Mobility and the Urban-Rural Continuum

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Abstract

In the past decades, we have witnessed the greatest increase in population in 'urban areas'. What does this mean for mobility patterns? This paper seeks to address this issue for the Netherlands, a typical example of a low density urbanized area. In this paper Dutch mobility patterns of inhabitants of the urban-rural continuum are investigated, based on the Dutch mobility survey. We found that there is a clear effect of urbanisation on mobility. This is not so much in terms of total kilometres travelled, or total trips made, but especially in the division of trip lengths and mobility purposes. An increase in the number of urban inhabitants thus implies an increase in shorter trips. The ongoing urbanisation thereby offers new opportunities for the bicycle. Meeting these requirements will be one of the important challenges for the transport planners of the future.

1. Introduction

In the past decades we have witnessed the greatest increase in population in 'urban areas'. According to the United Nations Populations Division (2004, 5) around 2007 the number of urban dwellers will overtake the number of rural dwellers. Current geographical and sociological literature suggests that the vast majority of people in Western Europe are leading lives that are essentially 'urban' in style. What consequences does this have for mobility and transport planning? This paper aims to address this issue for the Netherlands.

Planning literature on the relation between urban setting and mobility often suggests that urban areas generate deviating trip patterns. It is generally believed that the right city design can enhance the use of car alternatives. In the US, this is usually referred to as new urbanism, transit-oriented development (TOD) or smart growth (Renne & Newman 2002). In Europe, it is mainly referred to as the compact city. The concept has been extensively discussed in the past (Hillman 1996; Nijkamp & Rienstra 1995; de Roo & Miller 2000; Thomas & Cousins 1996). Discussion of the role of urban structures in transport demand was initiated by the often-quoted article by Newman and Kenworthy from 1989. From a global comparison of cities all over the world, they concluded that the per capita use of gasoline declines with increasing densities. Numerous comments and additional research have been added subsequently (Bouwman 2000b; van Diepen 2000b; Gordon & Richardson 1989; Kenworthy & Laube 1999). Recent statistical analysis of Newman and Kenworthy's results suggests no direct impact of urban density on energy consumption (Mindali, Raveh, & Salomon 2004). Initial studies mainly investigated global relationships between urban density and mobility. Other authors focused on how mobility patterns change with increasing density (Barrett 1996; van Diepen 2000a). Such changes in mobility may be very relevant for transport planners facing increasing urbanisation. It seems obvious that higher densities result in more possible destinations within a certain distance. Increasing urbanisation with higher population densities then results in an increase in short distance trips. We will test this hypothesis for the Netherlands.

