

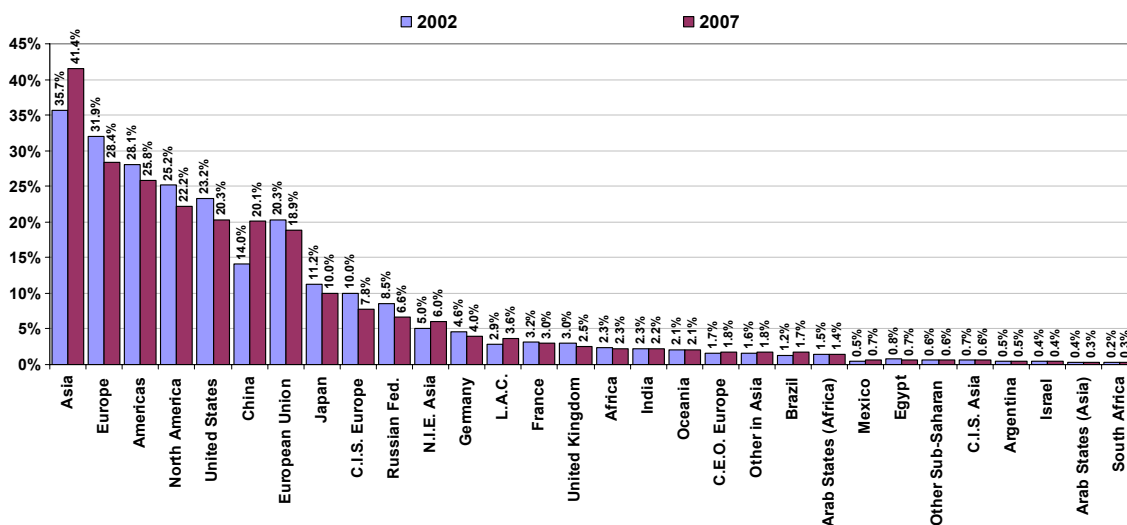
# A GLOBAL PERSPECTIVE ON RESEARCH AND DEVELOPMENT

The UNESCO Institute for Statistics (UIS) works with governments and diverse organizations to provide global statistics on science and technology. The Institute also helps to ensure that survey instruments accurately reflect the conditions surrounding research and development (R&D), especially in developing countries. The aim is to provide the information needed for effective policymaking.

## Human resources in R&D

Figure 1 presents the distribution of researchers in the world by main regions/countries in 2002 and 2007. Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned (*Frascati Manual*, 2002).

**Figure 1. Where are researchers located?**  
Shares of world researchers by principal regions/countries, 2002 and 2007 (%)



Source: UNESCO Institute for Statistics estimates, September 2009.

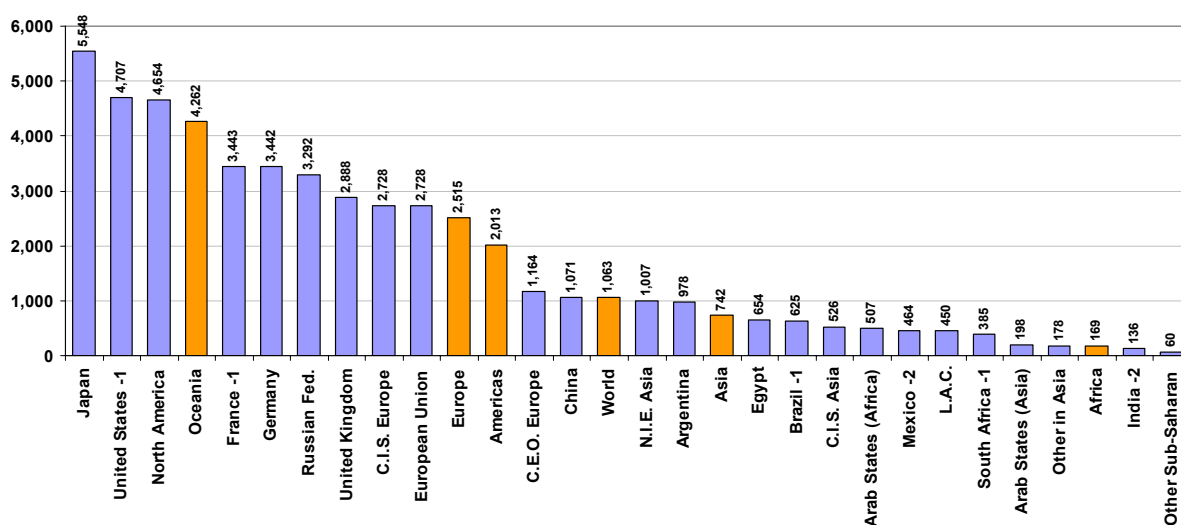
According to recent UIS estimates and data illustrated in **Figure 1**:

