Land Use and Cycling

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Summary:

Research about correlation between land use and transport mode choice has focused on the choice between public transport and private cars. But is land use an important factor for the level of cycling? Two studies were made in order to answer this question.

One study was an analysis of Danish towns. The analysis compares data gathered from the national travel survey and other statistical sources. Using discrete choice models made it possible to isolate effects of number of inhabitants, size of urban areas, population density, topography and income.

The other study was a literature study about several aspects of land use and transport mode choice including location of work places and shops.

The studies show that land use has a major influence on transport mode choice. Especially topography and population density influences the level of cycling. The number of inhabitants only influences the level of cycling, when the number of inhabitants in the town is less than 10,000.

In short, people choose the bicycle more often in a dense populated, circular, flat town with more than 10,000 inhabitants, where most housing are located in the town centre - than in other towns.

1. Introduction

Research about correlation between land use and transport mode choice has focused on the choice between public transport and private cars. But is land use an important factor for the level of cycling? Two studies were made as part of the preparation of the book Collection of Cycle Concepts (1). References can be found in the book and a paper (2).

2. Town study

38 Danish towns of more than 10,000 inhabitants are included in the study. Some towns were excluded. Rønne was excluded due to its location on the small island. Copenhagen and its satellite towns were excluded due to the presence of fast moving, local public transport. Two large towns were also excluded due to the choice of parameter for topography. Excluding these towns made the models better to predict modal split. Each of the 38 towns in the study has local bus transport and 36 towns have 1 train station. Two towns do not have a train station.

Data from the national travel survey 1993-1996 has formed basis for describing modal split among the population of each town. The travel survey is based on telephone interviews with 16-74-year-olds inhabitants. One out of 90 inhabitants has been interviewed during 1993-1996. Modal split varies considerably between the 38 towns:

Walking:	6-24%
Cycling:	12-36%
Car:	45-74%
Bus:	0-12%
Train:	0-7%

The town area is in this study defined as the coherent built-up area. As indicator for topography is the difference between the highest and the lowest terrain level above sea in the built-up area used. 5 explanatory variables were included in the modelling. These variables also varies to some extent between the towns:

Number of inhabitants:	10,300-117,534
Size of urban area:	5-49 sq. km
Number of inhabitants per square kilometre:	882-2469
Maximum difference in terrain level:	6-101 metres
Average personal income (before tax):	142,500-168,100 DKK

Aggregate figures for modal split and explanatory variables for each town are used for modelling. Each town has the same statistical weight in the models. The logistic procedure in the programme SAS has been used for modelling. A logit model is better than ordinary regression in this case, due to the fact that the number of trips per person per day is almost the same in each town.

In none of the models average personal income had a statistical significant influence on mode choice, except for the choice of bus. The size of urban area co-varies too much with number of inhabitants and population density, and size of urban area has the lowest explanatory value of these three variables. Income and size of urban area is therefore not included in the model with highest likelihood score statistic, which is presented in the following. The model can explain approximately 88% of transport mode choices in medium sized Danish towns.

3. Number of inhabitants

The number of inhabitants in the studied towns does not have statistical significant influence on the choice of bicycle and car. In larger Danish towns relative more choose the bus and fewer choose the train and to walk than in smaller Danish towns, see figure 1.