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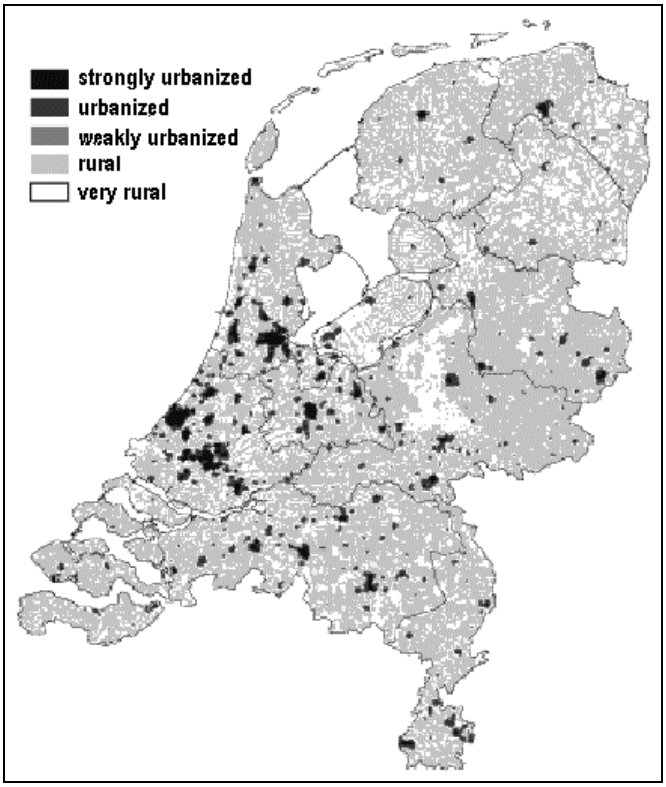
Short trips have recently received increasing policy attention in the Netherlands. In 1998, a large research project on this subject was started in the context of the new Dutch National Traffic and Transport Plan. Although short trips only have a limited share in the total distance travelled, their importance for overall mobility should not be underestimated. It can be argued that short trips fulfil almost half of all trip purposes, though they only make up 5% of all kilometres travelled. From this perspective short trips form a crucial part of individuals' freedom of movement and clearly deserve attention from both researchers and policy makers. However, the trend of recent years is clearly towards a longer average trip length. Between 1985 and 1997, Dutch mobility rose by 32%. This increased mobility was caused by an increased population and different population composition (8%), an increase in the number of trips (4%), and an increase in the average trip length (16%) (Hilbers, Raaijmakers, & van den Broeke 1999). This increase in mobility occurred primarily for the purposes of commuting, sport and recreation, and for the category *other purposes*. To test the hypothesis that higher density results in more short trips, we use the outcomes of the Dutch Mobility survey of 2003, which distinguishes five different urban settings. The next section discusses these settings in more detail. Section 3, 4 and 5 focus on the mobility patterns associated with the settings. The last sections discuss the consequences of urbanisation for transport planning in cities.

2. The Urban-Rural Continuum

The Netherlands is a typical example of a low density urbanized area. As it is shown in Figure 1, the highest densities are in the western part of the country where the four biggest towns are found: Amsterdam, Rotterdam, The Hague and Utrecht.

Figure 1. The Dutch urban-rural continuum.



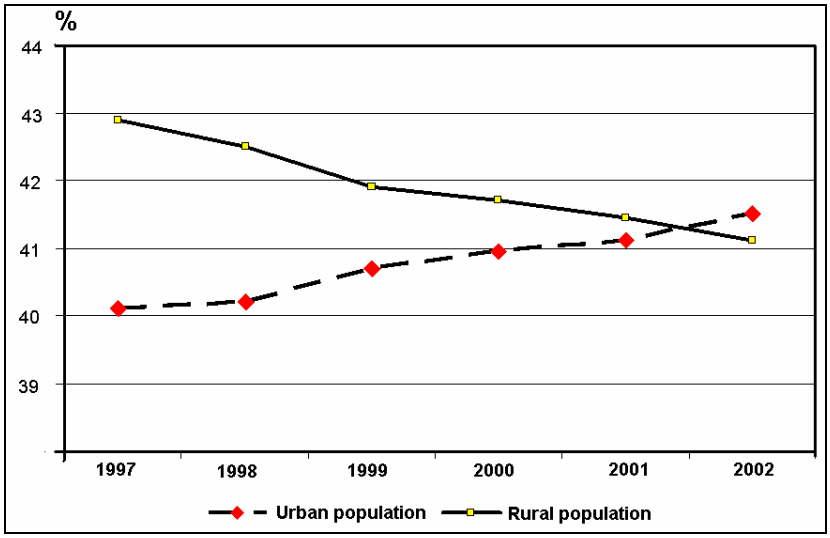
Source: CBS, 2005.

The map in Figure 1 is based on a measurement of the number of postal addresses per grid of 100 by 100 meters, using the following model of the urban-rural continuum (cf. CBS, 2005):

- Strongly urbanized (> 2500 addresses/km^2),
- Urbanized (1500 – 2500 addresses/km^2),
- Weakly urbanized (1000 – 1500 addresses/km^2),
- Rural (500 – 1000 addresses/km^2),
- Very rural (< 500 addresses/km^2).

