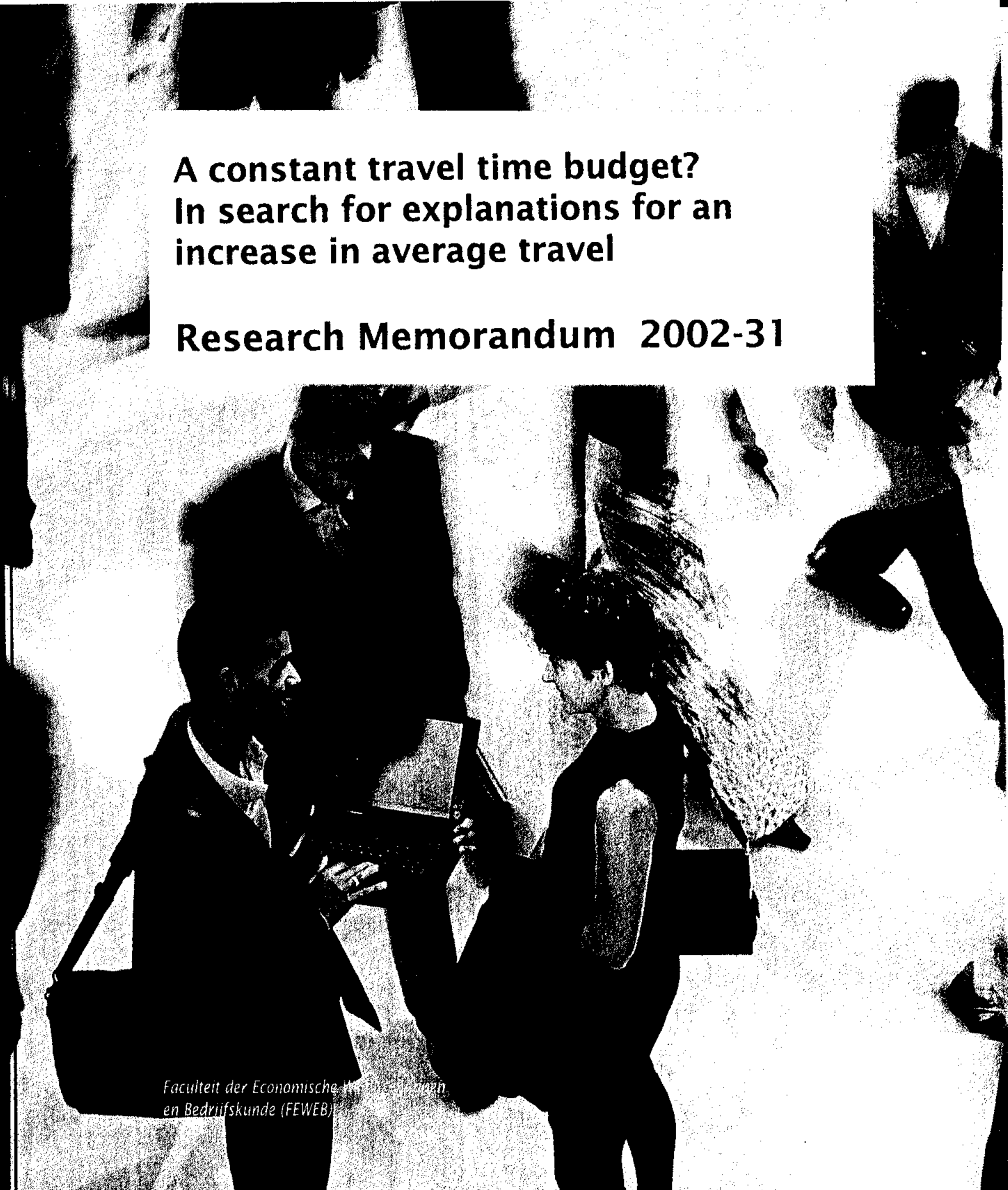
A constant travel time budget? In search for explanations for an increase in average travel

Research Memorandum 2002-31



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Abstract

Recent research suggests that during the past decades the average travel time of the Dutch population has probably increased. However, different data sources show different levels of increase. Possible causes of the increase in average travel time are presented here. Increased incomes have probably resulted in an increase in both costs and benefits of travel. The increase in travel time may also be due to benefits having increased more rapidly than costs. Costs may even have decreased due to the increased comfort level of cars and increased opportunities offered to make double use of one's time (e.g. working in a train).