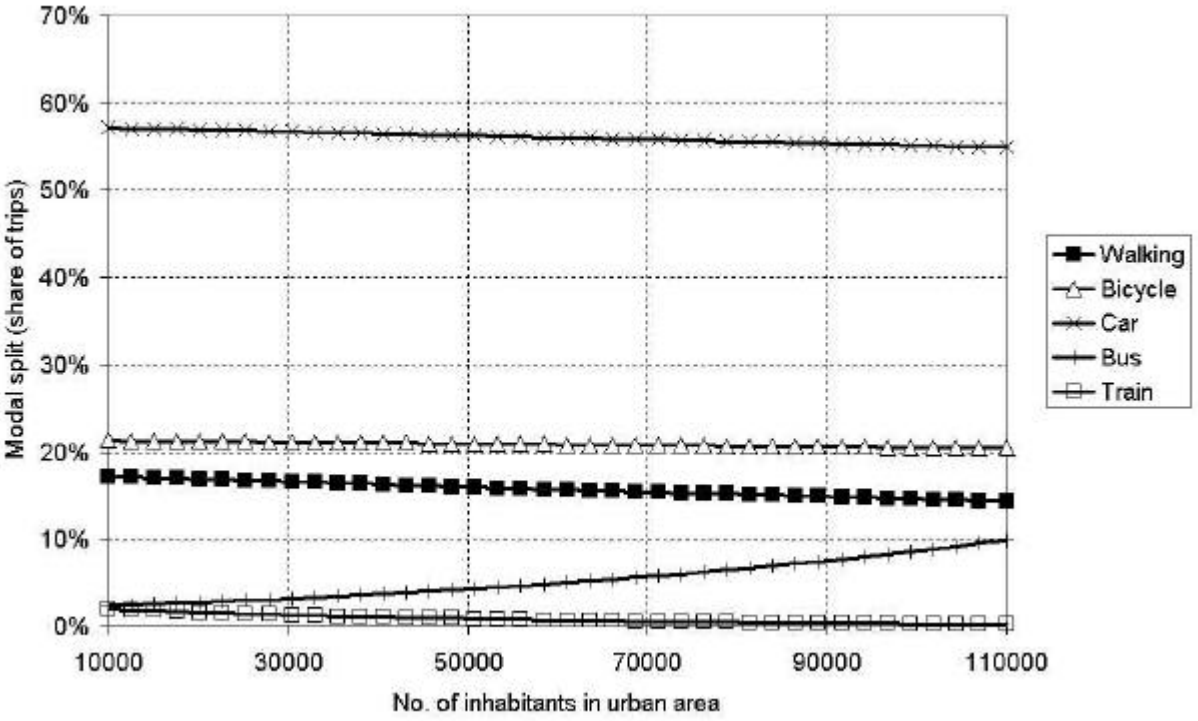

Figure 1. Modal split as a function of number of inhabitants in a fictive Danish town with 2,000 inhabitants per square kilometre and a maximum difference of 50 metres in terrain level.

It might be a surprise that relatively fewer choose the train in more populated towns. However, the average distance to the train station becomes longer in larger towns and since Danes rarely cycle to the station, the result is maybe somewhat logical.

The number of inhabitants only influence the level of cycling in towns with less than 10,000 inhabitants, so relatively few chooses to cycle in rural districts, see figure 2. Relatively more chooses public transport in Greater Copenhagen, primarily due to fast moving local trains.