If the population figures of the strongly urbanized and urbanized regions are amalgamated and labelled as 'urban', and equally the rural and very rural population as 'rural', the growing urbanization of the Netherlands can be made visible. Figure 2 shows that since 2002 more people live in an urban setting than in a rural environment.

Figure 2. Urban and rural population development in the Netherlands.



Source: CBS, 2005.

3. Mobility Patterns

As stated in the introduction, much research on the effects of urban density focused on global indicators such as energy use. This paper focuses on its effects on mobility. But how can mobility be measured? An obvious solution is to express mobility in terms of the distance travelled per period of time. Such information can easily be found in transport statistics and appears to be a good indicator. The question is whether this is relevant from the perspective of an individual (see for example Ross 2000; Vickerman 1974). Transport is considered to be a derived demand. It is not a goal in itself but a way to reach other goals, such as going to work, taking part in sport or visiting a friend. From that perspective, the number of trips, i.e. the number of goals reached, can be argued to be a better measure of mobility. We therefore not only present results mobility patterns in terms of travelled distances, but also as the number of destinations reached. For analysing mobility patterns we use the Dutch travel survey of about 75,000 Dutch inhabitants (CBS 2005). Participants keep a diary of their mobility pattern for one day. Dutch inhabitants travelled on average 31.9 kilometres per day in 2003, in 3.09 trips. About 70% of all trips were shorter than 7.5 kilometres. However, these trips only marginally (16%) contribute to the total distance travelled. 65% of all kilometres are travelled in trips with a length of over 20 kilometres, though these only make up 13 % of all Dutch trips.

Table 1: Mobility patterns of Dutch inhabitants by trip length category 2003.

	Trips		Distance	
Trip length	Number	Share	Distance	Share
< 2.5 km	1,39	45,0%	1,53	4,8%
2.5 - 7.5 km	0,81	26,2%	3,64	11,4%
7.5 - 20 km	0,49	15,9%	6,07	19,0%
20-50 km	0,27	8,7%	8,2	25,7%
> 50 km	0,14	4,5%	12,47	39,1%
Total	3.09		31.92	

Source: CBS, 2005.

4. Mobility Patterns Including the Urban-Rural Continuum

A similar overview can be provided for the continuum of urban settings in the Netherlands, see table 2 and 3. Similar to the results for energy use, we also see here only small differences in the total figures. The total amount of trips only varies up to 3 percent compared to the average value. For the distance travelled, the deviations are similar, except for the strongly urbanised settings (-6%).

Table 2: Average number of trips of Dutch inhabitants, by urban setting, 2001.

Urban setting	Strongly urbanised	Urbanised	Weakly urbanised	Rural	Very rural
< 2.5 km	45,7%	44,4%	45,7%	45,8%	43,6%
2.5 - 7.5 km	27,0%	28,9%	27,1%	22,8%	21,8%
7.5 - 20 km	14,7%	13,2%	14,8%	17,6%	20,1%
20 - 50 km	7,7%	8,7%	8,8%	9,3%	9,9%
> 50 km	4,7%	4,8%	4,1%	4,5%	4,3%
Total number of trips (/day)	3,00	3,11	3,17	3,12	3,03

Source: CBS, 2005.

However, if we focus on the mobility patterns, we see somewhat larger deviations. Rural inhabitants make fewer short trips (<7.5 kilometres) and more trips between 7.5 and 50 kilometres. Long distance trips have a quite similar share for all settings. This implies that increasing urbanisation may decrease the number of longer trips (up to 50 kilometres) in favour of shorter trips. The increase in short trips is not observable on the very short trips (<2.5 kilometres), but is attributed to trips with a length between 2.5 and 5 kilometres and continues in the range of 5 to 7.5 kilometres. A similar pattern can be observed when looking at the daily travelled distance, as shown in table 3.

Table 3: Average daily mobility of Dutch inhabitants, by urban setting, 2001.