1. Introduction

During the past three decades a discussion has been going in the literature about the question if people on average have a more or less constant travel time budget. Researchers who conclude so are, among others, Szalai et *al.* (1972), Zahavi (1979) and Shafer and Victor (1997). In recent years several Dutch authors have done research on this subject and discussed the hypotheses of constant travel time budgets (see, for example, Goudappel Coffeng, 2001; Kraan, 1996; Muconsult, 1997, 2001; Peters *et* al., 2001; Rietveld, 1999; SCP, 1999; Van Goeverden, 1999). The theme is important because constancy of travel time implies that neither long run developments such as technological change and economic growth, nor transportation policies have a notable impact on total transport volumes. Changes in the composition and spatial patterns may of course be substantial, but the total volumes would remain unaltered. In particular the constancy of travel time would imply that the development of faster modes would lead to longer travel distances.

The objective of this paper is to establish developments in time use in The Netherlands over the past 25 years using available data sources. Subsequently, hypotheses will be discussed which might explain the trends found in the data.

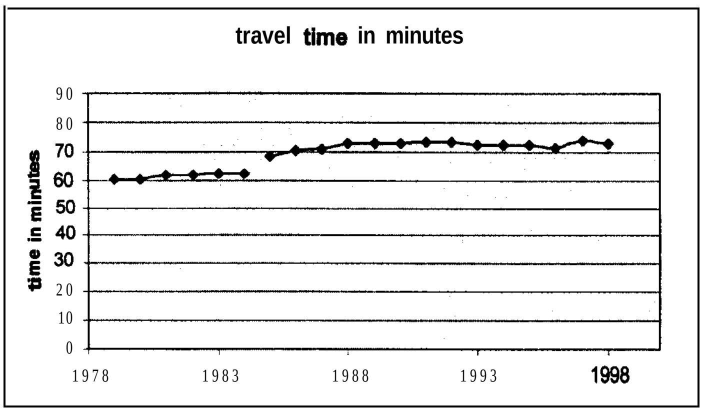
Section 2 describes and discusses the development in average travel time using the two data sets of the CBS as mentioned above. Section 3 presents categories of explanations for constant travel time budgets as presented in Peters *et* al. (2001). In section 4 possible explanations for the increase in travel times are dicussed. Section 5 gives a general overview of our findings, discusses them and presents suggestions for further research.

2. A overview of data

In The Netherlands two data sources exist to investigate trends in time use for transport: The National Travel Survey (OVG) and the Time Use Survey (TBO).

The OVG is a cross-sectional survey conducted by Statistics Netherlands (CBS) continuously every year since 1978. The sampling unit is the household. Sample sizes incrcased from 10,000 in the periode 1978-1995 to 60,000 households from 1995 onwards. Data on travel are collected using travel diaries. The design of this survey changed in 1985 and 1995, implying that trends over a longer period are subject to trend breaches. This is a serious limititation, which can only be partially corrected. In 1999 a new design was introduced. Data from 1999 onwards are not used in this paper.

Figure 1 shows the developments in time used per day for travel for persons aged 12 or older



Source: CBS, National Travel Survey (OVG, various years)

Fig 1: Average time usedfor travel per person per day, travel survey data

The figure shows a trend breach for 1984. The figure is analysed using two trend regressions, for the period 1979-1984 and for 19851998. Results indicate that between 1979 and 1984 time used for travel did indeed increase with 2.1 minutes. Between 1985 and 1998 travel time increased with 2.8 minutes. Hence, in total travel time increased between 1979 and 1998 with 4.9 minutes, correcting for the trend breach. Hence, this suggests that total travel time increased since 1979 with about 8%.

