KNOWLEDGE PRODUCTION AND INTERNATIONAL TECHNOLOGY TRANSFERS

francesco.venturini@unipg.it
Department of Economics
University of Perugia

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Innovation is the new paradigm of modern economics.

This talk is about how and why new technology is created and disseminates throughout the economy.

Our keywords are **technology production (i.e. innovation)**, **technology adoption** and **technology imitation**

Research questions:

1. What's innovation?
2. Who innovates?
3. What motives innovation?
4. Who uses the new technology?
5. Who pays for the new technology?
6. Which means promote technology transfer?
7. Which technologies and types of knowledge are internationally transferred?

What's innovation?

Innovation consists in introducing new goods, new ways of production, new organisational solutions, new approach to the market, new ways of advertising, etc.

It is a creative solution to an economic problem, which goes beyond the current state-of-the-art.

Innovation is not an adaptation to state-of-the-art.

Who innovates?

Innovation is implemented by firms, companies, public agencies and other economic units that run a bundle of activities aimed at bringing goods, services, etc. to the market.

What motives innovation?

- Private companies develop new goods or new ways of production to gain a competitive advantage over their competitors and serve a larger fraction of the market. The ultimate motivation of innovation is the greater profits associated with increased sales or with the reduced costs. Innovation developed by privately-own firms is commercially exploitable.
- Public agencies perform innovation which is not marketable or commercially exploitable (basic research) or is very risky, technologically complex or have public interest (life science, health, nuclear, defence, etc.).

Who uses the innovation (1)?

- Innovation is primarily used and commercially exploited by the firm that has developed the innovation. The innovating firm takes the risk and the cost of doing research in order to gain profits from innovation. Undertaking innovation implies managing technologically complex tasks, hiring highly qualified people, allocating funds whose return is uncertain and may materialise with a long delay.

  Innovation is not easy, explaining why, among the established firms (*incumbents*), only the largest and more efficient companies engage in **technology production** (at least in the most technologically advanced sectors).

  However, the new comers (*start-up*) are much more innovative as their business is entirely focused on the launch of new product/process.

Who uses the innovation (2)?

- However, the innovator may decide to make the innovation available on the market (**technology adoption**), selling it or renting it out for a certain fee or licence. On the other side, there are firms that choose to not produce a new technology by their own, but rather acquire it from more specialized producers. In this case, technology adoption occurs through the market.

Who uses the innovation (3)?

- The new technology can be also imitated without any compensation for the innovator (**technology imitation**). Hence, the main risk for the innovator is that the new technological knowledge created with the development of the new product/process is appropriated by other firms. This may easily occur as technological knowledge is intangible and immaterial, and hence difficult to protect. This reduces the firm' s incentive to innovate (under-investment problems).

  On the other side, returns to innovation are much larger from the social point of view than private returns. Indeed, by bringing new technological knowledge to the market, the innovator enables further innovation by competitors, costumers, providers, imitators, etc.

  This leads to a typical mismatch between private and public incentives to innovation, which may justify the intervention of the government to support privately-owned firms in undertaking R&D and innovation projects.

Government is interested to promote innovation by granting adequate returns to innovator and, meanwhile, that the innovation spreads out through the society and the economy so to prompt further innovation. In general, it is not easy to handle both interests. However, the patenting system is able to accommodate both purposes (more private innovation, more public knowledge).

The value of the new technology or innovation is not easy to quantify. Innovation has a very high initial cost of production but a very low cost of re-production. Formal and codified innovation easily transferable but difficult to be appropriated by the innovator.

There are two mechanisms enabling technology or knowledge transfers:

- market-based technology transfers: knowledge is licensed or waved over payment.
- non-market technology transfers: knowledge spills over across space and time as it can be taken as *free lunch*.

Which means promote technology transfer?

- Circulation of goods (trade)
- Circulation of productive capital (FDI)
- People's mobility across jobs and places, i.e. city, regions, nations (labour mobility and migration)
- Circulation of ideas (patent and technology license)

TRADE

When goods are sold on the market (home or abroad), purchasers can get information of their technical characteristics, for instance by means of reverse engineering. This means that a portion of knowledge embodied in the products passes from the seller to the purchaser.

FDI

Among other reasons, multinational enterprises acquire firms abroad to get R&D labs and technology endowment of the foreign company.

Workers' mobility

When people move from a firm to another, from a country to another, they bring earlier experience and knowledge to the new firm. This motives a valuable market for talented workers and innovators.

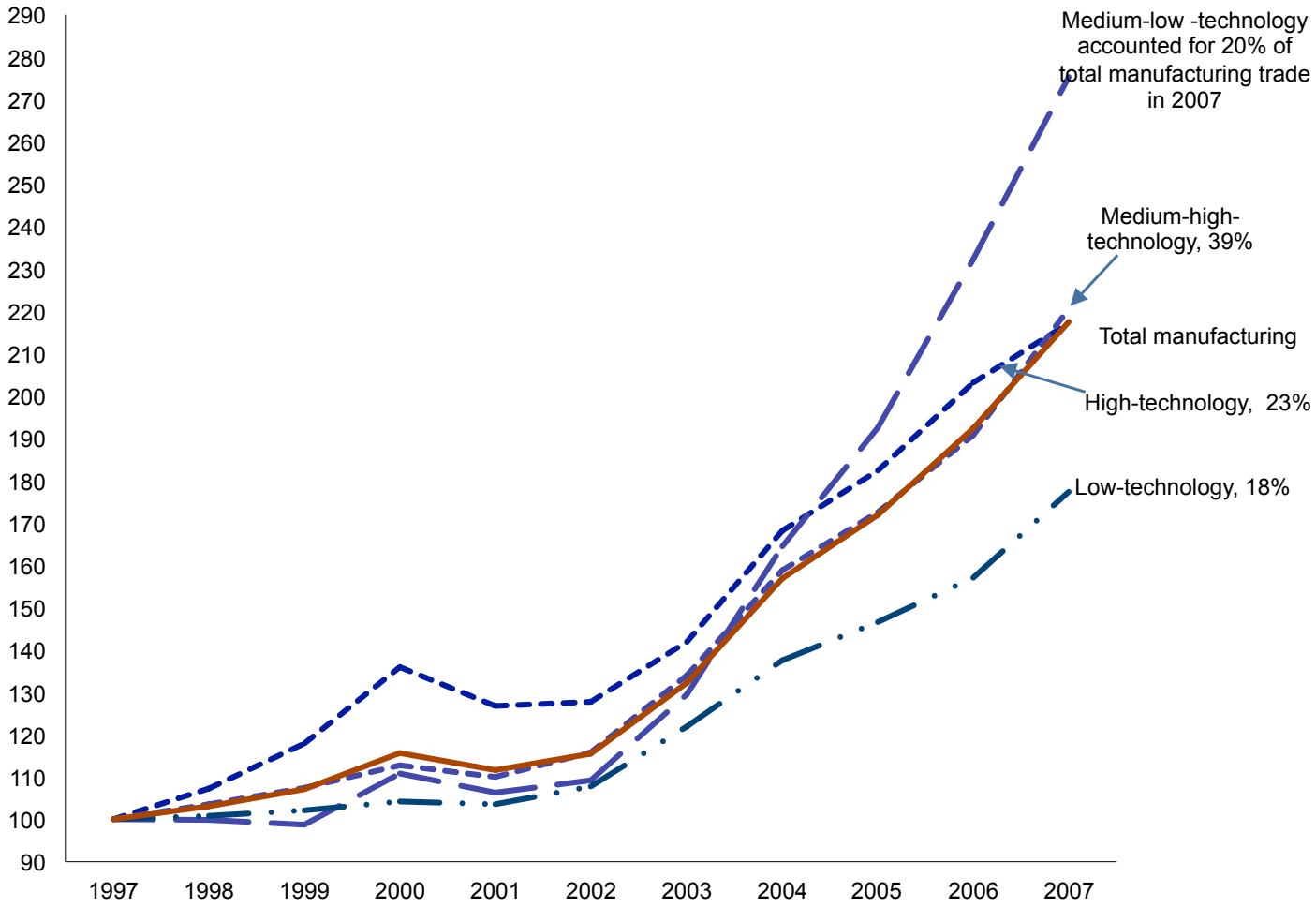
Ideas

Patents and licensed technologies allow to acquire technical information on the new products or production processes. Knowledge transfers that materialise by by means of patent documents do not rely on any physical conduit. In contrast to patents, firms may try to protect their innovation by secrecy.

