Innovation, SDGs and evaluation
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<table>
<thead>
<tr>
<th>Goal</th>
<th>Business innovation</th>
<th>Government innovation</th>
<th>Policy</th>
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<tbody>
<tr>
<td>1. End Poverty</td>
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<td>2. End hunger and provide food security</td>
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<td>3. Healthy lives</td>
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<td>4. Inclusive and equitable education</td>
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<td>5. Gender equality</td>
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<td>6. Sustainable water and sanitation</td>
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<td>7. Affordable and sustainable energy</td>
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<td>8. Sustainable economic growth</td>
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<td>9. Resilient infrastructure</td>
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<td>10. Reduce inequality</td>
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<td>11. Sustainable cities</td>
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<td>12. Sustainable consumption &amp; production</td>
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<td>13. Combat climate change</td>
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<td>14. Sustainable use of oceans</td>
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<td>15. Sustainable use of land</td>
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<td>16. Peaceful and inclusive societies</td>
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Business innovation will not necessarily solve poverty.
Role of business sector innovation in SDGs

<table>
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<th>Level of role</th>
<th>Areas</th>
<th>Number of SDGs</th>
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<tr>
<td>High</td>
<td>Sustainable zero CO2 emission energy, Sustainable production</td>
<td>3</td>
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<td>Moderate</td>
<td>Utilities: water, sanitation &amp; infrastructure</td>
<td>2</td>
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<td>Low</td>
<td>Sustainable agriculture, fishing, forestry; health, cities and growth</td>
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Much of this is covered under ‘environmental innovation’
Relevant data that can be collected in innovation surveys

- Environmental and social objectives for innovation
- Outcomes within the firm (decline in energy and material use per unit of output, internal recycling, etc.)
- Types of innovation by industry

Questions focused on environmental innovation:

- Drivers (regulations, consumer demand, etc.)
- Obstacles (regulations, lack of demand, lack of skills, etc.)
- Expenditures
- Methods used (end-of-pipe, process innovation, product innovation, etc.)
Emerging innovation concepts of relevance to SDGs

- **Inclusive innovation** (Heeks et al, Chattaway et al. etc.)
- **Grassroots innovation** (Gupta, Smith et al, etc.)
- **Frugal innovation** (Prahalad and Mashelker, Tewari, etc.)
- **Social innovation** (Mulgan, Kemp et al and many others)
  - Relevant to both the business and government sectors

Emerging components of innovation:

- Shared economy (e.g. uber, airbnb etc) or solidarity economy (faire trade, local exchange trading systems)
- Creative commons/open source; crowdfunding
- Design-thinking, co-creation

- All of these topics can be covered in innovation surveys
Innovation outcomes of relevance to SDGs

• Difficult to ask survey respondents about effects outside the boundaries of their organisation (but can be done cautiously).

• Best to link data on innovation with independent data sources, such as on CO2 emissions or food production, etc.
Linking different types of data

- R&D investments by field of research (FOR)
  - Are investments correlated with innovation survey data on objectives?

- International Energy Agency (IEA) data on investments on CO2 emissions by sector and shares of different energy types (renewables, fossil fuels etc.)
  - Can track emissions per GDP by sector (transport, commercial, etc.) to see if energy intensity is improving

- Link changes in energy intensity to innovation survey data on innovation expenditures, objectives / outcomes
Performance evaluation (micro-analysis)

- Link innovation survey data to outcome data after a suitable time lag.
- Use regression to evaluate the effect of different firm-level characteristics and innovation activities on:
  - firm performance (innovation outputs, economic outcomes such as sales increase, productivity, etc.)
  - firm reported environmental outputs such as CO2 emissions
Effect of innovation on national, regional or sector outcomes (macro level analysis)

• Link innovation survey data to outcomes of interest: agricultural production, air pollution, CO2 emissions, etc.

• Regression to carefully control for other factors that could cause the same outcomes:
  – CO2 emissions: decline in economic activity, shift in production overseas, non-innovation shifts in energy types (coal to gas), etc.