The Time Use Survey (data have been collected by SCP) presents a picture of the use of time in The Netherlands. The survey started in 1975 and has been repeated every five years. About 3,000 respondents keep a diary for a week in which they note what they have been doing. The survey is not comparable with the OVG-survey, hence the results on time use for travel will be different. Specifically, time use is measured in 15-minutes intervals. Hence, the respondents will not register short trips. Table 1 shows the results

Table 1: Time use for travel from the Dutch Time Use Suwey @er person per week andper day)

	1975	1980	1985	1990	1995	2000
Hours per week	6.6	6.8	7.1	7.9	8.5	8.4
Minutes per day	56.6	58.3	60.9	67.7	72.8	72.0

Source: SCP, Time Use Survey (TBO, various years)

Travel time increased, accordingly to the Time Use Survey with about 15 minutes per day from 1975 to 2000. This is an increase of about 26% from 1975 to 2000. The difference between the outcomes for the two data sources (an increase of 8% versus 26%) can be explained partly because OVG covers a shorter period (8% for 20 years implies about 10% for 25 years). Another explanation is that if total travel time per day increases it will demonstrate itself probably more clearly in the time use data than in the travel survey data. The reason is that when short trips take clearly less than 15 minutes they will remain underreported in the time use data. An increase in the travel time for all trips would imply that the probability of tmderreporting of short trips decreases. This would lead to a more than proportional increase in total reported travel time. For a tùrther discussion of travel time data issues see Rietveld (2002).

We conclude that although the two sources differ in terms of the magnitude of the increase in travel time, they are in agreement that it increased during the past decades.

3. Explanations for constant travel time budgets

Based on an extensive literature review, including literature hom economics, psychology, biology, sociology and other disciplines Peters et *al.* (2001) present three categories of explanations for constant travel time budgets,

Reductionistic explanations

Reductionistic approaches use more or less absolute explanations for human behaviour and related constant travel time budgets. Examples can be found in biology, zoology, socio-biology, experimental psychology and evolutionary psychology. For example, evolutionary psychology assumes that most of human behaviour has a genetic background. That background may also explain travel behaviour. The genetic structure results from a long evolutionary development. The explanations for constant travel time budgets can be found in a homeostatic regulatory system, in a need for a minimum leve1 of exercise to stimulate muscles, and in a complex system of hormones related to tbe costs of travel (discomfort, stress, energy use) and benefits (the access to destinations, the pleasure of cycling, driving a car or travelling by train) and in biological clocks.

Reconstructive explanations

Reconstructive approaches explain human behaviour in mathematica1 ways (quantitative models) based on theoretical pre-assumptions on behaviour. Examples can be found in disciplines that describe human behaviour in terms of utility (as can be found in economics, psychology, geography). The assumption is that human behaviour results from (economic) rational behaviour: it is the result of choices between different options. Explanations result from an optimal balance between time for activities and for related travel @ijst, 1995; Bhat and Koppelman, 1999) and from the marginal disutility of extra travel time or additional trips compared to the marginal benefits of related activities (e.g. a job at a bigger distance from home might increase the utility of working).

Contextualising explanations

These approaches explain human behaviour from a historic, cultural, socio-psychological, social or geographical perspective. Examples can be found in history, psychology, geography and cultural anthropology. According to these strategies a constant travel time can not be explained by individual behaviour. It is the context in which an individual functions that explains travel behaviour. Evolutionary leaming processes might explain travel time budgets.

In our opinion the first type of explanations, the reductionistic explanations, give little opporttmities to explain the possible increase in travel time: the increase conflicts with these explanations. In principle the third category, contextualising explanations might be helptûl to explain an increase in travel times, but during the period 1975-2000 in our society changes have been too limited to explain the increase in travel time by this category of explanations. Therefore the reconstructing strategies are the most helpful to explain the increase in average travel time: the increasc might result from (a) an increase in benefits of travel, (b) a decrease in costs, or (c) a change in the composition of population, e.g. with respect to age and income. In this article we adopt these three categories of possible explanations and discuss them.

4. Possible causes for an increase in average travel time

In this section we present *possible* causes of the increase in travel times. Further research is needed to fmd out if they really play a role (see section 5).