Urban setting	Strongly urbanised	Urbanised	Weakly urbanised	Rural	Very rural
< 2.5 km	5,1%	4,8%	5,1%	4,7%	4,1%
2.5 - 7.5 km	12,9%	12,5%	11,8%	9,7%	9,4%
7.5 - 20 km	18,3%	15,8%	18,7%	21,2%	23,6%
20 - 50 km	22,9%	25,8%	26,1%	26,4%	27,1%
> 50 km	40,7%	41,1%	38,4%	38,0%	35,8%
Total distance (km/day)	30,05	32,42	31,56	32,64	32,75

Source: CBS, 2005.

The results as shown in table 2 and 3 seem to confirm the hypothesis of a larger amount of short trips in areas with higher address density. However, one of the main difficulties in analysing the effects of urbanisation on mobility is the fact that, at present, the population in urban areas differs significantly from the population in rural areas. Table 4 shows a number of variables to indicate these differences.

Table 4: Characteristics of urban settings.

Urban setting	Strongly urbanised	Urbanised	Weakly urbanised	Rural	Very rural
Inhabitants (thousands)	3 079	3 644	2 865	3 204	3 402
Number of households (thousands)	1 447	1 879	1 351	1 347	850
Number of persons per household	1,9	2,2	2,4	2,5	2,6
Children under 12 per household	0,29	0,38	0,42	0,46	0,47
Number of persons with income	1,5	1,7	1,8	1,8	1,8
Primary income per household	38,7	44,6	47,6	49,1	45,7
Standardised income per household	18	19,2	19,9	20	18,6
Households with 2 or more cars	10,3	18,3	23,6	28,7	30,6
Households with car	49,6	57,5	58,4	56,8	57,4
Households without a car	40,2	24,2	17,9	14,5	12,1
Winter sports holidays per 100 inhab.	7,2	8,6	5,8	8,9	3,0

Source: CBS, 2005.

Households in urbanised areas are smaller than in rural areas and generally have fewer children. Their standardised income (income corrected for household size and composition) is lower than in rural areas. Vehicle ownership levels are considerably lower in urban than rural areas. Children in general lower average mobility; higher incomes and higher vehicle ownership increase it (Centraal Bureau voor de Statistiek & Kluwer Voertuigtechniek 1996). Several researchers point out that it is not clear what leads to the differences in mobility patterns observed between various urban settings (Boarnet & Crane 2001; Dieleman, Dijst, & Burghouwt 2002; van Diepen & Voogd 2001; Handy 1996). Part of the variation in mobility may be explained by the fact that households in large cities deviate in terms of average income, household size, vehicle ownership, etc. (Bouwman 2000a). Ideally multivariate statistical analysis should correct for differences in population. Unfortunately, we do not have access to the raw survey data so have not been able to resolve this matter in a statistical way. Considerably larger effects of address density on short trips make it still very likely that density affects trip length. To further test this, we zoom in on specific trip purposes.

5. Differences in Mobility Patterns by Trip Purpose

The Dutch mobility survey indicates trip purpose. It is likely that distances are only reduced when there is a choice of destinations. This is mainly the case for shopping, schools, medical care etc. For purposes such as work, higher education or visiting friends or relatives, address density seems less likely to affect trip distance. We therefore select four categories of trip making to further study the effects of address density. Shopping and personal services are trip purposes for which we expect the strongest effect of address density on trip length. Commuting and visiting are expected to be least affected. The results for the two most import trip length categories are shown in figure 3 and 4. These only present mobility by trip purpose expressed in distance travelled. The number of daily trips by purpose is too small to draw any specific conclusions.

Figure 3: Deviation of the average distance travelled by urban setting and trip purpose for trips 2.5 to 7.5 kilometres.

