a particularity of the respondents as regards

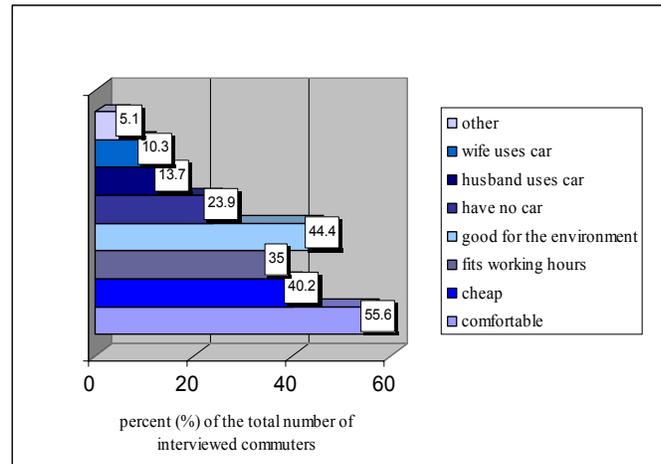


Figure 13. Reasons for which the commuters from Dalby to Lund choose to travel by bus.

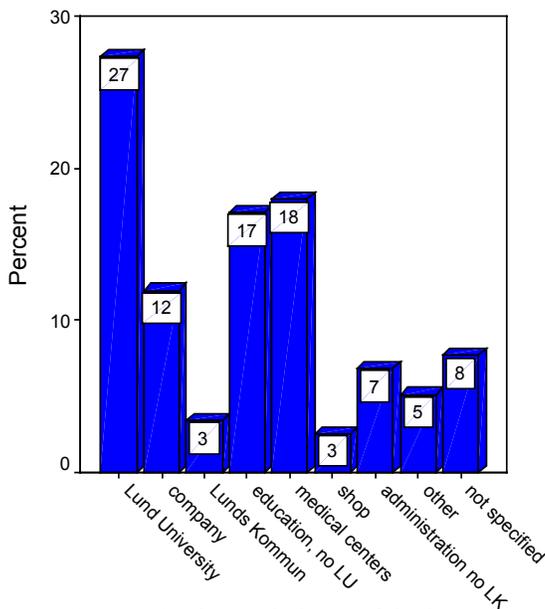


Figure 14. The workplaces of the interviewed commuters.

their working place: they form an “academic oasis” in Dalby, as 62% of them work in educational, research or medical centres. Most of the people living in Dalby and commuting to Lund for work, which have responded to the questionnaire, work at Lund University (27%). It can be thus seen how Lund University, with all its educational and research centres, constitutes a magnet for the people living in Lund’s Kommunn area because it has the potential to offer a high number of jobs, and for the other people living in the region, since there are many towns similar to Dalby in South-Western Skåne. The other educational centres in Lund, as well as the medical centres, also attract many people from Dalby (35% of the respondents work in these kinds of centres). This has imprinted to the city of Lund the label of “academic city” or “the city of ideas” for so many years now. However, workers in international companies are also well represented in our sample (12%), while the rest of the people work in administration, shops or other places; 8% of the respondents avoided to give indications about their workplace – even though the questionnaire was anonymous; this is likely to be related to the confidentiality of the salaries that some of the employers pretend from the employees.

What it is also interesting at this point is that people working in international companies seem to have a particular profile: they belong to the highest income group and almost all have a personal car. The chi-square coefficients for the relation between the workplace on one side, and income and owning a car on the other, are both significant at 0.01 level. This indicates that it is more likely for a person working in an international company to have a high income and a personal car, two variables that have been positively associated with predominantly unsustainable travel behaviours.

Furthermore, according to the field data, women living in Dalby travel more by bus than men do, for work-related purposes (Figure 15). This result is consistent with the theories about males’ unsustainable travel habits (subchapter 2.2., 2.3.). Table 4 shows that in 2003 there has been almost no difference between the number of women and the number of men of working age living in Dalby – there have been counted 2,081 (50.1%) women and 2,066 (49.9%) men of working age (since Dalby’s population changes very slowly in number and composition, we can consider these numbers as reference numbers for 2004). However, 58% of the interviewed commuters are women, and only 42% are men. This shows a difference of 16% in favor of women. This result can also be connected to the relation between gender and income. With a significance of $p=0.01$, the crosstabulation shows that men are more likely to gain a higher income than women, which is consistent with what other authors have found about the relation between these variables (subchapter 2.2.).

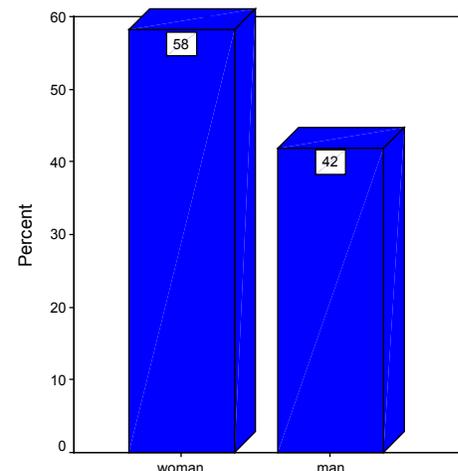


Figure 15. The gender of the commuters.

However, the significance level (p) for the chi-square coefficient concerning the relation between gender and respondents’ travel behaviours is higher than 0.05, indicating a non-significant relation. This is surprising, as it was expected that gender influences the choice of the travel mode. However, indirect relations show that gender is indeed a determinant – through, for example, income.