4.1 A possible increase in the utility of travel

According to the reconstructive explanations an increase in the utility of travel results - ceteris paribus - in an increase in travel times. Possible reasons why this utility might have increased are presented below.

Spatial trends

Due to spatial trends the utility of extra travel time might have increased. Relevant trends are increaaes of the scale at which services are available. E.g. in health care and hospitals the number of services have decreased and the average size of remaining services have increased (SCP, 1996) Therefore people need to travel more to reach the same service. Also the locations of jobs related to employees have changed: recently developed employment areas are relatively often located at the outskirts of town. The size of cities and towns have increased, resulting in bigger distances between new residential areas and town centres. lherefore, for the same utility people have to travel more.

Specialisation on the labour market and of the skills of employers

The labour marked is specialising more and more. The same holds for employees. The educational leve1 of employees has increased as well as the education level required for many jobs. Many jobs require specialised education and training. These trends imply that nowadays a person searching for a new job has to search in a much bigger search area to select 5 possible jobs than some decades ago. Again, the utility of traveling longer distances increases (see for example Rietveld and van Woudenberg, *2002).*

Segmentation in the housing market

Due to higher income levels people's aspirations with respect to housing (both dwellings and the residential environment) have increased. Preferences probably have become more specific ('a pre-war house in a nice, green environment that is attractive for children'). Therefore the search area of households might have increased. This process may further be stimulated by the decreased leve1 of social relationships at the neighbourhood or village level. The chance that people find an attractive dwelling close to their job location has decreased. This trend may further be strengthened by the relatively homogeneous way in which in the Netherlands post-war residential areas have been designed. Due to the increased search area for dwellings travel times to locations of jobs, relatives, friends etc. may have increased.

A diversification of leisure *activities*

Within the same overall time for leisure people tend to participate in more leisure activities. The genera1 wish for more diversification in leisure explains this trend, but also the desire to participate in more expensive leisure activities made possible by the increased incomes (Batenburg and Knulst, 1993). This trend results in an increase of leisure related travel time.

Travel for the fun of it

People partly travel for the fun of it (Mokhtarian and Salomon, 1999). Research shows that the time spent for fun travel increases. Examples are Sunday touring by bike, motorcycle and the car (Batenburg and Knulst, 1993).

Other economic developments

Like most countries the Netherlands has become a service society. The transition from an agricultural and industrial to a service society results in an increasing need for face-to-face contacts and possibly an increase in business travel. Only part of these needs can be fulfilled by ICT. Secondly the trend of increasing *outsourcing* of non-core business probably results in the spatial separation of core activities and suppliers and therefore in an increase of related mobility.

4.2 The changing costs of travel

The second category of possible explanations for an increase of average travel time might be the changing costs of travel. In this section we present some explanations of this type.

The increase in the share of car kilometres of motorways

The road network is relatively safe and comfortable. The chance per kilometre of getting killed in a road accident on a motorway, is only one third to 11% of that chance on other categories of roads outside the built-up area (Koornsta, 1998): The share of car kilometres on the express-way network has increased during the past decades, at the expense of the share of kilometres in the built-up area (CBS, 2001). The impact on average travel time per person per day is difficult to predict because it has two effects with a different sign. On the one hand generalised transport costs per km will have decreased due to the higher safety and comfort level, resulting in more travel. On the other hand generalised transport costs *per hour* have increased because the speeds on the motorways are much higher than average. Therefore people drive more kilometres per hour and have higher monetary costs. Further research is needed to conclude what the impact is of the increase in the share of the motorways on travel time budgets.

A reduction in the improvements of the road network

In the past two decades, as in many other countries (such as Britain) the improvements in the road network have been limited compared to the previous decades (V&W, 1999; CEMT, 1999). We not only refer to new motorways and other major roads outside the built-up areas but also to major roads within the built-up areas. However, car use and car ownership have continued to increase during the past decades. Besides, the utility of longer travel distances has probably increased, for several reasons as presented in this paper. Possibly the improvements in the road infrastructure have not been able to cope with the increased level of car use, with an increase of congestion as a result (see CEMT, 1999). For given combinations of origins and destinations travel times probably have increased. Because the travel times increase slowly and in a rather smooth way people might get used to the increases and accept them, and therefore not consider a change of jobs or residential location. or of other destinations.