Let's move to the data!

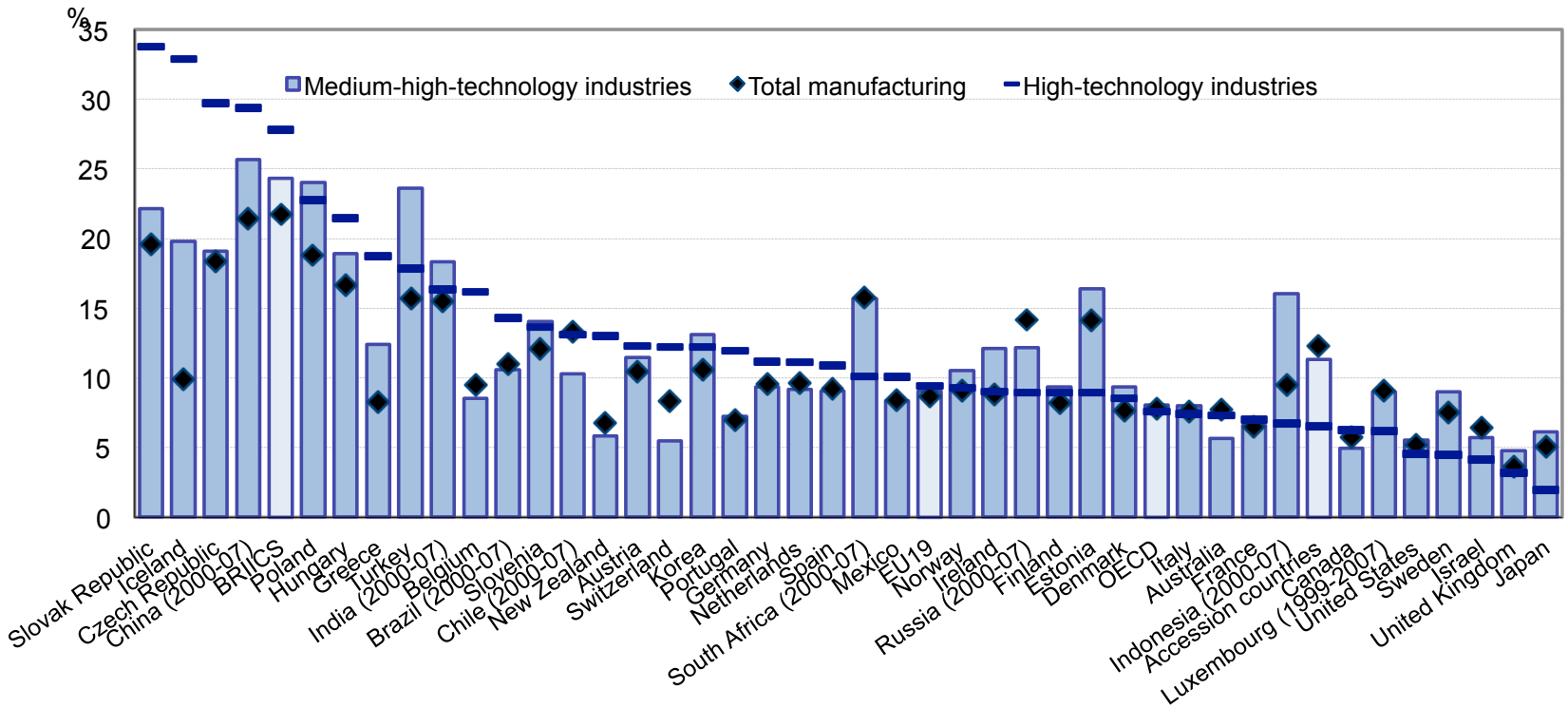
Trade (1)

Figure : OECD manufacturing trade by technology intensity, 1997-2007 (1997=100)



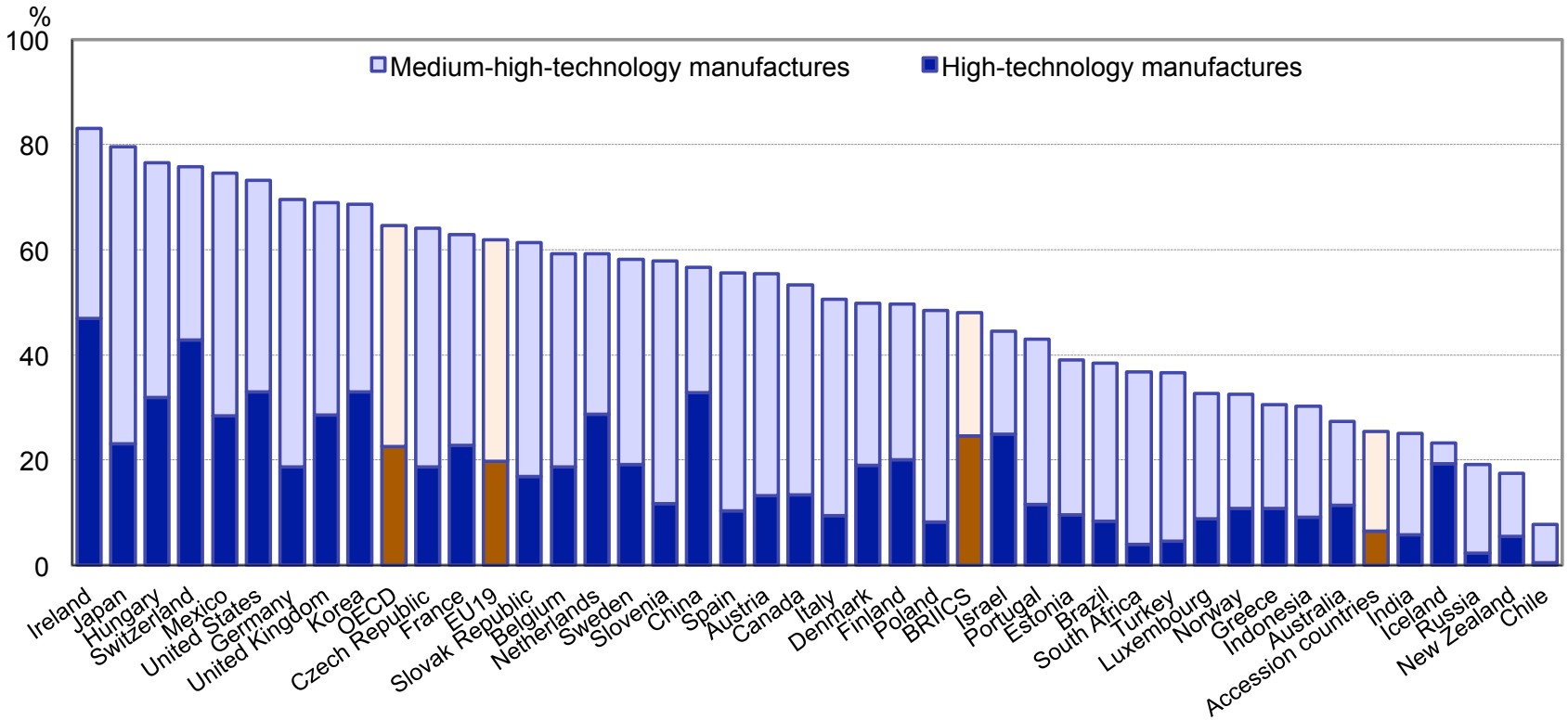
Trade (2)

