Implications of climate change adaptation for public finance: A case study for Austria

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Research Agenda

- Elicit which climate adaptation cost categories are budgetary significant
- Identify adaptation needs and costs for public authorities in Austria at different governance levels
- Explore adaptation cost dynamics (mid and long term)
- Estimate the macroeconomic effects of public adaptation
- Identify synergies and potential trade-offs between public and private adaptation
Introduction

- Context of national study
  - Long term budget forecast (by Federal Ministry of Finance)
    - Demographic change
    - Climate change

(Mechler et al., 2010)
Climate change impacts and adaptation in a national framework

- 12 “impact fields”
  - According to Austria’s National Adaptation Strategy
  - Detailed sectoral analyses (bottom-up)

- Consistent scenario definitions
  - Shared Socioeconomic Pathway (SSP) developed for all impact fields
  - Consistent climate scenario(s): Ø 2016-2045 and Ø 2036-2065

- CGE evaluation
  - Feed in results from sectoral analyses (10 impact fields)

- Compare **Baseline scenario** (no climate change but socioeconomic development) to **Climate Change scenario**
Climate change impacts in Austria

- Ø 2036-2065: GDP -0.15%; welfare -0.48% (relative to Baseline)

Steininger et al. (2016); Bachner et al. (2015)

## Climate change impacts in Austria

<table>
<thead>
<tr>
<th>Impact Field</th>
<th>Impact chains</th>
<th>% GDP 2050</th>
<th>% Welfare 2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Changed crop productivity of main crops and grassland due to changes in temperature and precipitation</td>
<td>+0.08%</td>
<td>+0.03%</td>
</tr>
<tr>
<td>Forestry</td>
<td><strong>Changed yield in commercial forests</strong> (less biomass productivity, bark beetle disturbances); reduced protection functionality of <strong>protection forests</strong></td>
<td>-0.08%</td>
<td>-0.10%</td>
</tr>
<tr>
<td>Buildings: Heating and Cooling</td>
<td>Increased <strong>cooling energy demand</strong> in summer, decreased <strong>heating energy demand</strong> in winter</td>
<td>+0.01%</td>
<td>+0.03%</td>
</tr>
<tr>
<td>Electricity</td>
<td>Change in <strong>hydro, wind and PV generation potential</strong>; lower availability of <strong>cooling water</strong> for thermal/nuclear plants, change in <strong>generation mix</strong>, reduction in <strong>reliability of the electricity system</strong></td>
<td>-0.08%</td>
<td>-0.09%</td>
</tr>
<tr>
<td>Catastrophe Management</td>
<td><strong>Building damages</strong> due to riverine flooding</td>
<td>-0.01%</td>
<td>-0.24%</td>
</tr>
<tr>
<td>Tourism</td>
<td>Changes in <strong>winter and summer tourism demand</strong></td>
<td>-0.06%</td>
<td>-0.07%</td>
</tr>
<tr>
<td>Rest</td>
<td></td>
<td>-0.02%</td>
<td>-0.03%</td>
</tr>
<tr>
<td>Net effect</td>
<td></td>
<td>-0.15%</td>
<td>-0.48%</td>
</tr>
</tbody>
</table>

Steininger et al. (2016); Bachner et al. (2015)
## Impact Field: Catastrophe Management

<table>
<thead>
<tr>
<th>Adaptation scenario assumptions</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>protection of all areas against a future 100-year event</td>
<td>BASE project (Jeuken et al. 2015)</td>
</tr>
<tr>
<td>Current adaptation deficit included</td>
<td></td>
</tr>
<tr>
<td>Adaptation costs for upgrading dikes</td>
<td></td>
</tr>
<tr>
<td>Average benefit-cost ratio of 1.74</td>
<td></td>
</tr>
<tr>
<td>Investment volume: 25% of expected annual damage</td>
<td></td>
</tr>
</tbody>
</table>

### Forestry
- Tending, thinning, harvesting & diversification of tree species:
  - Change in production cost structure of forest sector (+5% labor; +0.5% capital)
- Knowledge creation:
  - More government expenditure towards R&D (+6% increase of Baseline spending for R&D); more demand for "science"-sector in forestry
- 20% damage reduction
  - Seidler et al. (2011); Kolström et al. (2011)