The income distribution for the respondents shows that the numbers are surprisingly high (Figure 16). 49% of them receive more than 20,001 SEK per month, while 25% receive between 16,001 and 20,000 SEK per month. It is also likely that income is a determinant for travel behaviour, as the relation between these two variables is significant at a 0.05 level. SPSS’s crosstabs show that people in all income groups travel always by bus, but mostly people with medium to high incomes (over 16,001 SEK per month) travel only sometimes by bus, meaning that they also travel by car; this is a viable deduction, when considering the distance between Dalby and Lund and the weather in Skåne.

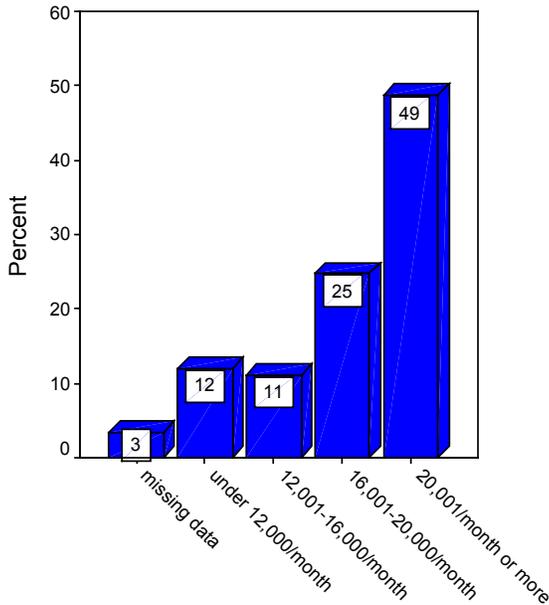


Figure 16. Income distribution for the commuters.

Furthermore, the crosstabulation between the income and the reasons for traveling by bus shows that the commuters with low incomes tend to travel by bus because it is cheap and because they have no car. *I don't have a car and I don't think I will buy one. It is expensive to have a car, especially if you take into consideration the cost of buying the car and repairing the car. Then, traffic is bad, and it is better to go by bus because you are not stressed by driving; you can do whatever you want while going by bus. (Male commuter, 60-64 years old)* Meanwhile, commuters with high incomes tend to travel by bus because the partner uses the car and for other reasons. It also seems that commuters in lower income groups are more aware

of the environmental threats than commuters in the upper income classes, as they acknowledge more as a reason for choosing bus over car as transportation mean the fact that “it is good for the environment”. However, both low and high income groups travel by bus because it is comfortable.

Because the sample was build as a targeted one, aimed at underlining working age persons’ characteristics, Figure 17 offers no surprises concerning the age of the respondents. Most of them are 25-59 years old (82%), some are 60-64 years old, while only few are 20-24 or over 65 years old. However, 5% of the respondents are aged 15-19 years old. The strong direct relation between age and income is revealed for the analyzed commuters. There is a positive connection between these two variables, significant at a 0.01 level. At a p=0.05 significance level it is also revealed the direct relation between age and having driver’s license, owning a car, and the number of rooms in the house. Obtaining the driver’s license is more expensive nowadays than during the last decades of the 20th century (Lindén, 2004, personal communication). Thus, it is not surprising that young people are more likely not to have driver’s licenses than older people. However, it also appears that older people motivate more their choice for traveling by bus by saying that they do not have a car; this is consistent with the outburst registered during the last years on the cars’ market; there are the younger generations that begins to see car travel as a necessity; for the older generations having a car in the family have not always represented a must. Now it seems that it becomes both a necessity and a symbol of ones’ status. However, age in itself has not been considered much a determinant for this study because of the way the age groups were designed, with a dominance of the people aged 25-64 and without the possibility to differentiate between them.

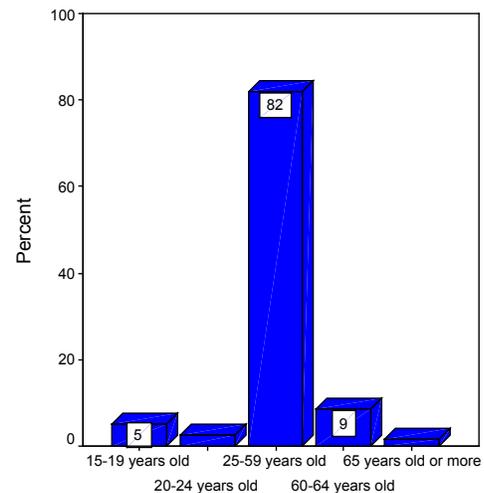


Figure 17. Age distribution amongst the interviewed commuters.

The number of children younger than 15 years in commuter’s households also confirms the theoretical description of the commuters (subchapter 2.2.). As shown in Figure 18, 73% of the commuters by bus have no children younger than 15 years. Furthermore, the SPSS analysis shows that there is a strong relation between travel behaviours and the number of children of non-working age, with a very high level of significance ($p < 0.01$). This shows that people without children younger than 15 years use to always travel by bus, while those persons having children younger than 15 years travel only sometimes by bus. When small children enter the family, the temptation of buying and using a car is very high because of the need for traveling to different places (i.e. kindergarten, school, doctors, at different hours of day and night). Subsequently to its acquisition for children related purposes the car will also be used for traveling to work. Asked what would he prefer if he could choose between traveling by car or by bus, a commuter says: *It depends when. If we are talking about rush hours, I would not choose car. Otherwise, car isn’t much more expensive than bus, if you already have the car. And then, if you have a family (children – a.n.) you need a car. (Male commuter, 25-59 years old)*

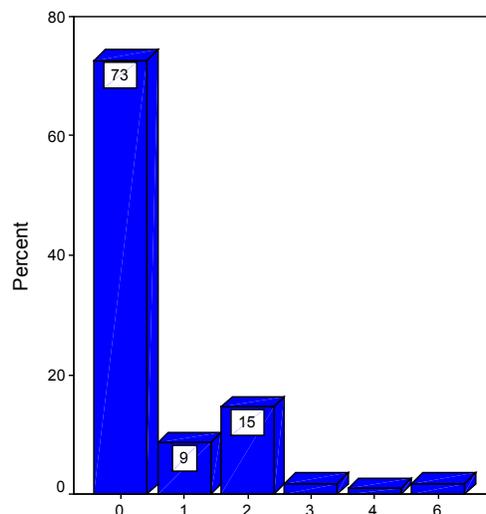


Figure 18. The number of children under 15 years old in the household.