Figure : Growth of high- and medium-high-technology exports, 1997-2007 (average annual growth rate)



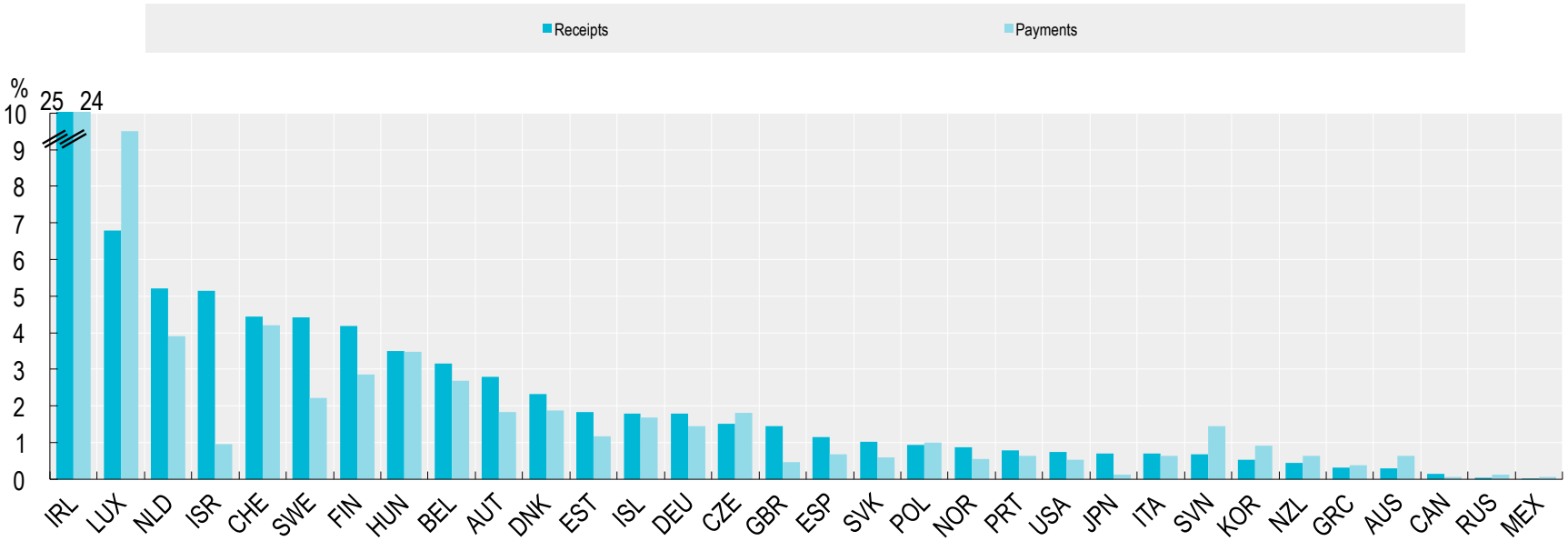
Trade (3)

Figure : Share of high and medium-high-technologies in manufacturing exports, 2007



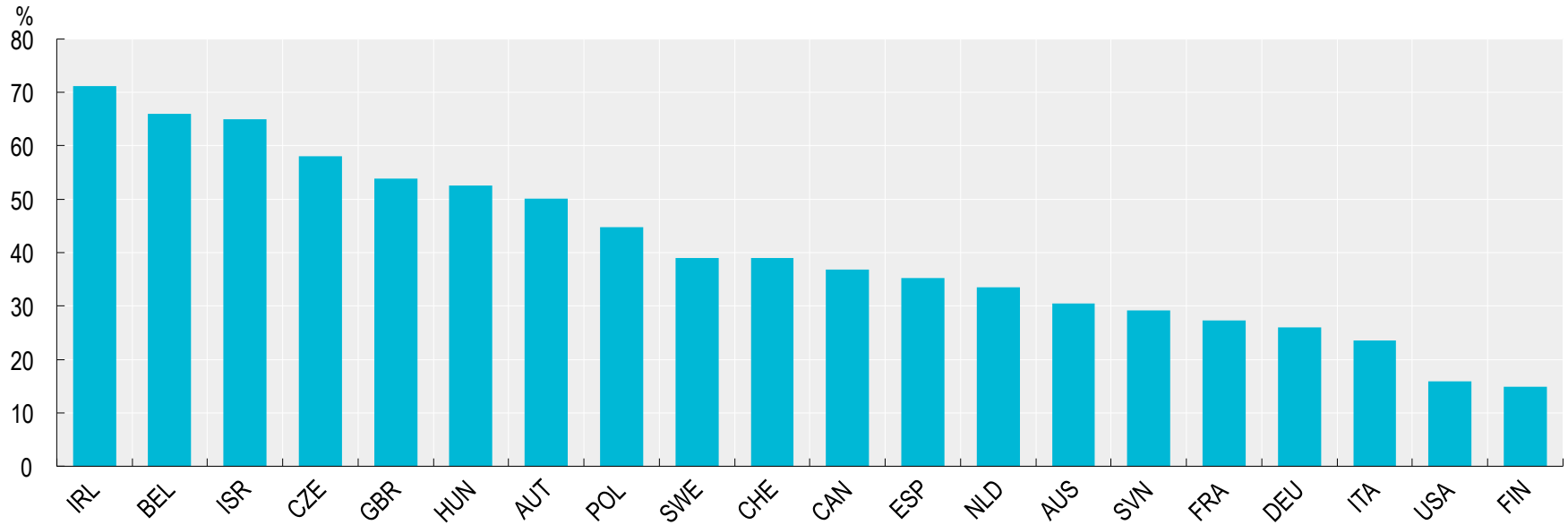
Trade (4)

Figure : International trade in knowledge assets, 2013 (receipts and payments as % of GDP)



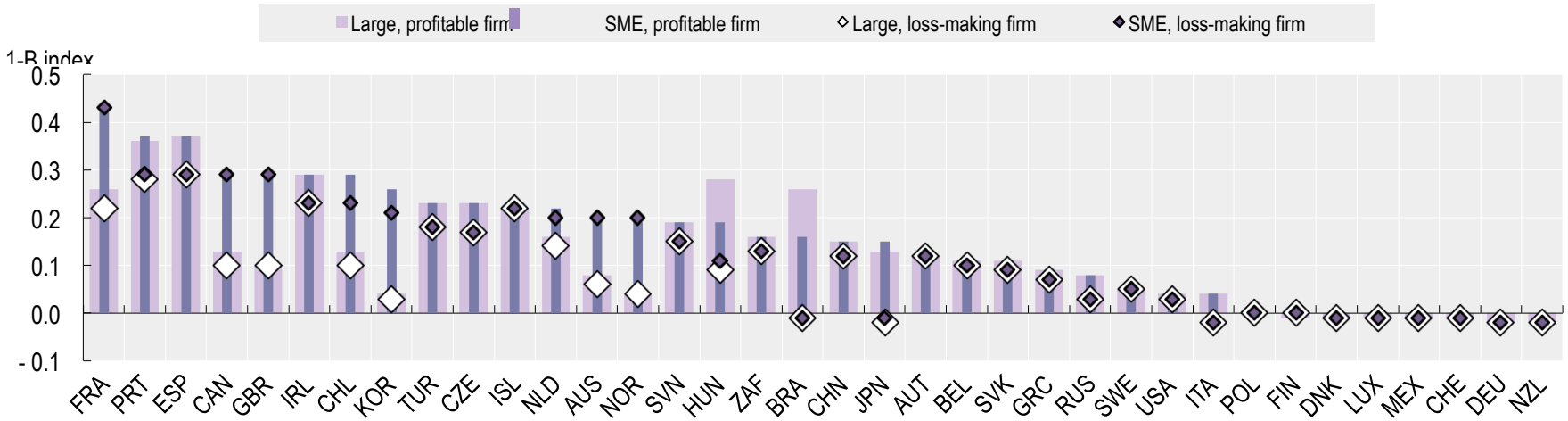
FDI (1)

