Measurement of technological activities

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Most common indicators

Standardised methodologies

- R&D expenditures
- Patent statistics
- Technological balance of payments
- Bibliometric indicators
- High-tech trade
- Human capital
- Innovation surveys (e.g. CIS)

Non standardised methodologies

- Innovation counts
- Literature-based
- Technology surveys

Development of new technology indicators - I

➢ Theoretical developments:

from <u>linear model</u>   to <u>chain-linked model</u>

- R&D as *input*
- Patents, TBP and high-tech trade as *output*
- **Firm** = main unit of analysis

- More 'learning' activities than just R&D and patents
- Complexity and feedbacks
- Several actors involved in innovative process

➢ Changes in technology policy

From
- R&D subsidies
- Patent law
- Support to high-tech industries

To
- Technology transfer (university↔industry; low-tech industries)
- R&D co-operation
- Standards

Knowledge flows and indicators

Activities/Flows/Knowledge characteristics outside the realm of traditional indicators:

- *Absorption*: absorptive R&D, reverse engineering, co-operative R&D, licences...
- Non scientific inputs and outputs (design, "pure" technical skills...)
- *Tacit* knowledge (non codified)
- Wide range of appropriability means
- Networks of innovators
- ⟹ require NEW indicators

Questions to be answered by innovation indicators

	Creation	Dissemination	Absorption
Who	Source (large-small firms, universities..)	Vehicles (people, products, patents..)	Users, Competitors
What	Types of knowledge (tacit, codified..)	Secrecy, reverse engineering…	Necessary absorptive capabilities
Where	Location of source (institutional, geographical)	Links (formal, informal); directions of flows	Location of users, competitors
When	lenght of research (and funding) time;	Patent expiry date: perception lag	Adoption/diffusion lag
Contextual factors	financial conditions, knowledge externalities, research infrastructure, local environment, rules of behavior		

Strengths/weaknesses of selected indicators - I

		Strenghts	Weaknesses
Traditional	**R&D**	▪ Regular data collection ▪ Sectoral comparability ▪ International "	▪ Excludes design, software, engineering ▪ Underestimates inn. in SMEs and services
	Patents	▪ Regular data collection ▪ Details on tech. fields ▪ International comparab. ▪ Info. on networks	▪ Mismatch patents-innovations ▪ No info. on services ▪ Role of propensity to patent (firm/regime)
	TBP	▪ Regular data collection	▪ No info. on non-tranferred technologies
	Trade of High-Tech products	▪ Regular data collection ▪ Measure of country perfomance ▪ International comparab.	▪ No info. on traditional industries ▪ No info. on domestic inn. ▪ Selection bias

Strengths/weaknesses of selected indicators - II

New	**Bibliometrics**	▪ Measure of scientific inputs ▪ Info. on networks ▪ Details on tech. fields ▪ International comparab.	▪ Mismatch publications-innovations ▪ Role of propensity to publish (firm/regime) ▪ Language barriers
	Innovation Surveys	▪ Direct measure of innovativeness ▪ Potential inclusion of all innovative activities ▪ Both manufacturing and services	▪ Cross-country + time comparability ▪ Lack of periodicity ▪ Sample selection problems ▪ Subjective answers

	Object approach	**Subject approach**
Unit of analysis	The innovation	The innovator
Method of collecting info	Selection of items from secondary soources: ▪new product catalogues ▪innovation inventories ▪patents ...	Questionnaires/Interviews to: ▪ Firms ▪ Universities ▪ Public labs...

References and web resources for "publicly available" data - 1

R&D
OECD: http://www.oecd.org
Main Science and Technology Indicators (1991-1997)
Basic Science and Technology Statistics (1981-1995)
(A few documents online with useful data)

Bibliometric
BEST: http://www.sussex.ac.uk/spru/best/index.html
ISI: http://www.isinet.com/
BIDS: http://www.sussex.ac.uk/library/pier/bids1.html
Chemical Abstracts: http://www.cas.org/

Patents:
EPO: http://www.european-patent-office.org/
USPTO: http://www.uspto.gov/
WIPO: http://www.wipo.org
CHI: http://www.chiresearch.com/index.html
DERWENT: http://www.derwent.com

References and web resources for "publicly available" data - 2

Europe:
CORDIS: http://www.cordis.lu
(Database on R&D co-operative projects financed by the EC and other information on S&T activities of the EC)

ERSTI (1994, 1997), European Report on Science and Technology Indicators, European Commission DGXII.
(*Few chapters on web*)

EUROSTAT: http://europa.eu.int/en/comm/eurostat/serven/part1/1som.htm
(*Basic economic indicator for EU countries*)

US:
National Science Foundation: http://www.nsf.gov/sbe/srs/stats.htm
(*Various reports on S&T in the US and two databases on university research and education and employment in S&E*)