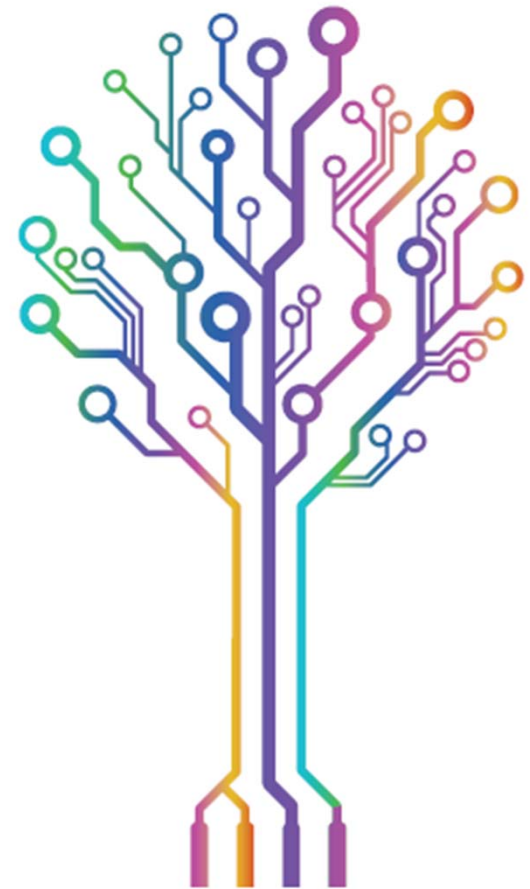


UNESCO Science Report

Towards 2030

Global overview

Luc Soete and Susan Schneegans



Key Messages - Outline

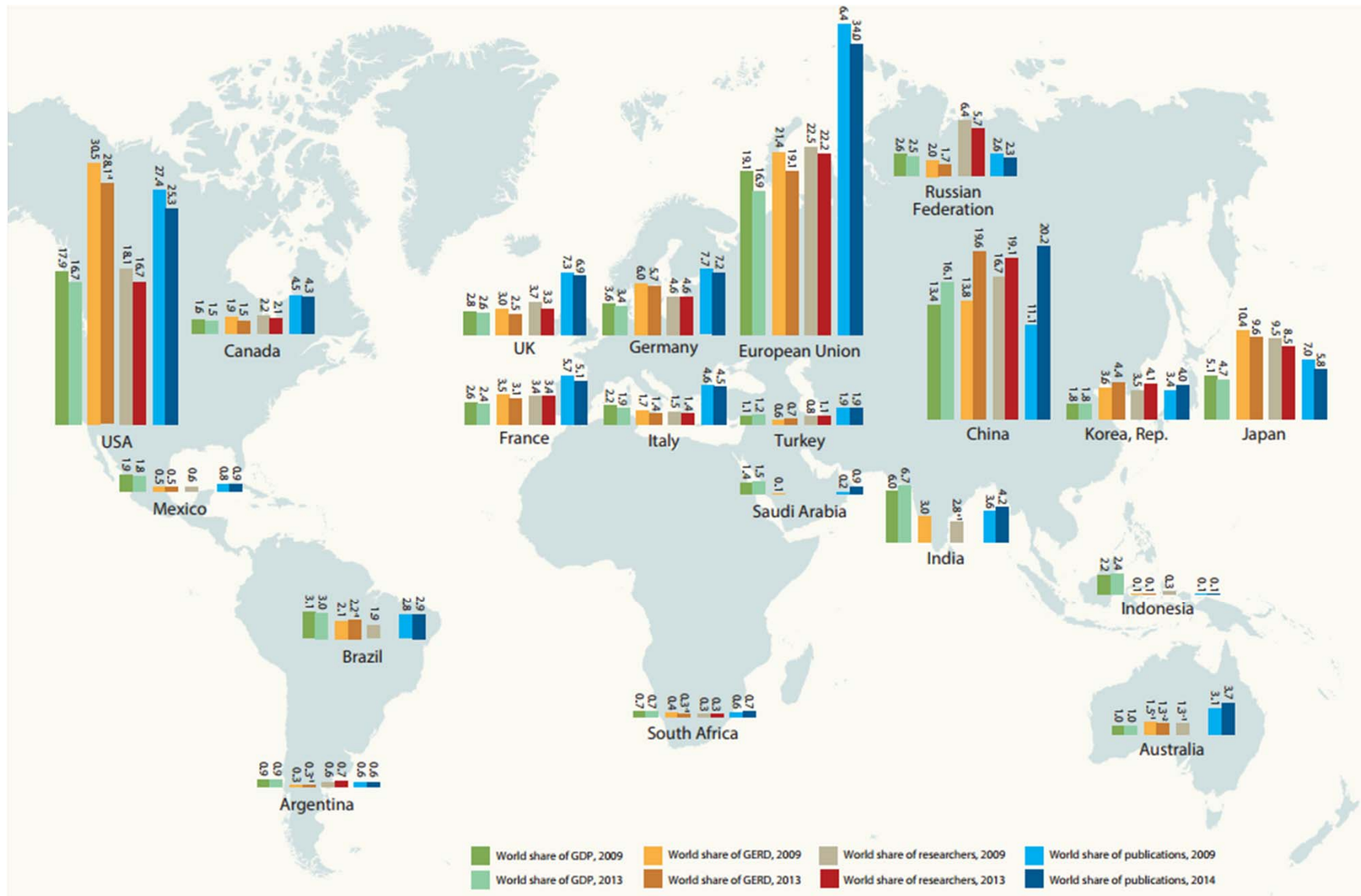
1. A South-North “convergence” in science, technology and innovation continues ... but remains very uneven.
2. Declining public commitment to science in high-income countries ... Growing belief in science in emerging and lower income countries... Innovation occurring across the full spectrum of income levels.
3. Trend towards open science, open innovation and open education... Emergence of a global labour market for researchers.
4. Good governance is good for science... Debates on the role of public vs. private science... Increasing focus on science for productivity and a growing role for business-driven science.
5. Towards 2030: science for today’s vs tomorrow’s needs. How to achieve the new Sustainable Development Goals (Agenda 2030)?