Figure : R&D expenditures incurred by foreign-controlled affiliates, selected countries, 2011 (% of R&D performed by business enterprises)



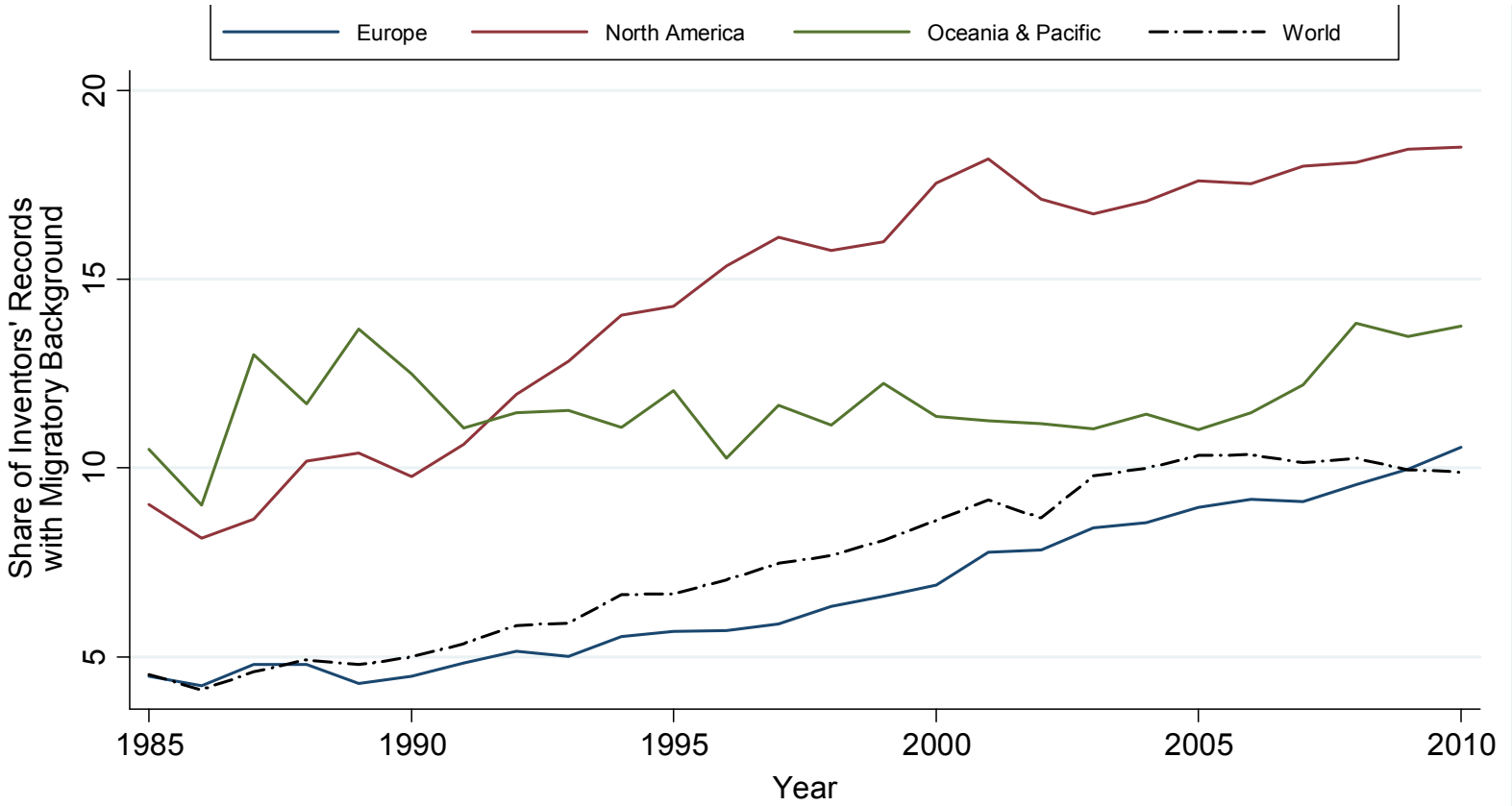
FDI (2)

Figure : Tax subsidy rates on R&D expenditures, 2015 (by firm size and profit scenario)



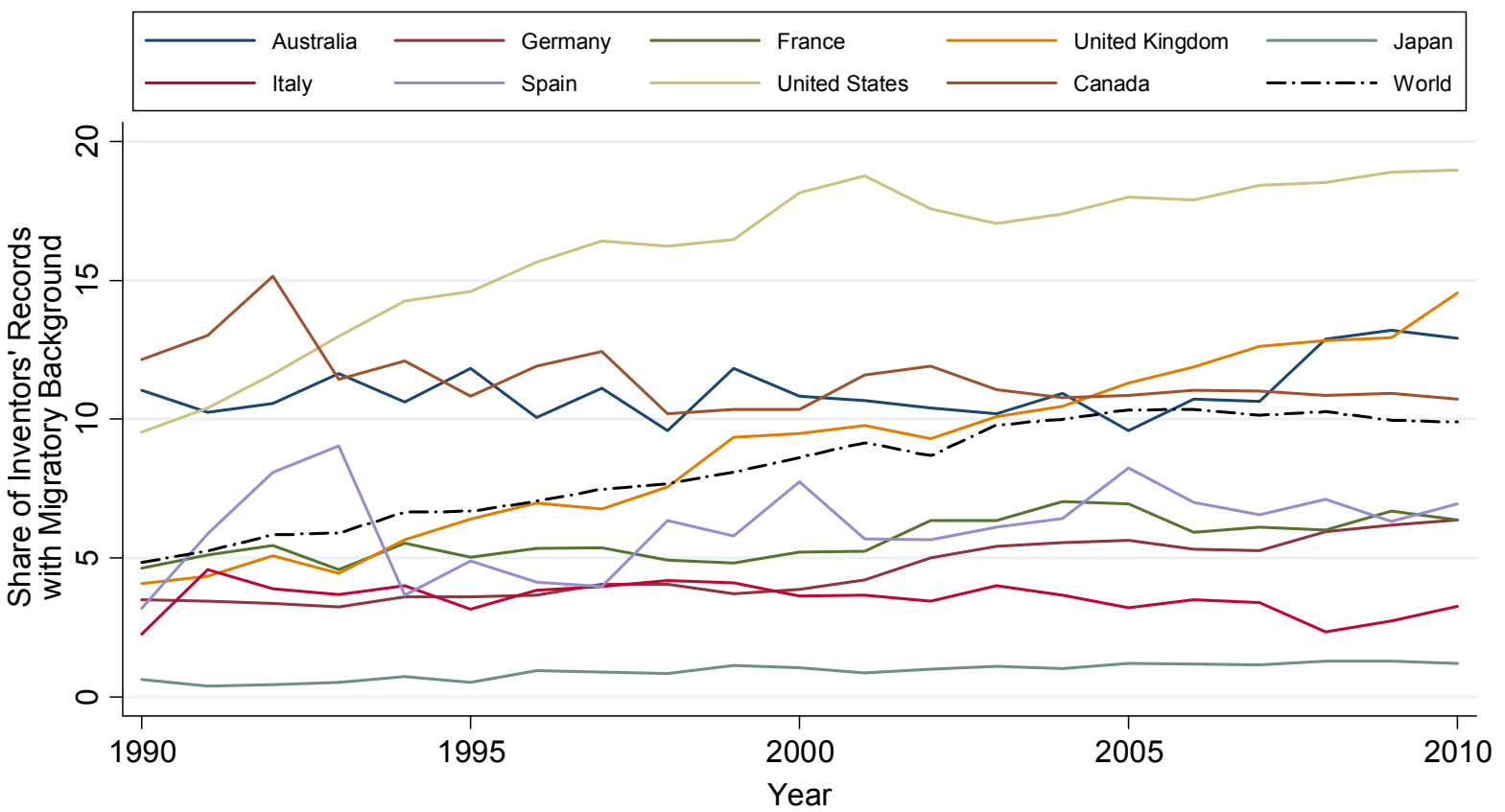
Inventors' mobility (1)

