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# Innovation Systems in the Emerging Countries from Central Europe

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# Outline

- Why innovations are important for competitiveness and sustainable development?
- Europe 2020 Strategy for Smart, Sustainable, and Inclusive Growth: goals, priorities and targets
- Restructuring innovation systems in the emerging EU economies in Central and Eastern Europe (EU11): does it lead towards competitiveness and sustainable development (*Smart growth – an economy based on knowledge and innovation*)
- Eco-innovations and patenting in green technologies
- Conclusions & policy recommendations



# **Innovations and their importance for competitiveness and sustainable development: conclusions from the literature review**

- Endogenous growth models have pointed to the existence of increasing returns and spillovers effects related to the R&D activities (e.g.: Romer, 1986; 1990; Aghion & Howitt, 1992; Lucas, 2008)
- Evolutionary scholars have emphasized the sector-specific nature of innovation and confirmed its impact on the competitiveness of different systems of innovation (e.g.: Nelson&Winter, 1977; Dosi, 1988; Nelson, 2005; Devezas, 2005; Soete, 2012)
- Innovation is at center of the international competitiveness concept (e.g.: Porter, 1990; 2008: Stern, Furman, Porter, 2000; 2002; De Grauwe, 2010; Misala, 2011)

# **Innovation, competitiveness and growth in Europe 2020 Strategy for Smart, Sustainable, and Inclusive Growth**

- **The main goal** of the European Union's Europe 2020 strategy is to achieve smart, sustainable and inclusive economy.

Three following priorities have been set in Europe 2020 strategy:

- 1. Smart growth**, which translates to developing a **knowledge and innovation based economy**;
- 2. Sustainable growth**, meaning **resource efficiency and more environmental friendly** and competitive economy;
- 3. Inclusive growth**, focused on **employment** and aiming at economic, social and territorial **cohesion** (EC, 2010, p. 10).

# Targets under the Europe 2020 Strategy

- 3% of the EU's GDP should be invested in R&D.
- The "20/20/20" climate/energy targets should be met (including an increase to 30% of emissions reduction if the conditions are right).
- 75 % of the population aged 20-64 should be employed.
- The share of early school leavers should be under 10% and at least 40% of the younger generation should have a tertiary degree.
- 20 million less people should be at risk of poverty.

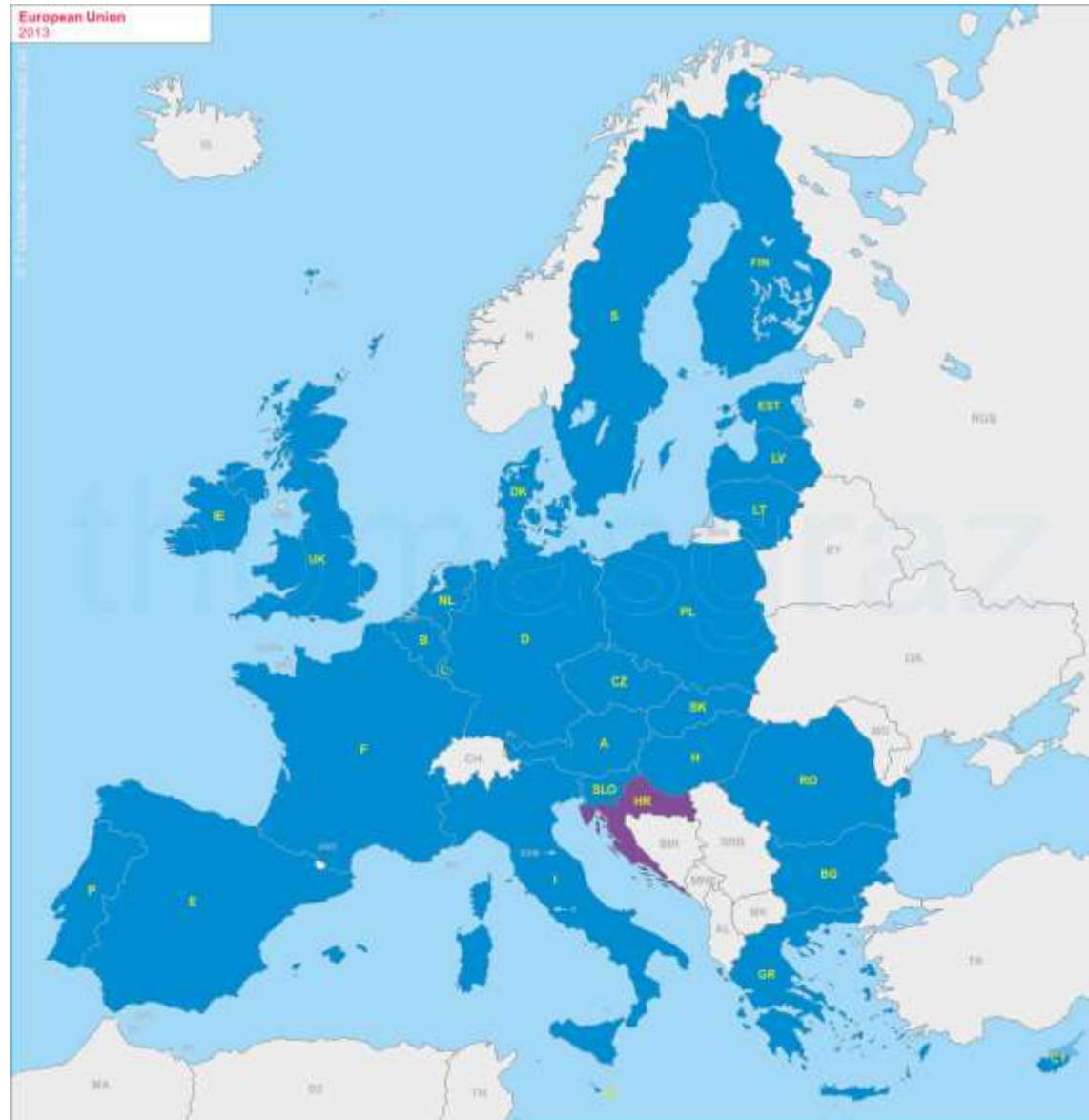
***Smart growth – an economy based on knowledge and innovation: the performance of the emerging EU economies from Central and Eastern Europe (EU11)***

EU11 =post communist countries, which underwent transition in 1990s and joined the EU in 2004, 2007 and 2013

- Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia, Croatia



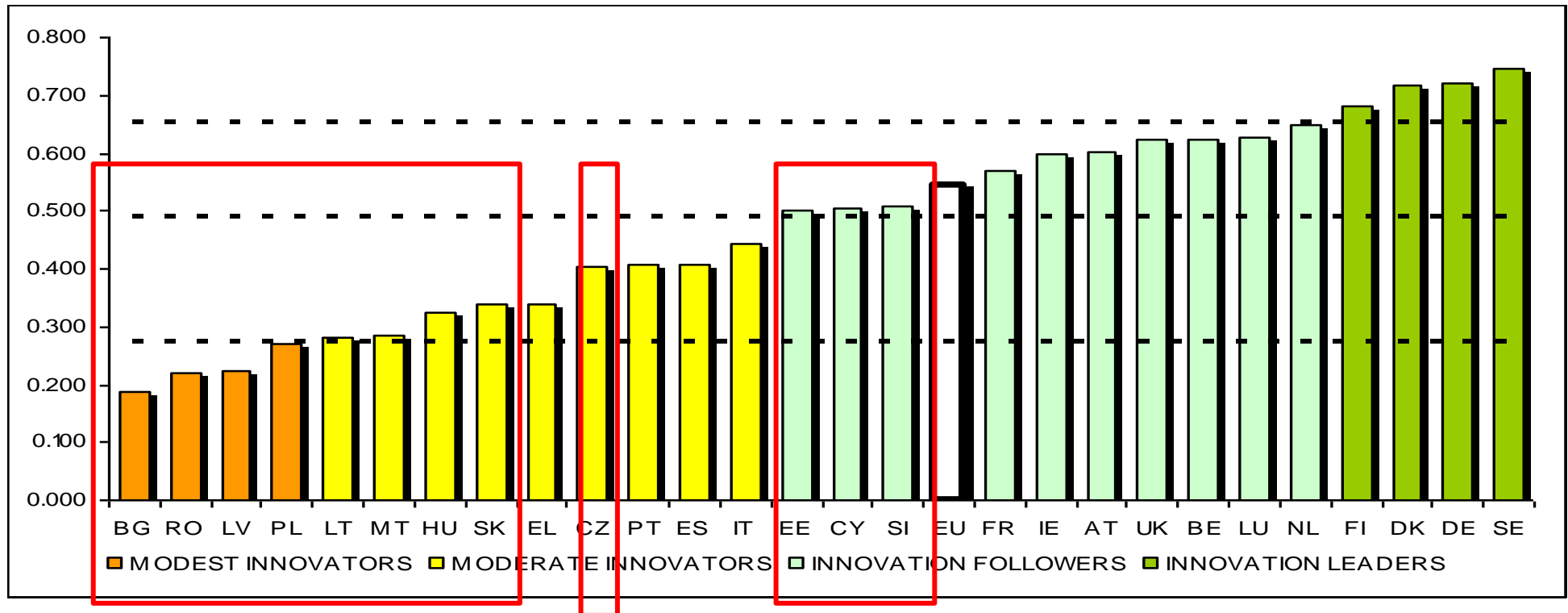
# EU Member States in 2013



Source: <http://www.thomasgraz.net/glass/map-EU-2013.htm>



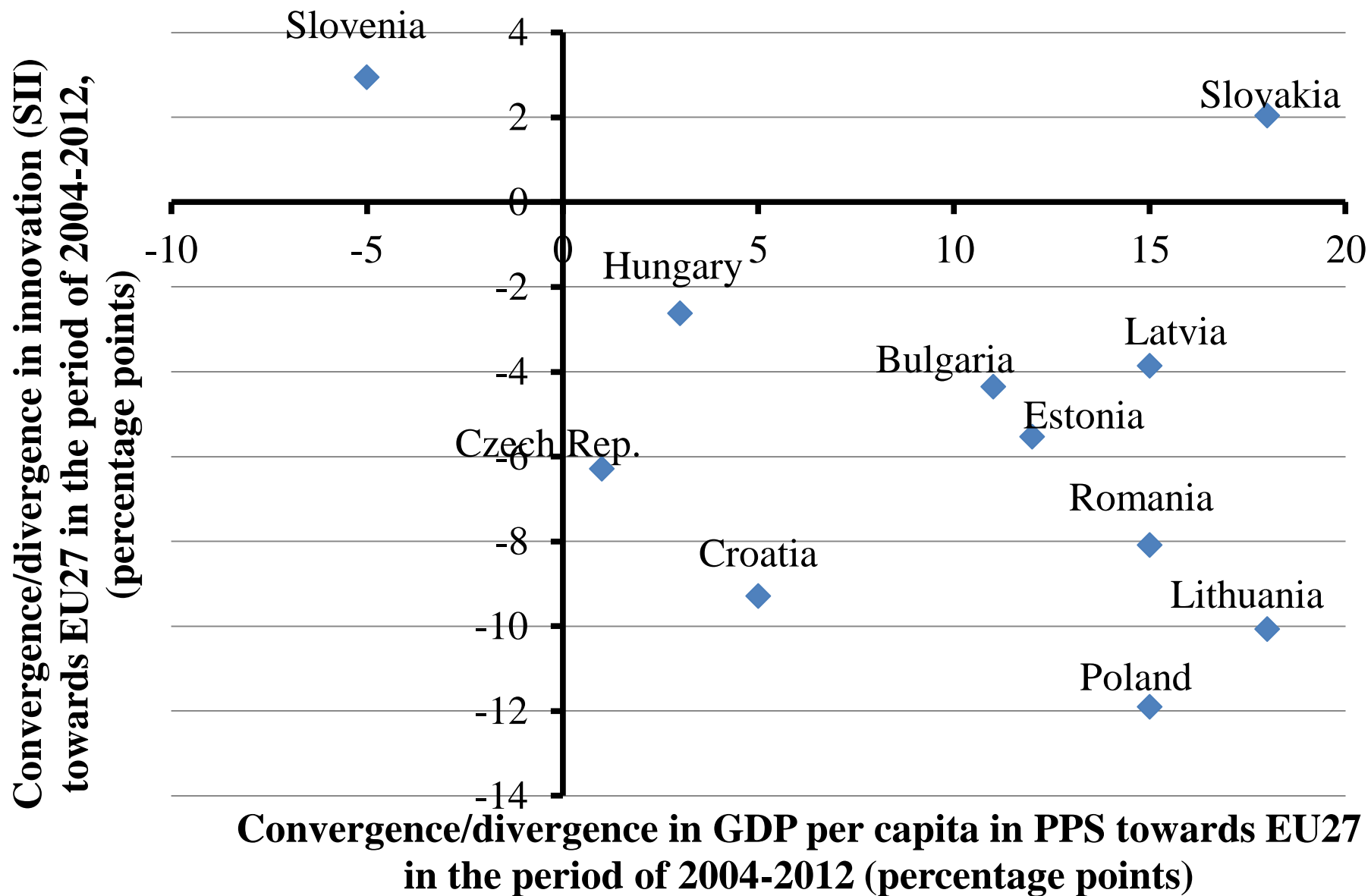
# Innovation performance in the EU countries from Central Europe, 2004-2011- summary innovation index (SII)



Note: Average performance is measured using a composite indicator building on data for 24 indicators going from a lowest possible performance of 0 to a maximum possible performance of 1. Average performance reflects performance in 2010/2011 due to a lag in data availability. The performance of Innovation leaders is 20% or more above that of the EU27; of Innovation followers it is less than 20% above but more than 10% below that of the EU27; of Moderate innovators it is less than 10% below but more than 50% below that of the EU27; and for Modest innovators it is below 50% that of the EU27

Source: EC, 2013, p. 5

# Innovation and development in emerging EU countries from CEE (EU11)



Source: Based on Eurostat data and EC, 2013

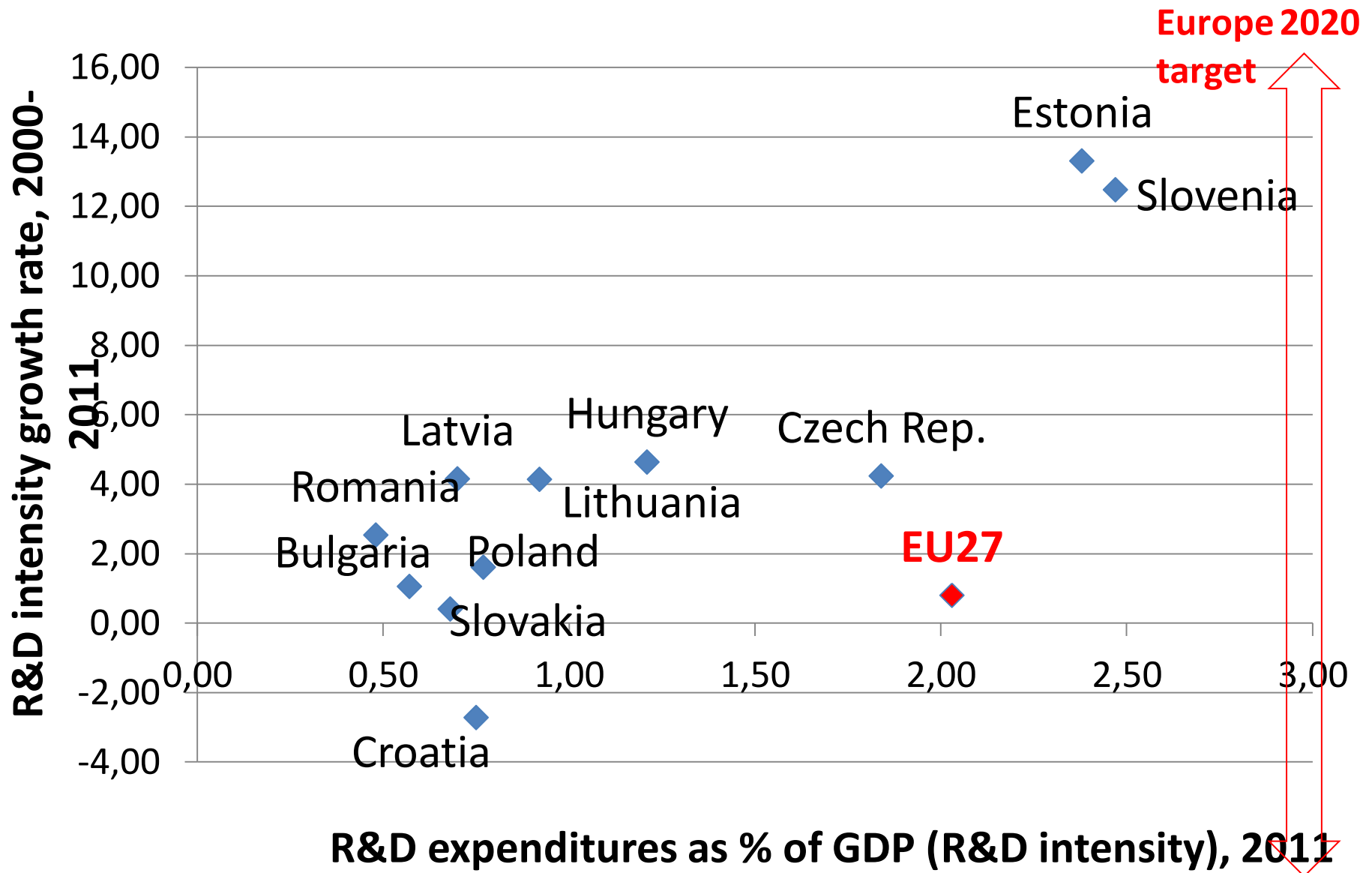
# **Innovation performance in the EU countries from Central & Eastern Europe, 2004-2011**

