# Innovation, SDGs and evaluation


## Anthony Arundel & Micheline Goedhuys

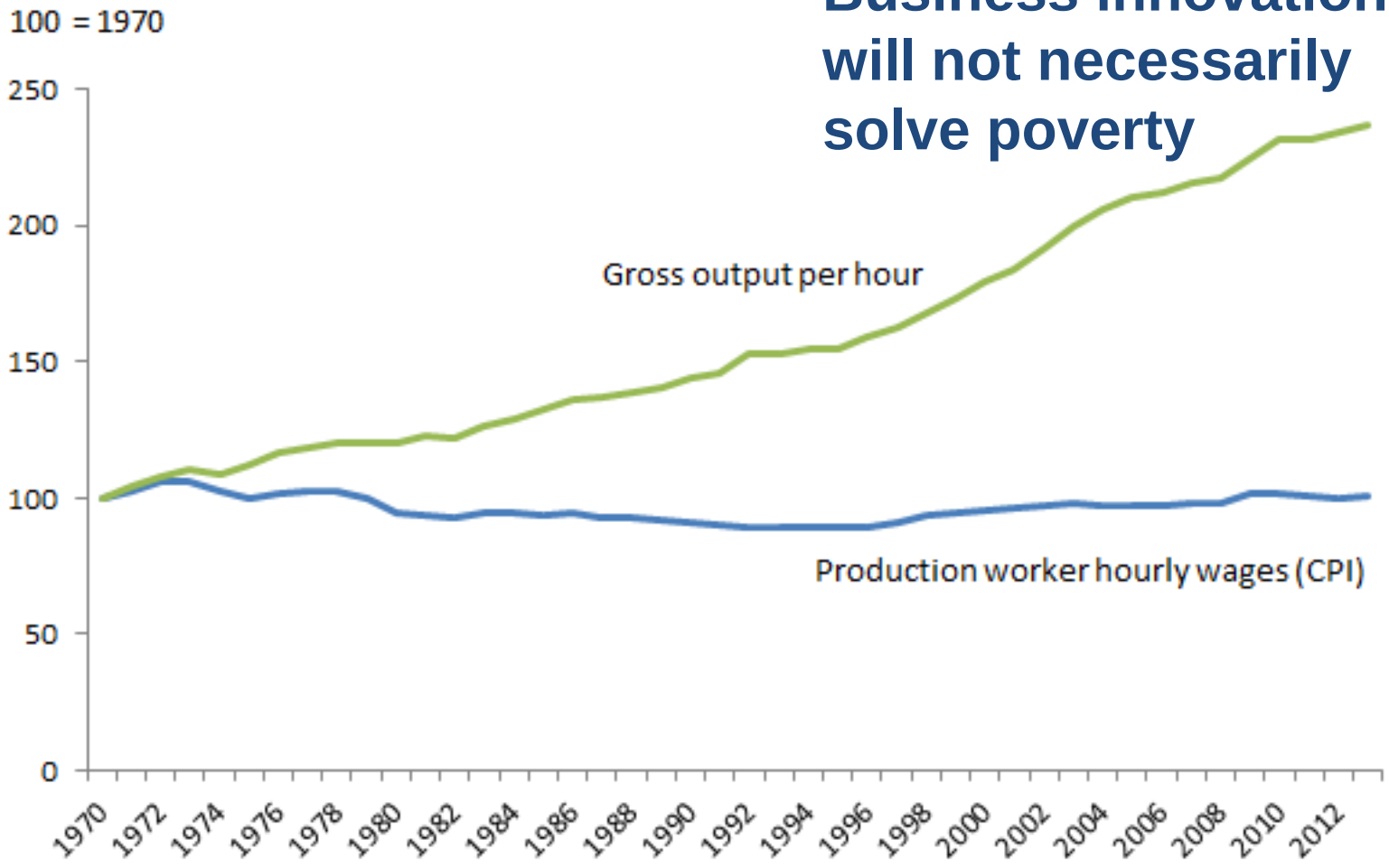



UNITED NATIONS UNIVERSITY
Maastricht University
UNU-MERIT

| Goal | Business innovation | Government innovation | Policy |
|---|---|---|---|
| 1. End Poverty | | | |
| 2. End hunger and provide food security | | | |
| 3. Healthy lives | | | |
| 4. Inclusive and equitable education | | | |
| 5. Gender equality | | | |
| 6. Sustainable water and sanitation | | | |
| 7. Affordable and sustainable energy | | | |
| 8. Sustainable economic growth | | | |
| 9. Resilient infrastructure | | | |
| 10. Reduce inequality | | | |
| 11. Sustainable cities | | | |
| 12. Sustainable consumption & production | | | |
| 13. Combat climate change | | | |
| 14. Sustainable use of oceans | | | |
| 15. Sustainable use of land | | | |
| 16. Peaceful and inclusive societies | | | |

# Business innovation will not necessarily solve poverty

**Figure 1 Real hourly wages and output per hour**




CPI = consumer price index

Note: Hourly wages are calculated using the consumer price index.

*Sources:* Bureau of Economic Analysis and US Bureau of Labor Statistics.

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# Role of business sector innovation in SDGs

| Level of role | Areas | Number of SDGs |
|---|---|---|
| High | Sustainable zero CO2 emission energy,<br>Sustainable production | 3 |
| Moderate | Utilities: water, sanitation & infrastructure | 2 |
| Low | Sustainable agriculture, fishing, forestry; health, cities and growth | 5 |

**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.