Global trends and best practices in STI policy

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Strong growth in research input and output

Global research spending progressed faster (+30.5%) than global economy (+20.1%) between 2007 and 2013.

A steep rise in both research input and output since 2007:

- research expenditure (+30.5%)
- the number of researchers (+21%, FTE)
- scientific publications (+23%)
China and Rep. Korea making a stronger impact

G20: World shares of GDP, GERD, researchers and publications, 2009 and 2013 (%)
Why the steep rise in research spending, despite the crisis?

In many high-income countries struggling with austerity measures:

* a drop in public commitment to research was compensated by business research expenditure. Businesses sought to conjugate the crisis by maintaining or increasing investment in R&D.

In many lower income countries (e.g. Argentina, Ethiopia, Kenya, Mali, Mexico), growth fuelled by the commodities boom enabled:

* a rise in public commitment to research – but business spending on research remains low or not measured. (China’s stimulus package fostered investment in infrastructure, urbanization, maintained strong demand for commodities.)

Consequently, the gap in public commitment to research is shrinking for some developed and developing countries. Example: 0.44% of GDP in Argentina and the UK, 0.38% in Mexico
Greater convergence in public commitment to R&D

China, Argentina, Poland and Mexico approaching Japan, Canada, Italy and UK

Convergence between USA and Russian Fed.

GERD financed by government as a share of GDP, 2005–2013 (%)
But a persistent divergence in business expenditure on research
(exception: China)

GERD financed by business as a share of GDP, 2005–2013 (%)
World shares of business R&D, 2001–2011 (in PPP$)

China and India: 20%, steep rise since 2008

Former Soviet states: 2.6%

Middle East and Africa: 2.4%

Latin America: 1.5%

Few LA countries have used the commodities boom to embrace technology-driven competitiveness.

Japan and Asian Tigers stable: 22%

N.B. Here, Asian Tigers encompass Taiwan of China, Hong Kong (China), Indonesia, Malaysia, Philippines, Rep. Korea, Singapore, Thailand and Viet Nam
Patents still dominated by a minority

Taken together, the European Union, China, Japan, Republic of Korea and USA hold nine out of ten triadic patents.
Figure 2.3: Innovation rate of firms in the BRICS
Share of manufacturing firms (%)

Source: UNESCO Institute for Statistics, September 2014
Challenges for innovation in Brazil and India

• In the latest innovation survey conducted by the Brazilian Institute of Geography and Statistics, all firms (public and private) reported a drop in innovation activity since 2008 (IBGE, 2013). Industry affected by 2008 global crisis and worsening economic situation in Brazil since 2011

• India needs to broaden its innovation culture
South Africa: public private partnership to boost industrial R&D

- **Sector-Specific Innovation Fund** launched in 2013 to help reach GERD/GDP ratio of at least 1%, after private sector R&D fell from 0.50% to 0.32% of GDP between 2008 and 2012
- Fund targets specific industrial sectors, which partner with the government through the DST to support the industry’s specific research, development and innovation needs, through a co-funding arrangement.
Singapore: supporting incubators for disruptive start-ups

• Singapore plans to become Asia’s innovation capital
• National Research Foundation launched incubator in 2013 with Innosight Ventures Ptd Ltd, a Singapore-based venture capital firm.
• 85% of funding comes from NRF and rest from incubator
• Differs from USA, where corporations like Google, LinkedIn supporting disruptive start-ups, more cost-effective than acquiring new technology
Science powers commerce – but not only

With public budgets under pressure in advanced economies, public research budgets being diverted towards the commercialization end of innovation cycle to accelerate economic growth and productivity (e.g. Australia, Canada)

but

a risk that public good science and basic science could suffer.

USA: could austerity budget hurt basic research, government funded?

Could China’s low investment in basic research (4.7%) be holding it back?
The political leadership is dissatisfied with the return on its massive investment in R&D, mainly for experimental development (84.6%).

EU has resisted temptation: European Research Council for basic research (est. 2007); its budget = 17% of Horizon 2020.
Israel’s dilemma: are its universities prepared for tomorrow?

‘The Israeli economy is driven by industries based on electronics, computers and communication technologies, the result of over 50 years of investment in the country’s defence infrastructure. […]

However, the next waves of high technologies are expected to emanate from other disciplines, including molecular biology, biotechnology and pharmaceuticals, nanotechnology, material sciences and chemistry, in intimate synergy with ICTs.

These disciplines are rooted in the basic research laboratories of universities rather than the defence industries.’

Daphne Getz and Zehev Tadmor, authors of chapter on Israel, UNESCO Science Report
A ‘cultural revolution’ in Rep. Korea

Development model no longer suited to global markets.

