COSTS OF COMMUTING AS A MEASURE OF SUSTAINABILITY OF SPATIAL DEVELOPMENT STRATEGIES

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Summary

The presented paper deals with the issue of sustainability of the spatial arrangement of homes and jobs in city regions. Based on the findings of the research, majority of Czech commuters commute to their jobs on daily basis (i.e. 5 times a week to the same location). Extending distances between homes and workplaces of the commuters indeed impose pressure on transport infrastructure, environment, energy security, and both social and economic well being of the commuters.

Based on the statistical data on commuting behaviour of Czech commuters, we present a model for assessment of the changing accessibility to work. This model has been verified on a case study, which is an administrative district of the Czech Republic. Results of the model are presented and discussed with data acquired from an extensive questionnaire survey of Czech commuters.

This indeed poses a serious threat to sustainability of those communities. Since the margin costs (i.e. those that would pose too heavy burden on family budgets of the commuters) were close to those realized and the prices of fuel steadily grow (which trend can be expected to continue).

Keywords: commuting, accessibility, costs, model

1 Introduction

Accessibility is defined as “an ability to be reached, entered, influenced” (Brown, 1993) and as such is a characteristic measuring the potential intensity of connection between the people and their desired goods (employment, services). These connections are sustained by mobility of people within the fabric of places and connections of their settlement.
system. Growing (individual) mobility enabled the people to locate their homes relatively independently on the location of their workplace. This indeed was supported by the changes in global economy, where working in one place for a long time has become an exception rather than a rule (Schwanen and Dijst, 2002; Clark et al., 2003; Milbourne, 2004; Maier et al., 2007). This process was so wide spread in the last decades that the late spatial developments of city regions are referred to as (formless) “sprawl”.

As daily commuting has become a typical behaviour of workers in developed world, ways of how the commuter perceives distance from workplace indeed started to be questioned. According to the literature, the true factors that affect an individual’s tolerance to commuting distance is not the physical distance itself, but the time of the travel (e.g. Van Ommeren et al., 1997; Wee et al., 2001; Schwanen & Dijst, 2002) and its costs (e.g. Zenou & Smith, 1995; Kulkarni et al., 2000) instead, which are often generalized as commuting disutility (Novotny, 2011; Modelistica, 2012).

2 Material and methods

2.1 Data

The presented results are based on three sets of data. First, for the model development and verification, data from the Czech statistical office were employed as they were published as the official yearbooks (Czech Statistical Office, 2009) and outcomes of the 2001 census of population (Czech Statistical Office, 2005). Second, for the application of the model, geo-data from the Planning Analytical Documents of Kolin municipality were used. Both the above are publicly accessible data. Third, data from a single questionnaire survey among 900 Czech commuters, that was executed in summer 2012.

2.2 Methods

The land use is represented by polygons of entrepreneurial assets only, which are treated as the centers of employment, i.e. they are attributed a weight in the job market which is the number of jobs available. Based on the geodata available, the final commuting time in public transport is computed following equation (1):

\[ t = \Sigma tW + \Sigma tT + \Sigma tWT, \]

where “t” stands for total commuting time, “\( \Sigma tW \)” stands for time spent, “\( \Sigma tT \)” stands of time the commuter spends in the transportation mode (i.e. sum of the times between the nodes) and “\( \Sigma tWT \)” is the sum of penalty times (waiting for the buses). The time of commuting by individual modes of transport (such as walking, cycling and driving a car) is computed using equation (2):

\[ t = s / v, \]

where “t” is the time spent in the transportation mean for the given journey, “s” is the physical length of the travel and “v” is the velocity of movement on the section. The cost of public transportation was deliberately set as a flexible cost of transportation dependent on the length of the commute only. It has been set to 1 CZK per kilometer on the basis of a brief research of price lists of bus and train companies in the Czech Republic as charged for regular commuters. This was supported by the results of the questionnaire, where the drivers generally did not consider the amortization of their car as part of their commuting
costs. To translate the numerical values of time and cost of travel using the different modes of transport into commuters’ willingness to travel, following equations were used:

\[
WC(x) = 1 - \Phi \left[ f - l(g(x)) - \mu(I) / \sigma(I) \right],
\]

\[
WT(x) = 1 - \Phi \left[ (t(x) - \mu) / \sigma \right],
\]

where \( WC(x) \) is a willingness to pay costs and \( WT(x) \) time to overcome the physical distance using the mode of transport. We used the distribution function for both (instead of typically used exponential function) as the results of Novotny (2011) suggest. The commuting disutility measure for each centre of employment from any point in the case study was using equation (5):

\[
WX = \max \left\{ \min \left[ WC(x), WT(x) \right] \right\},
\]

3 Results and discussion

The results of the model revealed that the accessibility to jobs is predominantly satisfied by the use of POV. This conforms to the results of the questionnaire from 2012, where the commuters living in municipalities under 5000 inhabitants dominantly used POV’s or COV’s to get to their jobs. This is due to the current affordability of fuel for nearly anyone, who has a stable job (and the relative inconvenience of public transport). The above finding was supported by the fact that the (dis)utility of use of public transport highly correlated with inhabitants with unstable jobs (such as part-timing). The respondents of the questionnaire that earn above 15000 CZK/month generally claimed to spend as much as 3000 CZK/month on commuting when using car (60 % of commuters from small municipalities, P50 of them spending 1600 CZK/month on fuel). The important message though is, that most drivers are near the edge of what they can accept to pay (maximum P50 acceptable cost being 2000 CZK). It may be derived from the overall statistics that the model generally corresponds with the observed values (modeled mean 79.9 % and median of 80.4 % versus observed mean of 80.2 % and median 81.1 %). The reality shows higher variance, 75.9 % to 10.8 %, which was expected. The decrease of standard deviation, as well as the increase of the average commuting rates, implies that it is small communities that suffer lower accessibility both in reality and the model.

4 Conclusions

Concluding the above, the best explanatory factors for modal choice of the respondents of this research were the size of the hometown of the respondent and his/her need to leave it to get a job. This was proved both by the model and the questionnaire research. Generally speaking, Czech commuters seem to value commuting time over other factors, while the typical acceptable time for Czech commuter is 30 minutes (disregarding the mode of transport). The very limited job market of the smallest settlements than drives their economically active population outside their borders, which results in higher monetary commuting costs, since the commuters typically give higher importance to keep the time of their commute in reasonable limits. More sustainable modes of transport are generally more affordable than POV. These combined therefore makes commuting cost to be a better indicator for description of commuting behaviour of people than is commuting time, which is generally used.
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References