Indirect impacts on the regional economy caused by accessibility improvements in public transport


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Background

- Disadvantages of traditional CBA (tCBA)
- Indirect long term impacts on regional economy (added value)
Definition of direct and indirect impacts

DIRECT IMPACTS

TRANSPORTATION MARKET

Effects in transport network

§ travel time/costs
§ externalities
§ …

NON TRANSPORTATION MARKET

Effects in the socio-economic overall system

§ employment
§ property prices
§ …

INDIRECT IMPACTS

MEASURE

tCBA

X
Disadvantages of traditional CBA (tCBA)

Indirect long term impacts on regional economy (added value)

GOAL:
- Explanation of employment & property prices as changes of pt accessibility
- Implementation as benefit-cost-element into tCBA eCBA
- Bringing economic theories to practice (improved evaluation procedure of infrastructure and other transport measures)
- But: quantitative assessment? data availability?

GOAL:
- Identification of all influencing variables on employment & property prices
eCBA for the city of Innsbruck (Austria)

- 120,000 inhabitants (2011)
- Light rail transit (new construction, extensions in two directions)
Case study: underground network extension Vienna 1991 - 2001
Working hypothesis

Increase of accessibility -> Increase or redistribution of employment -> regional added value
Work steps

1. Collection of basis data
2. Definition of accessibility: Accessibility model
3. Model analysis: Employment model
4. Assessment of regional added value caused by increased accessibility: Regional added value model
Basis data

(1) **Small scale structural data** (special census analyses)
   - inhabitants
   - employees
   - ...

(2) **Travel time matrices** (transport model)
   - indicators of **pt accessibility**

(3) **Spatial data** (building density)
   - Model stratifications

(4) **Aggregation units:**
   - 361 cells Vienna
Accessibility model

\[ \Delta \text{acc}_o = \sum_{d=1}^{n} \exp^{\alpha \times tt_{od,pt,t2}} \times i_{d,t2} - \sum_{d=1}^{n} \exp^{\alpha \times tt_{od,pt,t1}} \times i_{d,t1} \]

<table>
<thead>
<tr>
<th>( \Delta \text{acc}_{o,pt} )</th>
<th>change of public transport accessibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>( tt_{od,pt} )</td>
<td>travel time between cell ( o ) and cell ( d ) in public transport</td>
</tr>
<tr>
<td>( t1, t2 )</td>
<td>start year (1991) and end year (2001) of investigation</td>
</tr>
<tr>
<td>( i_{d} )</td>
<td>structure variable</td>
</tr>
<tr>
<td>( \alpha, \beta )</td>
<td>parameters</td>
</tr>
</tbody>
</table>
Employment model

\[
\Delta \text{emp}_o = b_0 + b_1 \times \left[ \frac{1}{1 + \kappa \times \exp(\delta \times \Delta \text{a}_o)} \right] \times p_o
\]

<table>
<thead>
<tr>
<th>(\Delta \text{emp}_o)</th>
<th>change of employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\Delta \text{a}_o)</td>
<td>change in pt accessibility (varied by indicators)</td>
</tr>
<tr>
<td>(p_o)</td>
<td>local economic / planning potential for development</td>
</tr>
<tr>
<td>(\kappa, \delta)</td>
<td>model parameters</td>
</tr>
</tbody>
</table>

![Graph showing the relationship between change of employment and change in accessibility]
Results of employment model

§ Whole city area: no effects [ ][ ] spatial autocorrelation, data noise [ ][ ] application of model stratifications

§ Disaggregated:

Urban area with high building density without parking space management (Rsqu=0.26)

- U3 surrounding (Rsqu=0.29)

- Cell « Erdberg » with high development potential
Regional added value model

\[ \Delta av = \sum_s (\Delta emp_s \times lpr_{s,2001}) \]

<table>
<thead>
<tr>
<th>( \Delta av )</th>
<th>change to added value per year [Euros/year]</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta emp )</td>
<td>change to employment in economic sector per year</td>
</tr>
<tr>
<td>( lpr )</td>
<td>labor productivity Vienna, 2001 by economic sector [Euros/employee]</td>
</tr>
<tr>
<td>( s )</td>
<td>economic sector</td>
</tr>
</tbody>
</table>
## Results of regional added value model

<table>
<thead>
<tr>
<th>Application of employment model:</th>
<th>whole urban area</th>
<th>urban area with high building density</th>
<th>vicinity metro u3</th>
</tr>
</thead>
</table>

### Not included:
- § direct benefits
- § added value generated on the property market
Conclusions

§ Accessibility improvements create potential for value added

§ Extension of CBA required

§ Further research and challenges

  § Double counting?

  § Further explanatory variables
     
     (development potential, image factor, demand data, …)

  § Redistribution effects?

  § Projection onto other cities?
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# Results of regional added value model

<table>
<thead>
<tr>
<th></th>
<th>Vienna</th>
<th>High building density</th>
<th>Metro u3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$av_{1,2001}$ [m Euros/year]</td>
<td>366.5</td>
<td>246.7</td>
<td>266.1</td>
</tr>
<tr>
<td>$av_{2,2001}$ [m Euros/year]</td>
<td>6.8</td>
<td>35.4</td>
<td>2.6</td>
</tr>
<tr>
<td>$b_{2001} = av_{1,2001} + av_{2,2001}$ [m Euros/year]</td>
<td>373.2</td>
<td>282.2</td>
<td>268.7</td>
</tr>
<tr>
<td>$c_{2001}$ [m Euros/year]</td>
<td>336.0</td>
<td>336.0</td>
<td>336.0</td>
</tr>
<tr>
<td>$b/c_{2001}$ [-]</td>
<td>1.13</td>
<td>0.85</td>
<td>0.81</td>
</tr>
</tbody>
</table>
Whole city: effects of spatial autocorrelation

application of model stratifications

Disaggregated:

- Urban area with high building density with parking space management

- U3 surrounding
Austrian guidelines

- welfare effects: considered as benefits in transport market (travel time savings, change in operation costs)
- generalized costs for the assessment of induced traffic
- Guidelines distinguish between primary and secondary generated traffic
- Approaches:
  - Bökemann & Kramar, 1997
  - Ernst Basler & Partner, 2005
  - Institute of Advanced Studies Vienna

macro-economic models, definition of accessibility?