1. Convergence – Divergence: the data

- The share of low and middle-income economies in global expenditure on R&D rose from 20.3% to 30.7% over the same period.
- Since 2007, the share of low and middle-income economies among world researchers has increased by 5 percentage points to 35.6% in 2013; China is responsible for about half this rise.
- Between 2008 and 2014, the number scientific articles included in the Thomson Reuters' Web of Science – Science Citation Index grew by 23. Growth was strongest among the upper middle-income economies (94%) and low-income ones (68%).
- The availability of STI data to inform policy-making has improved moderately: 108 countries have recent data on research expenditure (up from 102 in the 2010 edition), thanks in part to new observatories of STI, such as in Africa and some Arab States. Many countries do not yet survey business R&D, however.

Much of the current convergence is confined to large emerging economies

Figure 1.7* World shares of GDP, GERD, researchers and publications for the G20, 2009 and 2013 (%)

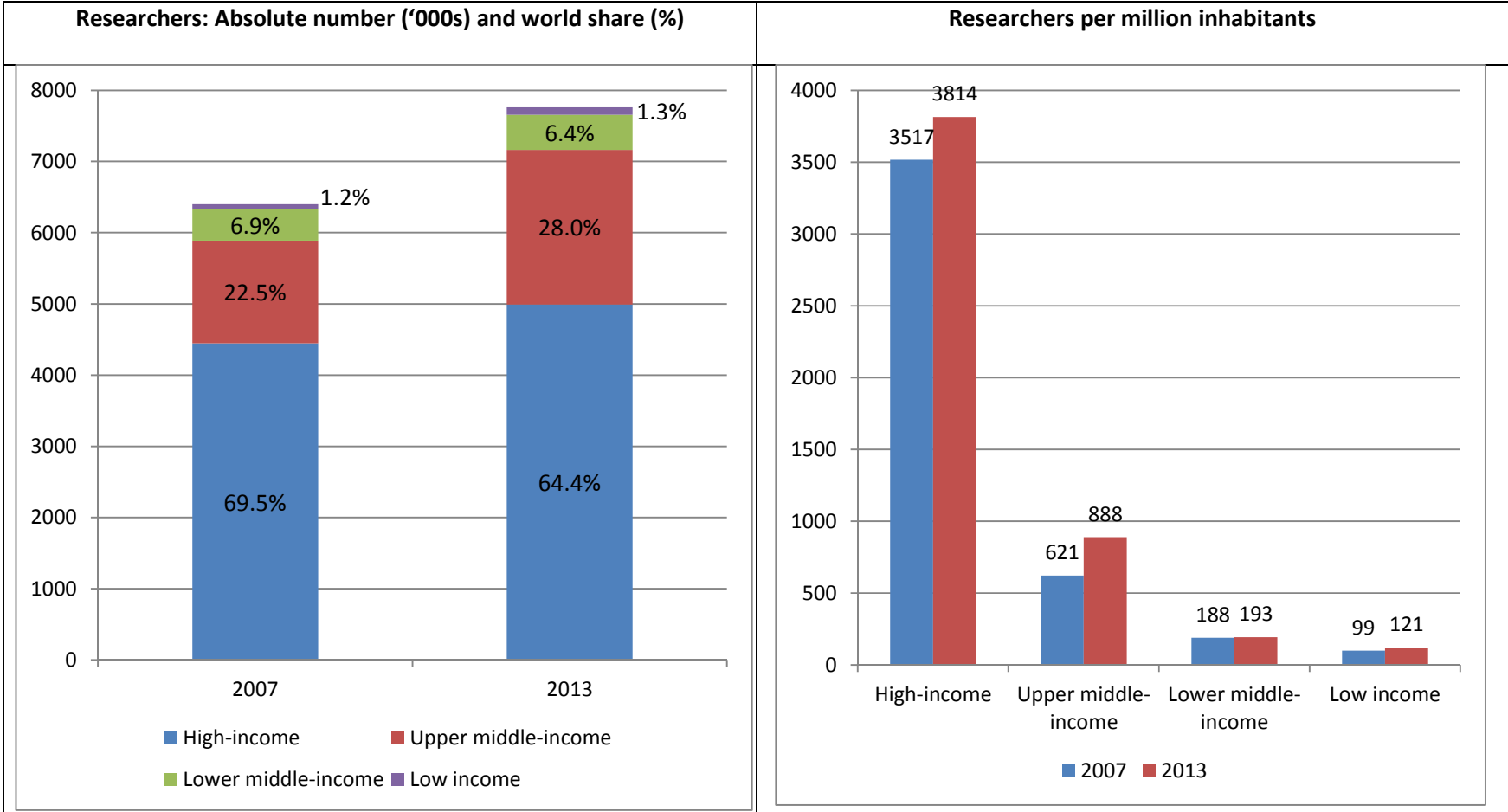


* Figure numbering same as in the report, except for Figures A, B and C

1. (Cont'd) Convergence – Divergence: Researchers

- **The number of researchers grew by 21% between 2007 and 2013, to 7.8 million. Few of them work in low-income countries (Figure A – left side).**
- Researchers represent 0.11% of the world population, or, roughly 0.2% of its labour force.
- Germany is the only major advanced economy that has maintained its world *share* of researchers (**Figure 1.7**).
- The rising world share of middle-income countries is *primarily* driven by China, despite a major downward revision of researcher statistics in China in 2009. There has also been strong progress in the Republic of Korea.
- The number of researchers per million inhabitants (**Figure A**, right side) in high-income countries is still 9 times higher than in the upper-middle income countries and 20 times higher than in lower-middle income countries.

Figure A: Researchers and researcher intensity, 2007 and 2013



Note: Upper middle-income includes China (19.1% of world researchers in 2013)

Based on Table 1.3 in the report

2. A shifting public commitment towards R&D

- ***A de facto* convergence, due to declining government investment in R&D in a number of advanced economies, and strong growth in a few “emerging” ones.**
- Government funding for R&D has been weaker (as a % share of GDP) in most G7 countries since the 2008 crisis (**Figure 1.1**)
- **Nearly all countries are striving to increase the share of innovation undertaken by business enterprises, with varying levels of success (Figure 1.2).**
- Globally, China and India account for most of the convergence in R&D performed by businesses (**Figure 2.1**).
- But significant growth in R&D intensity is found in economies at different stages of development: GERD-GDP ratio has reached 0.79% in Kenya in 2010, well above the average of lower middle income economies (0.50%), or, for instance, Latin America (around 0.65% – 0.67%).
- Several middle-income economies are becoming hubs for nanotechnologies – or harbour this ambition –, including Brazil, China, India, Iran and Malaysia.
- Innovation enabled by the technology embedded in acquired machinery or other means (independent from in-house R&D) is increasingly important for many developing countries.

Figure 1.1: GERD financed by government as a share of GDP, 2005–2013 (%)