A high number of the commuters by bus have driver’s license, irrespectively of their gender. However, as Figure 12 shows, the commuters in our sample do not make use of their driver’s license, or do not make use of it on a regular basis. However, the crosstabs obtained with the aid of SPSS indicate that the relation between having a driver’s license and the choice for a certain type of travel behaviour is not significant.

Nevertheless, the relation between owning a car and the travel behaviour is significant. As Figure 20 shows, a surprisingly high number of commuters by bus own a car; 26% of them own their personal car, while 48% have a car in the family. A superficial interpretation of this result would be likely to infirm, for the considered group, the theory stating that owning a car leads to car oriented travel behaviours. However, the statistical analysis of the relation between owning a car and the preference for a certain transportation mode reveals other interesting details. The persons not owning a car or at the most owning only a car in the family are more likely to always travel by bus than the persons owning at least a car in the family or their own personal car, who only sometimes travel by bus.

More men than women use to travel by bus because they do not have a car; this result suggest that men would be more tempted than women to use a car if they had it and sends us back to what other authors have already argued, that men are more likely to have unsustainable transport behaviours than women. Furthermore, more men than women make use of a car; at a first look, the results of the crosstabulation between gender and owning a car show that more men own a personal car and more women own a car in the family. However, as

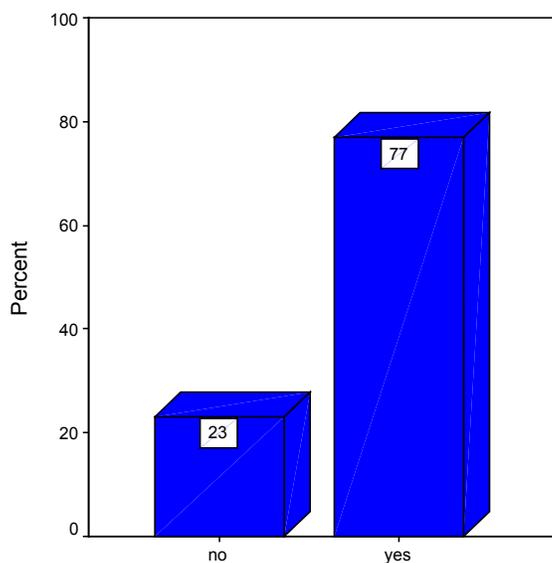


Figure 19. Commuters having driver’s license.

these women travel by bus (they have been interviewed in the bus stations or in the bus), it can be argued that even if they own a car in the family, it is the partner who uses it. They also acknowledge this fact, as 24% of the interviewed women say that one of the reasons why they travel by bus is because their husband/partner uses the

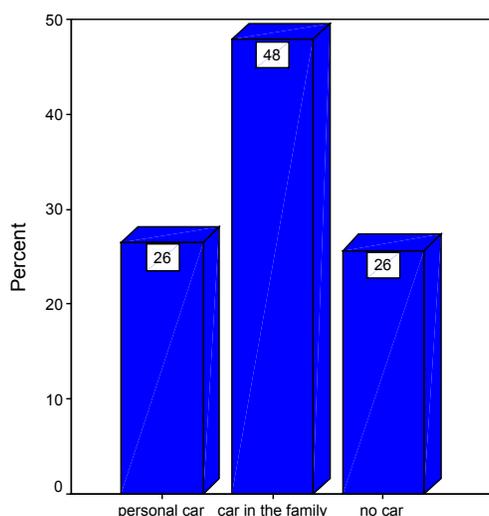


Figure 20. Commuters owning a car.

a particular reason. *We bought the car with my father's money, when he died. But then I sold it. (Male commuter, 60-64 years old)* Moreover, people owning cars also tend to live in owned one family big houses. They tend to travel by bus because the partner uses the car or for other reasons (i.e. high parking fees in Lund).

The houses the commuters live in are mostly one-family houses. This is one of the reasons why some of them moved to Dalby. As already shown, to find and to afford to buy a house in Lund, even at the periphery, can prove to be very difficult. On the contrary, one can buy a house in Dalby, similar to the ones in Lund, but at a considerable lower price. Asked if he would move to Lund if he had the possibility, a commuter answered: *Yes, I would move to Lund, it is closer to my job. If I move to Lund, I would gain one more hour per day. So if you think at transportation, yes. But it is more expensive to live in Lund. I couldn't afford living in Lund the way I live in Dalby. As I have children, I need a house with garden, but I couldn't afford to have a house with garden in Lund. (Male commuter, 25-59 years old)* The commuters with lower incomes tend to live in rented or cooperative houses, with fewer rooms, and travel by bus especially because they have no car.

However, the type of house seem not to be directly related with the travel behaviour, as the significance coefficient (p) obtained when analyzing the relation between these two variables is higher than 0.05. But the number of rooms seems to be significant; if the respondents who always travel by bus show a wide spread distribution when it comes to the number of rooms of their house, from 1-2 rooms to 10 rooms, the respondents who go by bus only sometimes live in houses with at least 3 rooms (only 2 respondents live in houses with 2 rooms and none in houses with only 1 room). However, the number of rooms of the houses the commuters included in our sample live in is high. 85% of the houses of the interviewed commuters have at least 3 rooms and kitchen. The number for the total Dalby is of 80% (Table 6), already much higher than for other localities/regions in South-Western Sweden. Thus, Dalby

only car in the family. However, the same percent of men motivate their travel choice through a similar reason concerning their partners. But men using this motivation are older than women using the same motivation; this suggests a surprising tendency for the younger generation of men to use the car more than women, opposite to what have been expected, since it is said that women tend more and more to resemble men's travel behaviours.

