Macroeconomics of Natural Disasters: Meta-Analysis and Policy Options

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The paper in a nutshell

• Emerging field: *macro*economic impact of natural disasters
• Meta analysis of 20 macro-econometric studies (including ‘grey’ literature):
  – with and without control group
  – different sets of resilience factors
  – with and without disaster variable
  – Substantial heterogeneity in results
• Meta-regression analysis to assess the influence of empirical design (data and econometric specifications) and methodology
• Comparison with the leading research synthesis (IPCC narrative)
• **Major finding 1:** heterogeneity of results is due to modelling strategies and data set; importantly it distorts evaluation of mitigating instruments.
• **Major finding 2:** narrative could have been *more confident* on negative impact and *more transparent* on inclusion and qualification of studies if complemented by a meta-analysis
• **Most important research needs:**
  – Inclusion of population and institutions in primary studies.
  – Use of alternative data sets.
Macroeconomics of natural disasters

Increasing costs of man-made, weather & earth related disasters

Median $t$-value of the primary studies 2002-2013

![Chart showing median $t$-value of primary studies from 2002 to 2013.](chart.png)

Source: Swiss Re

Economist.com/graphicdetail
447 t statistics statistics of 20 studies in the meta analysis


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Macroeconomic costs of natural disasters
IPCC Special Report for Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaption

- Highly political/controversial issue
  - since Albala-Bertrand (1993) (long run impact is small)
  - disaster vulnerability and development (non graduating LDCs)
- IPCC’s (2012) major & highly influential research synthesis is narrative.
  - Aims to ‘assess science in a way that is relevant to policy but not policy prescriptive’
  - Assigns ‘medium confidence’ to the prevalence of a negative impact of disasters in the short run
  - ‘Disagreement is due to analytical weaknesses’ (lack of counterfactual, failure to account for informal sector, insurance, aid and disaster type)
Motivation for meta-analysis:
Our reading of the reasons for heterogeneity

• Methodological differences
  – Research design decisions in emerging research field
  – Literature *looks* homogeneous (cross referencing & less heterogeneous than micro and case studies), but actually two literatures

• Preliminary state of findings (for example replication of Toya and Skidmore (2007) by Reed and Mercer (2013))

• Intrinsic motivation and bias of the researchers (cf Doucouliagos and Paldam 2009 on development aid)
Two approaches: theory

1: Direct costs

- Population
- GDP
- Education
- Investment
- Openness
- Institutions (quality)

COUNTRY CHARACTERISTICS (Factors of resilience)

Disaster indicator (count, affected)

DISASTER IMPACT

- Number of affected
- Number of killed
- Damages (% GDP)

2: Indirect costs

- Population
- GDP
- Education
- Investment
- Openness
- Institutions (quality)

COUNTRY CHARACTERISTICS (Factors of resilience)

NATURAL DISASTER (indicators)

- Occurrence (dummy)
- Frequency (count)
- Number of affected
- Number of killed
- Damages (% GDP)

DISASTER IMPACT

- GDP (level/growth)

IPCC narrative: ‘categories are rarely fully exclusive, and items or activities can have elements in all categories’
Two approaches: consequences for impact mitigating factors

Model 1 direct costs

Model 2 indirect costs

Negative  Positive
Number of coefficients for different resilience variables

Source: Lazzaroni and van Bergeijk, 2013, Appendix Table A2
Key findings from the meta (regression) analysis

• We can be confident about the negative impact of natural disasters based on the evidence in the 20 macro-econometric studies.
• Indirect costs studies are less likely to find a negative impact of natural disasters (± direct cost studies are more likely…)
• The use of EM-DAT (Center for Research on the Epidemiology of Disasters) decreases the likelihood of finding a negative disaster impact (± alternative data sets increase…)
• Contradictions in terms of impact of mitigating factors related to research design
• Relatively little evidence is available for mitigating role of institutions and population
• Primary studies do not always report key statistics necessary for meta-analysis
Studies (76) on disaster impacts in the IPCC Report by type of analysis

- Mathematical: 4%
- Macro econometric: 30%
- Micro econometric: 1%
- Input-Output: 4%
- CGE: 4%
- Other*: 57%
Impact of natural disasters on economic development

Positive impact

- IPCC
- Skidmore & Toya (2002)

Negative impact

- Okuyama & Sahin (2009)
- Meta analysis

NM: Non-macroconometric studies
### Strengths and weaknesses of narrative and meta analysis

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Traditional literature review (IPCC 2012)</th>
<th>Meta analysis (Lazzaroni and van Bergeijk 2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualitative analysis and case studies</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Quantitative analysis</td>
<td>yes</td>
<td>Yes, but not CGE, VAR and Input-Output</td>
</tr>
<tr>
<td>Identification of methodological differences</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Identification of <em>impact</em> of methodological differences</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Possibility to include ‘incomplete studies’</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Coverage of literature relevant for method</td>
<td>Incomplete (selective)</td>
<td>Incomplete (search strategy)</td>
</tr>
<tr>
<td>Transparent non-subjective synthesis</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>
Thank you

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