This trend of increased travel times for given combinations and destinations seems to conflict with the overall increase in speeds of travel at the road network, but it does not. Despite the increase of congestion, speeds at the motorways still are much higher than on other roads. In the Netherlands on a yearly basis about 10% over travel time at the main roads is lost due to congestion. This means that - assuming an average travel speed of 100 km/h without congestion - the average travel speed including congestion stil1 is 90 km/h. And this, of course, is much higher than the average for all roads. Therefore the increase in the share of kilometres at the main road network has resulted in an increase of average speed for all car kilometres at the complete road network, despite the strong increase in congestion in the past two decades (Van Wee and Van den Brink, 1999).

The role of the bicycle

The share of the bike decreases rapidly at distances longer than 5 and certainly 10 km. E.g. only few people cycle to their work if the home-to-work distance is more than 10 km. Probably the disutility of cycling increases more than proportional at longer distances. This might be explained by physiological factors. Assuming the trend towards bigger distances and the increased leve1 of car ownership more people can reach destinations at further distances by changing their modal choice from the bicycle to the car. But once they use the car, the more than proportional disutility after 5 tot 10 kilometres does not exist anymore, or at least to a lesser extent. This is especially true because at longer car distances the share of kilometres on the relatively comfortable and safe motorway increases. The overall effect may be a lower disutility of longer travel times.

The increased level of comfort of cars

Nowadays cars are much more comfortable than some decades ago. Bennis *et al.* (1991) developed a quality index for cars. Between 1962 and 1990 the index for 'comparable cars' increased by 30%. This increase results in a decrease of the disutility of travel by car. Besides, many people consider travelling by car as more comfortable compared to travelling by public transport or the bicycle. The increased leve1 of car ownership makes comfortable travel by car available for more people. Besides, cars have become much safer, also leading to a decrease of the disutility of travel (see also below). Finally, the reliability of cars has improved, making the use of them more attractive. In short, the better quality of cars has resulted in a decrease of the disutility of using them.

Improved road safety

The risk of getting killed in a road accident has rapidly decreased. Despite the increase in mobility nowadays the number of people killed in road traffic is only one third of the level in the early seventies (CBS, 1995). This is not only caused by the increased safety of cars, as mentioned before, but also by improvements in road infrastructure and health care (including the time an ambulance needs to reach the location of a road accident and to return to a hospital). Safer travel means a lower disutility of it.

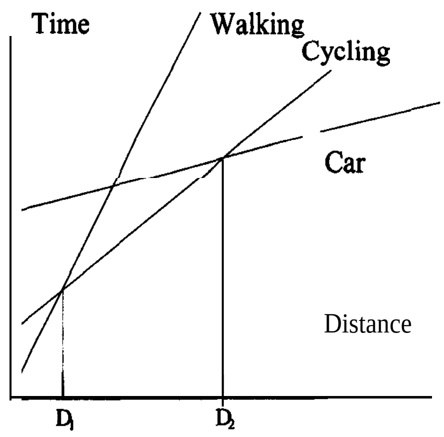
Zncreasedpossibilities to combine travel with other activities

Possibilities to combine travel with other activities have increased. E.g. one can work in a train by using a portable computer. And people can make phone calls both in trains as well as in cars. The increased possibilities to combine travel with other activities have resulted in a decrease of the disutility of travel time.