There is a strong correlation between having driver's license and having a car (at least a car in the family). *If you don't have a car, than it is expensive to travel by car because you have to first buy the car. I don't have a car, so I can say that for me it is much cheaper to go by bus. If you already have a car and you only take into consideration gasoline's price, then it might be cheaper to go by car; but when you add the price you pay for service and other taxes, I don't think it stays cheaper. I used to have a car, but I sold it. I don't have driving license, my wife used to drive the car. It just happened so, that I don't have driving license, it wasn't for*

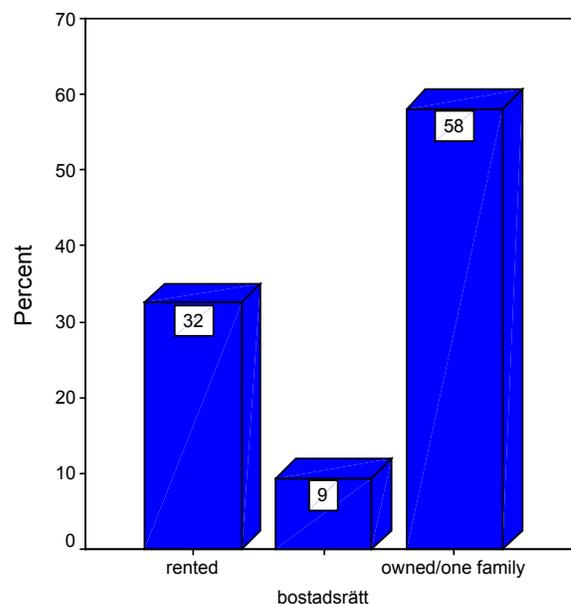


Figure 21. The type of house the commuters live in.

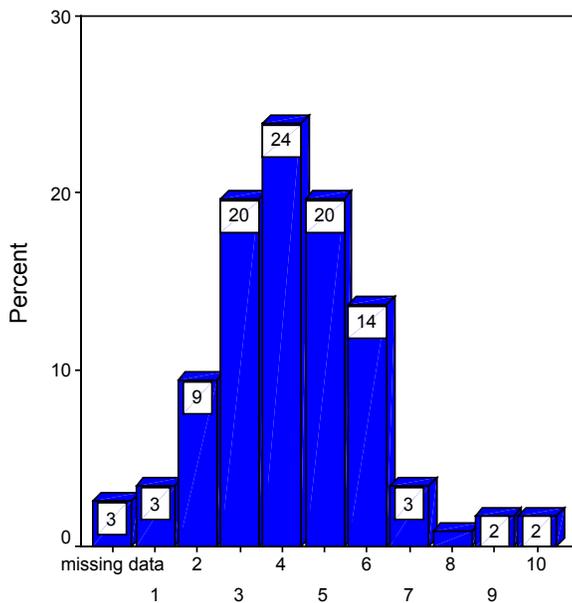


Figure 22. The number of rooms for the houses the commuters live in.

seems to be an oasis for the academic staff who like to live at high standards and cannot afford to do it in Lund or cannot find a suitable house because Lund seem to be very crowded nowadays. *It seems that everyone working in Lund and having an academic title but no permanent employment ends up in Dalby or Staffanstorp, but most of these people are in Dalby. (Male commuter, 25-59 years old)*

Thus, we have to deal with the middle to high class in Dalby, formed of people who enjoy living in a comfortable manner. However not affording to live in a big city, or not finding a suitable place, they look for the comfort that this small locality can give. If they like nature, they can also find it here. *Dalby is nice; I like very much nature and especially forests. Dalby offers you the possibility of having them very close to you. This is why I moved to Dalby. (Male commuter, 60-64 years old)* The analysis suggests that there are different groups of commuters traveling by bus to Lund, according to their demographic and socio-economic characteristics, travel habits, and reasons motivating their travel habits. The next subchapter will summarize the characteristics of these groups of people and will argue that income is an important variable that differentiates amongst them.

6.3. Discussing the hypotheses. Differentiating amongst commuters' profiles

The discussion in subchapter 6.2. allows us to delimitate two different profiles for the daily commuters for work from Dalby to Lund:

- The commuters with tendency towards sustainable transport behaviours. These are the commuters who always travel by bus; they tend to be mostly women, not working in international companies. They also tend to have a lower income than the ones in the second category, have no children younger than 15 years old, not owning a personal car, and living in rented or cooperative houses with a lower number of rooms than the persons in the second category. They travel by bus because it is cheap, because bus timetable fits their working hours, because they have no car, and because it is good for the environment.
- The commuters with tendency towards unsustainable transport behaviours. These are the commuters who only sometimes travel by bus (sometimes or most of the times traveling by car), mostly men, working in international companies, and having a high income. They may have children younger than 15 years old, own a personal car, and live in owned one-family houses with at least 3 rooms and kitchen. They use to travel by bus because the partner uses the car in the family and for other reasons.