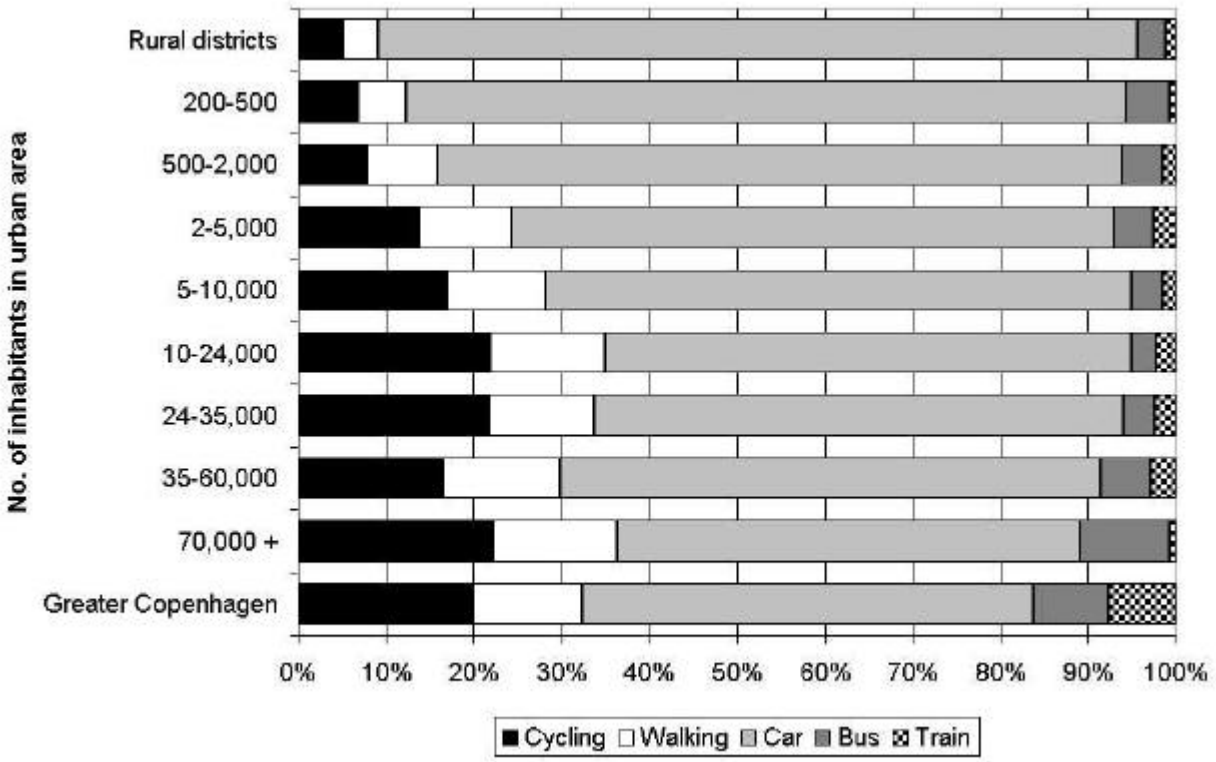

Figure 2. Modal split among 16-74-year-olds Danes. Trips shorter than 300 metres are not included.

4. Population density

In more dense populated Danish towns relatively more walk and cycle and fewer drive cars than in less dense towns, see figure 3. Population density does not significant affect the choice of bus and train in medium sized towns.

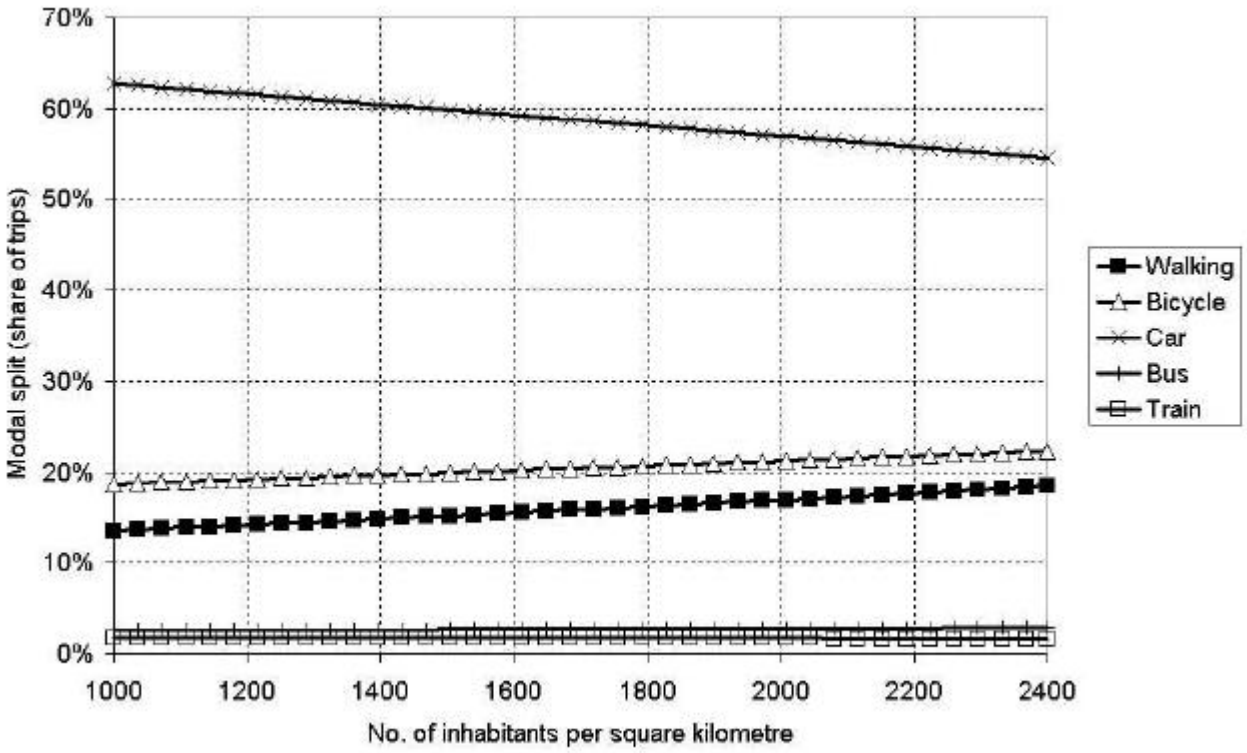

Figure 3. Modal split as a function of the population density in a fictive Danish town with 20,000 inhabitants and a maximum difference of 50 metres in terrain level.