4.3 An analysis of changes in costs and utility

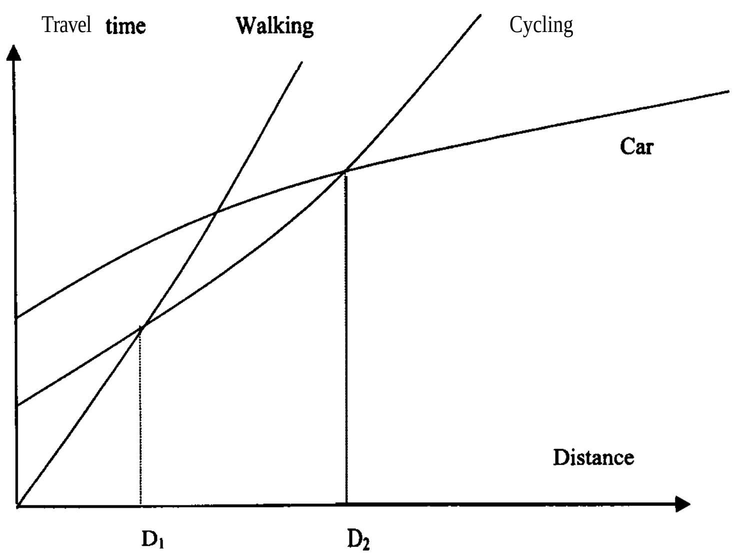
In this section we present a simple model to demonstrate the impact of the changes in costs and utility on average travel time. The model shows the choices of persons under changes in costs and utility of travel on the one hand, and the resulting travel time on the other hand. We assume a person chooses between three modes: walking, the bicycle and the car. We start analysing (changes in) costs. Figure 1 visualises the travel times for trips for each mode.

Figure 1: travel times per model; a linear relationship between travel distance and travel time



We firstly assume constant speeds with respect to distance. Because using a car means one has to spend time to walk from home to the car (parking place), get into it and start it, the car is less attractive for very short distances. The same holds for the bicycle, but to a lesser extent. However, in practice travel speeds are not constant. For people walking or cycling the average speed will decrease as distances increase because they need time to rest. For the car average speed will increase, because the share of the motorway increases as distances increase. Note that only with very long trips (after a few hours) a car driver has to rest. In the rest of this article we do not assume resting time for car users. Figure 2 visualises the result.

Figure 2: travel times per mode assuming non-constant speeds.

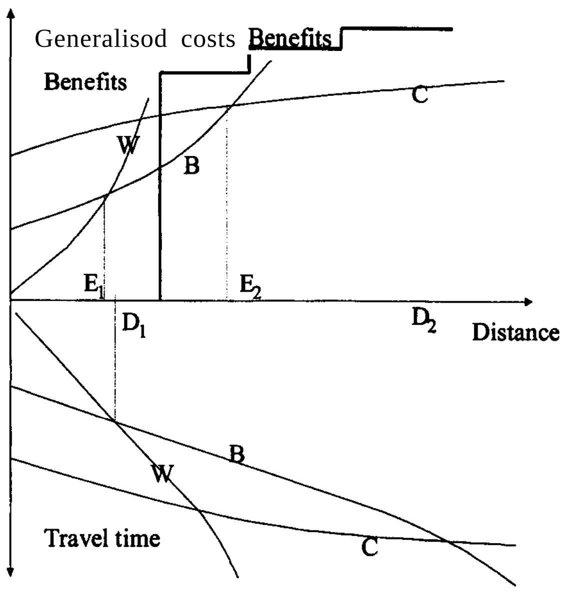


If the choice of the person would only be based on distance the areas per mode would be defined by D_1 en D_2.

Generalised transport costs not only depend on travel time only and the valuation of it. The car is more comfortable compared to the bicycle, especially in case of bad weather, and for longer trips. Many people like cycling for a short period, e.g. 10 minutes, but not for, for example, one hour. Besides, social and physical safety have impact on generalised transport costs as monetary cost (hke fuel costs, parking costs and tolls) do. Figure 3 visualises the possible level of generalised transport costs as a function of travel for different travel times. It is clear that the areas for each mode as defined by Et and E_2 will differ from the areas defined by D_1 and D_2 as presented in

Figure 2, the result being that an increase in distance does not necessarily result in an increase in travel time. To illustrate this we assume the shift from the bicycle to the car. Only based on travel time this shift may occur at a distance of – for example ▪ 3 km. A person who dislikes cycling may switch at 1.5 km, someone who likes cycling only at 5 km. In other words: if the distance increases from 4.5 to 5.5 kilometres the latter person will switch from the bike to the car. Although the distance increases, travel time decreases. This example shows that discontinuities might occur: longer distances can be combined with shorter travel times. The more generalised transport costs are dominated by travel time the lower this effect. Note that this effect only occurs due to a shift of modes. (We do not consider here a decrease in car travel time due to a change of routes after an increase in distance, e.g. due to choosing the relatively fast motorway for longer trips).