• fostering **linkages between basic sciences and business** International Science Business Belt (Korea’s Silicon Valley) being set up. National Institute for Basic Science opened on site in 2011 and heavy ion accelerator under construction;

• has raised spending on basic research from 13% to 18% of total, now roughly equivalent to USA and Russian Fed.;

• plans to devote 5% of GDP to R&D by 2017 (4.2% in 2013);

• doubled its investment in **green technology** between 2008 and 2012 to maintain competitiveness. A new government-funded think tank, the Green Technology Center Korea, since 2013;

• plans to revitalize manufacturing by making country more entrepreneurial and creative, including by investing in **creative industries**.
Fourth Industrial Revolution

blurring the barriers between services and industry,

digitalizing industry to revitalize manufacturing:
• Germany’s Industry 4.0 programme
• France’s Industry of the Future programme.
• Chinese Internet of Things Centre,
• USA’s Advanced Manufacturing Partnership,
• Indian Cyberphysical Systems Innovation Hub,

One focus are creative industries that are increasingly web-based: e.g. France, Netherlands, Republic of Korea, Japan.

Examples of manufactured products: 3D printing, digital and lightweight manufacturing, connected reality, Google’s self-driving car, next-generation robotics.

Challenge for EU: none of top 15 public internet companies European (11 USA, 4 Chinese). Digital Agenda for Europe to develop digital single market (Europe 2020 strategy).
Japan’s priorities: ICTs, nanotech and environmental technologies

Chronic low growth has affected investor confidence. Japanese firms reluctant to raise R&D spending or staff salaries and averse to risk-taking.

‘Japanese industry can use its technological strength to satisfy global demand with system-oriented, network-based innovation supported by ICTs.’ *(UNESCO Science Report)*


Priority cross-cutting areas: ICTs, nanotechnology and environmental technology.
Countries seeking to become nanotech hubs

Articles on nanoscience per million population, 2009-2013
A growing priority: green technologies

The value of patent applications by **EU28** to EPO for environment-related technologies rose by 50% between 2005 and 2011 (to PP€0.46 per billion GDP).

In **Japan**, cost of solar electricity has dropped. After 2011 earthquake, government introduced feed-in tariff, a system which mandates utilities to purchase electricity from renewable energy producers at fixed prices (plus deregulation and tax benefits).

Green cities are planned for **Morocco**, **Gabon**, **Rwanda**, **United Arab Emirates**, etc. Also, **Kenya** (geothermal), **Gabon** hydropower, **Tunisia** (solar), **Morocco** (solar and wind).

Some oil-rent economies are investing in renewable energy amid rising energy consumption (e.g. for desalination) e.g. **Algeria** (wind and solar since 2011), **Saudi Arabia** (solar since 2015),
Brazilian electricity companies must fund clean energy R&D

By law, public and private Brazilian electricity companies must invest a share of their revenue in energy efficiency programmes.

*Distribution companies*: 0.20% of net operating revenue (NOR) in R&D, 0.50% in energy efficiency and 0.20% to National S&T Development Fund (FINDCT);  *generation and transmission companies*: 0.40% of NOR in R&D and 0.40% to FINDCT.
Science has become more mobile

- More firms are relocating R&D abroad, their physical infrastructure is more mobile than that of university campuses
- A growing global labour market for researchers and university students
- Greater virtual mobility: Internet has facilitated online university courses (MOOCs) and international scientific collaboration: 80-100% of articles in most LDCs have foreign partners (G20 average = 25%, OECD average = 29%)

Figure 1.4: Long-term growth of tertiary-level international students worldwide, 1975–2013

Source: UNESCO Institute for Statistics, June 2015
A PhD market still dominated by the USA

Ten countries host 89\% of international PhD students in science and engineering fields.

Malaysia plans to attract 200 000 students by 2020 (56 000+ in 2012), double that in 2007.
Switzerland’s recipe for success

- High levels of investment in R&D: 3% of GDP in 2012.
- About 30% of R&D expenditure goes to basic research.
- 61% of R&D funded by industry; business-friendly environment
- ALSO, more than half of labour force qualified for demanding jobs in S&T, thanks to excellent vocational training and ability to attract international talent to private industry and academia.

Figure 2.15: Percentage of foreign doctorate-holders in selected countries, 2009

Switzerland’s world share of triadic patents in 2012, up from 1.8% in 2002, the biggest leap among high-income countries
Many governments are fostering mobility to develop and attract talent

Examples
Publicly funded EU institutions must advertise vacancies internationally; EU’s scientific visa facilitates mobility of non-EU applicants.

Brazil’s Science without Borders (2011-2015): 100 000 scholarships in STEM for study abroad at best universities + grants to researchers from abroad to work with local researchers on joint projects.
A high level of mobility fosters innovation

‘Studies conducted across Europe have shown that a high level of mobility by qualified personnel between sectors (such as universities and industries) and across countries contributes to the overall professionalism of the labour force and innovative performance of the economy.’

UNESCO Science Report, based on 2014 European Research Area Progress Report
Thank you

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http://en.unesco.org/unesco_science_report