An urban structure where most of the buildings are located in long ribbons with public transport routes will result in short walking distances to public transport. Many of the Danish towns are located near the sea, and this also creates long ribbons of buildings close to sea. However, travel distances are quite long in "ribbon" towns and inhabitants are more dependent of motorised transportation. The result is that fewer choose to cycle in "ribbon" towns than in circular towns.

5. Topography

Topography is the factor that can explain most of the variations in modal split in the Danish towns. In a flat town more cycle and fewer choose the car, bus and to walk, see figure 4. Topography does not have significant influence on train transport in Danish towns.

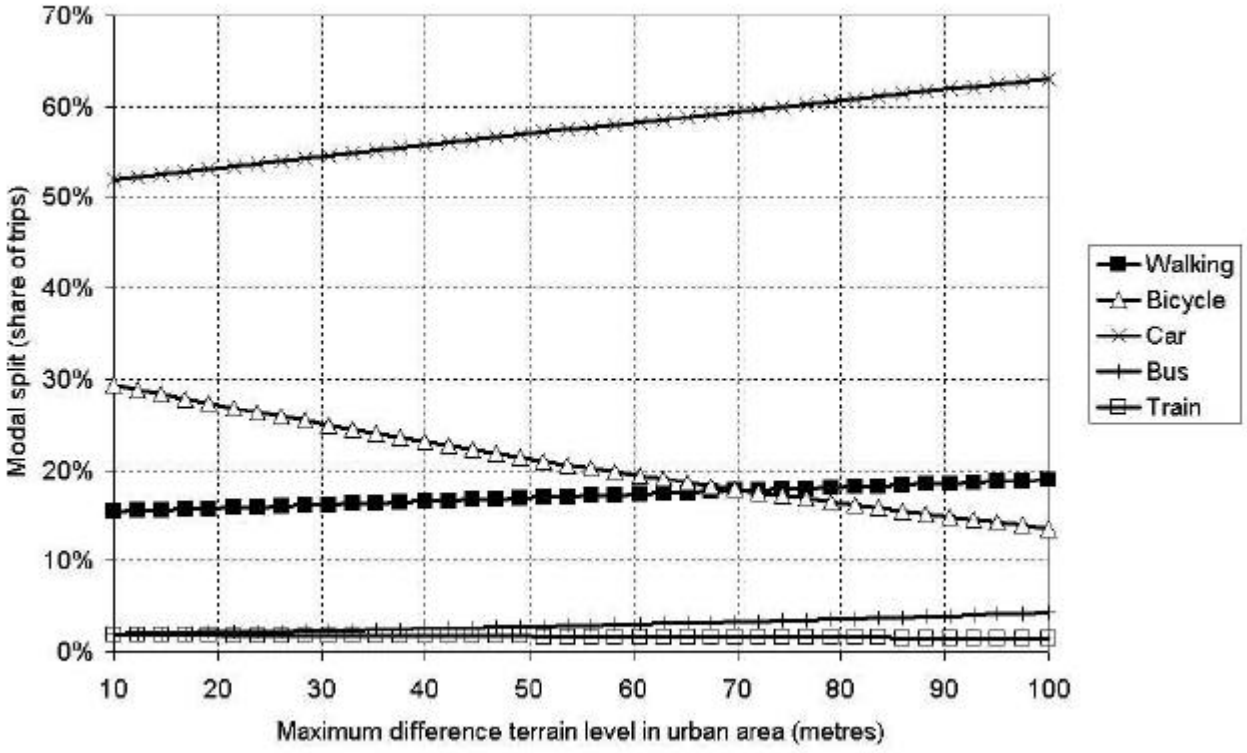

Figure 4. Modal split as a function of the maximum difference in terrain level in a fictive Danish town with 20,000 inhabitants and 2,000 inhabitants per square kilometre.

