Commuting to school within Košice functional urban region

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Main objective:
identify the areas with most **intensive commuting flows** to elementary schools in the functional urban region delineated by Bezák (2014), and to **identify the factors** related to this commuting flow.

Why elementary schools:
- pupils fulfill the legislative requirement of **mandatory schooling**
- establishment and/or abolition of elementary schools belong to the **competencies of municipalities**
- topic for **cooperation** between municipalities, improving public services (capacities, transportation,...)
Functional urban regions: core + network of relationships (Bezák, 2014).

Delineation: commuting flows to work (Coombes, 2010; Halás et al., 2014; Ručinská and Výrostová, 2016), to schools (Hampl, 2005), to services (Halás and Zuskáčová, 2013).

Functional urban region of Košice as defined by Bezák (2014a), based on 2001 census, 50 FURs.

139 municipalities, classification FUR 01-A

core: Košice, all 22 boroughs

Data on commuting flows to schools from 2011 population and housing census.

Measures of commuting intensity:

- fraction of pupil commuters to elementary schools in Košice to all elementary school commuters from municipality
- fraction of commuters to secondary schools to Košice to all secondary school commuters from municipality
Econometric model

**Dependent variable:** share of commuting flows of pupils to elementary schools from municipality to Košice, as a fraction of children between 5 and 16 years of the municipality.

**Explanatory variables:**
- **duration** of travel, average of both directions
- **work flows** of economically active commuters / number of active inhabitants
- **elementary school dummies:** does the municipality has its own elementary school? (either 1–4 or 1–9)
Estimation procedures

Simple OLS

\[ \text{Pupils flow}_{KE_i} = \beta_0 + \beta_1 \text{duration}_{KE_i} + \beta_3 \text{Active flow}_{KE_i} \]
\[ + \beta_4 \text{ELschool}(1 - 4)_i + \beta_5 \text{ELschool}(1 - 9)_i + \epsilon_i \]

Spatial lag model

\[ y^* = \rho W y^* + X \beta + \epsilon, \quad \epsilon \sim N \left( 0, \sigma_{\epsilon}^2 I_N \right) \]

Spatial error model

\[ y^* = X \beta + u, \quad u = \lambda W u + \epsilon, \quad \epsilon \sim N \left( 0, \sigma_u^2 I_N \right) \]
Location of elementary schools

Map source © Úrad geodézie, kartografie a katastra Slovenskej republiky.
Commuting flows
Regression analysis
Discussion

Percentage of pupil commuters to elementary schools

Map source © Úrad geodézie, kartografie a katastra Slovenskej republiky.

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Percentage of pupil commuters to secondary schools

Map source © Úrad geodézie, kartografie a katastra Slovenskej republiky.
## Regression results

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>Spatial lag</th>
<th>Spatial error</th>
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<tbody>
<tr>
<td>Intercept</td>
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<td>-0.022</td>
<td>-0.046</td>
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<tr>
<td>Spatial parameter</td>
<td></td>
<td>0.016</td>
<td>0.064 ***</td>
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<tr>
<td>Duration KE</td>
<td>0.000</td>
<td>0.000</td>
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<tr>
<td>Active flow</td>
<td>0.452 **</td>
<td>0.462 ***</td>
<td>0.520 ***</td>
</tr>
<tr>
<td>Elementary school (1-4)</td>
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<td>-0.053 ***</td>
<td>-0.049 ***</td>
</tr>
<tr>
<td>Elementary school (1-9)</td>
<td>-0.059 ***</td>
<td>-0.065 ***</td>
<td>-0.063 ***</td>
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<tr>
<td>AIC</td>
<td>-278.98</td>
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<tr>
<td>$R^2$</td>
<td>0.472</td>
<td>0.492</td>
<td>0.512</td>
</tr>
</tbody>
</table>
Commuting vs. traveling time

The graph illustrates the commuting share vs. duration for different groups:
- Commuters
- Students
- Economically active

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Results on commuting to schools:

- Around 40% of the elementary schools pupils commute to the core of Košice.
- Commuting depends on distance and road network.
- Positive relationship between commuting of pupils and economically active population.
- Commuting not so influenced by travelling time.
- Commuting to secondary schools affected by school density.
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