Figure : Share of immigrant inventors (1985-2010)



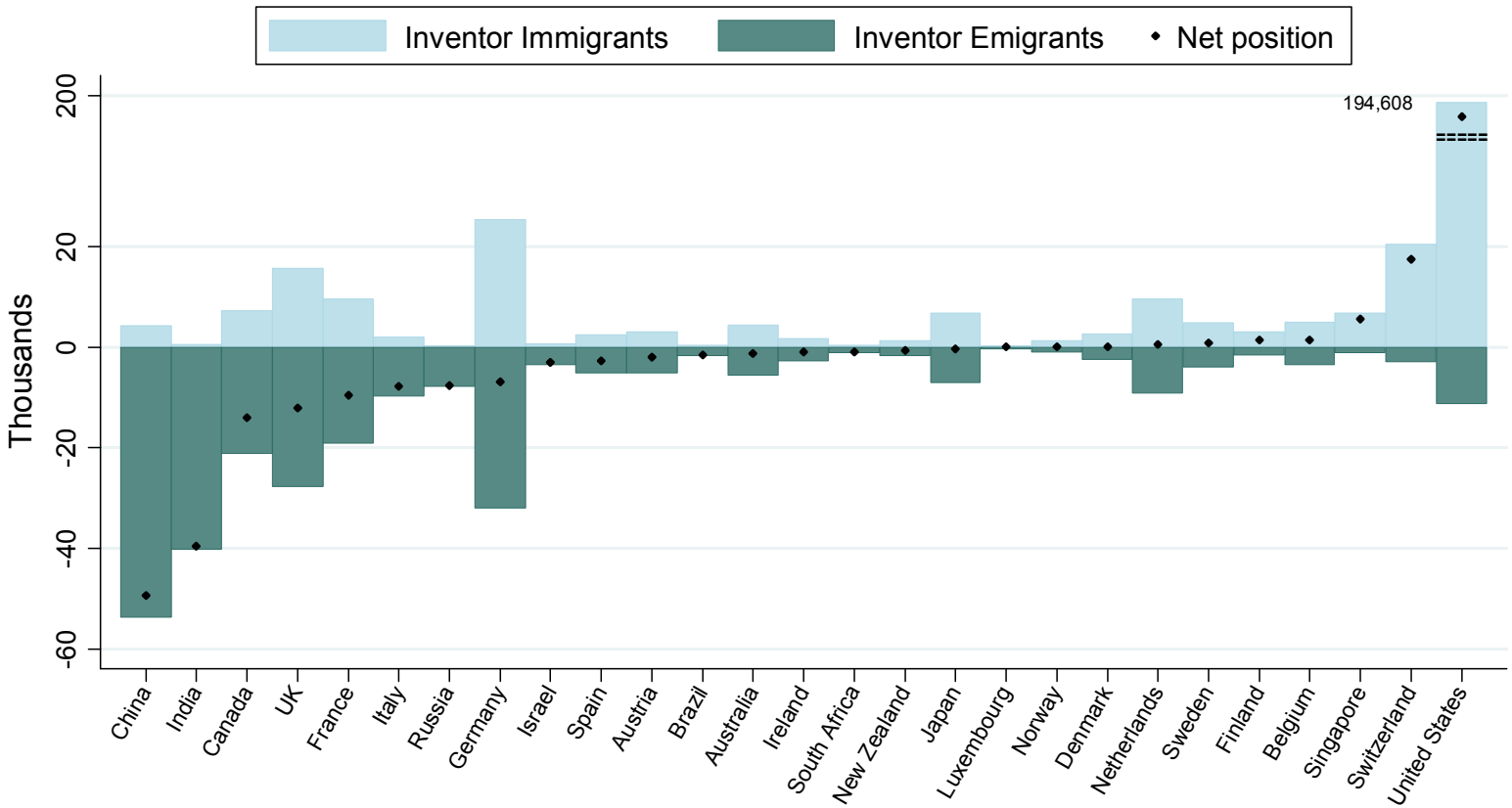
Inventors' mobility (2)

Figure : Share of immigrant inventors (1985-2010)



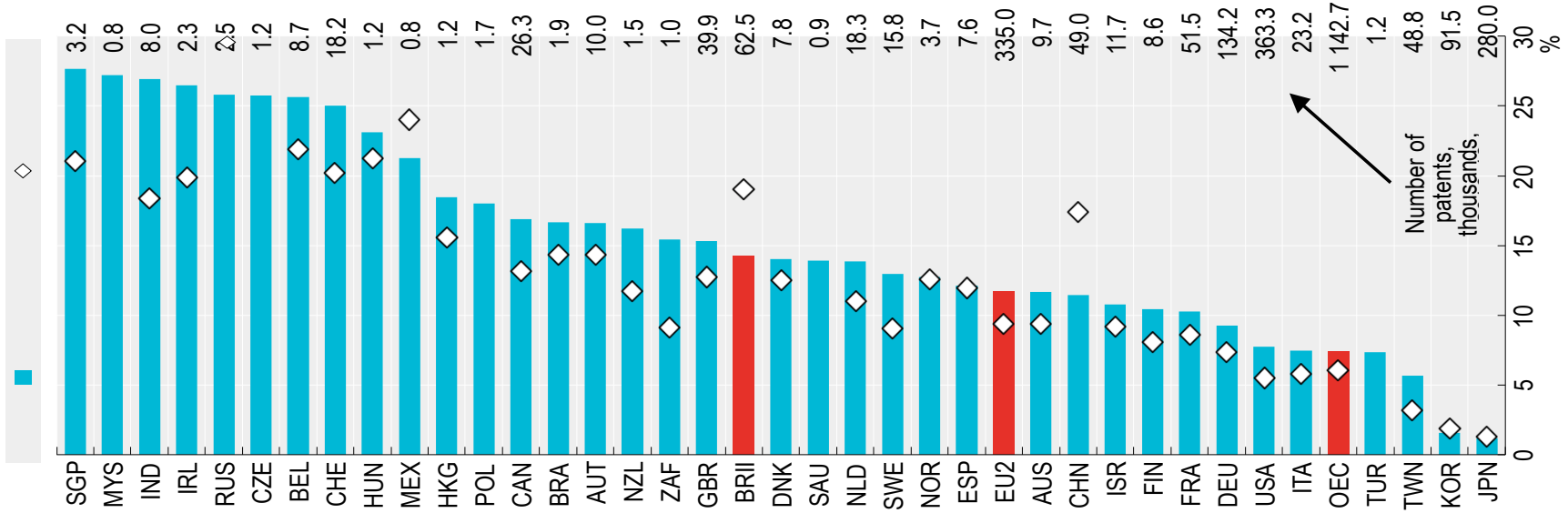
Inventors' mobility (3)