### Tourism
- Artificial snow making:
  - Change in production cost structure of land transport sector (more capital, labor, electricity, leasing)
  - 75% damage reduction
  - Schinko et al. (2015)

### Climate change adaptation in Austria
Catastrophe Management

GDP Welfare

<table>
<thead>
<tr>
<th></th>
<th>2030</th>
<th>2050</th>
<th>2030</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welfare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Rest of impact fields
- Catastrophe Management
- Tourism
- Heating and Cooling
- Electricity Supply
- Forestry
- Agriculture
- All impact fields (net)
Catastrophe Management

Note: Error bars stand for different assumptions on effectiveness (10% to 200% B-C ratio)
Effectiveness of adaptation: Minimum B-C ratio for net gain
• GDP: positive GDP effect for very low B-C ratio (10%)
• Welfare: positive welfare effect for B-C ratio below 1 (75%)
Forestry

Public Adaptation to Climate Change

Note: Error bars stand for different assumptions on effectiveness and costs (20% to 50% B-C ratio, higher K intensity: +0.05% to +2%)
Tourism

GDP 2030 | 2050  
Welfare 2030 | 2050

- Rest of impact fields
- Catastrophe Management
- Tourism
- Heating and Cooling
- Electricity Supply
- Forestry
- Agriculture
- All impact fields (net)
Tourism

Public Adaptation to Climate Change

Climate change impacts only
With adaptation (50% damage reduction)

Note: Error bars stand for different assumptions on effectiveness (Benefit cost ratio 25% to 75%)
Adaptation measures combined

<table>
<thead>
<tr>
<th></th>
<th>GDP</th>
<th>welfare</th>
<th>unemployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change impacts only</td>
<td>-0.50%</td>
<td>-66%</td>
<td>-44%</td>
</tr>
<tr>
<td>With adaptation in flood protection, forestry, tourism</td>
<td>-0.40%</td>
<td>-33%</td>
<td></td>
</tr>
</tbody>
</table>

GDP, welfare, and unemployment changes with and without adaptation measures.
Effects on public budgets

• **Direct expenditure effects of CC impacts:**
  higher public expenditures on
  – Disaster relief payments
  – Reconstruction of public infrastructure (incl. protective forests)

• **Direct expenditure effects of CC adaptation:**
  higher public expenditures on
  – Investment in flood protection (dikes)
  – R&D investment for development of new forest tree species

• **Indirect effects on government expenditures and revenues:**
  – Lower tax base
  – Unemployment benefits

• **Public austerity and budgetary rules:**
  – Balanced budget
  – (Increase deficit)
  – (Foreign lending)
Adaptation measures combined

Government expenditures

<table>
<thead>
<tr>
<th>Climate induced relief payments</th>
<th>Other Government Consumption</th>
<th>Unemployment benefits</th>
<th>Transfers to households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change impacts only</td>
<td>-66%</td>
<td>-60%</td>
<td>-58%</td>
</tr>
<tr>
<td>With adaptation in flood protection, forestry, tourism</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Graph showing percentage changes in government expenditures with and without adaptation measures.]
Adaptation measures combined

Government revenues

<table>
<thead>
<tr>
<th>Production Tax</th>
<th>Labor Tax</th>
<th>Capital Tax</th>
<th>Value added Tax</th>
<th>Other taxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>-800,000</td>
<td>-600,000</td>
<td>-400,000</td>
<td>-200,000</td>
<td>0</td>
</tr>
</tbody>
</table>

- Climate change impacts only
- With adaptation in flood protection, forestry, tourism
Conclusions

• **Adaptation in 3 most important impact fields** can reduce
  – 2/3 of relief payments and GDP costs
  – 1/3 of welfare costs
  – almost 1/2 of unemployment

• **Public adaptation spending on flood protection, forestry, tourism is highly effective**
  – government balance improves, because of lower expenditures on disaster relief and unemployment benefits
  – more room for other government consumption (education, health etc.) which contributes positively to GDP and welfare

• But: results depend on reliability of benefit and cost estimates of adaptation – more research needed
• PACINAS website:  
http://anpassung.ccca.at/pacinas/

• The Cost of Inaction (COIN) Project  
http://coin.ccca.at


Steininger, K.W., Bednar-Friedl, B., Formayer, H. König, M., 2016. Consistent economic cross-sectoral climate change impact scenario analysis: Method and application to Austria. Climate Services 1, 39-52.