Growth, freight-transport and emissions

LETS WP5 workshop
February 8th, 2011, Lund

Karl-Johan Lundquist & Lars-Olof Olander
Department of Human Geography
Lund University
The research

Aims to investigate the relations between long term growth and CO2-emissions (decoupling) from freight transports taking into account that:

• The drivers of economic growth alter and change the amount of transport work in cycles
• The economic behavior and rationality change in cycles
• The impact of macro and micro related factors change in cycles
Growth cycles*

- Initiated by structural shifts based on GPT (General Purpose Technologies)
- Developed by complementarities
- Observable in annual growth rates (as well as investment patterns and productivity rates)
- Periods of a cycle: Crisis (5 years) - Transformation (15-20 years) - Rationalization (10-15 years) - Crisis (5 years)
- Total length of about 40 years

* Schön 2000, 2006; Lundquist & Olander 2001, 2009
Characteristics:

**Transformation**
- GPT initiation
- new industries
- GPT diffusion
- home market driven
- supply-driven industries
- complementarities
- slow productivity growth
- bottle necks
- divergence in space

**Rationalization**
- diffusion of competence
- technology standardization
- demand-driven industries
- decomposition
- rapid productivity growth
- international trade
- consumption growth
- credit market expansion
- convergence in space
Drivers of growth
Sweden 1994 - 2006

Annual growth rate (VA)

- Transformation
- Rationalization

- New/renewed manufacturing industries
- Advanced producer services
- Consumer services
- GDP (public sector excluded)

Shift of periods
Consolidators
Sweden 1994-2008

Annual growth rate (VA)

Transformation → Rationalization

Old manufacturing industries
Less advanced producer services
General services
GDP(public sector excluded)

shift of periods

Generating hypotheses of freight transport and emissions

Growth Cycle Theory
tells us about changes in economic behaviour
and technology implementation,
influencing CO2-emissions over time
Implications for backcasting and forecasting transport CO2 emissions

• Decomposition model (Shapley)
• Long term dynamics
• Changing impact of macro and micro oriented factors
• The Swedish case 1990-2008
• Foundation for different growth scenarios 2020 and 2050
## Decomposition model

### Factors

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic activity (GDP)</td>
<td>SEK</td>
</tr>
<tr>
<td>Inverse value density</td>
<td>ton/SEK</td>
</tr>
<tr>
<td>Transport intensity</td>
<td>Ton km/ton</td>
</tr>
<tr>
<td>Modal split</td>
<td>fraction</td>
</tr>
<tr>
<td>Traffic intensity of mode m</td>
<td>Vehicle km/ton km</td>
</tr>
<tr>
<td>Emission factor of mode m</td>
<td>Kg CO$_2$/vehicle km</td>
</tr>
<tr>
<td>Freight transport CO$_2$ emissions</td>
<td>Kg CO$_2$</td>
</tr>
</tbody>
</table>
## Decomposition model

### Results

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic activity (GDP)</td>
<td>16,94%</td>
<td>26,00%</td>
<td>47,02%</td>
</tr>
<tr>
<td>Inverse value density</td>
<td>-33,52%</td>
<td>-14,40%</td>
<td>-50,18%</td>
</tr>
<tr>
<td>Transport intensity</td>
<td>30,64%</td>
<td>6,00%</td>
<td>37,58%</td>
</tr>
<tr>
<td>Modal split</td>
<td>11,36%</td>
<td>-3,59%</td>
<td>7,21%</td>
</tr>
<tr>
<td>Traffic intensity of mode</td>
<td>-14,98%</td>
<td>6,23%</td>
<td>-7,78%</td>
</tr>
<tr>
<td>Emission factor of mode</td>
<td>5,26%</td>
<td>-9,43%</td>
<td>-5,65%</td>
</tr>
<tr>
<td>Freight transport CO₂ emissions</td>
<td>15,70%</td>
<td>10,81%</td>
<td>28,20%</td>
</tr>
</tbody>
</table>

Outsourcing and transport intensity

Outsourcing and trip length

- All industries outsourcing ratio
- All industries, approximate trip length
Conclusions

• No strong linear relation between growth and emissions
• Changing relations and impact of the different factors
• Macro factors seem to be decisive in transformation and micro in rationalization
• Strongest decoupling when interacting
Roads to 2050?

Current growth cycle | Crisis | Next growth cycle
--- | --- | ---

- **GDP**
- **CO₂**
- **tonkm**

- **Growth and transformation 'as usual'**
- **Increased technical and logistic efficiency; increased share of fossil free fuels**
- **New growth directions; support from other sectors or less consumption/production**