Figure : Net positions (1985-2010)



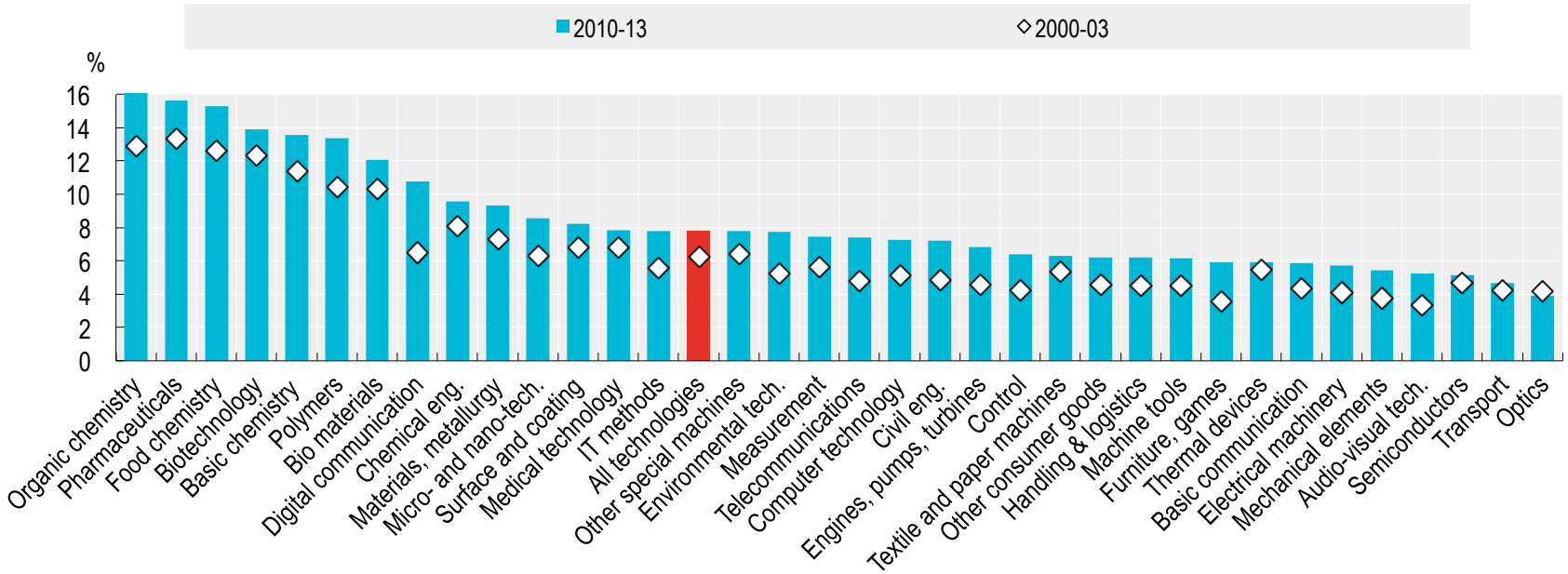
Circulation of ideas (1)

Figure : International co-inventions in patents, 2000-03 and 2010-13 (% of total patents)



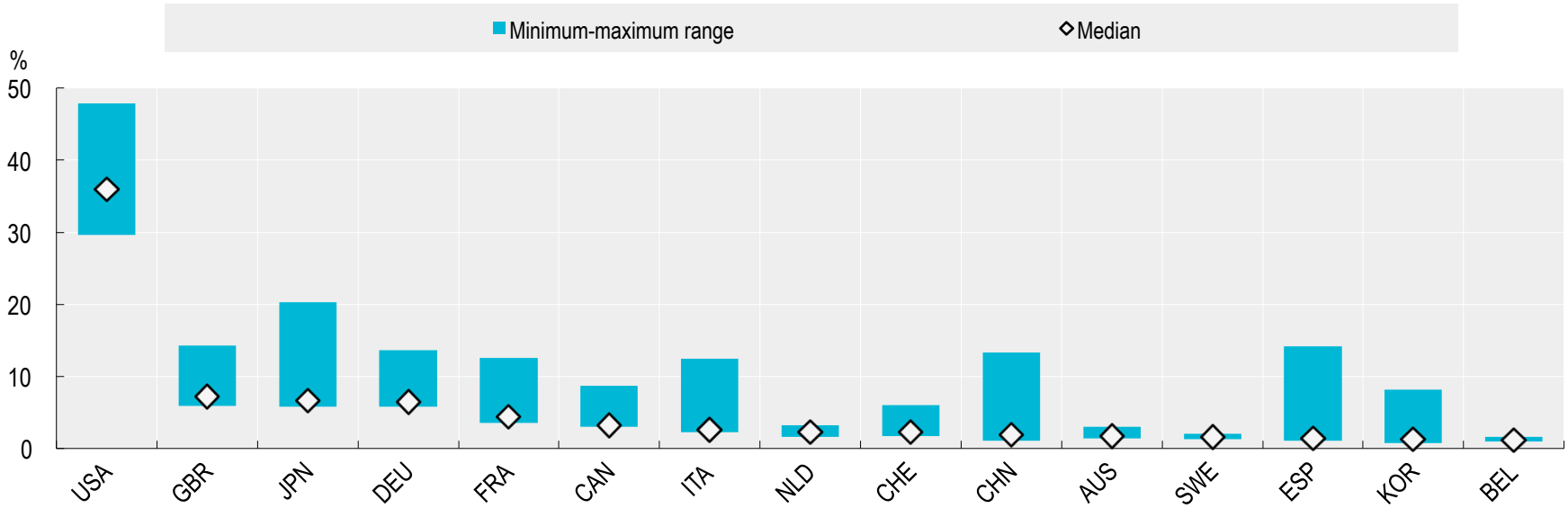
Circulation of ideas (2)

Figure : International co-inventions by technology fields, 2000-03 and 2010-13 (% of total patents in the technology field)



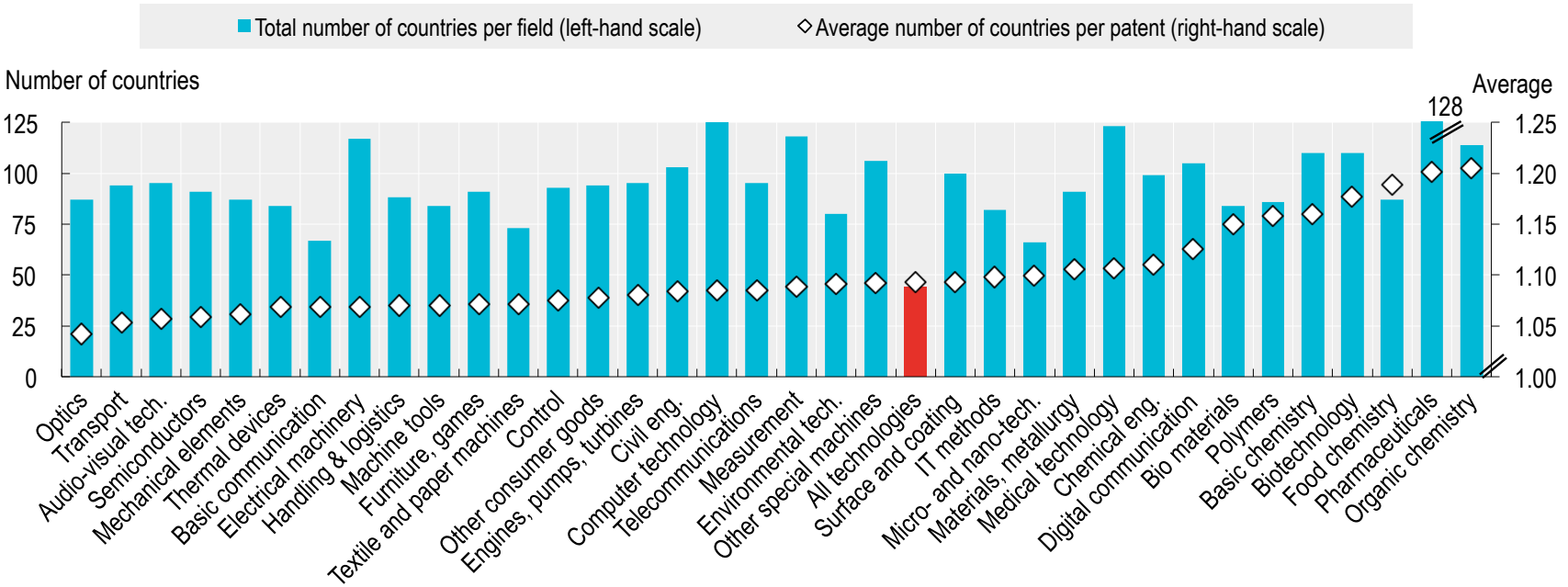
Circulation of ideas (4)