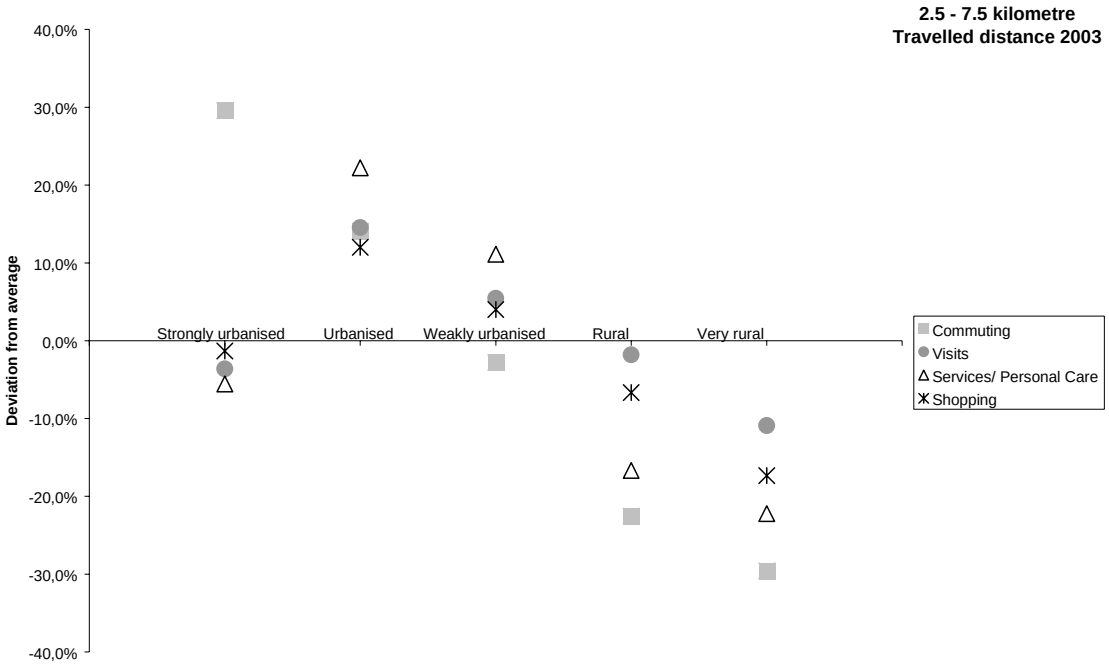
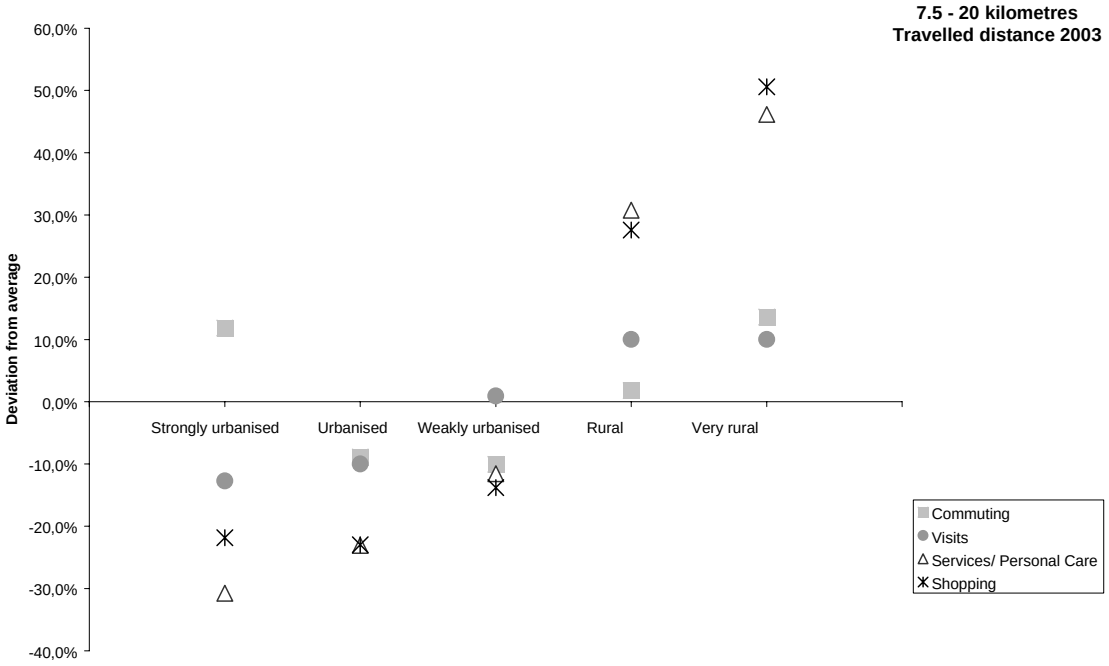


