The Netherlands Research School for Transport, Infrastructure and Logistics

TRAIL

A residential location model based on characteristics of spatial proximity: A case study in the North of Belgium

Abstract

By combining a number of characteristics of spatial proximity and recent daily travel distance data in an econometric model we can gain understanding on the additional traffic volume that will be generated by developing a new housing unit, dependent on the location. We apply this method on the study area of Flanders (Belgium). Model results are represented in a map that can be used in urban and regional planning practice.

Introduction

Previous research shows that in regional studies (which go beyond the urban scale), the daily distance travelled per person is a good approximation of sustainability of travel behaviour. The aim of this research is the development of a model for the study area of Flanders, based on spatial characteristics, indicating how much mobility (expressed in daily travel distance per person) the location of an additional housing unit in a certain area would generate. We do this using data from the third phase of the Travel Behaviour Survey Flanders (Janssens et al., 2009) and a number of additional data sets containing spatial variables. Based on a regression equation, eventually for each ward a map is produced, indicating how much mobility is generated by dwellings in this location. As is expected from the literature in this field, the model will explain only a limited share of the expected variance, an aspect which should be taken into account in the interpretation.

Used variables

The daily kilometrage per respondent is used as the dependent variable in the regression analysis. A total of six different explanatory variables are selected, each of which can be considered as a measure for mutual spatial proximity between potential destinations. These variables are: accessibility (*ACC*), residential population density (*POPD*), spatial diversity (*DIV*), job density (*JOBD*), minimum commuting distance (*MCD*) and the proximity of facilities (*SPROX*). The applied control variables are: education level (*EDU*), income level (*INC*), age (*AGE*) and gender (GND).

To avoid biased results by the influence of geographical scale at which the data are aggregated, each variable was calculated at three different levels of aggregation. To this end, the residential location of each respondent is used as the centre of three circles with radii (*r*) equal to 1 km, 4 km and 8 km. Within these circles data is aggregated on the basis of proportional overlap with the original zones for which the variables were calculated (wards, traffic analysis zones or a one-square-kilometre grid).

Model

Basic equation:

$$\log_e(PKM) = \alpha + \sum_{r=1,4,8}\beta_{1r}\cdot ACC_r + \sum_{r=1,4,8}\beta_{2r}\cdot POPD_r + \sum_{r=1,4,8}\beta_{3r}\cdot DIV_r + \sum_{r=1,4,8}\beta_{4r}\cdot JOBD_r + \sum_{r=1,4,8}\beta_{5r}\cdot MCD_r + \sum_{r=1,4,8}\beta_{6r}\cdot SPROX_r + \gamma_1\cdot AGE_{0-19} + \gamma_2\cdot AGE_{20-39} + \gamma_3\cdot AGE_{40-59} + \gamma_4\cdot AGE_{60-79} + \gamma_5\cdot GND + \gamma_6\cdot EDU + \gamma_7\cdot INC + \varepsilon$$

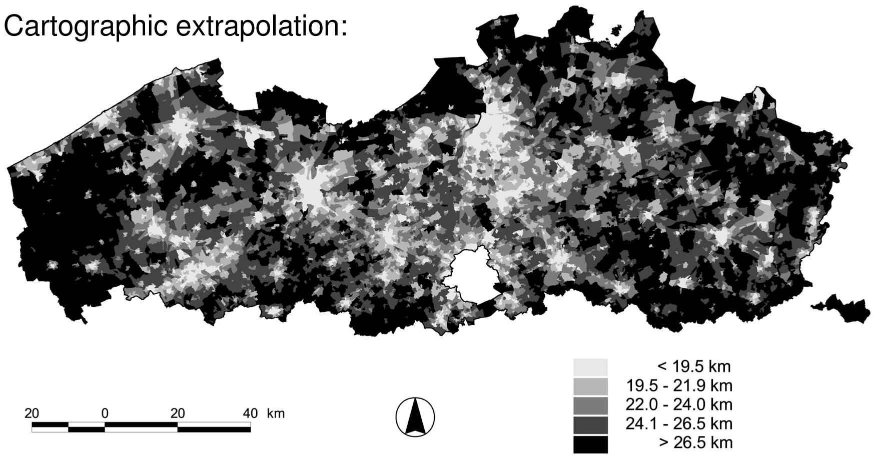
Equation, trimmed based on non-significance of correlations:

$$\log_e(PKM) = \alpha + \beta_1\cdot POPD_1 + \beta_2\cdot DIV_1 + \beta_3\cdot SPROX_1 + \gamma_1\cdot AGE_{0-19} + \gamma_2\cdot AGE_{20-39} + \gamma_3\cdot AGE_{40-59} + \gamma_4\cdot AGE_{60-79} + \gamma_5\cdot GND + \gamma_6\cdot EDU + \gamma_7\cdot INC + \varepsilon$$

Results:

$R^2 = 0.143$	**coefficient**	**p-value**
(constant)	1.502	0.000
$POPD_1$	$-3.99 \cdot 10^{-5}$	0.000
DIV_1	-0.278	0.001
$SPROX_1$	0.004	0.000
AGE_{0-19}	0.847	0.000
AGE_{20-39}	1.066	0.000
AGE_{40-59}	0.969	0.000
AGE_{60-79}	0.624	0.000
GND	-0.245	0.000
EDU	0.173	0.000
INC	0.111	0.000

Cartographic extrapolation:



Interpretation

We find that intuitively expected relationships appear to be statistically significant (1) but explain only a small fraction of the observed variance (2). This means that the influence of spatial characteristics on travel behaviour is actually very limited.

Although, because of the low proportion of explained variance, models that are mainly built on spatial variables have been heavily critized, these remain useful for spatial policy. The reason is that the built environment is still determining the physical preconditions for sustainable mobility patterns. We argue that the importance of the spatial component in the genesis of travel patterns is not constant throughout history, but is linked to the declining cost and the rising speed of mobility. Both developments have led to the weakening of the transport-land use connection.

Based on the peak oil theory we can say that the relative cost of energy will significantly increase over time, leading to a reduction in mobility and an increase in the interest of mutual spatial proximity of destinations. This means that the share of the variance in travel patterns that is explained by spatial structure will grow in the future.

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