Figure : Affiliations of scientific authors cited in patents, 2007-13 (Range of economies' share in citations made at selected patent offices)



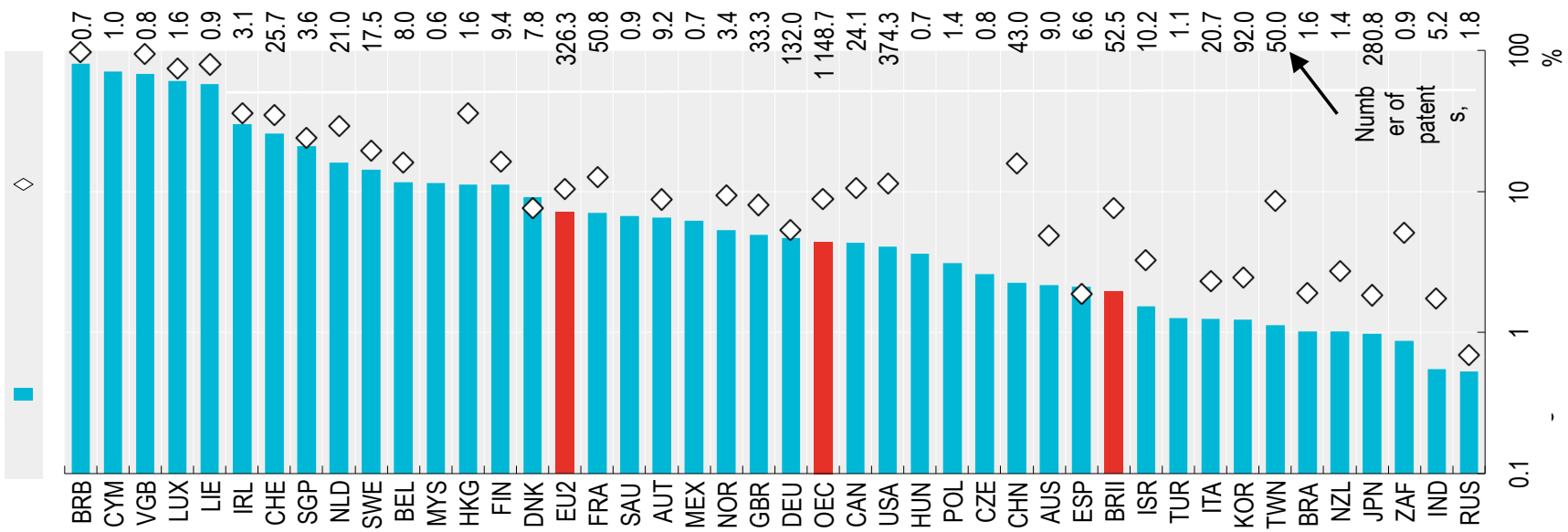
Circulation of ideas (3)

Figure : Location of inventors by technology field, 2010-13 (Total number of countries active in technology field and average number of countries per patent family)



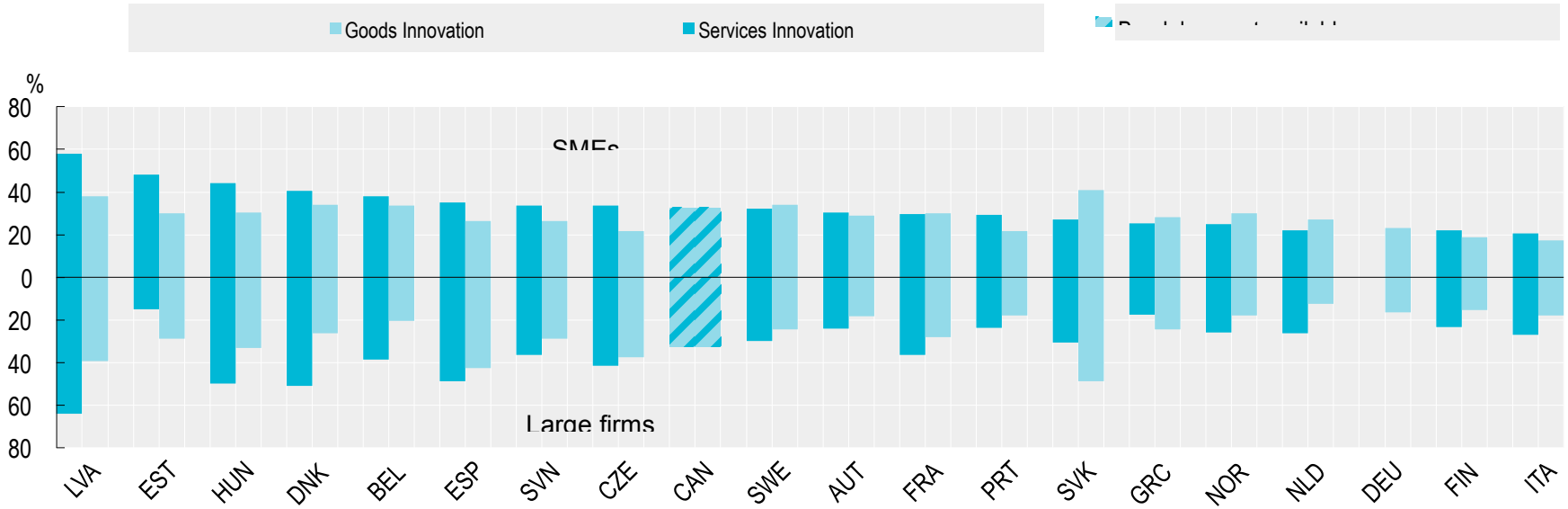
Circulation of ideas (4)

Figure : Foreign inventions owned by economies, 2000-03 and 2010-13 (% of total economy 's patents)