However, a series of variables do not allow us to make a definitive difference between the two categories or necessitate further discussion. Traveling by bus because it is comfortable, for example. People in both groups use to travel by bus because it is comfortable. This is a fact to be considered by the policy makers, meaning that increasing bus-added qualities might have the force to determine both poorer and richer people to travel by bus. Furthermore, there are more men than women traveling by bus because they have no car. However, there are more people with low income that travel by car because of the same reason, and this relation seems to be stronger, consequently this motivation has been considered as characteristic for the first group. Age is another variable to be discussed. The analysis shows that it is likely that younger people travel always by bus, while older people travel only sometimes by bus. However, because the sample was built as a focused one, almost all respondents are aged 25-59, thus we can not make a difference between them. Having or not having driver's license and the type of house the commuters live in are not significant either for the travel behaviour. The latter

is easy to explain, as usually a household in Dalby is formed by two partners (Lindén, 2004, personal communication) (with or without children), of which one man and one woman, with different travel behaviours. However, the first hypothesis is verified, as the analysis has shown that there are two different groups of people. This is also confirmed by the analysis of the secondary data in Chapter 5, where it has not only been argued that Dalby's inhabitants may have a tendency towards car travel when commuting to work, but also that there may be a difference between some groups of people. The result is also consistent to what other authors say when they differentiate between commuter's travel behaviours.

The distribution of commuters' travel behaviours according to their income helps us test the second hypothesis. Table 9 shows the results of the crosstabulation between these two variables. To check the probability to always choose bus travel over car travel the respondents have been split into two groups: respondents always traveling by bus and respondents only sometimes traveling by bus (including "sometimes traveling by bus" and "sometimes traveling by car", as the last alternative ("always traveling by car") was, as expected, not chosen by any of the commuters). The percentage represented by the people always traveling by bus out of the people in every income group has been computed.

Table 9. Results of the crosstabulation between income and travel behaviours.

How do people travel to work	Income*				Total
	< 12,000	12,001-16,000	16,001-20,000	> 20,001	
Always by bus	14	11	17	29	71
Sometimes by bus	0		12	26	40
Sometimes by car	0	0	0	2	2
Always by car	0	0	0	0	0
Total	1	1	2	5	113*
Percentage of people always traveling by bus	10	8	5	5	6

* SEK per month.

** The total number of commuters indicating their income has been of 113.

The results confirm the hypothesis that affirm that income is the main variable that determines travel behaviours, and that the lower the income, the higher the probability for the people to always choose bus over car as transportation mode for commuting to work. The computed percentages decrease as the income increases, counting for 100%, 85%, 59%, and 51% respectively. This means that, while it is likely that all people earning less than 12,000 SEK per month always travel by bus, only half of the people earning more than 20,001 SEK per month would always choose bus as transportation mode to travel to work. The difference is significant at a 0.05 level. However, as the sample is not representative for the commuter population in Dalby, confidence intervals were not built and none of these results were extrapolated to this population; they are nevertheless interesting and relevant for the considered targeted sample. When it comes to the whole commuter population, as stated in Chapter 5, it is expected that a high number of commuters travel by car to Lund. The results discussed here suggest that these commuters are likely to be situated in the higher income classes.

Chapter 7. Future Work. Recommendations for the Policy Makers

The advantage of describing the profiles of the commuters from Dalby to Lund is that the policy makers can use them when designing measures to decrease car transport in the region. However, before applying them, the effect of these policies on each group of commuters must be tested, in order to determine the response of each group. The policies can prove to be more or less effective, depending on each group of commuters. The policy makers can choose amongst a wide range of policies that may be targeted at variables both internal (i.e. the perceptions and attitudes towards traveling by car) and external (i.e. the costs of traveling by car) to the individual. Some of these policies are shortly described below.

One of the most common policies used to decrease car travel is increasing parking fees (Figure 23; the “determinant variables” are the variables considered as causal in subchapter 2.4., i.e. income, owning a car, and so on), while in the same time limiting the number of parking places. This is a measure already applied in Lund. *It is cheaper to go by bus. There is a problem with parking places in Lund, you know. There are only few and it is very expensive to park your car in the city. So it is better then to take the bus. (Female commuter, 25-59 years old)* However, as car travel is still a problem, it means that the measure is not effective enough and that it must be used in interconnection with other measures. Baldassare et al (1998) show that, in the United States (the US) fees (parking fees, smog fees, congestion fees) have lower effect on the solo driving than other measures – as for example cash bonuses given by the employers to their employees for

Figure 23. RBP for policy measures: increasing parking fees in Lund.

stopping solo driving, introducing more alternatives for public transport, and introducing carpools at work. The effect of these measures on different commuters is also different. It is shown that younger people, with lower incomes, less educated, who travel shorter time to work, and who are more worried about the environmental problems are more likely to say that they would change/stop driving alone if fees (parking fees, smog (exhaust) fees, congestion fees) were increased or if they were provided cash bonuses for carpooling or for taking public transport to work. Other researchers indicate that carpooling is a solution most commonly accepted by people with lower incomes, longer drives, and less access to a vehicle (Margolin et al, 1978; Teal, 1987; Hwang and Giuliano, 1990 in Baldassare et al, 1998). People traveling longer to work, who need their automobile on the job less often, liberal in their policies, and worried about environmental problems, are more likely to change their unsustainable travel behaviours if public transit was expanded (i.e. through introducing new lines or increasing the frequency of the buses – which represent added qualities for the buses) or if rail was available. Moreover, young people with low incomes, who need their automobile on the job less often, and have liberal policies, would change their travel behaviours if carpools were available. A rail line is a solution also suggested by one of the commuters interviewed for the present study. *You know that they want to introduce a rail line between Lund and Dalby. It is supposed to be ready by 2015. In fact there was a rail line connecting Lund to Dalby, but it was taken out in the '60s, I think. However, I think many people will give up car and go by rail, when the line is ready. (Male commuter, 25-59 years old)* With the introduction of the light rail line from Malmö to Dalby (through Lund) and even further (Olsson, 2004), a decrease in car traveling is expected.

