Innovation surveys and indicators: an international perspective and emerging issues

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Outline and introduction

• OECD involvement in innovation measurement: surveys and indicators
• Methodological and conceptual work
• Data collection and indicators
• Analytical work: microdata
• Ongoing work: business R&D and innovation survey (re)design, public sector innovation
Methodological work

• Long tradition of manuals and guidelines for the measurement of S&T activities
• Frascati (R&D): since 1960s, now 6th edition (2002)
• Oslo (innovation): since early 90s, now 3rd edition (2005)
• Others: patents, HRST (Canberra), economic globalisation, information society, biotech
Oslo Manual

- Co-managed with Eurostat since the 2nd edition (1997), developed and reviewed through peer process (NESTI + ESTAT WP STI)
- Provides conceptual background for analysis of innovation in firms
- Built on economic framework (elements from Schumpeter, systems of innovation approach), subject approach, creation and diffusion of knowledge
- Provides definitions and recommendations for developing surveys, but not a template or list of indicators
- Latest revision: expansion to non-technological innovation (org + mkt), innovation linkages, annex on developing countries
Harmonised data collection: the Community Innovation Survey (CIS)

- Run since reference year 1992, now biannually
- Used by all EU Member States + some Candidate / Associated countries
- Guided by:
  - EC Regulation 1450/2004 → list of mandatory/voluntary indicators (around 50/50 in CIS-2010)
  - Business survey questionnaire + methodology
- Harmonised questionnaire (incl. ad-hoc modules) which is then implemented nationally with some modifications
- Methodological guidelines + aggregations/tabulations
Use of CIS indicators

• National reports
• Eurostat reports
• EU Innovation Union Scoreboard - IUS (ex-EIS):
• Growing use but still less widely used than R&D statistics → some concerns about quality, policy relevance, international comparability (outside EU)
Innovation surveys outside Europe

• Increasing use in OECD and developing countries: around 80 countries worldwide have carried some type of innovation survey, mainly following Oslo Manual framework

• 3 broad types:
  – Close to CIS design with some adaptations: China, Japan, Korea, Russia, South Africa
  – Joint R&D/innovation surveys close to CIS: Brazil, Chile, Israel, Mexico, United States* (BRDIS)
  – Broader surveys (business strategies/operations): Australia, Canada, New Zealand, Switzerland
Some examples

- Australia (Business Characteristics Survey 2008-09): modular approach with sections on business structure and operations, financing, innovation, markets & competition, skills, ICTs
- Canada (Survey of Innovation and Business Strategy 2009): strategic decisions, innovation activities, operational tactics + involvement in global value chains
Challenges

• Differences in:
  – scope and type of survey: stand-alone, joint R&D/innov, module within broader survey
  – Target population: industries, firm size threshold
  – length of observation period (2-3 years)
  – Reference period
  – Scope of certain variables: e.g. collaboration, expenditure

• Methodological problems remain, even for CIS countries:
  – Data quality due to low response rates, widespread use of imputation, qualitative/subjective measures
  – Voluntary/mandatory variables (ad-hoc modules)
An example: innovation expenditure

- Current model CIS (and similar surveys): levels are collected for 4 activities (only for product innovation), binary (Y/N) for other activities (e.g. training)
- Switzerland (2008): 5-level scale by type of innovation (product/process) and expenditure category (research, development, design and preparations, subsequent investments, ICT). + levels for 3 categories over 3-yr period
- Canada (2009): expenditure on process innovations, expenditure on product innovations, expenditure on marketing innovations (as a share of total marketing expenditures).
- Japan (J-NIS 2003): total value for innovation expenditure (related to product / process) and shares for certain activities (similar to CIS).
- Australia (2008-09): only a binary variable (Y/N) is used for 8 activities relating to all 4 types of innovations (product, process, marketing, organisational).
- New Zealand (2009): values for 4 categories relating to product development & related activities (R&D, design, marketing and market research, other) + Y/N to list of 10 activities (and whether to support innovation)
OECD Innovation Microdata Project

• Rationale and approach: restrictions on accessing microdata → decentralised approach with OECD coordinating and country leads, develop common routines (STATA/SAS)
• Participants and organisation: over 20 countries, around 50 researchers
• 3 modules: (1) indicators; (2) mixed modes and non-tech innovation; (3) innovation and productivity (econometric analysis)
• 2 phases: 2007-09 and 2009-11
• Data used for *OECD Innovation Strategy* reports, in particular “Measuring Innovation: A New Perspective” (2010)
Microdata Project 1: indicators

• 3 main objectives:
  – International comparability: CIS / others → construct indicators using similar scope (industries, firm size), map variables to CIS
  – Develop new indicators and taxonomies
  – Exploit new breakdowns for existing indicators
Indicators (1)

