



# Internationalisation of STI



## *Challenges for measurement*

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# Introduction

A complex phenomenon, often discussed, but whose drivers and impact are not yet fully understood

- The multiple channels of internationalisation of STI
- Key Issues for policy makers
- Currently available statistics
- Implications for measurement and indicator building in future



# I. The multiple channels of internationalisation of STI

- Wide variety of processes
  - Internationalisation of Science and Technology Development at research institutes/universities
    - International mobility of students & researchers, international collaboration
  - Internationalisation of Technology Development and Innovations by firms
    - Sourcing know-how internationally
      - By doing R&D abroad
      - Importing technology from abroad for R&D done at home
  - International collaboration in S&T, private-public
  - International exploitation of technology
    - licensing, exporting, FDI
- Broadly based across S&T actors
  - Large multinational firms, small high-tech start ups, technology absorbing firms, research institutes, S&T researchers, S&T intermediaries



## II. Key issues in internationalisation of STI

Specialisation, concentration in a few centers of excellence worldwide (?)

- Large technology intensive MNEs play a key role in international generation and diffusion of know-how. What drives these firms international R&D strategies? *World-wide learning process, mobilizing dispersed sources of knowledge to build competitive advantage on world-wide markets*
- Impact of Internationalisation of STI on national/regional innovation and growth?
  - Motives for MNEs to transfer know-how abroad
    - Complex reverse and interactive international technology transfers



# Some key issues for STI policy

- How to attract innovative companies, research institutes and researchers? What forces determine the location decisions of MNEs in the field of R&D? What are the reasons for R&D clustering in some economic hubs?
  - What is the role of public research organisations and universities as magnets for knowledge intensive foreign investments in regional hubs of global innovations systems?
- Will R&D abroad substitute or complement for R&D at home?
- How will globalisation of firm's R&D strategies change the conditions for S&T output to contribute to economic growth at a national or regional level?
  - What is the impact of cross-border knowledge spillovers and R&D collaborations on the national and regional innovation systems?
    - How can a country/region access international know-how?
    - How to develop absorptive capacity?

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## III. Challenges for measurement

Do we have the data to tackle these key issues?

# Tacking Stock on Indicators for Internationalisation of STI

Restricted availability of internationally comparable data on all dimensions of STI internationalisation

Reviewing existing data on Internationalisation of STI

- First indicators on internationalisation of STI
  - Internationalisation of R&D through MNEs
- Further indicators on internationalisation

# First Indicators on STI internationalisation

*Cf OECD Handbook on Economic Globalisation Indicators*

- Trade in high-tech products (affiliates & parent companies)
- International technology receipts & payments (licensing, financing of R&D outsourced abroad...)
- FDI: internationalisation of R&D of MNEs (OECD, R&D survey)
  - INWARD: Identifying the foreign affiliates in the host country and assessing their R&D expenditures/personnel and sales...
  - INWARD: R&D expenditures financed from abroad
  - OUTWARD: Identifying the parent firm in home country and assessing their R&D expenditures/personnel at home and abroad.



# Further indicators on Internationalisation of STI :

Restricted availability of internationally comparable data on other dimensions of STI internationalisation; especially wrt :

- Internationalisation of science and technology creation (co-publishing, cross-border and co-patenting...
- International technology transfers through other channels  
*Migration of S&T workers, International (research) collaborations and alliances, Informal international contacts,...* (

- Indicators on :

- International mobility of human capital
- Cross-border ownership of inventions
- International co-operation in S&T

# Cross-border ownership of inventions

- Mapping « inventor » countries and « applicant » countries in patent info
  - Inward: Foreign applicants to domestic inventions
    - Foreign Applicants: Foreign based vs Foreign Affiliates at home
  - Outward: Domestic applicants with foreign inventors
    - Domestic applicants: MNEs vs local firms

# International Cooperation in S&T

Partners from more than one country jointly research and develop technological know-how and innovations. Actors here are not only enterprises, but also research institutions.

- Co-patenting
- Co-operative R&D agreements
- Co-publishing

# Internationalisation of Science

- *The international Development of Science* at public or private research institutes or universities: the international collaboration among S&T researchers (as witnessed by joint publications or joint projects), through the international mobility of S&T students and researchers; ...
- *The international exploitation of Science*

# International Mobility of Human Capital

- « Brain Drain » receives lots of policy attention, but data that are internationally comparable are scarce
  - Foreign born scientists and engineers, HRST
  - Foreign PhD students

# Studies on R&D internationalisation strategies and motives of MNEs

On the basis of ad-hoc academic surveys

- Although the %R&D carried out abroad is increasing, most R&D remains at headquarters
- Motives for R&D decentralization: both supply and demand related
- Role of subsidiaries in MNE innovative strategies: mostly interdependent labs; nevertheless adapting still predominant

# Studies using patent citations to measure technology transfers

*e.g. Branstetter (2000); Almeida (1996)*

- If technology sourcing is an (increasingly more) important motive for decentralizing R&D this should be reflected in technology transfers from local sources to foreign subsidiaries .
  - Confirmed with patent citation information *on USPTO & Japanese FDI in US; and for US semiconductor industry*
- Are innovation active foreign subsidiaries sources of knowledge spillovers to the local economy
  - Confirmed with patent citation information *on USPTO & Japanese FDI in US; and for US semiconductor industry*

# Studies using direct measures of technology transfer

*Survey evidence from CIS I-Belgium (Veugelers & Cassiman (2002) on two-way external transfer of know-how between subsidiaries and local competitors.*

**% R&D active (MAKE) subsidiaries (N=160)**

- transferring technology to external national partners:17.5%\*
- acquiring know-how from external national partners:50%\*
- having cooperative agreements with external national partners:51%

\*acquiring/transferring technology through licensing and/or through R&D contracting and/or through consultancy services and/or purchase of another enterprise **and/or hiring skilled employees, and/or other informal forms**



## IV. Implications for Measurement and Indicator Building

Due to the lack of comparable data on all the different dimensions of internationalisation, it is not yet possible to draw a comprehensive picture on the key issues for policy makers. A first challenge is hence to set up an internationally comparable data structure on the various dimensions of internationalisation of S&T.

# Implications for Indicator Building

- Develop a sufficiently international comparable data base on all the different dimensions of internationalisation
  - What are the best indicators of internationalisation of STI?
  - How to measure and evaluate the impact of cross-border knowledge flows on national/regional innovation systems?
  - How can international technology adoption be measured?

# Implications for Indicator Building

- First line of actions
  - Exploit the internationalisation dimension present through the existing instruments
    - R&D survey instrument for international ownership of R&D
    - R&D survey instrument for international financing of R&D

(see the *OECD Globalisation Indicators efforts*)

    - CIS survey instrument for international collaboration, ...
- Second line of actions:
  - Further develop existing instruments to better incorporate the internationalisation dimension (extra questions, identification of MNEs, subsidiaries of foreign firms,
    - R&D survey instrument for quantitative info eg on R&D spent home/abroad
    - CIS-survey instrument for qualitative info eg on dissemination of know-how
  - ...
- Third line of actions:
  - Develop new instruments to further measure the internationalisation dimensions
    - E.g. Surveys of MNEs on location factors
    - Labour Mobility
    - ...