Uncertainty in LCA from Economic Input Output Models

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Uncertainty in LCA

- Uncertainty exists for all LCA data: mass flows, emissions, impacts, weights and change effects, e.g.
  - Proprietary data problems
  - Boundary problems: Lenzen (2000, JIE) finds truncation errors on the order of 50% for Australian LCA.

Uncertainty Implications

- Consistency and reproducibility of results (e.g. paper vs. plastic cups).
- Certainty of conclusions and usefulness of LCA.
- Numbers of significant digits.

EIO-LCA Uncertainty Sources

- Survey Errors: sampling and reporting errors – depends on companies and census agencies.
- Old Data: IO tables are typically 2 to 7 years old. Last US benchmark: 1997 released 12/2002.
- Incomplete Data: reports from only some sectors or plants (e.g. tri sector and threshold limits). Note: similarity to boundary problem in conventional LCA!

EIO-LCA Uncertainty (cont)

- Missing data: Census data missing many topics, such as habitat destruction. Non-monetary uses also not represented, e.g. congestion effects from truck services.
- Aggregation: Sectors too large for detailed analysis on specific products. (Often need a hybrid approach, combining EIO-LCA and process models).
- Imports: EIO treats imports as similar to domestic production.
- Model form: Linearity of EIO, lack of substitution

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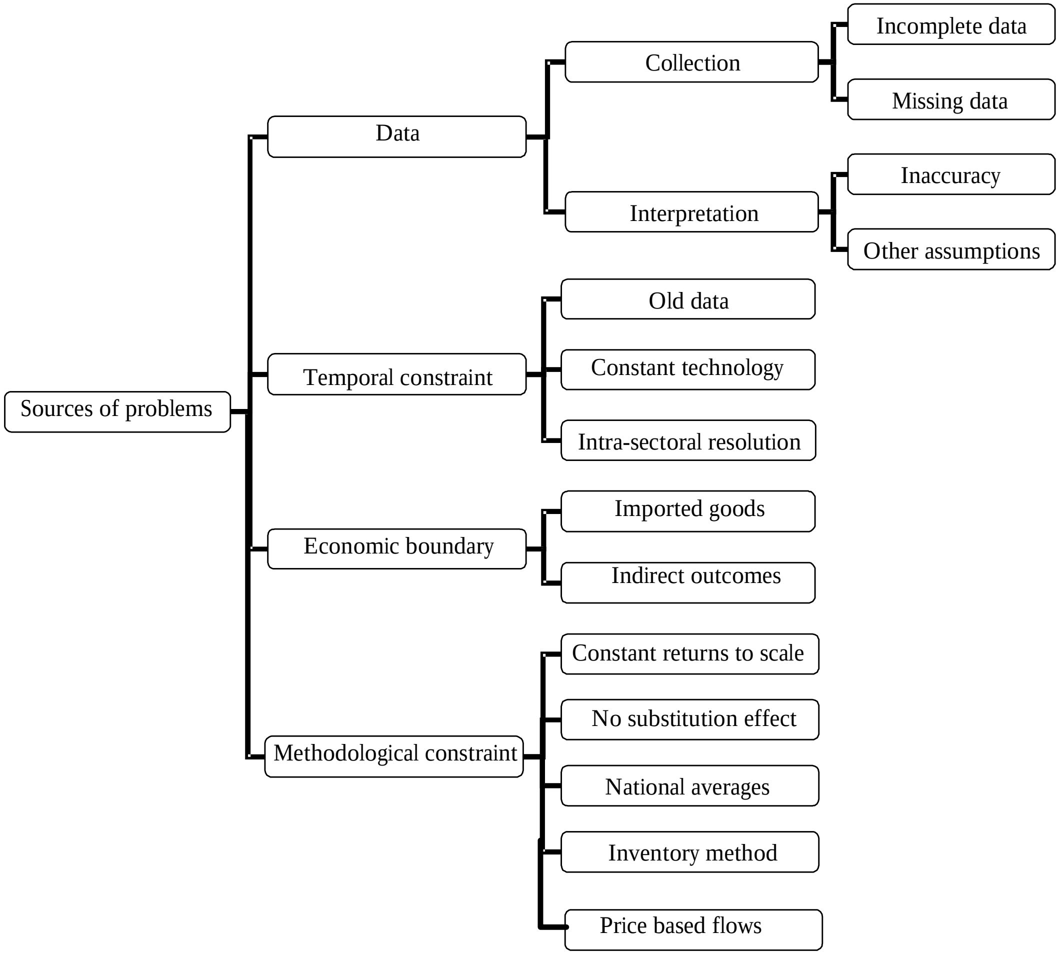
Uncertainty (Pacca 2003)



Mitigating Factors and Approaches

- Parameter stability over time
- Positive Correlations
- More and better data
- Simulation analyses
- User adjustments

Parameter Stability Over Time

- Using 1961 final demand from IO tables 1939-1961 found similar intermediate outputs (Carter, 1970).
- Intermediate use relatively constant (Ma, 2003)

Intermediate Use 1972-1997

Total Intermediate Use Percentages

	1972	*1987*	*1992*	*1997*
Manufacturing	49%	41%	39%	35%
Natural Resources	11%	9%	8%	9%
Trade	16%	19%	20%	27%
Services	22%	29%	31%	28%
Miscellaneous	2%	2%	2%	2%
Infrastructure	22%	24%	25%	26%

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Positive Correlations

- Deciding on the best of two designs may be more certain than overall impact due to positive correlations. The designs may share many elements in common, and these elements would be positively correlated. If the element is bad, it is bad for both. If good, it is good for both.
- Numerical analysis of effect – Cano (2000).

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More and Better Data

- Mixed picture for more and better data.
- No water use data since 1980s in US.
- No workfiles for 1997 benchmark released.
- Better industrial environmental management systems.
- More international co-operation and public data.

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Simulation

- Computationally straightforward to simulate effects of uncertain EIO and impact vectors to develop confidence intervals on results.
  - Information to identify underlying distributions and variability often not available.
  - Missing information must be assumed – note truncation problem.

User Adjustments

- Many adjustments possible due to known aggregation or emissions problems
  - Hybrid models including EIO and process models.
  - Parameter adjustments to reflect non-linearities.
  - Disaggregating individual EIO sectors.
- Bayesian methods applicable here – adjusting estimates based on expectations.
- Multiple approaches: EIO-LCA and Conventional LCA.

Conclusions

- Uncertainty is a major concern for LCA.
- Several mitigation approaches possible and should be applied:
  - Simulation
  - Hybrid models and alternative approaches
  - Bayesian parameter adjustments
  - Disaggregation

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References

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