Figure 3: generalised costs, benefits and travel time per mode, by distance



W = walking
B = bicycle

C =car

A change of modes may also result in an increase in travel time. Consider an individual that dislikes cycling. An increase of travel distance from 1.4 to 1.6 km results in a shift from the bicycle to the car and to an increase of travel time. The same occurs often if a person shifts from the car to public transport.

Not only the costs but also the benefits play a role. Let US assume the trip to a shop for daily needs. Consider a person who lives near an average quality shop within cycling distance and there are more remote, high quality shops. The line showing the benefits is the stepped line as presented in Figure 3. Note that shops at bigger distances with lower quality are not relevant and therefore excluded in Figure 3. The curve of benefits can be found by sorting shops by distance and then excluding shops with a lower or equal quality compared to nearer shops. The preferred shop is the one with the biggest difference between costs and benefits. The utility of visiting this shop is expressed as the vertical difference between both the cost and the benefit curve. In the case of Figure 3 it is the shop accessible by bike. It is possible that for all possible locations, costs exceed benefits. Then the person will not make the trip. It is clear that the form of the curve of benefits depends on specific circumstances: the location of the household and the locations of services in its surroundings. Nevertheless, the model can be used in qualitative terms to demonstrate the effects of changes in benefits and costs on travel times. We now can link the possible explanations for increased travel times as presented in sections 4.1 and 4.2 to the model. We start with the explanations as presented in section 4.1

Spatial trends such as the increases in the scale of services imply that nearby services disappear. The supply curve only becomes positive at longer distances. It is clear that this results in longer trips and (apart from the rare exceptions due to longer travel times after switching modes) to longer travel times. *Specialisation on the labour market and of the skills of employers* also lead to a decrease of opportunities at shorter distances. The curve of benefits will shift to the right. The same holds for the *segmentation ut the housing market.* The developments with respect to leisure and the trends in economy (the transition to services, more outaourcing) result in the same pattem: an increase in the utility of travel and therefore an increase in travel time. The increase in travel time due to an increase in travel for the fun of it is evident.

Factors with respect to the costs as presented in section 3.2, the role of the bicycle, the increased comfort level and safety of cars and the increased possibilities to combine travel with other activities, result in lower costs. The reduction in generalised transport costs increases the chance that people will chose more remote opportunities. Besides, trips witb higher costs than benefits (for all opporhmities and related distances) will not be made without the reduction in generalised transport cots. But due to the decrease in these costs benefits might exceed the costs, resulting in more trips and therefore more time for travel.

We conclude that the model as presented in Figure 3 offers possibilities to analyse changes in the costs and benefits of trips, and the resulting travel time.

An important trend that deserves more attention is the increase in incomes. This trend has a complex impact on Figure 3. Firstly, an increase in income results in an increase in car use, making longer trips relatively more attractive. These longer trips do not necessarily result in more travel time because, generally speaking, the car is faster than the bicycle or public transport. On the other hand, people with higher incomes have a higher value of time (Gunn, 2001). On average they also have more expensive cars, resulting in higher monetary costs. Higher incomes therefore result in an upward effect on the cost curve. This upward effect is not the same at all distances. On average the optimal travel distance, and so travel time, will decrease due to the increase of generalised transport costs. On the other hand, benefits of opportunities will also vary with income. People with higher incomes will be prepared to pay more for the same opporhmities. Therefore not only the cost curve will show an upward trend due to higher incomes, but also the benefit curve. It is difficult to say beforehand what the impact on the optimal travel time and distance will be. For opportunities of which the benefits increase more than generalised transport costs, an increase in travel times will be the result. In the opposite case a decrease will occur. We give an example of the first possibility. Assume the value of time increases proportional with income and monetary costs increase less than proportionally with income. In that case generalised transport costs increase less than proportional with income. If the preference for variety increases proportionally with income the benefit curve will increase more than the curve of the generalised transport costs. Longer travel distances will result, and very likely also longer travel times. It is also relevant that due to the higher incomes the car gets more comfortable, resulting in a lower value of time. People with higher incomes can therefore decrease the disutility of travel and make the increase in the cost curve less than by shifting to more comfortable cars. We conclude that the effect of an increase in incomes on travel time depends on many factors and can be both positive and negative.