• Requirement: method requires a sufficiently large number of nations, regions or sectors.
Evaluation of innovation policies (or other policies to support SDG goals)

- Policy evaluation involves monitoring, evaluation and impact evaluation

- **Monitoring**: tracking what happens over time. Results can inform program implementation and day-to-day management

- **Evaluation**: Objective assessments of policy carried out at discrete points in time

- **Impact evaluation**: changes in outcomes that are caused by the policy
Impact evaluation

• Impact is the difference in outcomes (innovation, CO2 emissions) with and without a specific policy

• Impacts are difficult to identify because of:
  – Confounding factors: other causes of the same outcome that are also associated with the use of a policy (firm size, age, if the firm exports, etc)

  – Self-selection effects: individuals (firms) self-select to apply for an innovation support program
    » Can also be double selection: by the firm and by the agency responsible for a program
Evaluation problem

• Ideally, evaluation requires information on the counterfactual: what would have happened if the policy had not been in place (if the user of the policy had not done benefited from it)?

• But, the counterfactual is never observed – we can only observe and compare the performance of firms that did and did not make use of a policy.

• Evaluation techniques provide different solutions to the counterfactual problem, confounding, and self-selection.
Relevant innovation policies for evaluation

- R&D subsidies or tax incentives
- Research grants
- Grants / subsidies to hire university graduates (engineers)
- Grants / subsidies for equipment purchases (IT, etc)
- Subsidies or other support to venture capital
- IPR policies
- Public procurement that requires innovative solutions
- Policies to support collaboration on innovation
Example: grant to cover 50% of salary costs to hire a new doctorate in engineering to reduce CO2 emissions

- Best evaluation method: SMEs are randomly assigned to one of two groups – receive the grant or do not receive the grant (randomized trial).
- All firms need to be interested in the grant and have a baseline level of competence (reduces costs as the sample can be smaller).
- With randomization, any differences in the average outcomes (successful environmental innovations) after two years are likely to be due to the grant.
Alternative methods without randomization

Matching methods: Construct a control group for observable differences in firms that apply and do not apply for a grant.

Propensity score matching identifies a set of characteristics that is related to application for a grant and finds for each participant a matched control (or controls) that are very similar on the set of characteristics (measures of proximity).

Statistical techniques are available to account for variations in the proximity of matches.
• Propensity score matching can use innovation survey data if the survey collects data on the application for and use of grants among innovative firms (and preferably among non-innovative firms too – permits two control groups).

• The mean program ‘gain’ can be calculated between firms that received the grant and firms in the control group that did not receive the grant:

- Average CO2 emissions in firms with the grant: 2 t per (x)
- Average CO2 emissions in firms with no grant: 3 t per (x)
- Difference (program gain) -1 t per (x)
When panel data are available (firms tracked over time)

**Difference in differences** method.

- Useful when firms that receive and do not receive the grant differ in non-observable characteristics (management skills, corporate culture etc.) than can affect the outcome.
- Data are available from before the grant obtained and for after the grant obtained for firms that did and did not receive the grant.
- Uses internal controls based on outcomes from before receipt of the grant.

**Assumes:** 1) unobservables do not change over time
2) in the absence of the grant, the two groups would have followed parallel trends.
Conclusions

• Business sector innovation surveys are mostly relevant to SDGs with an environmental component; followed by SDGs for health, growth and cities.
• Government sector innovation surveys can also be of use.
• Innovation surveys are relevant to evaluations of firm performance for outcomes linked to SDGs.
• Innovation surveys can be used to evaluate macro outcomes such as regional trends in air pollutants, but requires a large number of ‘regions’.
Conclusions – policy evaluation

• Avoid ‘cheap and easy’ evaluation methods that do not control for self-selection and confounding because they can provide very misleading results:
  – Using innovation survey data to produce descriptive outcome data for firms that receive a grant and those that do not.
  » Asking firms in a survey if they benefited from a grant or not.

• Randomized trials are the most reliable, but are costly – innovations surveys not relevant here.

• Innovation surveys are of value to ex-post matching or difference in differences methods, but these are not as reliable as randomization and are difficult to conduct – requires experts to conduct the analyses.