- The number of researchers (measured in full-time equivalents – FTE) has increased from an estimated 5.8 million worldwide in 2002 to 7.1 million in 2007.
- Asia represented 41.4% of world researchers in 2007 compared to 35.7% in 2002. This rise was mainly due to the increasing share of researchers in China from 14.0% to 20.1% between 2002 and 2007.
- The rise in Asia’s share came at the expense of Europe and the Americas, which saw their shares decrease from 31.9% to 28.4% and from 28.1% to 25.8% respectively.

**Figure 2** illustrates the distribution of researchers in relation to the size of the population (density of researchers) in main regions/countries for 2007.

**Figure 2. How many researchers are there?**

Researchers per million inhabitants, by principal regions/countries, 2007 or latest year available



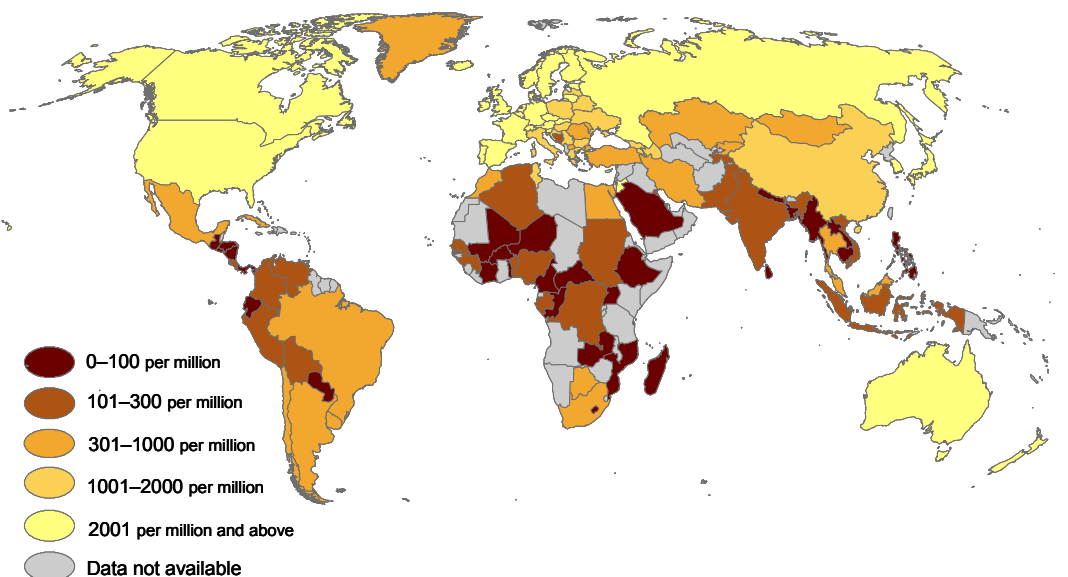
Source: UNESCO Institute for Statistics estimates, September 2009.

**Figure 3** presents a global map of the distribution of researchers (measured per million inhabitants).

According to the data illustrated in Figures 2 and 3:

- There were 1063 researchers per million inhabitants in the world in 2007.
- Researcher per million inhabitants in Oceania (4262), Europe (2515) and Americas (2013) were far higher than the world average, whereas research densities were low in Asia (742) and Africa (169).

**Figure 3. What are the national research densities?**  
 Researchers per million inhabitants, 2007 or latest available year



**Note:** Data in this map are based on FTE. However, figures in headcounts (HC) were considered for the following countries since the FTE figures were not available: Armenia; Azerbaijan; Bangladesh; Belarus; Benin; Botswana; Cameroon; Central African Republic; Cuba; Democratic Republic of the Congo; El Salvador; Gabon; Gambia; Georgia; Guinea; Jordan; Kazakhstan; Kyrgyzstan; Mauritius; Mongolia; Montenegro; Mozambique; Nauru; Nicaragua; Nigeria; Saint Lucia; Saint Vincent and the Grenadines; Saudi Arabia; Sudan; Tajikistan; The former Yugoslav Republic of Macedonia; Uganda; Venezuela; and Zambia. This has to be taken into account when interpreting the data.