We notice that many of the characteristics described by these authors are common for the profiles of the commuter groups in our study. It would be thus appropriate to see if the effects would be the same in South-Western Sweden, and if there is noticed a differentiated effect of these policies on the “sustainable” and the “unsustainable” commuter groups depicted in Chapter 6. However, one other thing is to be considered by the

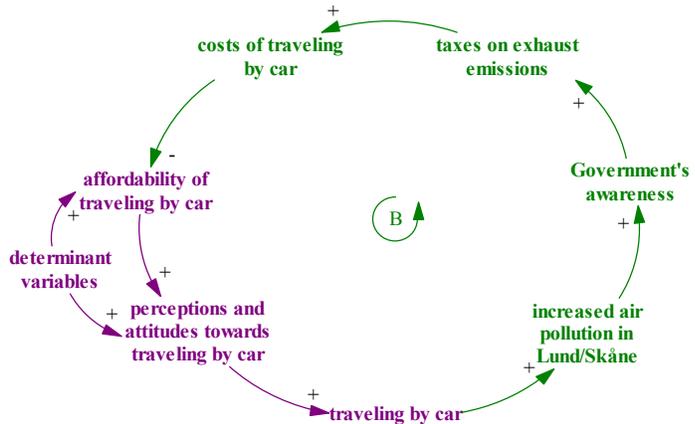
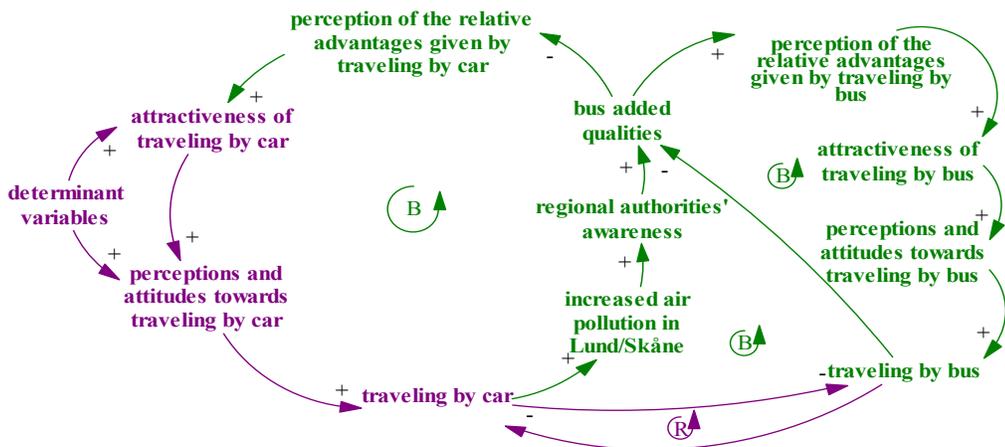


Figure 24. RBP for policy measures: increasing the taxes on exhaust emissions.

policy makers: different policies have different time scales, meaning that the results are to be seen faster (parking fees) or after a longer period of time (exhaust emissions fees (Figure 24)).

Some other measures²¹ are also suggested by the commuters; this shows that they are positive to commute by bus. The most common suggestions refers to better timetables, more direct routes, prolonging bus schedule in the evenings, increasing bus frequency at peak hours, and better connections, which would lead to lowering the waiting time and to increasing the comfort while traveling. *There are three lines leaving from Dalby to Lund, but all three leave within 10 minutes. It would have been easier to travel by bus if we had a bus leaving every twenty minutes. Sometimes when I take my boy to the kindergarten I am late for the bus and then I have to wait a long time. (Male commuter, 25-59 years old) It seems that no one is really thinking about the buses. When you leave Dalby between 7,30 and 8,00 in the morning, at least once in three days you don't have seat because there are a lot of school kids traveling to school. The same in the afternoon at 17,00. The planning is bad. In fact, there is*



no planning. For example when you have to change buses, you have to wait such a long time. I also work in Helsingborg. When I go there, I take the bus to Lund and then the train to Helsingborg, but the bus arrives to Lund central train station exactly when the train to Helsingborg leaves, so I have to wait for the next train. The actual traveling time should

Figure 25. RBP for policy measures: improving bus added qualities.

take no more than 1 hour, but waiting in the stations makes it much longer. And I am not the only person doing this, now I can recognize people going the same route as me, and they are all waiting so long. So going by car is sometimes time saving. (Male commuter, 25-59 years old) It is very convenient to travel by bus. However I wish the buses go until later in the evening. (Male commuter, 25-59 years old) It would be good if they could also arrange direct routes. I travel 5-6 hours per day from Tomelilla to Helsingborg and back and it is no little. But this is because I have no direct bus. (Male commuter, 25-59 years old) Improving these characteristics of traveling by bus means improving what it is described as “bus added qualities” in Figure 25, or transferring some of the car added qualities to the bus added qualities – i.e. the possibility of taking the bus at all times of day and in the evening; however, empty running must also considered. Furthermore, these solutions do not only refer to the timetables and connections, but also to the concrete characteristics of the buses. It also seems that there are the oldest buses going between Dalby and Lund. The ones going to Malmö or to Södra Sandby are more quiet and colder in the summer. (Male commuter, 25-59 years old) The problem in this situation (also identified for the other policies implying a decrease of the car travel and an increase of the bus travel) is that the attractiveness as traveling by bus increases, some of the bus added qualities decrease (for example, as more and more people travel by bus, the crowdedness of the buses becomes a problem), diminishing the perceptions of the relative advantages given by traveling by bus; it is thus important to analyze when is this predicted to happen as compared to decreasing car travel, and to take adequate measures (i.e. increasing further the frequency of the bus rides).