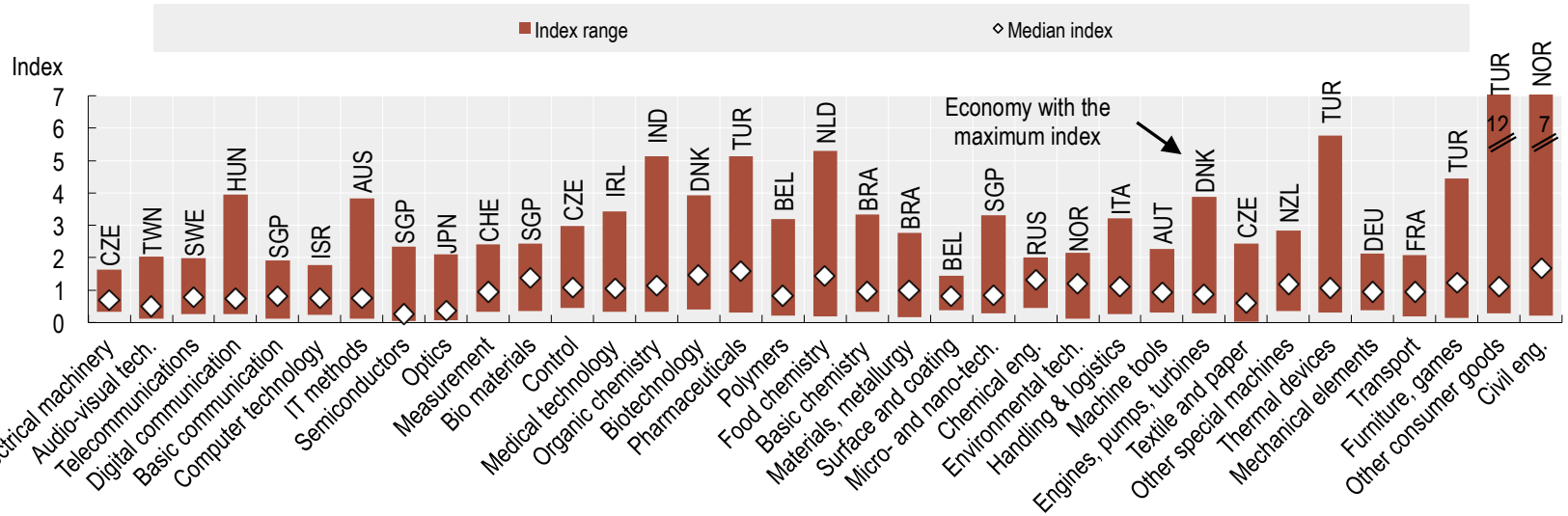
Circulation of technologies (1)

Figure : Externally developed goods and services innovation, by size, 2010-12 (% of firms introducing each type of innovation)



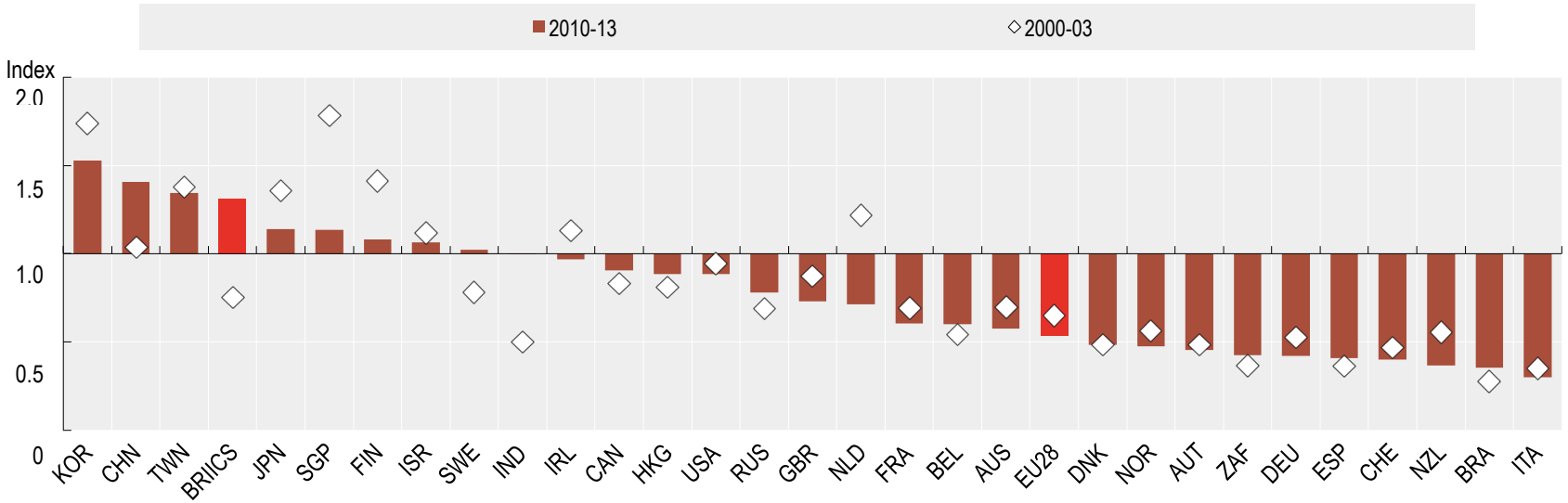
Technological specialization (1)

Figure : Economies' range of revealed technological advantage, by field, 2010-13 (index range 0-7)



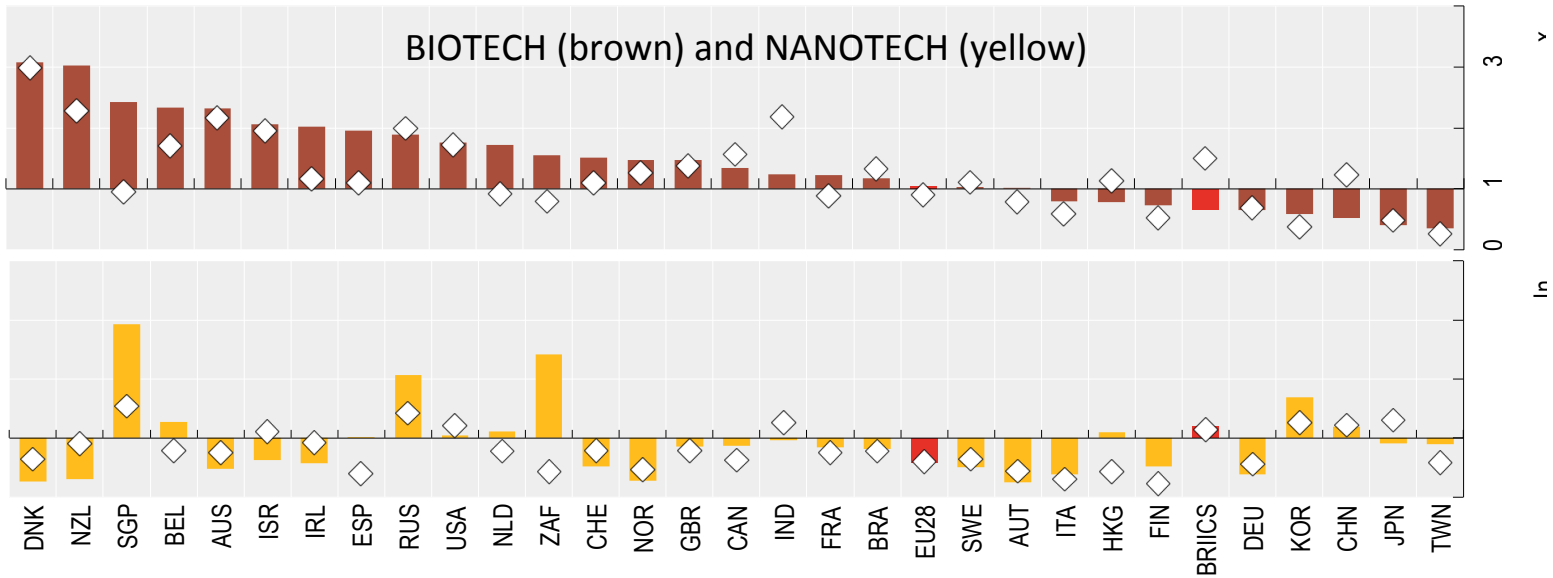
Technological specialization (2)

Figure : Revealed technological advantage in ICT, 2000-03 and 2010-13



Technological specialization (3)

Figure : Revealed technological advantage in bio-tech and nano-tech, 2000-03 and 2010-13



Thanks for your attention