*Source:* UNESCO Institute for Statistics, September 2009.

### Women in science

In 121 countries with available data<sup>1</sup>, women represent slightly more than one-quarter of researchers (29%). In 37% of these countries, they represent less than one-third. Only about 15% of countries have achieved gender parity, and only a handful of others have more women researchers than men.

According to the data illustrated in **Figure 4**:

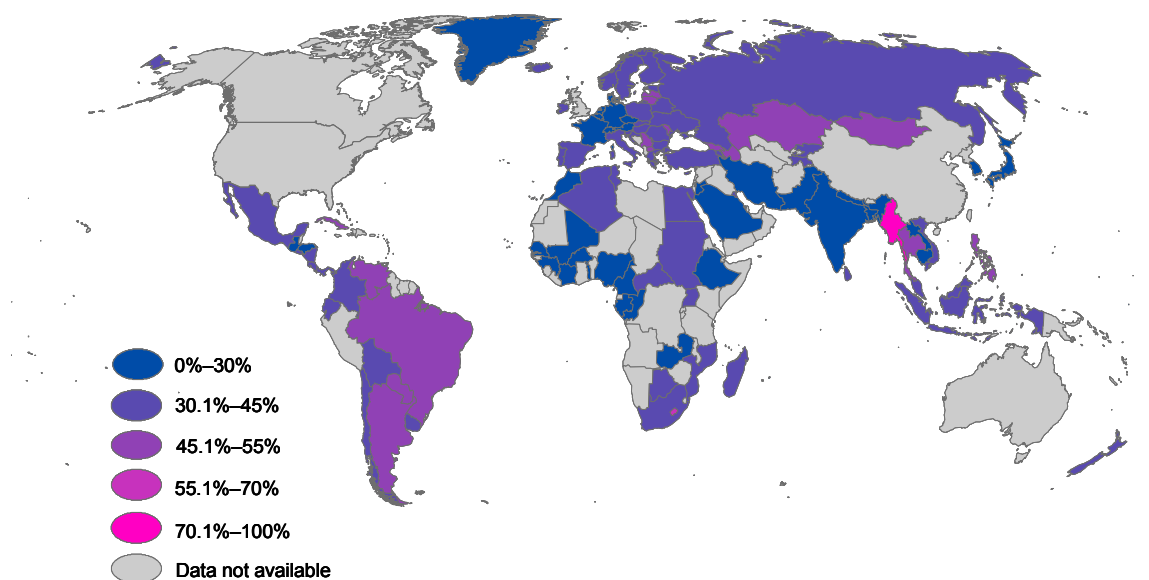
- In Latin America and the Caribbean<sup>2</sup>, 46% of researchers were women, exceeding the world average of 29%. Five countries have achieved gender parity: Argentina, Cuba, Brazil, Paraguay, and Venezuela. In contrast, men accounted for more than 70% of researchers in Chile, Guatemala, Honduras and the U.S. Virgin Islands.
- In Asia, women constituted only 18% of researchers, but there is considerable heterogeneity. South Asia had the lowest rate of 18%, mostly due to the rate in India (13%). Less than 30% of researchers were female in the Asian Arab States (21%), as well as in Japan (13%) and the Republic of Korea (15%). South East Asia reported a high share of female researchers at 40%. Most Central Asian countries reported gender parity (around 50%).

<sup>1</sup> Data are lacking for many countries with significant numbers of researchers – such as Australia, Canada, China, the United Kingdom and the United States.

<sup>2</sup> Regional totals for percentage of women researchers are based on HC and available data only.

- In Europe as a whole, only five countries have achieved gender parity: the Former Yugoslav Republic of Macedonia, Latvia, Lithuania, Rep. of Moldova and Serbia.
- In the Community of Independent States, women's participation in research was much higher - 43% - than the world average.
- In Africa, it was estimated that about 33% of researchers were women.

