The Impact of the Modal Split on accessibility in urban areas

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1 ABSTRACT

This paper deals with accessibility in large urban areas. A simple indicator of accessibility for a certain location is the number of people who are able to reach this location from their doorstep within a certain time. Based on data on average traffic speed, modal split, transport performance and population density fom 46 large metropolitan areas the impact of the modal split of urban travel on average accessibility is examined. It turns out that accessibility within urban areas is largely independent of the modal split. Moreover the effect of modal split on average traffic speed seems to be compensated by differences in urban population density in a way that accessibility remains constant.

2 ACCESSIBILITY WITHIN LARGE URBAN AREAS

2.1 Access is the purpose of the city

Despite all the obvious disadvantages of life in cities the continuous growth of large urban agglomerations is a world-wide phenomenon. The main asset of such agglomerations is a high degree of accessibility. It can be assumed that accessibility is the dominant force behind the development of urban agglomerations. Accessibility is crucial for the level of productivity reached by businesses located within the urban area (PRUDHOMME & LEE, 1999). To put it quite simple: Easy access to multiple places of activities such as work, shopping or entertainment is the purpose of cities. Therefore it is an important question, how the main asset of cities – accessibility – is affected by the modal split of urban travel.

2.2 Measuring Accessibility

To analyze accessibility it has to be defined and measured. Based on the so called 'isochrone concept' a very simple indicator of accessibility can be defined as a function of travelling speed and population density. This indicator 'A' is proportional to the number of residents who are able to reach a certain location within a certain time (20 minutes for example). This number depends on the size of the catchment area (indicated by average speed of urban travel 'V' squared) and on the population density 'D' within the area:

(1) A = D * V2

The average speed of urban travel 'V' is calculated by dividing total transport performance of all modes (person kilometres) by total travelling time of all modes in person hours:

(2) V = Total performance of urban travel / Total travelling time

2.3 Increased speed does not increase accessibility

Transport related data of 46 metropolitan areas in four continents (KENWORTHY & LAUBE, 2002) and corresponding data on urban densities (KENWORTHY, 2005) can be used as an empirical basis to analyze the relation between accessibility and a variety of transport characteristics. As expected, the average speed of urban travel declines strongly with increasing percentage of non-car modes (see figure 1). That however does not mean that high modal split of car travel results in high accessibility. This is because of an effect which can be shown by comparing average speed of urban travel[1] with population density (see figure 2). It turns out that in average the population density 'D' falls almost exactly with the second power of the average speed of travel 'V':

(3) D = Constant * V-2

If equation (3) is entered in equation (1) a surprisingly simple result appears for the indicator of accessibility:

(4) A = Constant * V-2 * V2 = Constant

This means that in fact metropolitan areas all over the world, despite huge differences in their urban transport systems, have a relatively similar level of accessibility. Obviously accessibility remains largely unchanged if the average speed is increased by increasing car use and by introducing urban motorway networks. It seems

[1] own calculations based on data by Kenworthy and Laube (2002).

that the effect of rising average travelling speed is almost exactly compensated by falling population density due to urban sprawl.