Figure 4: Deviation of the average distance travelled by urban setting and trip purpose for trips 7.5 to 20 kilometres.

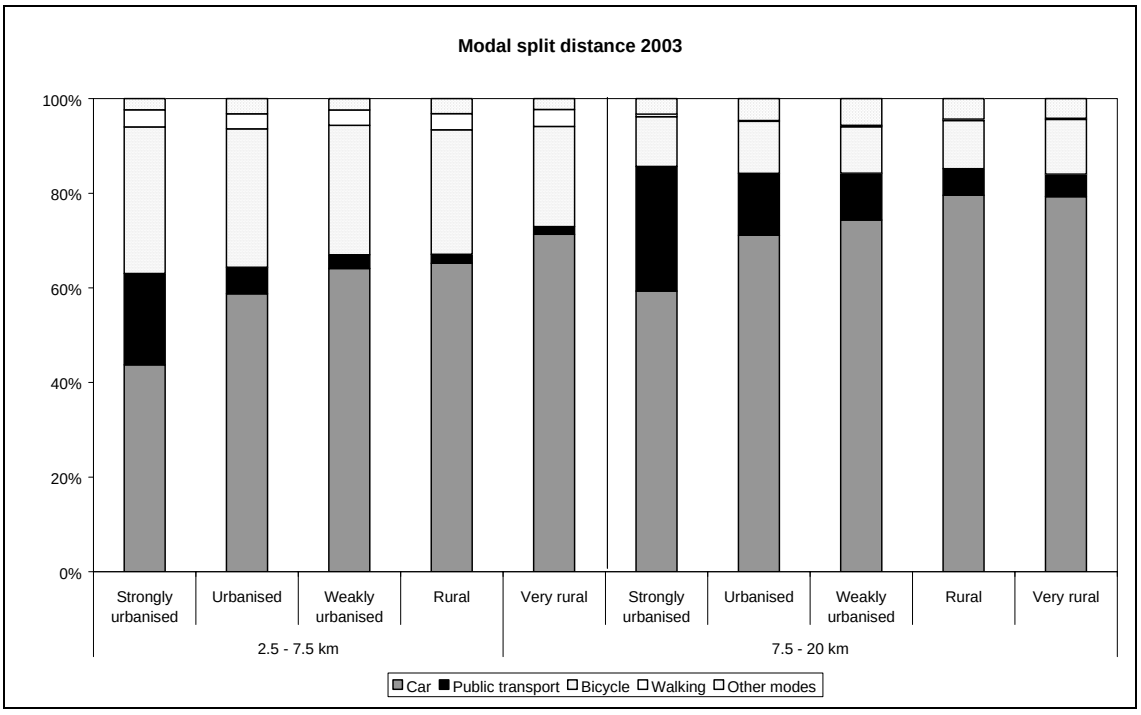


For trips with a distance between 2.5 and 7.5 kilometres, there is no clear effect of trip purpose. All four trip purposes show a similar and consistent pattern with considerably more short trips in urbanised areas. The suggested stronger effect for shopping and services does occur on longer trips. Where the differences among urban setting are relatively small for commuting trips and visits (up to ten per cent), they are considerably larger for shopping and services trips. Inhabitants of very rural areas travel about twice as many kilometres for shopping as inhabitants of urbanised areas in the range between 7.5 and 20 kilometres.