**Figure 4. The gender gap in science**  
Women as a share of total researchers, 2007 or latest available year

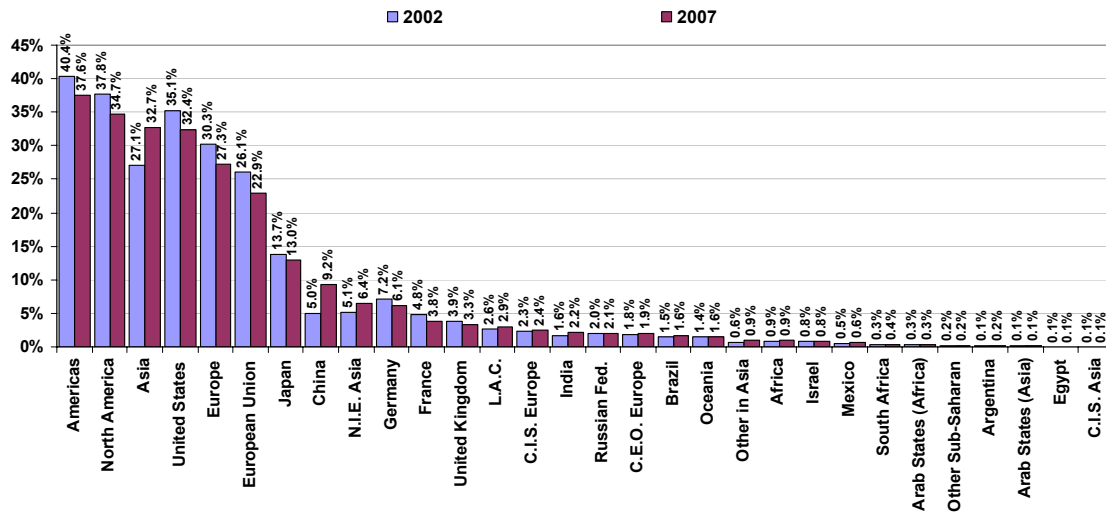


Source: UNESCO Institute for Statistics, September 2009.

### Investment in R&D

Gross domestic expenditure on R&D (GERD), expressed in PPP\$, and R&D intensity (percentage of gross domestic product – GDP – devoted to R&D activities), are the most commonly used indicators to monitor the resources devoted to R&D worldwide. **Figure 5** presents the distribution of R&D expenditure in the world by main regions/countries in 2002 and 2007.

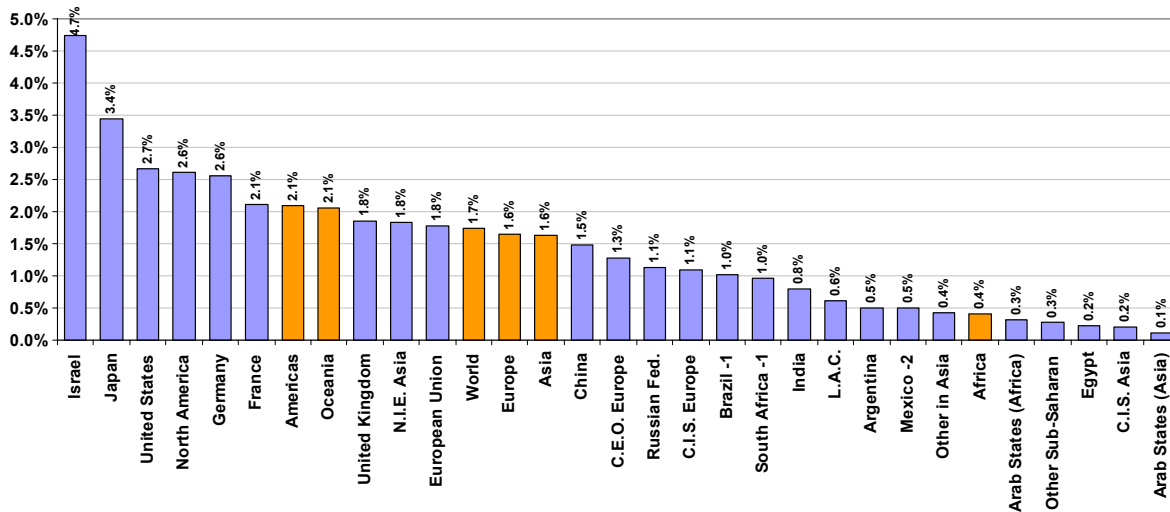
**Figure 5. Where are R&D investments made?**  
 Shares of world R&D expenditure (GERD) by principal regions/countries, 2002 and 2007 (%)



Source: UNESCO Institute for Statistics estimates, September 2009.