²¹ Other measures are also available, as for example car tolls or household taxes used for subsidies for the bus tickets. However, as it is not the specific aim of this thesis to discuss the measures, these have not been analyzed in the text.

Another measure to increase traveling by bus is to lower the price of the bus ticket. The expected effect is depicted in Figure 26. The effect of this policy has been tested in the US and in Great Britain (GB) by Fujii and Kitamura (2003). They have given free bus ticket valid for one month to a group of car drivers and observed their behaviours. The results show that drivers’ attitudes towards bus travel have become more positive and the frequency of the bus use increased; meanwhile, the habits of using the automobile decreased for the intervention period and even one month after. *It is good to travel by bus, but if they lowered down the prices it would be much better. It is too much for a short trip. It is comfortable, you can read the newspaper, and it is really fast, I only travel for 8 minutes from Dalby to my workplace. But too expensive. (Male commuter, 60-64 years old)*

As shown in Chapter 6, the persons sensitive to bus tickets prices tend to be part of the “sustainable” commuters. Thus it is for the “unsustainable” commuters that measures should be applied. This is a fact that has already been considered by the local authorities, because the price of the ticket in Lund will increase again soon (Anonymous Author, 2004c). As the commuters with unsustainable travel behaviours tend to have high incomes, price elasticity is anyhow likely to be low when switching from car to bus use.

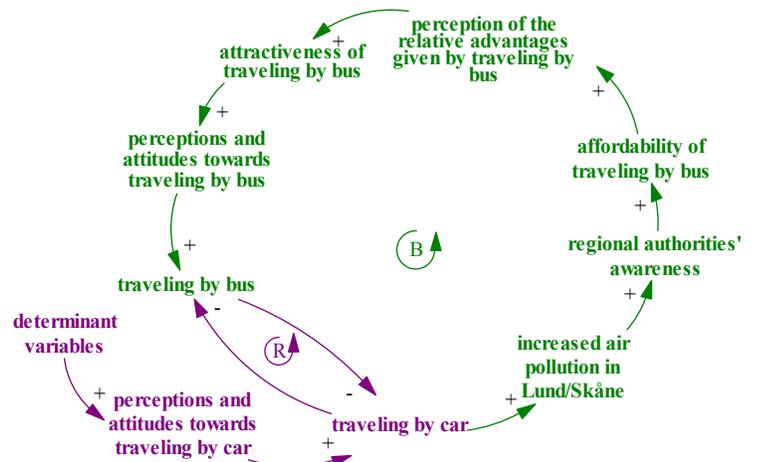


Figure 26. RBP for policy measures: increasing the affordability of traveling by bus

Consequently, reducing the price of the bus ticket may have no effect on their choice of the travel mode; therefore, other policies should be applied. This low elasticity is also due to the fact that it is not only the price that determines the decision of changing travel behaviours, but also other variables – for example, bus added qualities and car added qualities, as already discussed. Therefore, it is likely that this measure is effective only in relation with other measures that decrease the perceived relative advantages of car use as compared to bus use – as, for example, increasing bus added qualities, decreasing the amount of free parking offered by the companies (as suggested by Calthorp et al, 2000),

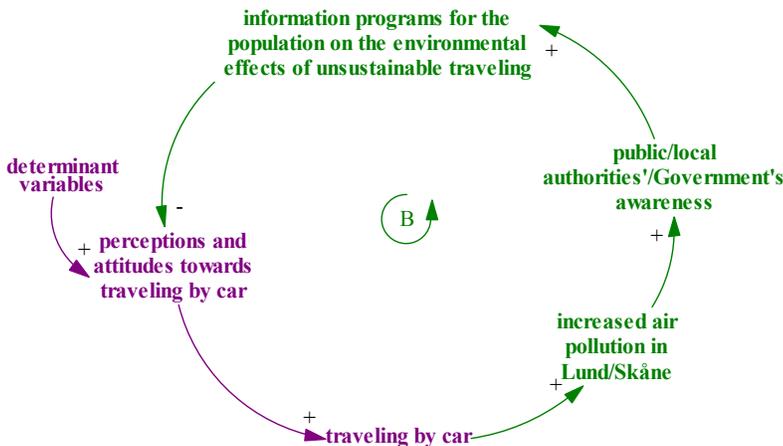


Figure 27. RBP for policy measures: implementing more programs aimed at informing the population on the environmental effects of unsustainable traveling.

increasing parking fees while also limiting the number of parking places, and implementing environmental education programs.

Another set of measures are the ones regarding information. Miller (2004) shows that environmental education is one of the most important factors for changing travel behaviours; Curitiba, one of Brazil’s cities, constitutes an excellent example of success in this respect. However, the analysis shows that the higher income classes do not choose bus travel so to protect the environment. Thus, these measures might not have the desired effects particularly on this group of people.

As already discussed, these measures do not have effect on all commuters, but only on some groups. Meanwhile, it is not a single measure that must be implemented, but the most appropriate mixture for the

respective commuter groups. This is why testing the response of every group to a certain set of measures must be carefully studied and must be regarded as a major step in the implementation process.

Thus, changing travel behaviours is a very important aspect of the future society, in South-Western Sweden as elsewhere in the world, because these increasing trends in car travel behaviour are, as argued in the introduction, encountered worldwide. Meanwhile, building energy efficient vehicles is also a necessity, together with better land use. Carlsson-Kanyama and Lindén (1999) portray a society where cars are no longer the dominant mode of transportation, all age groups are walking or cycling much longer distances than they are today, and where there is almost no use of energy-consuming vehicles for shopping and services. One could add changed travel behaviours for work purposes and especially changed travel behaviours of the “unsustainable” commuters. However, all these aspects of transforming transportation into a more sustainable domain must be regarded as a subsystem that represents only a part of the greater system for building a sustainable future.