- The convergence measured by the Summary Innovation Index (SII) varies across the new EU member states
- In majority of the emerging EU countries catching up with the EU27 average in terms of the GDP per capita is not accompanied by the same convergence in innovation performance in 2004-11
- In 9 countries (Lithuania, Poland, Estonia, Latvia, the Czech Rep., Hungary, Bulgaria, Romania and Croatia ) divergence towards the average EU27 levels of the Summary Innovation Index can be observed.
- 2 countries from the EU11 group improved slightly their innovation performance toward the average of the EU27 (Slovenia, Slovakia)

## **Main reasons behind the relatively slow growth rate of SII in the EU11 countries**

- Low R&D expenditures with a dominant role played by the government sector
- Lower than the EU average performance in terms of Excellence in S&T
- Economic impact of innovation on the economy was lower in CEE countries than the EU average.
- Not sufficient knowledge-intensity of CEE economies

# R&D intensity in CEE, 2011



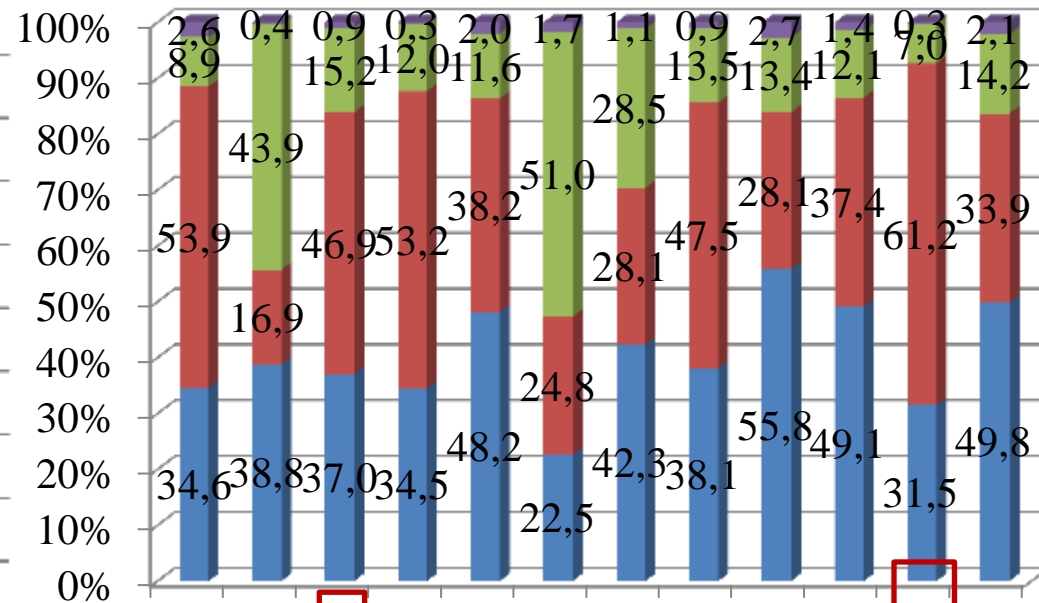
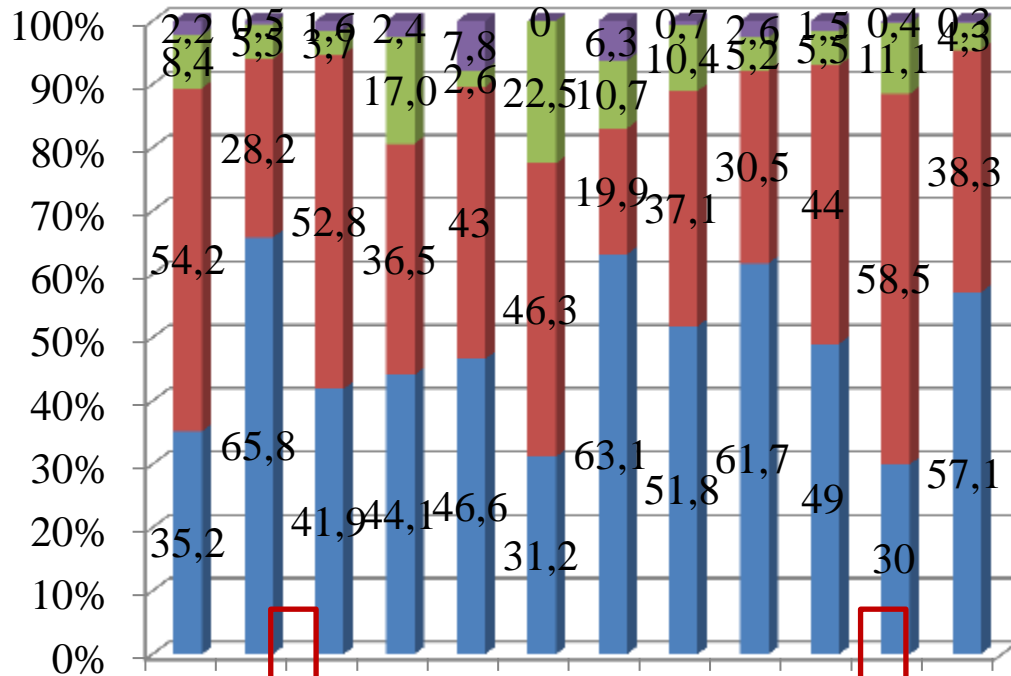
# The structure of R&D expenditures

- Most EU11 countries are still struggling with the problem of the R&D expenditure structure inherited from the communist era, with a dominant role played by the government sector.
- The countries that have restructured their R&D expenditure in a significant way: Estonia, Hungary, Slovenia and Lithuania.
- In the remaining EU11 countries, the business sector's contribution to R&D expenditure fell between 2004 and 2011, with the greatest decreases recorded in Latvia (by 21.5 p.p. to 24.8%) and Bulgaria (by 11.3 p.p. to 16.9%).

# The structure of R&D expenditures in CEE, 2004 and 2011 compared

2004

2011



Government sector

Business enterprise sector

Abroad

Other

Government sector

Business enterprise sector

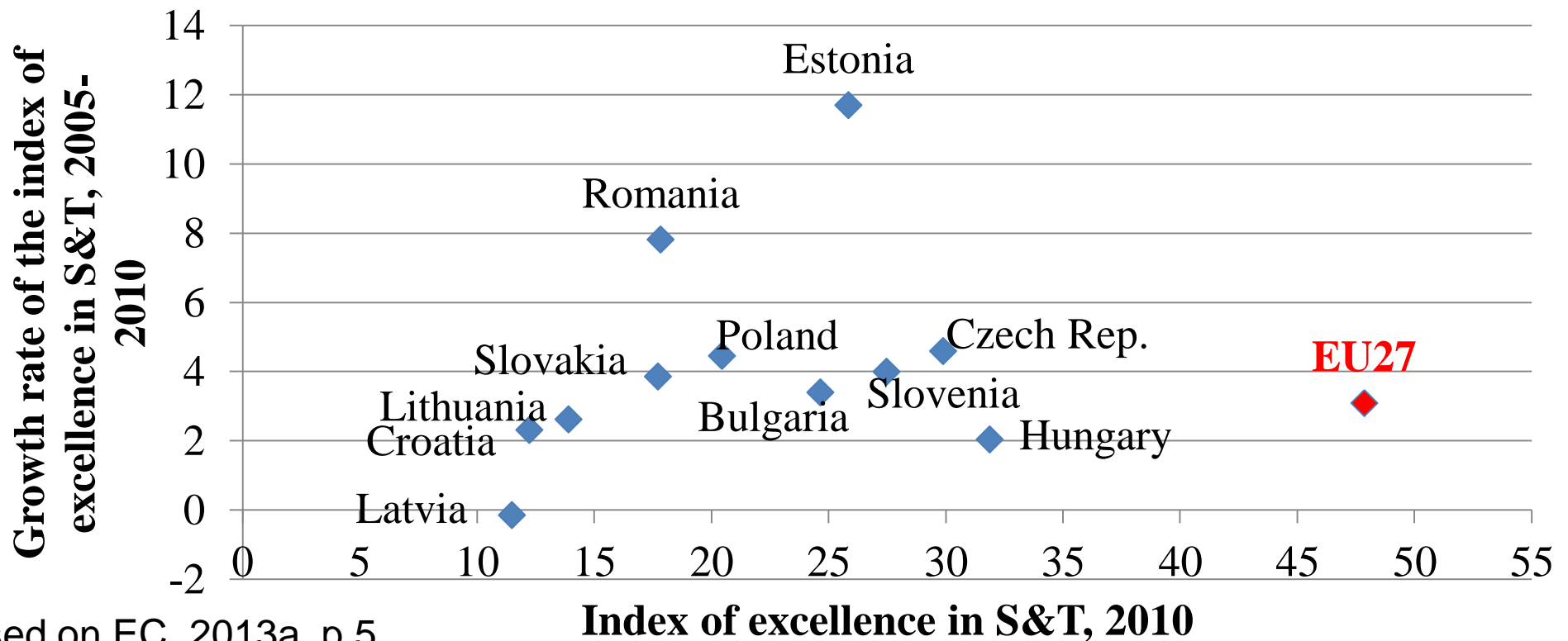
Abroad

Other

# Excellence in S&T in the EU11 countries

Measured by a composite indicator of 4 variables

- 1) the share of highly cited publications in all publications where at least one of the authors has an affiliation in a given country;
- 2) number of top scientific universities and public research organizations in a country divided by million population;
- 3) PCT patent applications per million population;
- 4) total value of ERC grants received divided by public R&D performed by the higher education and government sectors.