**Figure 6** illustrates the distribution of R&D intensity in main regions/countries for 2007. This indicator reflects a region's/country's R&D intensity by presenting R&D expenditure relative to the size of the regional/national economy.

**Figure 6. Which regions are most R&D intensive?**  
 Gross domestic expenditure on R&D as a % of GDP by principal regions/countries, 2007 or latest year available

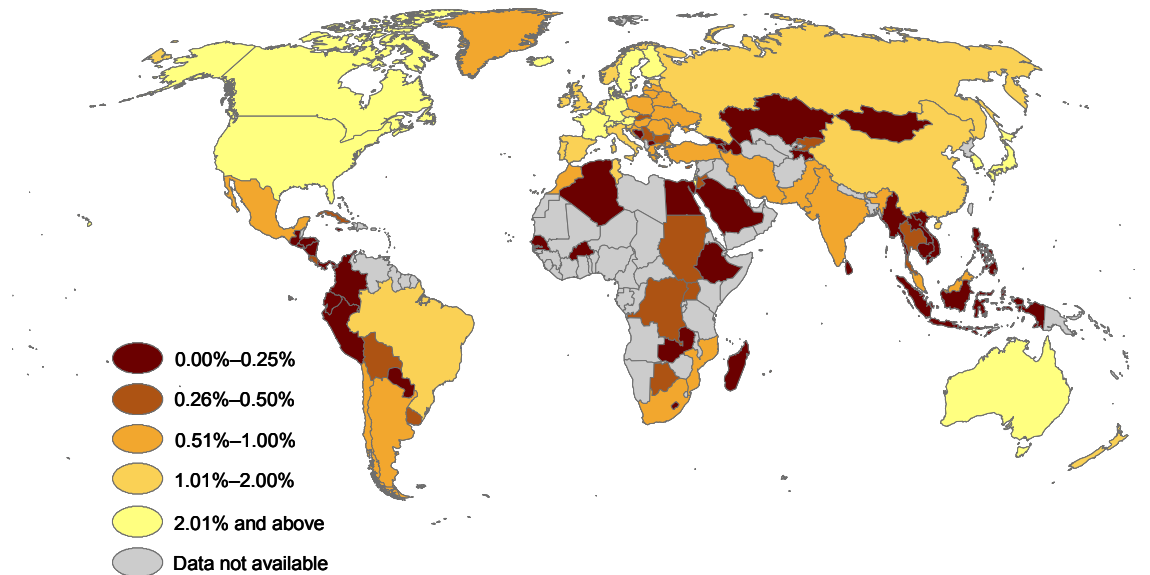


Source: UNESCO Institute for Statistics estimates, September 2009.

Governments are increasingly referring to international benchmarks when defining national science policies and allocating resources. In this context, **Figure 7** presents a global map of the percentage of GDP devoted to R&D activities.

**Figure 7. A snap-shot of R&D intensity**

Gross domestic expenditure on R&D as a percentage of GDP, 2007 or latest available year



Source: UNESCO Institute for Statistics, September 2009

According to the data illustrated in Figures 5, 6 and 7:

- From 2002 to 2007, world R&D expenditure has increased by 44% in absolute terms, from an estimated 788.5 billion PPP\$ to 1137.9 billion PPP\$. In relative terms, 1.7% of the world's GDP was devoted to R&D in 2007.
- The Americas accounted for 37.6% of world R&D expenditure in 2007 (a slight decrease compared to the 40.4% in 2002); and a significant part of this was due to R&D spending in the United States (32.4% in 2007). In North America, the United States and Canada spent 2.7% and 2% of GDP on R&D respectively in 2007.
- Contrary to the distribution of research density, Asia and Europe follow behind the Americas, accounting for 32.7% and 27.3% respectively of global R&D expenditure.
- The triad countries of the European Union, the United States and Japan represented almost 70% of global R&D expenditure, whereas Oceania and Africa accounted for insignificant shares.
- On average, R&D intensity in Asia was around 1.6% in 2007, although this was influenced by some of the emerging economies within the region. The top investors in East Asia were: Japan (3.4%), the Republic of Korea (3.5%) and Singapore (2.6%). In West Asia, Israel reported the highest R&D intensity (4.7%). China reported spending 1.5% of GDP on R&D, while India, the Islamic Republic of Iran, Malaysia and Pakistan invested between 0.6% and 0.8% of GDP. The figures ranged from 0.1% to 0.3% in Central Asia.