Chapter 8. Conclusions

This thesis identifies and discusses the demographic and socio-economic characteristics that determine the commuters from Dalby to Lund to choose between traveling by car and traveling by bus for work-related purposes. As the first chapters show, the most important factors already identified by other authors are income, gender, age, the employment status, education, the stage in the family lifecycle (especially the number of children of non-working age in the family), car ownership, holding a driving license, the location of workplaces, and other social and cultural aspects (i.e. leisure habits). Considering these factors, a model of the determinants for car and bus travel behaviours has been created with the aid of system analysis; this model has been used to discuss the particular case of Dalby, a small residential locality in South-Western Skåne, Sweden.

Secondary analysis, as well as a survey using questionnaires and interviews, have been used as methods of research. According to the theoretical description of the persons with unsustainable travel behaviours, and on the basis of the characteristics of its inhabitants, Dalby was characterized as a small satellite residential city whose inhabitants have strong predispositions towards car travel. The main reasons for drawing this conclusion were the high average income for Dalby’s inhabitants, a low unemployment rate correlated with a low number of persons receiving social service benefits, an increase in Dalby’s population number, a high number of owned single-family large houses – showing inhabitants’ desire for comfort. Furthermore, many of the households include children of non-working age and own cars – the average is of more than one car per household, showing that at least some of the houses own more than one car. Correlated with planning aspects that conducted to a low number of workplaces in the locality, bad planning for bus schedules and other low values for some of the “bus added qualities” (i.e. old buses, bad connections with other lines), these characteristics show that it is very likely for many people to commute by car from Dalby to other localities (i.e. Lund) for work related purposes.

As Dalby is not the only satellite locality in the region, but there are many other cities like Dalby in South-Western Sweden, the phenomenon seems to be general for this area. However, no generalization of the results obtained has been made, not for Dalby’s total population and not for the region, because the lack of both human and financial resources did not allow a representative study. Nevertheless, as the sample was built as a targeted one, the results are interesting and relevant for the population commuting from Dalby to Lund by bus for work related purposes, and are also informative for the entire region and for Dalby’s total population.

These results of the primary analysis show that there are differences between commuters. Two profiles have been identified: the “sustainable” commuters and the “unsustainable” commuters. The commuters manifesting sustainable travel behaviours – who always commute by bus – are mostly women, not working in international companies, with lower incomes, not having children younger than 15 years of age, not owning personal cars, who may live in rented or cooperative houses with a lower number of rooms than the second group, and traveling by bus because it is cheap, it fits working hours, because they have no car, and it is good for the environment. The “unsustainable” commuters travel only sometimes by bus and are mostly men, working in international companies, earning high incomes, who may have children younger than 15 years, who live in owned houses with at least 3 rooms and kitchen, owning their personal cars, and mostly traveling by bus when

the partner uses the car and for other reasons; thus, they suggest more selfish motivations for taking the bus to work and not at all connected with the protection of the environment. The analysis also shows that income is a major determinant factor for the travel behaviours, as people with lower incomes tend to always travel by bus and people with higher incomes only sometimes travel by bus.

The importance of the differentiation between these groups of commuters is for the policy makers to differentiate between the policies they apply in order to decrease car travel. As repeatedly argued, these policies are effective only if implemented in accordance with the profile of the commuters. However, in order to check the response of the different groups of commuters to certain policies, further research is needed. Meanwhile, pulling an alarm signal to be heard of both the community and the authorities is needed, in order to overcome this situation similar to a “tragedy of the commons” and to increase the responsibility and participation of every individual and meanwhile of the community and the authorities in this project for keeping the world green for the next generations.

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Appendix 1. Interview guide

1. If you could choose between traveling by car and traveling by bus, what would you choose?
2. How is it to commute by bus between Dalby and Lund?
3. What do you think about living in Dalby and working in Lund; is it ok to commute every day?
4. If you could choose, would you prefer to live in Lund?
5. Will you continue to commute by bus, or do you think to buy a car?
6. Why did you settle down in Dalby?



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Appendix 2. Questionnaire

Enkät nummer _____

Hej!

Jag heter Oana och denna enkät är en del av min uppgift för magisterexamen vid Lunds Universitet. Den är anonym och jag ska använda resultaten för att undersöka hur invånarna i Dalby reser till och från arbetet. Var snäll och fyll i den noga! Tack så mycket!

1. Hur brukar Du åka till arbetet?

- Jag åker alltid buss
- Jag åker buss ibland
- Jag åker alltid bil
- Jag åker bil ibland

2. Var arbetar Du?

Ort: _____

Arbetsplats: _____

- Kvinna
- Man

4. Ålder:

- under 15 år gammal
- 15-19 år gammal
- 20-24 år gammal
- 25-59 år gammal
- 60-64 år gammal
- 65 år gammal eller mera

5. Månadslön:

- under 12,000 SEK per månad
- 12,001-16,000 SEK per månad
- 16,001-20,000 SEK per månad
- 20,001 SEK per månad eller mera

6. Har Du barn som är yngre än 15 år?

- Ja. Hur många? _____
- Nej

7. Har Du körkort?

- Ja
- Nej

8. Har Du bil?

- Ja, egen bil
- Ja, bil i familjen
- Nej

9. Bor Du i hyreslägenhet, bostadsrätt eller privatägt småhus?

- Hyresrätt
- Bostadsrätt
- Äganderätt/småhus

10. Hur många rum har bostaden (exklusive köket)?

11. Varför reser Du med buss till arbetet?

- Det är bekvämt
- Det är billigt
- Det stämmer med mina arbetstider
- Det är bra för miljön
- Jag har ingen bil
- Min man använder bilen
- Annat _____