Based on EC, 2013a, p.5.

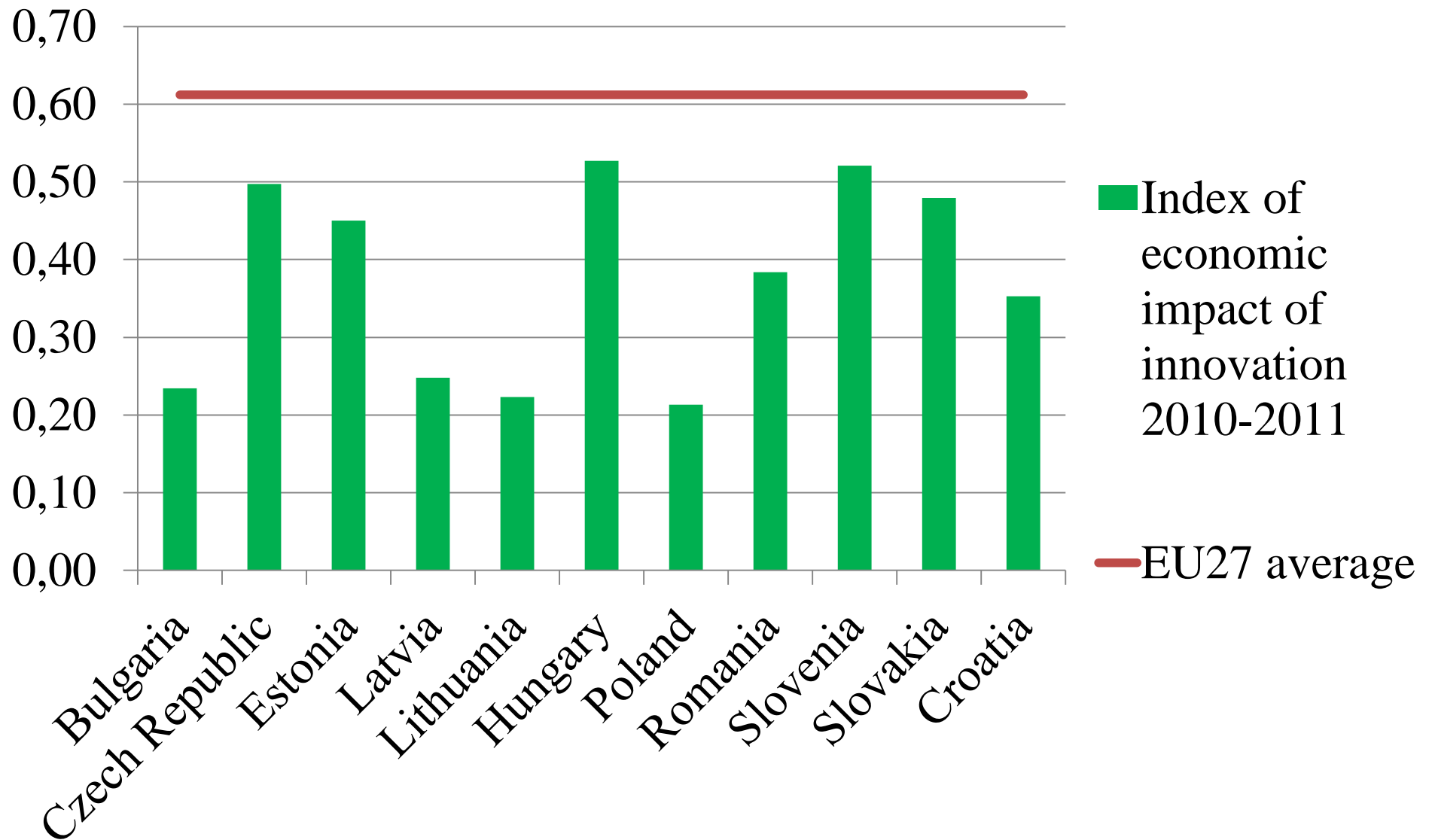


## **Economic Impact of Innovation - lower in CEE countries than the EU average**

Index of Economic Impact of Innovation is composed of five indicators:

- 1) PCT patent applications per billion GDP (in PPS€);
- 2) employment in knowledge-intensive manufacturing and service as % of total employment;
- 3) contribution of medium- and high-tech exports to trade balance;
- 4) sales of new-to-market and new-to-firm innovations as % of turnover
- 5) knowledge-intensive service exports as % of total service exports.

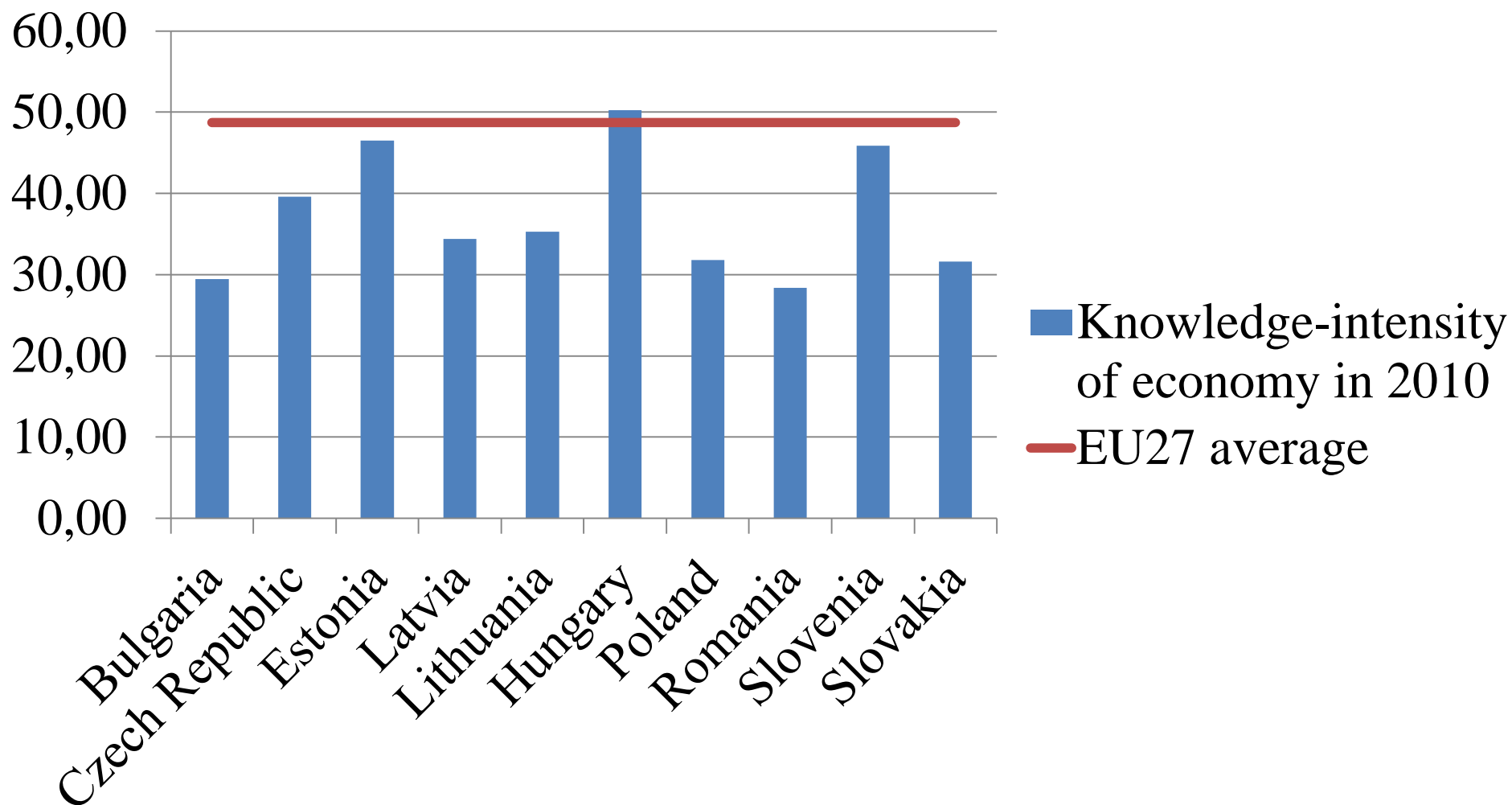
# Economic Impact of Innovation: EU11 and EU average compared



# The index of Knowledge Intensity of Economies

- This is a composite indicator of structural change, which measures changes in the actual sectoral composition of the economy. It is composed of eight indicators organized into five dimensions:
  - 1) the R&D dimension;
  - 2) the skills dimension measures;
  - 3) the sectoral specialization dimension;
  - 4) the international specialization dimension;
  - 5) the internationalization dimension refers to the changing international competitiveness of a country in terms of attracting and diffusing foreign direct investment (inward and outward foreign direct investments).