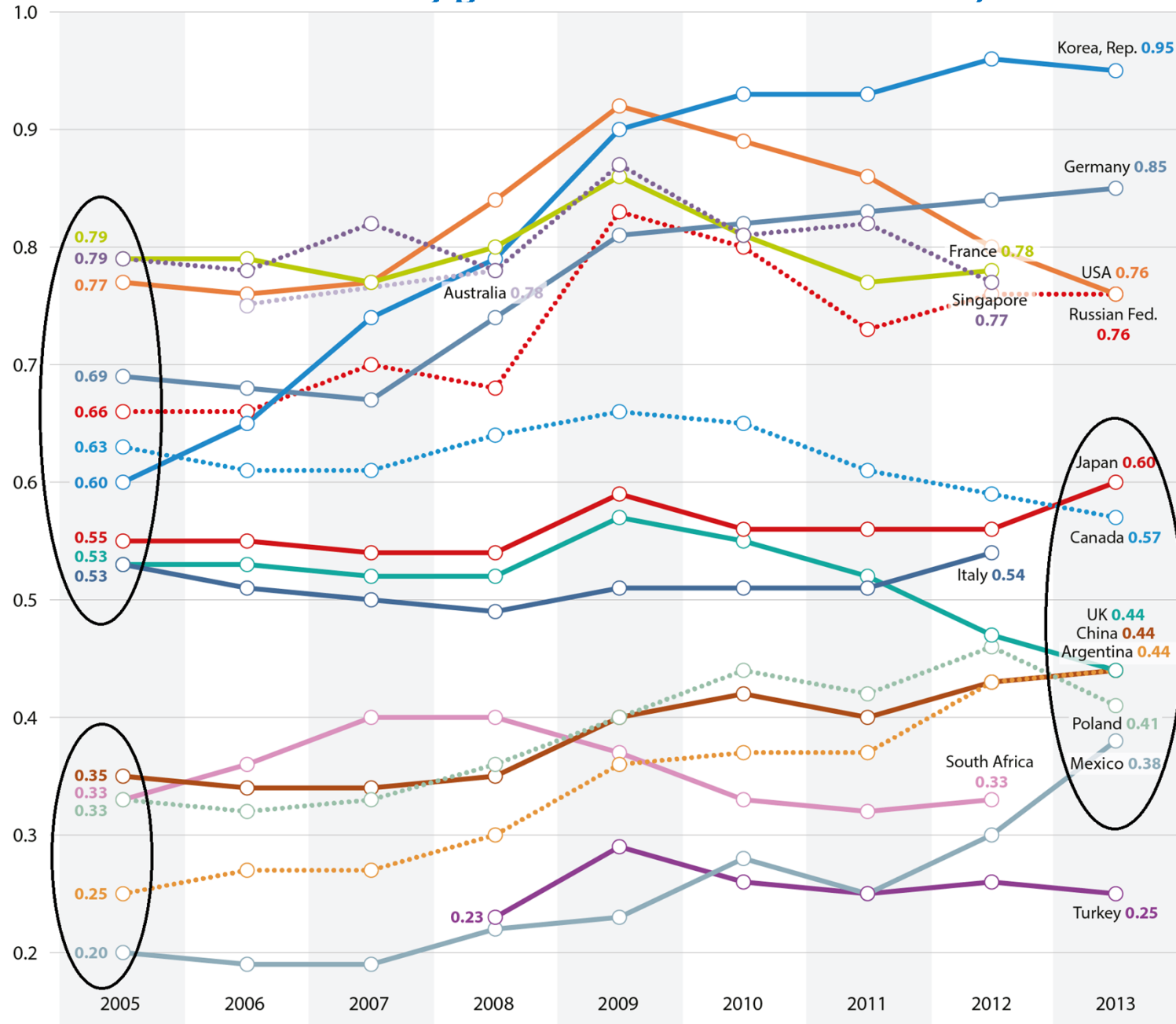
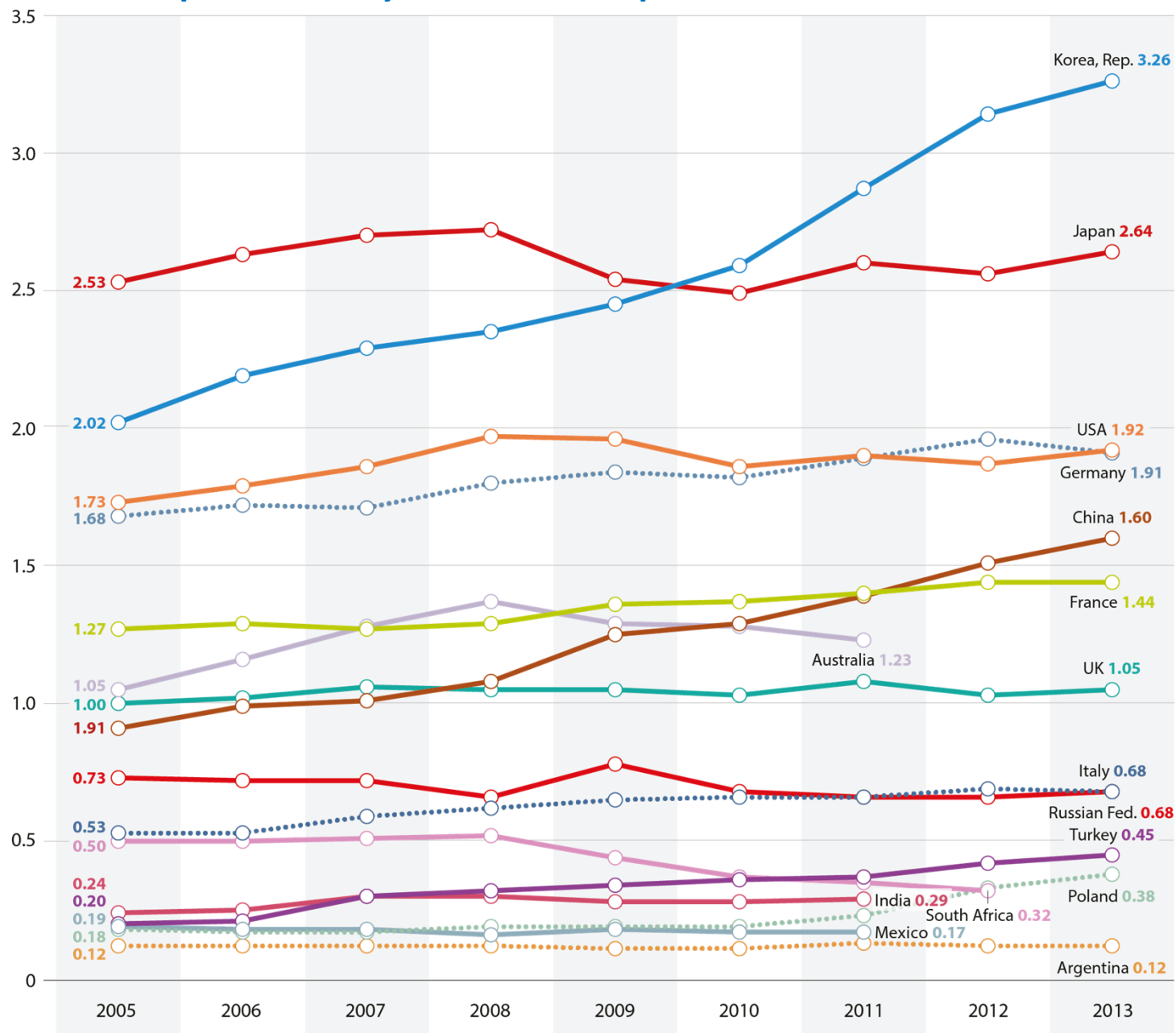


Figure 1.2: GERD performed by business enterprises as a share of GDP, 2005–2013 (%)