The decline in cycling after Second World War in Denmark might partly be explained by the urban expansion into more hilly areas. Many Danish town centres are situated close to sea and small river deltas with suburbs mostly built after 1950 on surrounding hills.

6. Location of urban functions

Other things being equal, a balance between the number of people in employment and the number of workplaces will mean least commuting. According to experience in England, however, this does not have much effect on passenger kilometres and mode choice. The placing of people's homes has a stronger effect on passenger kilometres than where the workplaces are situated.

Studies of commute made by office workers in the metropolitan area of Copenhagen show that the percentage of walking and cycling employees increases with the percentage of employees living close to their work. Employees in public service live closer to their work and therefore cycle more than employees in the private sector. Residents in the city centre live close to their work and cycle more than in the suburbs.

Workplaces situated in town centres have more cycling employees than workplaces on the outskirts. The location affects mode choice more at male dominated and high-income workplaces than at female dominated and low-income workplaces. The placing in relation to public transport terminals has no effect on the number of cyclists, but affects the choice between car, bus and train.

In the Netherlands the government has drawn up guidelines for the siting of workplaces and the extent of car parking provision on the basis of environmental considerations. The aim is to co-ordinate the transport requirements of workplaces with the accessibility of the transport system in

order to achieve the optimal environmental effect. Many towns and cities have an integrated land use and traffic planning in the Netherlands. In commercial and industrial areas a voluntary co-operation between workplaces and public authorities seeks to limit parking opportunities.

This policy has been applied in, for instance, Amsterdam, where attempts are also being made to improve conditions for cyclists. As early as in the general plan from 1935 the aim was that it should be possible to cycle from home to work in less than 30 minutes. For this reason the city has for many years been developing a system of cycle routes, which has in a number of instances resulted in curtailments in the capacity of the road system. Car traffic is expected to grow by 70% if there is no public intervention, but the location policy and the maximum parking norms will reduce this by 23%.

Integrated land use and traffic planning is also reducing car traffic in other countries, e.g. England and Denmark.

Fewer cycles to shops than for other purposes, as shopping is usually a matter of many, very short trips that Danes often make on foot. But at the same time many people often choose not to cycle on shopping trips of the same length as other cycle trips. The majority of shopping trips start from the home. Few people shop on their way home from work.

The use of cars to reach individual shopping centres varies primarily according to its catchment area. The location of the individual shopping centre is of less importance for the total shopping patterns of households. If a car is available, people choose a shopping centre outside walking distance, if the range and prices of goods in the nearest shopping centre do not suit them. A Norwegian study has shown that while 50% of the population could shop for their everyday necessities within 500 metres of their homes, only 27% did so.

In Denmark it is very difficult to get permission to establish new food outlets of more than 3,000 square metres and non-food outlets of more than 1,000 square metres. The planning law and system helps to maintain a decentralised structure and to stabilise the number of outlets, which would otherwise fall.

Cyclists spend slightly under half as much money per shopping trip as motorists in Danish town centres. On the other hand, cyclists shop more frequently in town centres. The traffic to large shopping centres and hypermarkets on the outskirts of towns is far more car-based than traffic to shops in town centres. One reason is that shopping centres and hypermarkets have far bigger catchment areas than other outlets, which means that on average customers have to travel further.

The establishment of a good local supply of service with small shops, schools and institutions might get more to cycle and reduce the number of passenger kilometres. In Denmark, most schools are relatively small with 200-1,000 pupil and most often parents choose the nearest school for their children, which probably are important reasons for the large cycle culture.

7. Conclusion

The two studies clearly show that land use planning has a major impact on the level of cycling. It is especially topography, population density and the size and location of urban functions, which affects the level of cycling. However, land use develops rather slowly due to the large locked-up capital in buildings.

References:

(1) Jensen, Søren Underlien et al. (2000): Collection of Cycle Concepts, Road Directorate, Denmark.
(2) Jensen, Søren Underlien and Thost, Per (1999): Bystrukturens betydning for cykeltrafikken, Proceedings of 'Trafikdage på Aalborg Universitet '99", Denmark.