# Knowledge-intensity of CEE economies



# Hot spots in key technologies in EU11 countries and sustainable development

**Bulgaria:** agriculture, nano- and biotechnology, ICT and Energy

**Croatia:** healthcare sector; Food processing and agribusiness; Energy technology; Electronics and Advanced materials and Digital techniques

**The Czech Republic:** Automobiles, transport, construction, materials, energy and environment

**Estonia:** Energy, Environment, Food and agriculture

**Hungary:** Health, Environment, Automobiles, Biotechnology

**Latvia:** Materials, Health, Nano-sciences, Environment, Energy

# Hot spots in key technologies in EU11 countries and sustainable development

**Lithuania:** Other transport technologies (other than automobiles and aeronautics), Construction technologies, Energy

**Poland:** Food, agriculture and fisheries; Energy; Environment; Security; ICT; Materials

**Romania:** Automobiles, ICT, New production technologies, Nanotechnologies, and Security

**Slovakia:** Food and agriculture, Energy, ICT, Materials

**Slovenia:** Health, Food and agriculture, ICT, Materials, New production technologies, Environment



***Sustainable growth – promoting greener and more competitive economy:***

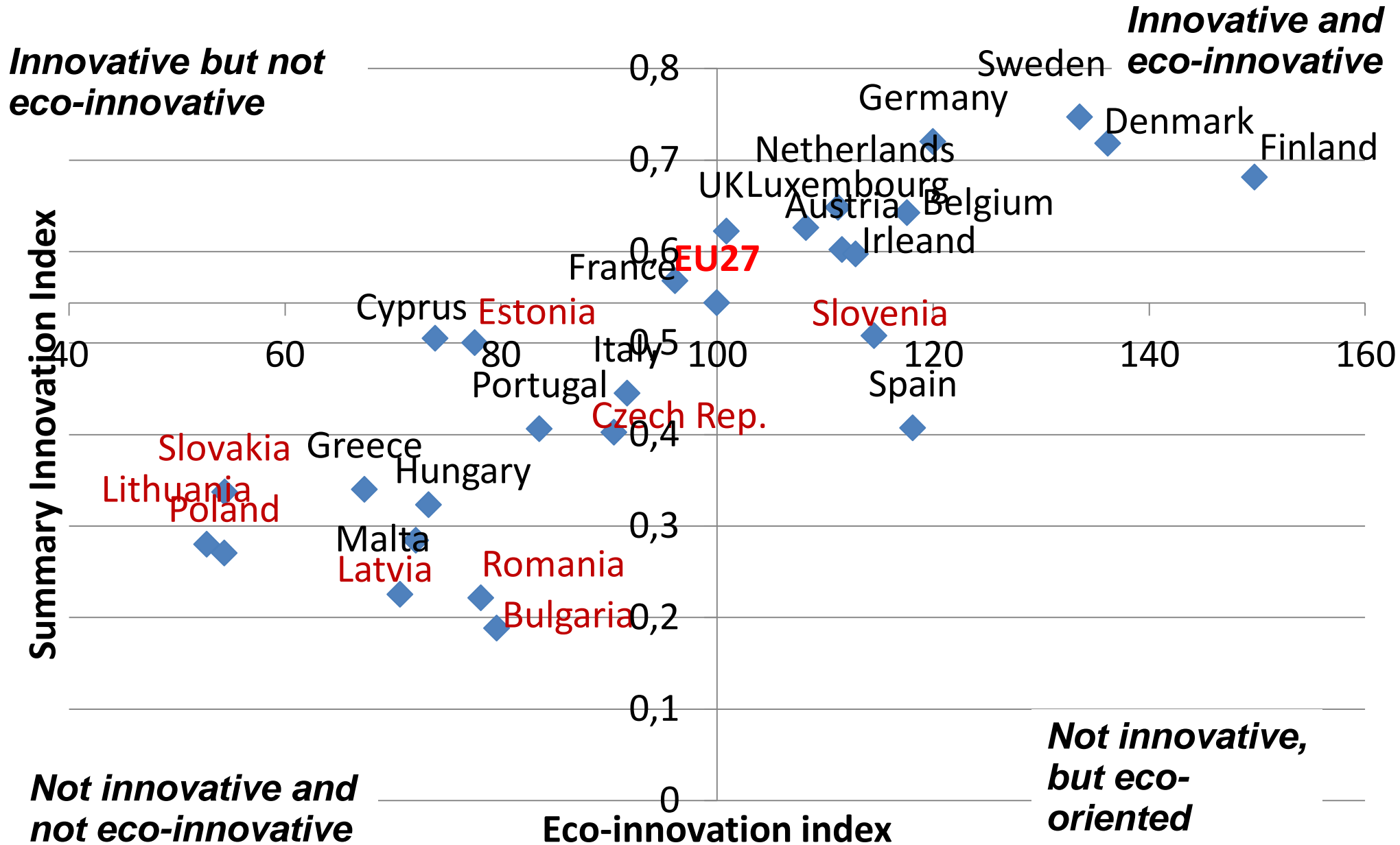
***the performance of the emerging EU economies from Central and Eastern Europe (EU11)***



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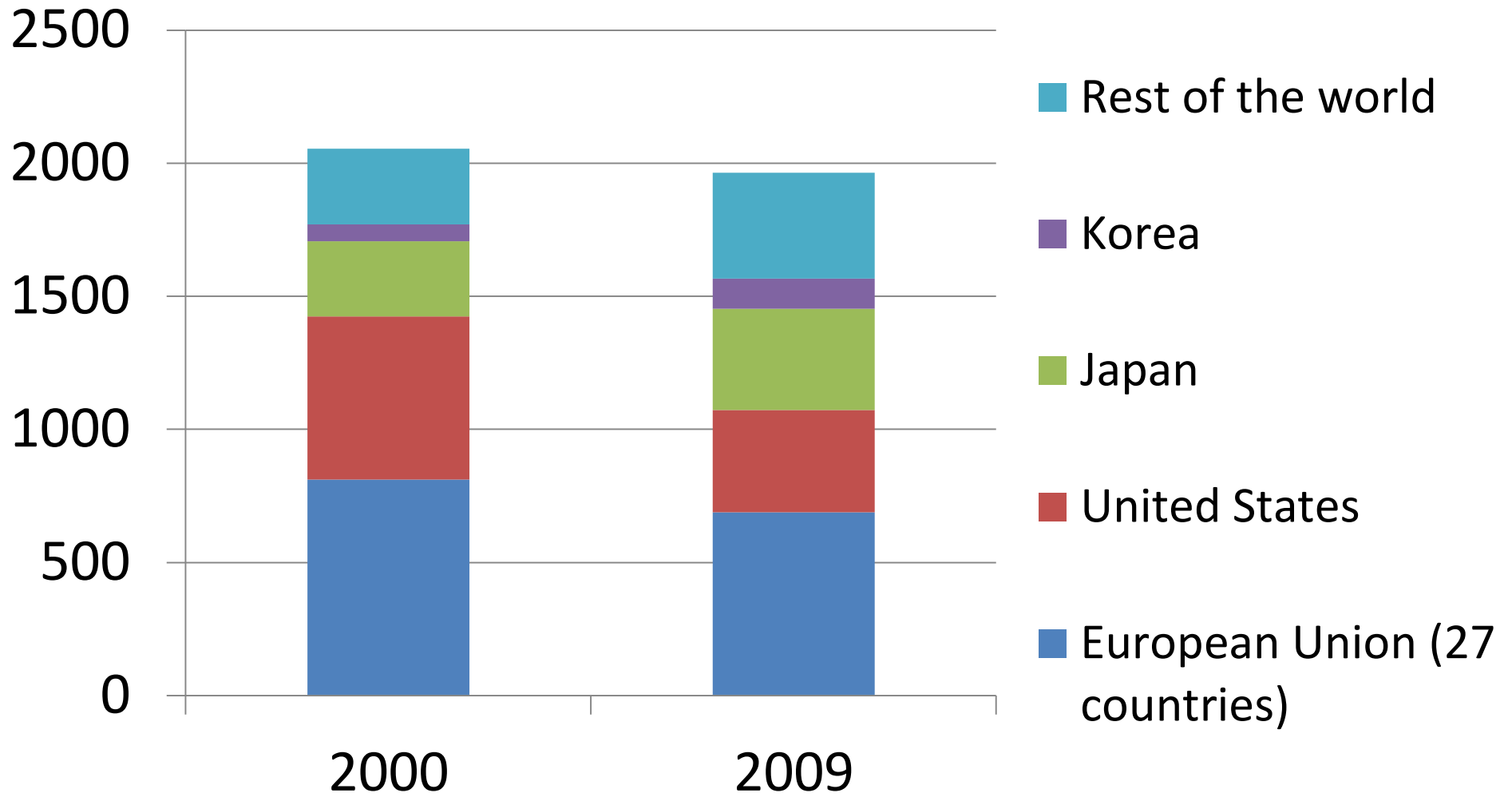