6. Consequences for Transport Planning

So, despite some interfering effects due to differences in population and household composition, at a more detailed level there are some effects of population and address density on mobility patterns. This concentrates on a shift of trips with a length between 7.5 and 20 kilometres to trips with a length below 7.5 kilometres. It is especially this distance category that is very interesting for a modal shift. Trips under 20 kilometres are mainly travelled by car, as there are hardly any alternatives. Public transport performs especially badly on these distances (Bouwman 2000a). Trips shorter than 7.5 kilometres offer interesting opportunities for bicycles. Figure 5 shows the current modal split for both trip length categories for the various urban settings in the Netherlands.

Figure 5: Modal split of travelled distances in the Netherlands 2003, by trip length and urban setting.



With a shift from trips above 7.5 kilometre to trips with shorter lengths, the chance of travelling by bike about triples. This considerably larger share for the bicycle is very consistent for all urban settings. Interestingly, the share of the bicycle is even higher in more urbanised than in more rural regions.

The literature on the difficulties in achieving modal change is widespread and diverse (Bovy, Baanders, & van der Waard 1990; Jensen 1999; Kingham, Dickinson, & Copsey 2001; Rooijers & Steg 1991; Stradling, Meadows, & Beatty 2000; van Driel et al. 2000). Recent policy documents (V&W & VROM 2004) in the Netherlands no longer focus on modal shift as policymakers feel that it is virtually impossible to achieve. Research into modal shift suggests that opportunities are however especially large for short trips. Mackett found that in the UK, car drivers could not suggest an alternative for only 22% of short trips. Walking and the bus are the main alternatives mentioned (Mackett 2001). In a bicycle investigation in the Netherlands, it was found that half of the car trips with a duration of between 4 and 10 minutes could be replaced by bicycle, according to the car drivers. This percentage is lower for longer trips (15-20% of trips up to 30 minutes are replaceable), but also for shorter trips. Of the car trips with a duration of less than 4 minutes, only 30% of the trips are said to be replaceable by bike (V&W 1993). Two reasons may be behind this figure. On the one hand, as the only question raised was whether or not a bike was an alternative for the trip, walking may well also have been an alternative. On the other hand, especially for extremely short trips, people may have a clear reason for using the car instead of other modes. This may be related to social safety, or to the luggage capacity of the car. It is not clear to which extent the acceptability of alternative modes depends on the cultural setting, in which it is more or less acceptable to use, for example, a bicycle. Although individuals indicate that modal shift is possible, policy practice is usually arduous. However, especially at a neighbourhood level, there seems to be room to manoeuvre for policymakers. They can change the physical appearance to a large extent by creating or replacing parking spaces, introducing one-way streets, etc. By changing the physical appearance, policymakers can change the relative attractiveness of the various transport modes. Further research into the effects of the physical design of a neighbourhood on the attractiveness of different transport systems is certainly to be recommended. An increasing population in urban areas thus seems to open opportunities for further stimulating the use of bicycles. The main destinations for these biking trips may be found in shops, personal care and service related addresses.

7. Conclusion

Throughout the world, an increasing urbanisation process is going on. The Netherlands is no exception to this. Transport planners have to adapt to this ongoing urbanisation. The analysis in this paper shows that increasing urbanisation will not affect the total demand for mobility, but there will be a shift towards more short distance trips. The higher address density results in shorter trips, especially for shopping and personal care. This effect occurs to a much lesser extent for commuting and social trips. Analysis suggests that increasing the number of interesting destinations in an area does contribute to an increase in short trips for certain purposes. This observation implies that not only increasing population densities but also increasing accessible employment, shops and facilities will result in less traffic. This is a clear stimulus for *smart growth* development and offers important opportunities for an increased share of mobility by bicycle in the future.

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