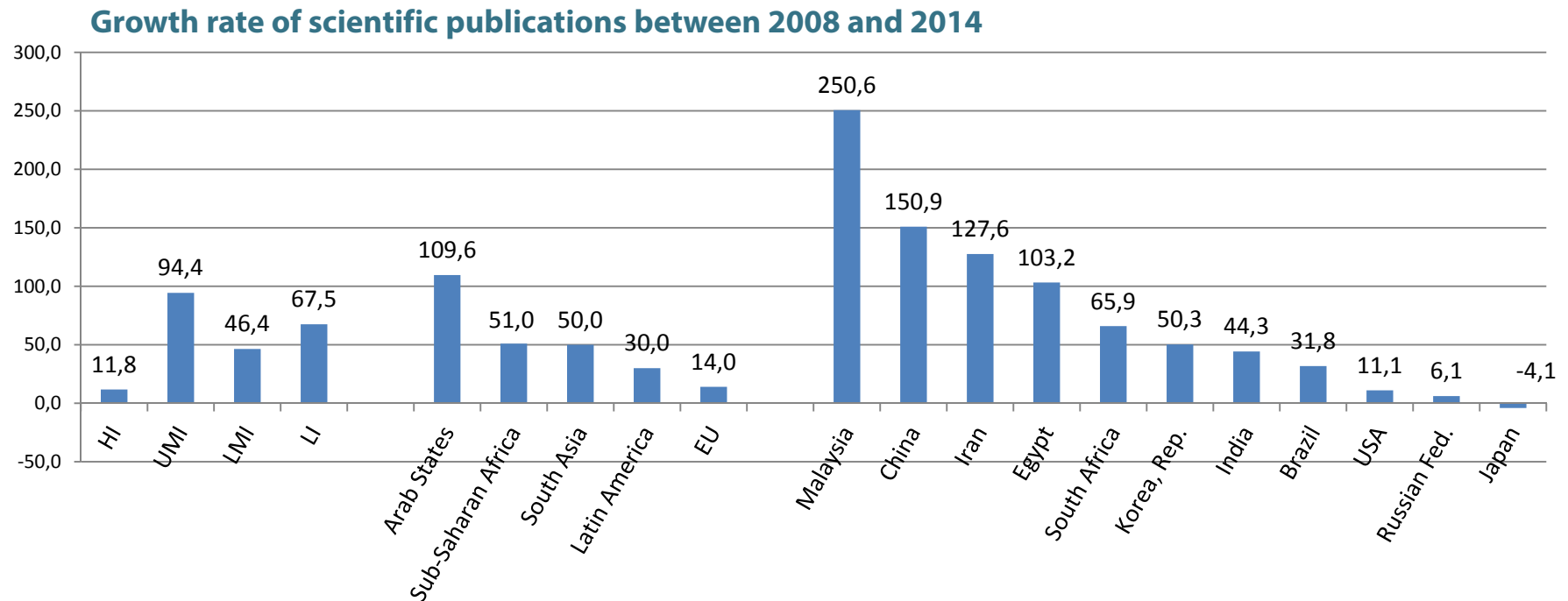


3. Open science and open education: an emerging global research labour market?

- **Open science and international mobility.**
- The number of international students rose by 46% between 2005 and 2013: from 2.8 million to 4.1 million.
- International mobility is higher at the doctoral level than at lower tertiary levels in science (29% of all mobile doctoral students were enrolled in science or engineering degrees, compared to 13% of other tertiary students).

Figure B: Strong growth in scientific production

- Publications are an area where convergence is most evident, with strong growth rates being observed in low and middle-income economies



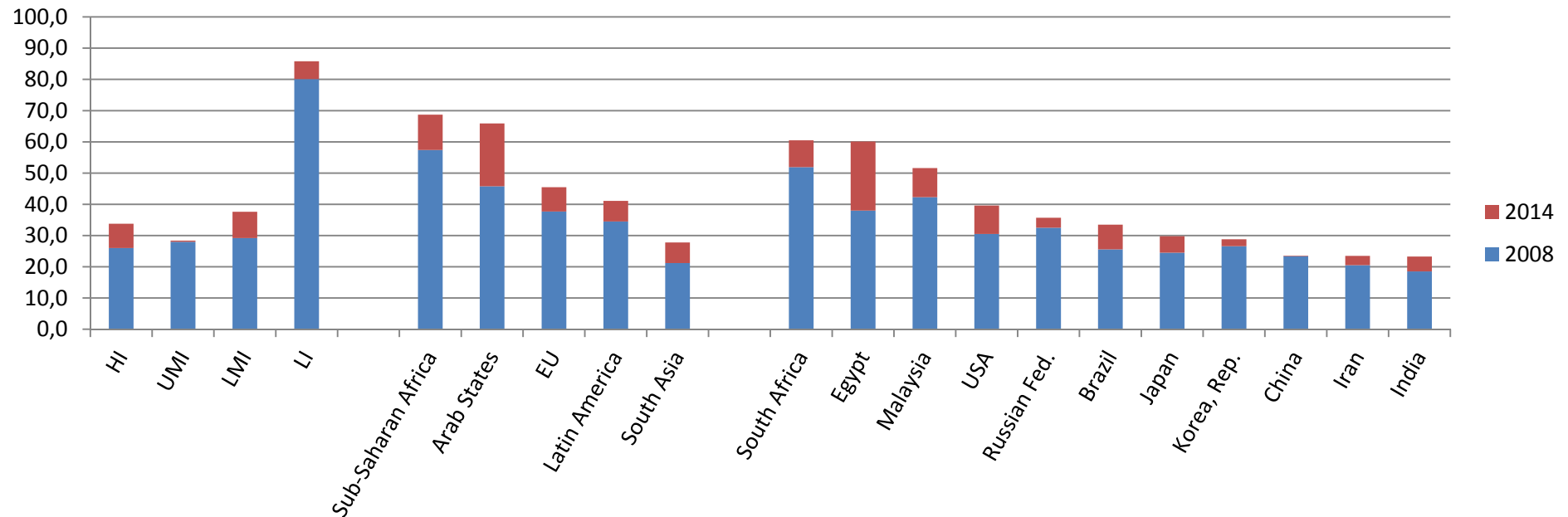
HI: High-income; UMI: Upper middle-income; LMI: Lower middle-income; LI: Low-income