# Eco-innovations in the emerging EU countries from CEE



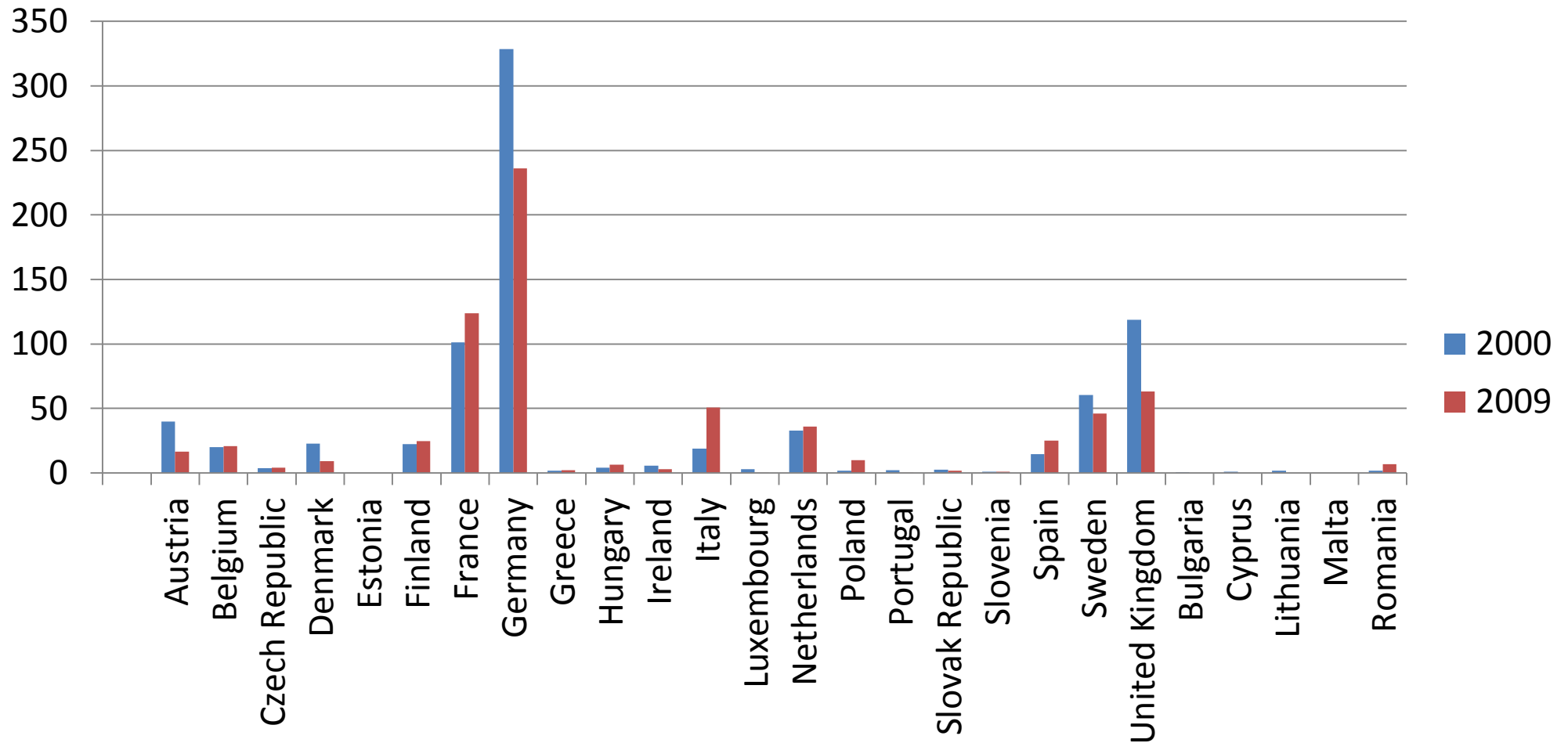


# PCT patents in environmental management: world leaders



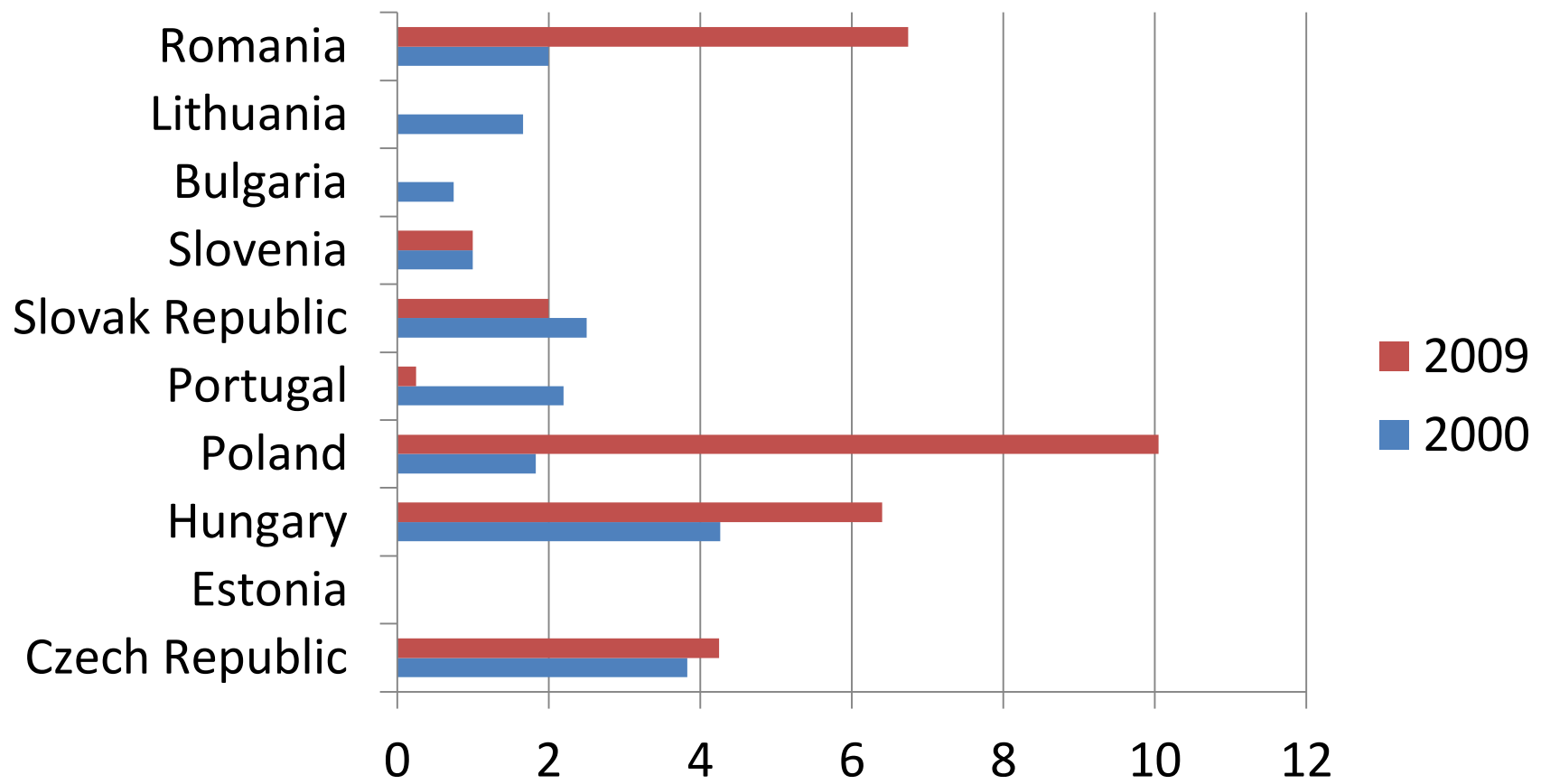
Source: OECD data

# PCT patents in environmental management: leaders in the EU



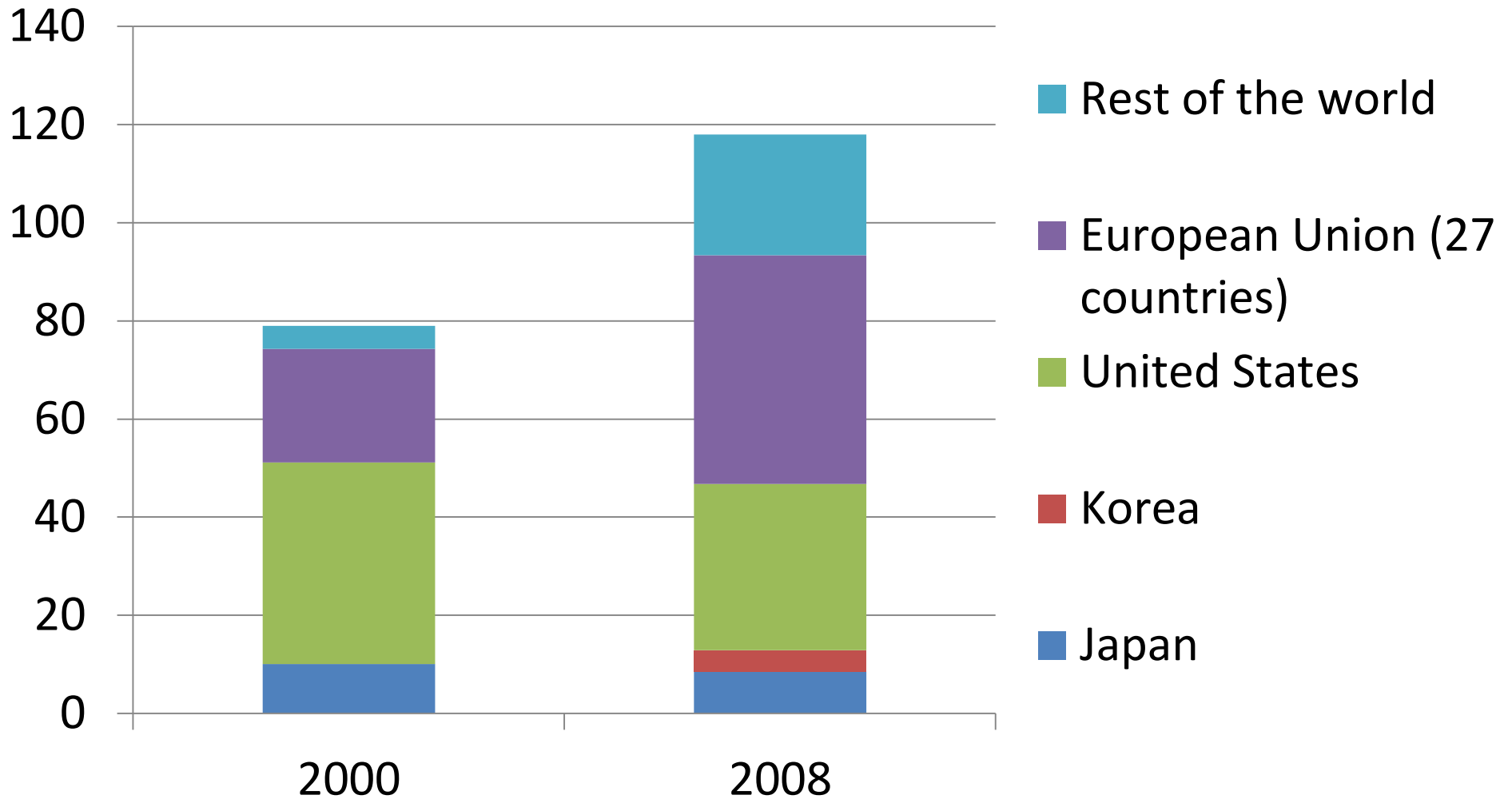
Source: OECD data

# PCT patents in environmental management: leaders among the emerging EU member states from CEE



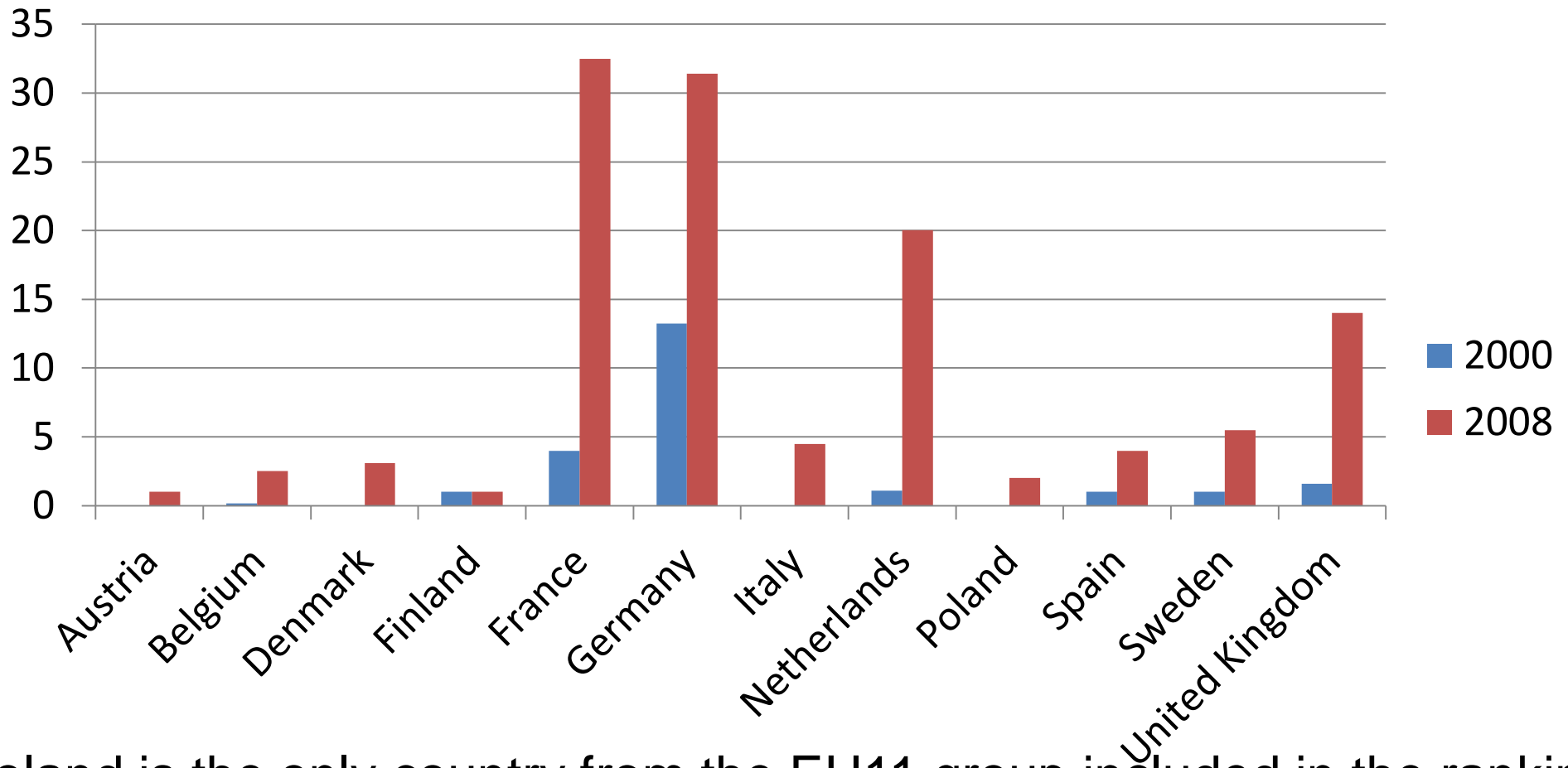
Source: OECD data

# PCT patents in technologies specific to climate change mitigation: world leaders



Source: OECD data

# PCT patents in technologies specific to climate change mitigation: leaders among the emerging EU member states



Poland is the only country from the EU11 group included in the ranking

# Specialization in green technologies

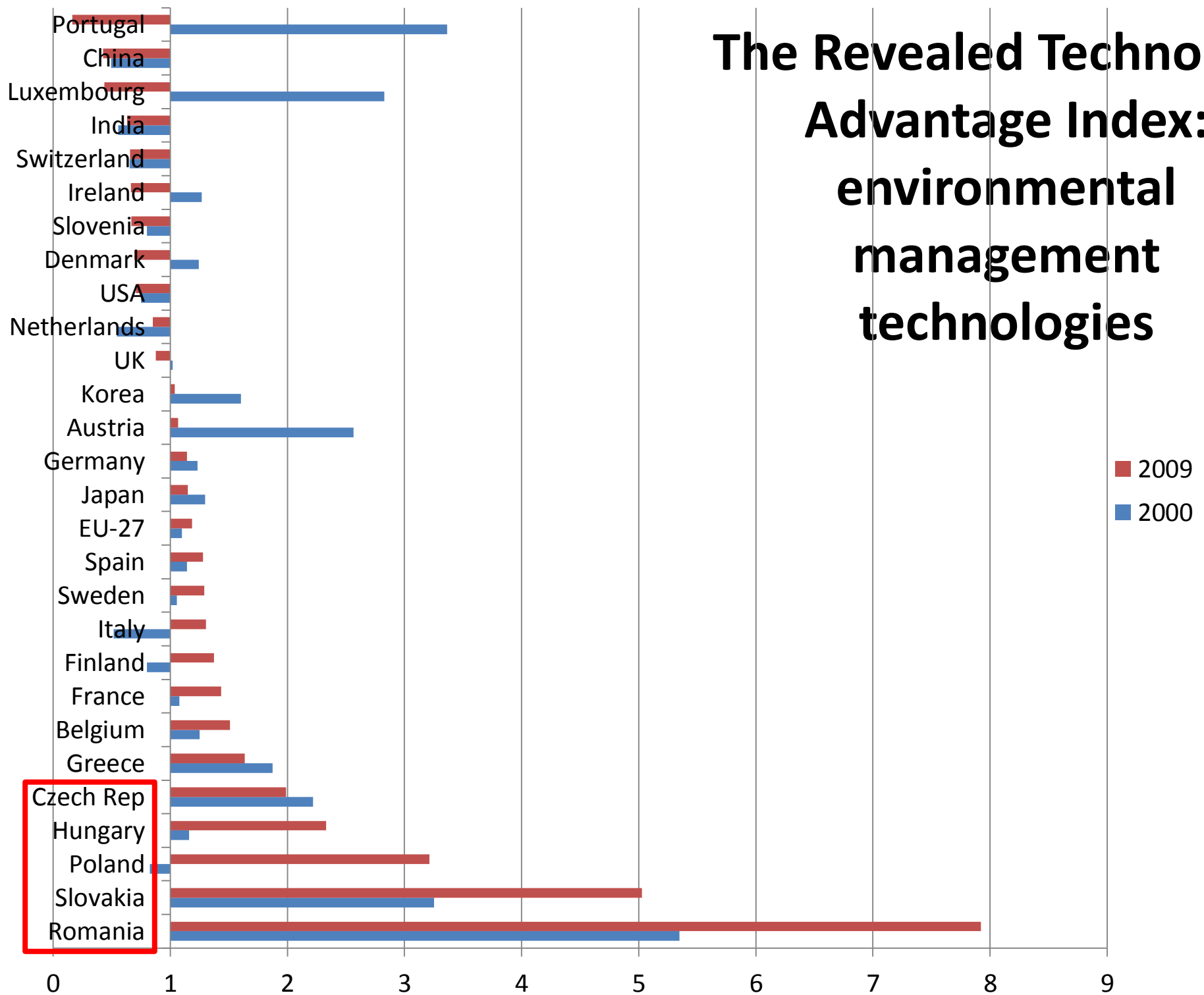
The assessment based on:

The Revealed Technology Advantage Index:

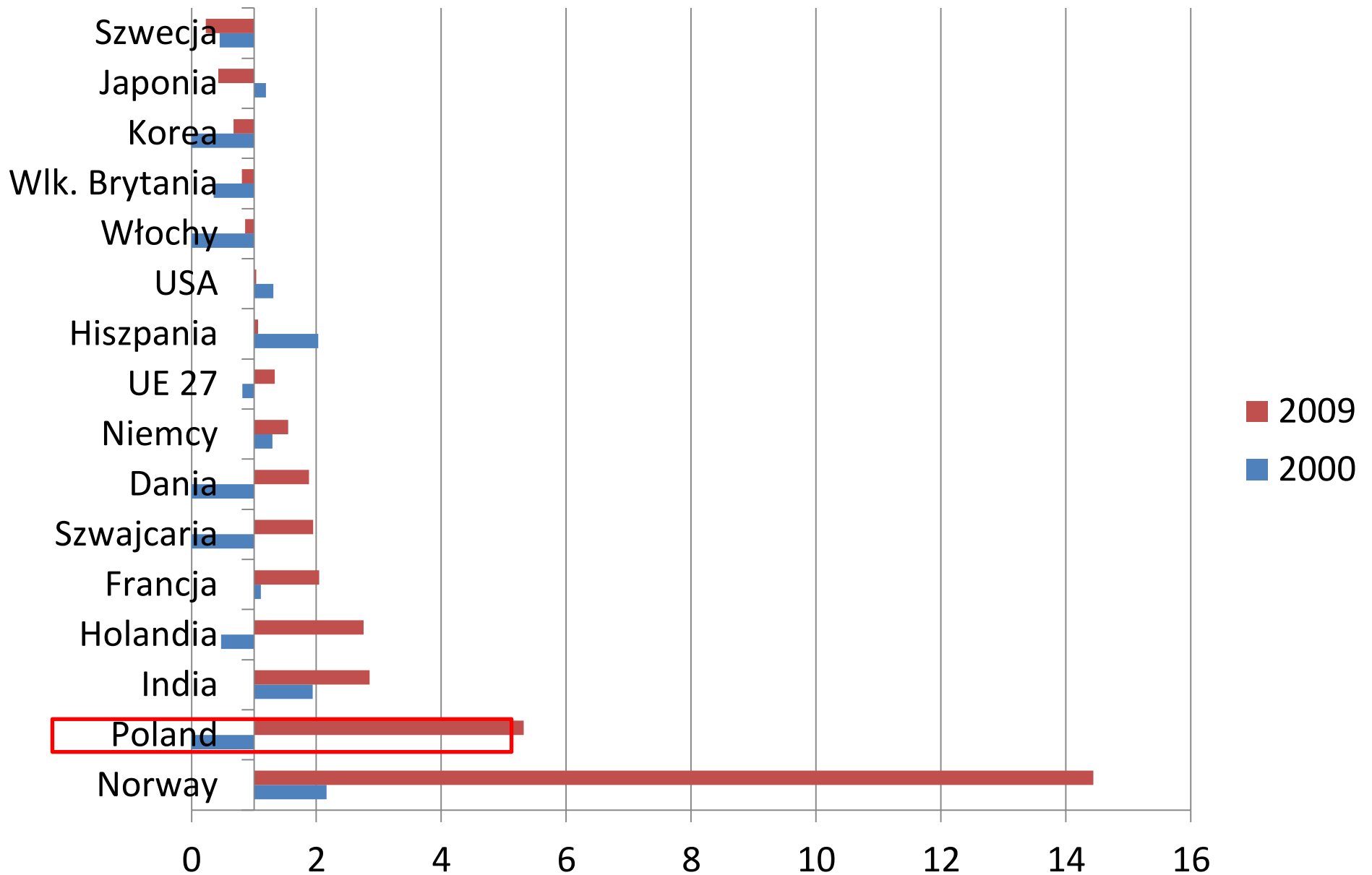
$$RTCA = P_{ij} / \sum_i P_j : \sum_j P_{ij} / \sum_i \sum_j P_{ij}$$

- $P_{ij}$  = number of patent applications by residents from the country  $i$  in the field  $j$
- $\sum_i P_j$  = total number of world patent applications in the field  $j$
- $\sum_j P_{ij}$  = total number of patent applications by residents of the country  $i$
- $\sum_i \sum_j P_{ij}$  = total number of world patent applications