One relevant aspect has been excluded so far. Due to an increase in the utility of travel and the related increase in travel time, time will get more scarce leading to an increase in the value if it. Figure 3 only assumes separate trips without paying attention to impact on the time budget for other activities. The inclusion of relationships between trips will make final changes in travel times less than Figure 3 assumes.

4.4 Changes in the population

Changes in the share of 'homogeneous groups of people '

Average travel time differs between 'homogeneous' groups of people (e.g. with respect to age, income and household situation). Therefore a change in the break-down of population may lead to an increase in average time spent on travel. Goudappel Coffeng (2001) made a break down of the population with respect to one variable (gender, age, household structure, the number of cars in the household, education, employment situation and urbanisation) using TBO data. The results show that for each disaggregated group the increase in travel time is more or less the same as for the whole population. Theoretically it is possible that a breakdown based on more than one variable gives other results, but this is not very likely. Our first conclusion is that changes in the population with respect to variables such as age and education do not explain the increase in average travel times of the whole Dutch population.

More people combining different tasks

Another change with respect to population may be relevant: an increase in the proportion of people combining tasks such as taking care of children and working.

E.g. between 1975 and 1995 in the Netherlands the number of working females increased by 80%, whereas the increase in the number of working males was less than 10% (AW, 1997). It is possible that the increase in the share of people combining tasks leads to an increase in average travel time. However, research by Batenburg and Knulst (1993) shows that this increase did not significantly contribute to the increase of average travel time.

A decrease in household size

Since the sixties the average household size decreased. This decrease may lead to an increase in mobility because per person the time needed for household related tasks, such as shopping, increases (Batenburg and Knulst, 1993).

5. Discussion and suggestions for further research

The above explorations suggest that the possible increase in travel time mainly is the result of the increased utility of longer trips (longer expressed in travel time) and changes in the transport system. Changes in the population probably hardly play a role. We suggest that in the past decades benefits of longer trips have increased and costs of travel have decreased, the result being an increase in average travel time of the Dutch population. The reduction in travel costs might explain why empirical research shows a decrease in the value of time in the Netherlands in the past decade, despite the increase in incomes (Gunn, 2001).

We suggest future research into travel time budgets with respect to next subjects:

1. Research into the subjects as discussed in this article. Important aspects may be:

- Spatial trends
- Specialisation on the labour market
- The reduction in the speed of improvements in the road network
- The increase of comfort and safety level of cars
- The increase in possibilities to combine travel with other activities

- The increase in the share of motorways in travel time and kilometres

2. Research into 'utility based' indicators for accessibility (see, for example Geurs and Ritsema van Eck, 2001). These indicators explicitly pay attention to the utility of travel for a person. They assume decreasing marginal utility of additional opportunities. E.g. the expected difference between one and two supermarkets within a walking distance of two minutes is bigger than the expected difference between 5 and 6 supermarkets at this distance. Using these indicators it is possible to find out if changes in the land-use and the transport system, and in the population or the preferences of the population will result in changes in the choice of opporhmities, travel distances and travel times.

3. Panel data research focusing on the question if people get used to slowly increasing travel times between given combinations of origins and destinations. Results from psychology, assuming that people are less sensitive for gradual but steady changes than for discontinue changes that are equally large, can be used. Another subject for panel data research may be changes in the lifestyles leading to an increased utility of visiting unique places, where a person has not been before.

4. Research into the effect of the increase of ICT use on travel behaviour, both with respect tot travel time as well as with respect to changes in activity pattems.

5. Historica1 research into travel behaviour in the past century and the impact of the factors as described in this article on it. Along similar lines cross country studies will shed light on the present theme.

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