Based on Table 1.4 in the report

Figure C: Strong growth in cross-border cooperation

- Cross-border co-authorship is an indicator of the level of international collaboration; it is on the rise everywhere.

Publications with international co-authors, 2008 and 2014 (%)



HI: High-income; UMI: Upper middle-income; LMI: Lower middle-income; LI: Low-income

Based on Table 1.4 in the report

3. Open science and open education: an emerging global research labour market? (Cont'd)

- **Growing competition among scientists to secure best jobs; growing competition among institutions and governments to retain and attract talent**
- **Internet has facilitated international scientific collaboration and online university courses (MOOCs)**
- **Despite the steep rise in researchers, women remain a minority in research (28.4% worldwide) and, even more so, in decision-making positions (boards of directors, university chancellors, etc); more policies are being put in place to close the gender gap (Figures 3.1 & 3.2).**

Not much convergence on gender parity

Figure 3.1: Regional shares of female researchers, 2013 (%)

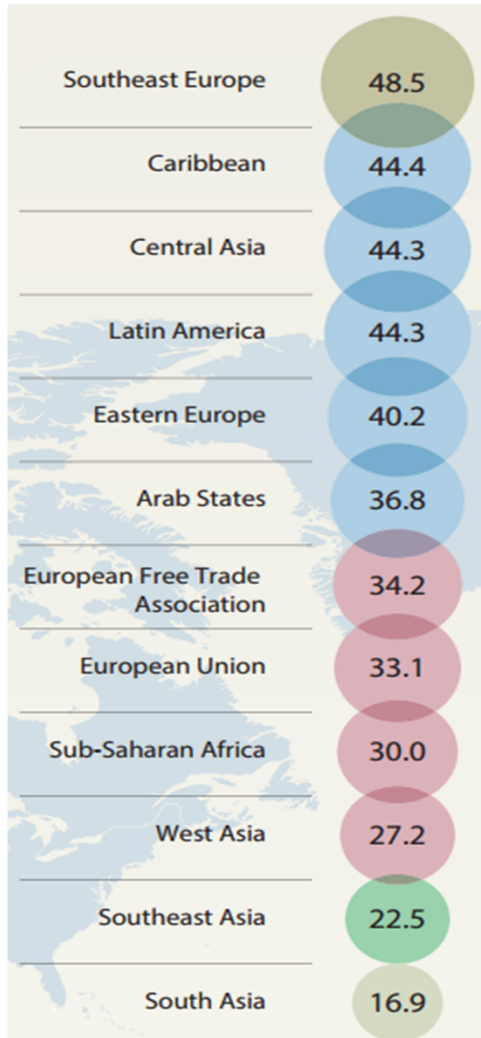
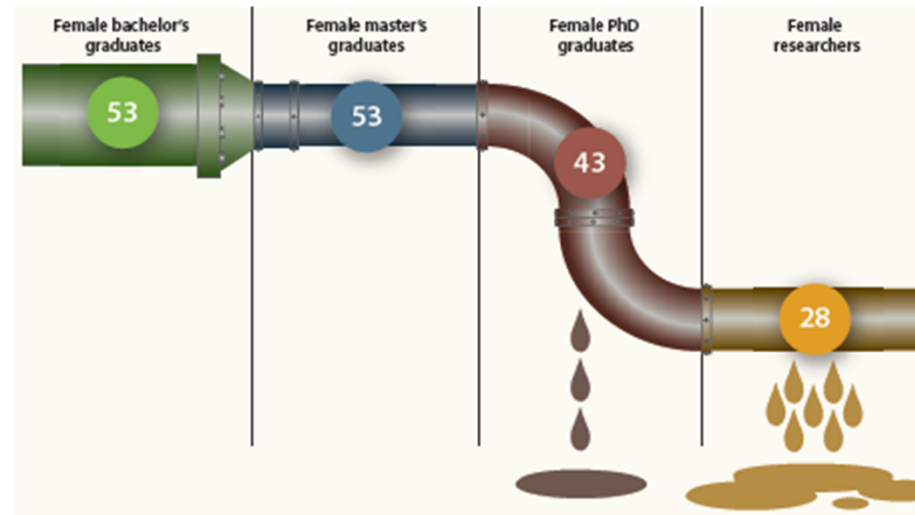


Figure 3.2: The leaky pipeline: share of women in higher education and research, 2013 (%)