- A country enjoys comparative technological advantage in industries where  $RTCA > 1$ . An  $RTCA < 1$  shows that the industry is relative technologically disadvantageous.

# The Revealed Technology Advantage Index: environmental management technologies



# The Revealed Technology Advantage Index: technologies specific to climate change mitigation





# Conclusions (1)

- In majority of the EU11 countries catching up with the EU27 average in terms of the GDP per capita was not accompanied by the same convergence in innovation performance in 2004-11
- the limitations to the restructuring of EU11 innovation systems that hamper a move toward innovation-driven competition include:
  - Low R&D expenditures with a dominant role played by the government sector
  - Low level of excellence in S&T and relatively slow improvements in this respect (exception: Estonia)
  - The economic impact of innovation lower than the EU-27 average
  - Too low knowledge intensity of the economies (exception: Hungary)

## Conclusions (2)

- There is some progress in EU11 with regard to sustainable development indicators:
  - Environment belongs to hot spots in in key technologies in majority of EU11 countries: Poland, the Czech Rep. Hungary, Estonia, Latvia, Slovenia
  - The number of PCT patents in in environmental management has been growing (the leaders in EU11 are: Poland, Romania, Hungary, the Czech Rep.)
  - Some countries (Poland) started to get PCT patents in technologies specific to climate change mitigation
  - Some EU11 countries enjoy revealed technological advantages in green technologies.
- EU11 countries are not eco-innovators yet (exception: Slovenia)

# How can innovation, sustainability and competitiveness be supported in EU11?

## Recommendations for the European STI policy

1. A differentiated approach to science, technology and innovation (STI) policy across the EU Member States is recommended
2. Different policy goals for different groups of countries (not only R&D expenditures as a main goal)
3. 2 dimensions that innovation policies should take into account:
  - level of country's development
  - the technological profile of the country (including existing pattern of comparative advantages/disadvantages in foreign trade)
4. Innovation policy in EU10 countries should be linked with the modernization of industries, and the focus should be on:
  - knowledge transfer
  - strengthening absorptive capacities through education and training
5. There is a need for a better coordination of different policies (innovation, environment, trade and FDI policies should be integrated)



Thank you for your attention

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