- Selected 20 “basic” indicators usually constructed with a single variable in survey
- Similar to indicators tabulated for CIS: product / process innovators, new-to-market process innovators, marketing / organisational, R&D performance, expenditures (as % of turnover), public support, collaboration, patents
- Map variables for non-CIS countries
Indicators (2)

- More ‘complex’ indicators and new taxonomies (combining several questions)
- Output-based modes (PP):
  - Combine degree of novelty (new-to-market) with international orientation (domestic-only/foreign)
- Open innovation:
  - Sourcing (extramural R&D, other external knowledge)
  - Joint innovation: product/process innovations with others
- Complementarities:
  - PP only, MO only, both
- Breakdowns: R&D status/intensity, SMEs (single/group)
Indicators: some examples

Output-based innovation modes, 2002-04 (as a % of all firms)

- Canada...
- Germany
- Luxembourg
- Belgium
- Sweden
- Denmark
- New Zealand
- United...
- Austria (CIS-3)
- Korea (manuf.)
- Finland
- Netherlands
- Brazil (manuf....)
- Norway
- France
- Japan


Innovation is not only about R&D...

New to market product innovators with and without R&D, 2004-06 (or latest)

As a percentage of innovative firms by R&D status

Microdata project 2: innovation modes

• Rationale: limited analysis of “non-tech” forms of innovation, understand complementarities between the 4 types (Prod, Proc, Mkt, Org) → identify different firm strategies

• Approach: include various variables relating to innovation outputs (e.g. new-to-market product innovation) and inputs (e.g. R&D activities) as well as different types of innovation.

• Around 17 variables were used in analysis for 9 countries (CIS + others)
Mixed-modes

• Exploratory factor analysis used to reduce set of binary variables into different concepts (factors) which relate to combinations of innovation inputs/outputs
• Factor solutions computed for all countries which are then identified and interpreted as *firm strategies*
• Cluster analysis is then conducted based on these factors to identify groups of firms with similar values across all factors
• Factor scores for each firm used as variables in regressions to predict firm-level (labour) productivity
Mixed-modes: brief results

• Four common modes identified:
  – Process modernising
  – Wider innovation
  – Marketing-based imitating
  – New-to-market innovating
    – [in phase 2: networked innovating + IP/technology innov]

• Country specificities: e.g. relative importance of design, appropriation strategies

• No consistent pattern regarding link to productivity

• Phase 2: stability over time, adding “systems” variables on knowledge flows, examine regional/sectoral patterns
Microdata project 3: innovation and productivity

• Rationale: use of a simplified framework to model the relation between innovation and its determinants through knowledge production function and the contribution of innovation to productivity using an output function.

• Core model: so-called “CDM” model (Crépon, Duguet & Mairesse, 1998)

• Some countries tested extended models based on data availability
Model used

1st stage: investment phase
Selection equation and innovation demand function

2nd stage: Reaping the benefits
Knowledge production function

Innovation decision

Innov (Y/N)
Size
Exports
Group

Innovation inputs
Innov expenditure intensity
Exports
Public support
Collaboration

Innovation outputs
Innov sales intensity
Size
Collaboration
Process

Productivity
Size
Process
Main messages from Phase 1

- Positive link between investment in innovation, sales from innovative products and firm’s productivity holds for most countries
- Firms that invest more on innovation are those that:
  - Belong to a group; export; collaborate; receive public financial support;
- Firms spending more on innovation (p/employee) earn greater returns from innovation (higher sales from innovative products p/employee)
  - and among those firms, the ones that introduce both product and process innovations have greater returns than those introducing only product innovation
- Firms with higher sales from innovative products are also those firms with higher productivity levels
  - and among the (small) innovative firms, those belonging to a group are the most productive
Phase 2: expanding the model

Incorporate:

- Measure of firms’ innovation capability using “distance to technological frontier” (distance to most productive firms in industry)
  - Findings: public financial support increases innovation spending, especially for firms far from the TF; for collaboration results mixed across countries

- Measure of competitive environment (market concentration)
  - Findings: mixed → higher concentration does not necessarily hamper innovation, but differences across industries. Need further work, improve measures of competition (e.g. profit-based)
Ongoing OECD work

- R&D and innovation survey redesign (2011-12) - Task Force being set up through NESTI to examine various issues including:
  1. Methodologies and data collection: survey design (e.g. target population, sampling methods, unit of analysis, non-response, weighting) data collection methods (e.g. joint surveys, data sources, online surveys), data processing (e.g. estimation)
  2. Data use and indicators: quality, comparability, use and relevance
  3. Designing and testing new questions (or different formulations)

- Framework for measuring public sector innovation
- Collaborate with other initiatives (e.g. ESTAT, UNESCO Institute for Statistics)