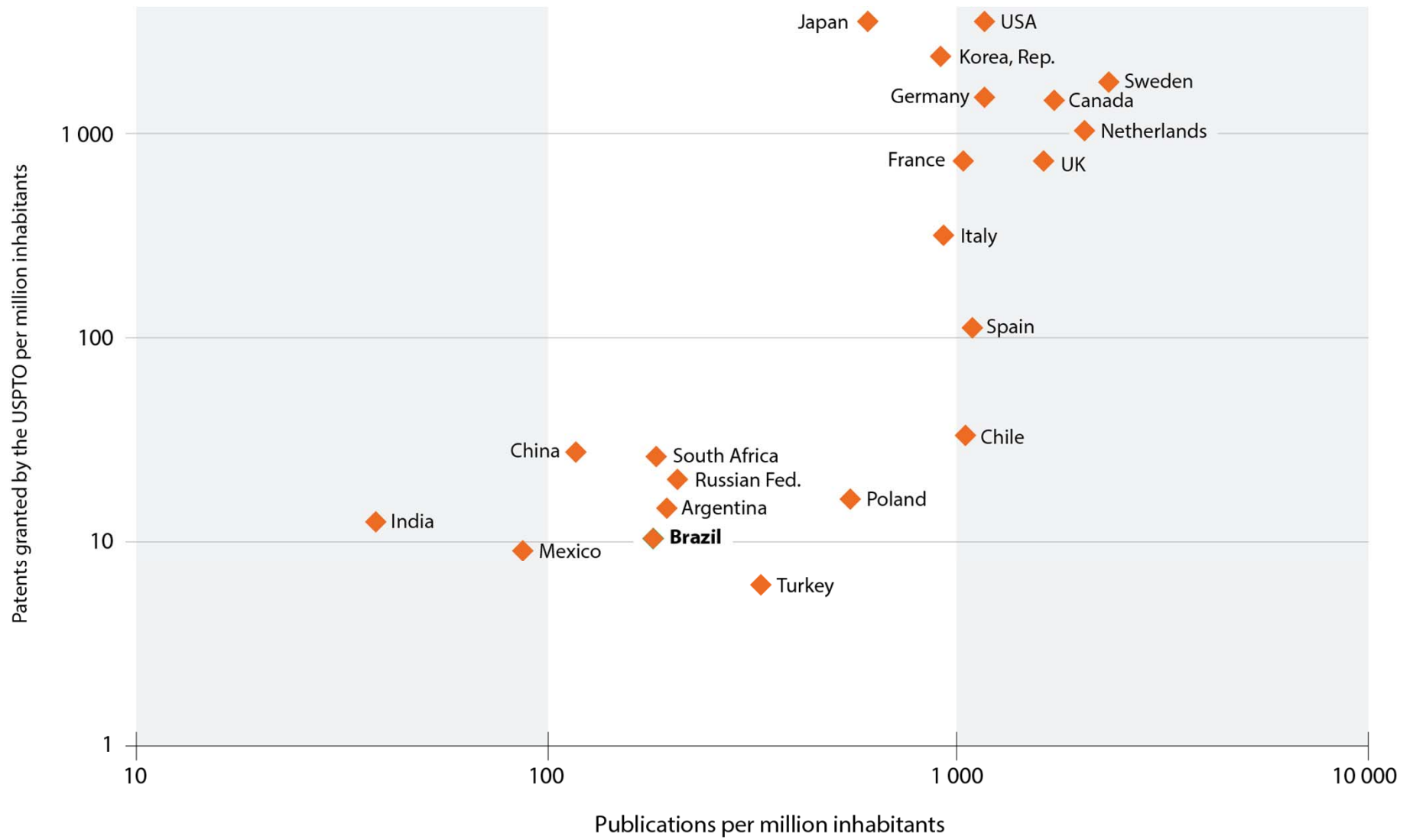


Although women have by and large reached parity in higher education, their share falls as one moves from education to research and plummets as one approaches the commanding heights of STI governance

4. “Good” governance is good for science: public vs private science

- **Patenting remains dominated by a minority of countries**
- Taken together, the European Union, China, Japan, Republic of Korea and USA hold nine out of ten triadic patents in the world
- **Countries vary considerably in the relative emphasis they place on publishing (diffusion of knowledge) vs patenting (appropriation of knowledge), Figure 8.10**