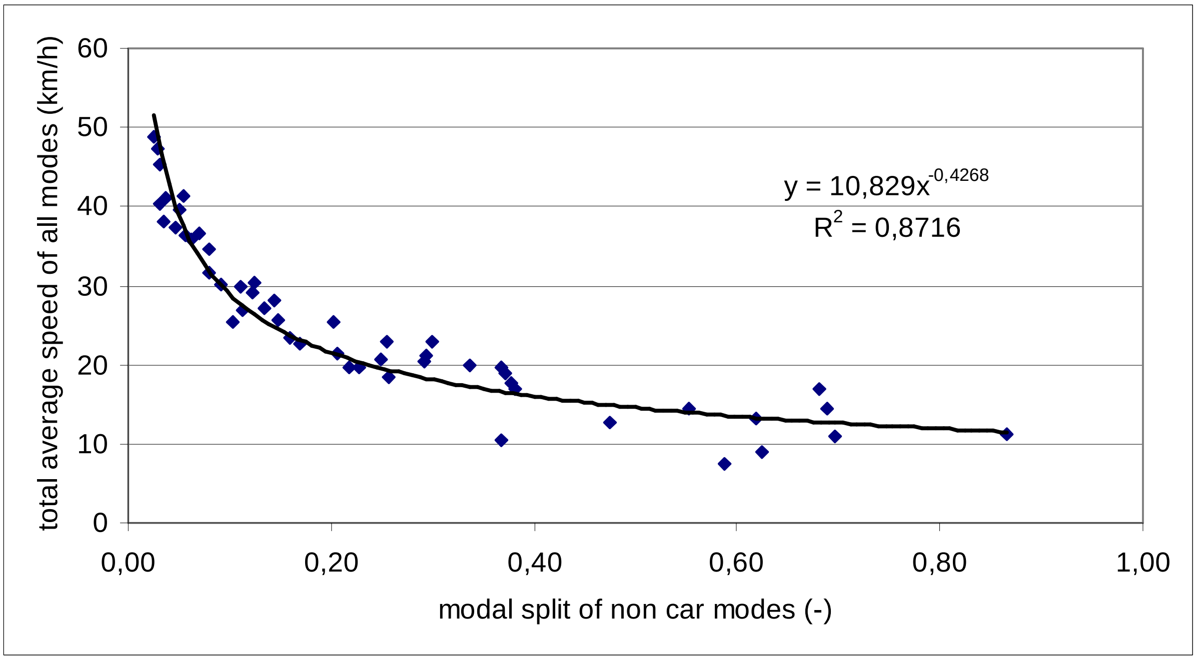

Fig. 1: Correlation between modal split and average speed of urban travel

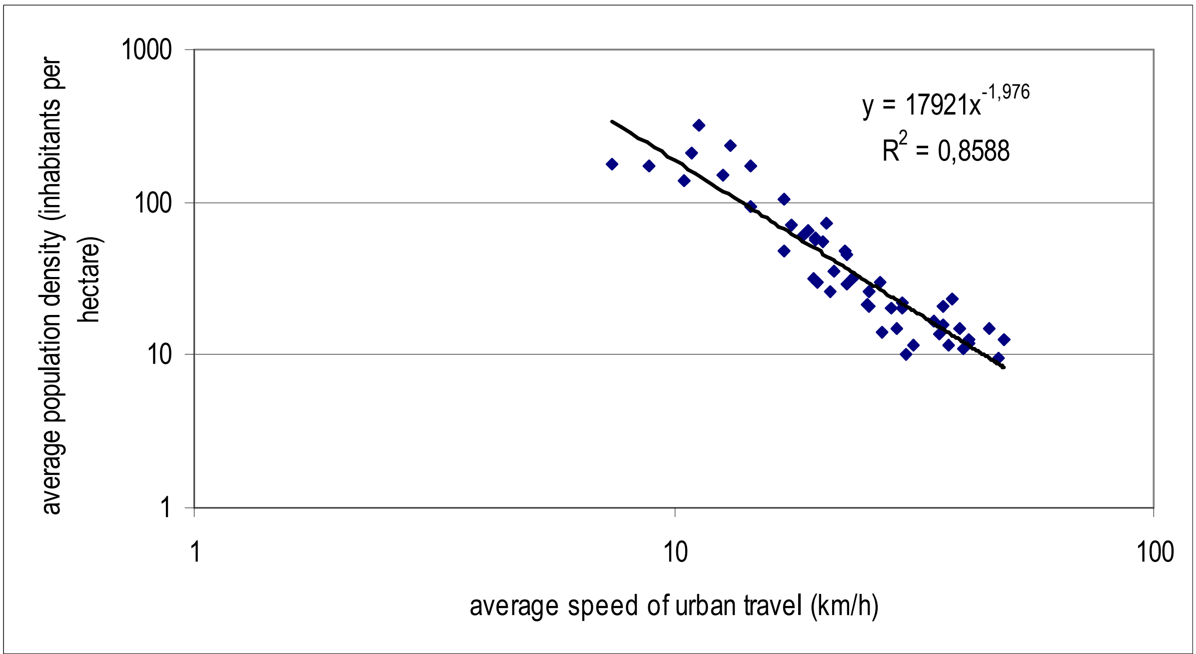

Fig. 2: Correlation between average speed of urban travel and population density

3 INTERPRETATION AND FURTHER CONSIDERATIONS

3.1 Modal split affects density and vice versa.

There is obviously a link between modal split, average speed of travel and population density. It is quite plausible, that increasing the modal split of car traffic will increase the average speed of travel. But what exactly is that mechanism which causes population density to fall as soon as the modal split of the car rises? Two typical conclusions are often drawn from the results of this mechanism. One is that speed – which is a result of private motorisation – is the immediate cause of urban sprawl. The other is the assumption that people have an overwhelming desire for in single family homes which makes them move to low density suburbs.

3.2 Accessibility and the Process of Suburbanisation

Contrary to popular belief it is neither an insatiable demand for single family homes nor the speed of cars which literally "drives" people out into the low density suburbs. It can be shown that it is quite simply congestion caused by car traffic which is the limiting factor for the density of cities (RAUH, 2008): Given a a certain population density and certain modal split within the urban area, only a very limited variation of congestion is possible, depending on the quality of traffic engineering and on the extent of urban motorways (hence the scattering of speeds observed in Figures 1 and 2). As soon as congestion in high density urban areas causes accessibility to fall below the level of accessibility in low density suburbs, residents and businesses will start to move to the latter.

4 CONCLUSION

Shifting urban travel from public transport to the private car will increase the average speed but in effect it tends not to increase accessibility. By adapting their infrastructure and their spacial structure to a given modal split, large metropolitan areas on different continents generally reach a similar level of accessibility. This means in practice that large low-density metropolises with an extended network of urban motorways tend to provide about the same level of accessibility to urban residents and businesses as smaller sized high density urban areas equipped with a dense network of subways, streetcars and buses. From an economic point of view both types of cities are equivalent, as long as they provide the same level of accessibility at the same total cost of urban travel. The cost to be considered is mainly the private cost of travel plus the public funds spent on transport infrastructure (road and rail) and on public transport. In which type of urban area the total cost of urban travel is in fact lower – the low density motorway city or the high density subway and streetcar city – should be subject to more intense research.

5 REFERENCES

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