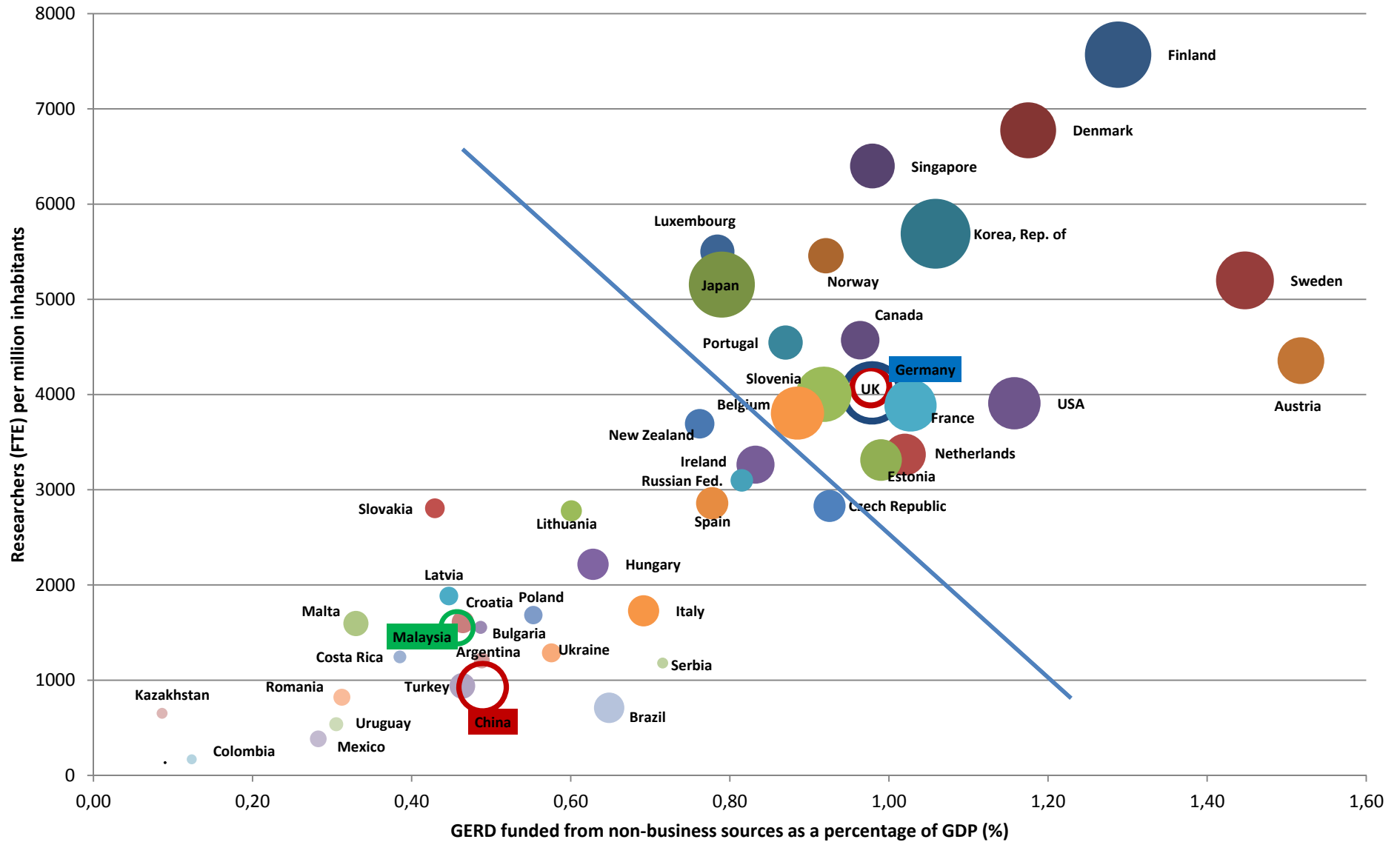
Figure 8.10: Publication vs patenting intensities



4. “Good” governance is good for science: public vs. private science (Cont’d)

- **Science powers commerce – but not only: commerce and government power modern science *together*.**
- With public budgets under pressure in advanced economies especially since the 2008 financial crisis, there is a temptation to divert public research budgets towards the commercialization end of the innovation cycle.
- But it is the combination of high public investment in R&D and availability of adequate human resources for S&T that underpins high business investment in research (**Figure 1.3**).
- Countries that combine a government investment *and* a high rate of availability in S&T human resources invariably achieve a high level of business investment in R&D.

Figure 1.3: Mutually reinforcing effect of strong government investment in R&D and researchers, 2010–2011
The size of the bubbles is proportionate to GERD funded by business as a share of GDP (%)



5. Science for today's vs tomorrow's needs

- **Few countries have increased their focus on basic research substantially**
- Despite phenomenal growth in total R&D, China's spending on basic research remains low, at 4.7% of total research expenditure in 2013.
- The US government traditionally supports basic research but current budgetary pressures risk reducing the country's long-term capacity to generate knowledge.

- **And yet some countries are making a big effort to support basic research**
- The European Research Council (est. 2007), the first pan-European funding body for frontier research in basic sciences, has been endowed with € 13.1 billion for the period 2014–2020, equivalent to 17% of Horizon 2020's overall budget.
- The Republic of Korea increased the share of its research expenditure going to basic research from 13% in 2001 to 18% in 2011. Malaysia has followed a similar path (from 11% in 2006 to 17% in 2011).

Conclusions: towards 2030

- **Why ‘towards 2030’?** This title refers to the fact that the *UNESCO Science Report* provides a means of charting progress towards the new Sustainable Development Goals, as it monitors the situation worldwide at the time Agenda 2030 was adopted
- **Examples :**
- Much of the social innovation reported in East and Central Africa focuses on overcoming sustainability challenges such as food security, renewable energy and climate change mitigation.
- Many Latin American countries have sophisticated regulatory frameworks and fiscal incentives in place to support renewable energy research (even if public funding for it has gone down in Brazil).

Conclusions: towards 2030 (cont'd)

- **Examples (cont'd):**
- Some oil-rich economies such as Algeria or Saudi Arabia are investing in solar energy technologies to ensure a sustainable role for themselves as energy suppliers; others such as Canada and the Russian Federation are finding the transition to sustainable growth more difficult.
- Small island developing states (SIDS) are jointly establishing sustainability targets and co-operation frameworks through regional initiatives.
- **Sustainable development has become today an integral part of national S&T strategies.**
- **But the Sustainable Development Goals (Agenda 2030) adopted in September 2015 will only be reached through further scientific and technological progress.**