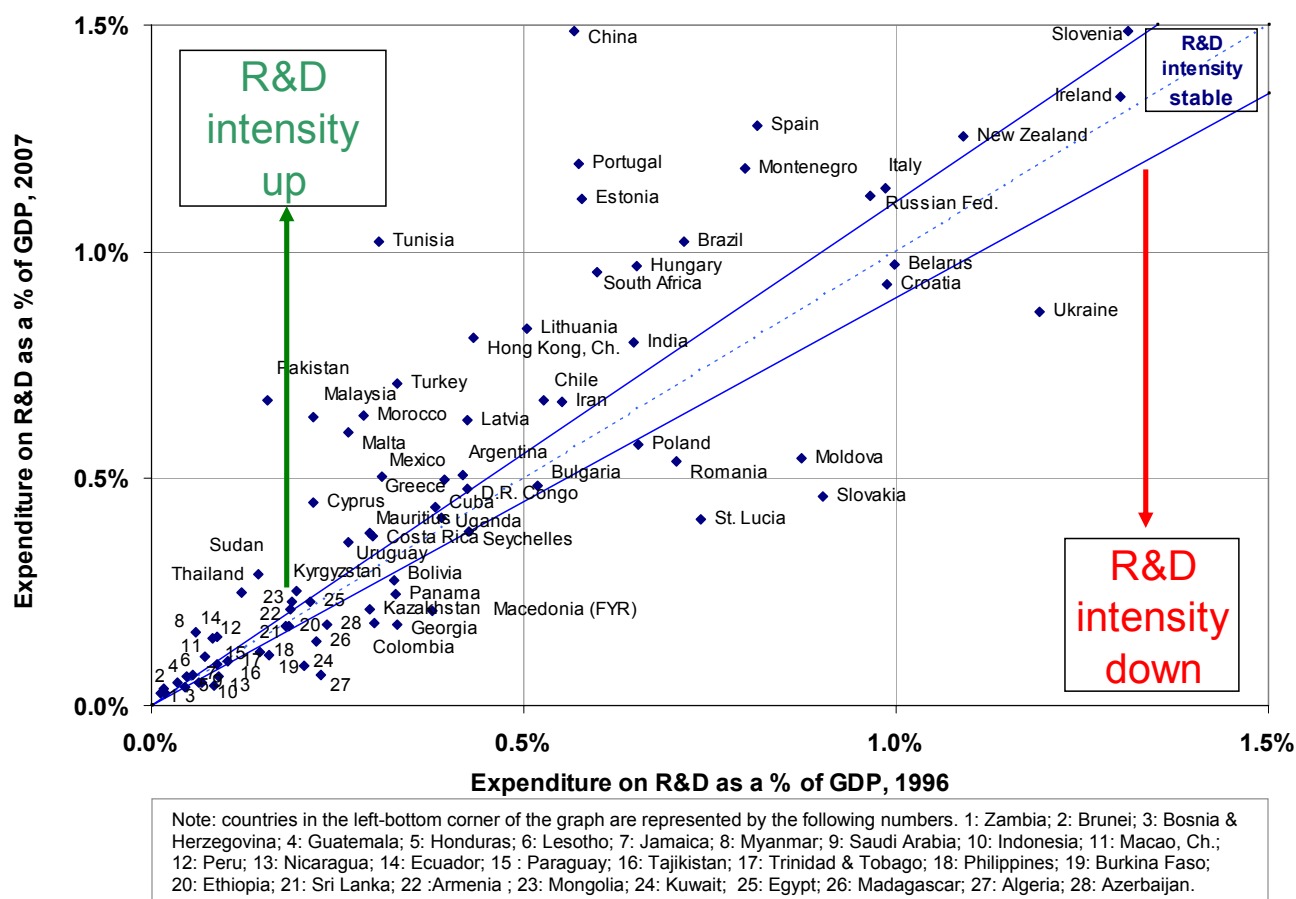
- In Europe, R&D intensity varied from 0.2% of GDP in the Former Yugoslav Republic of Macedonia to 3.7% in Sweden and 3.5% in Finland. The figures were between 2% and 3% in Austria, Denmark, France, Germany, Iceland and Switzerland.
- In Latin America, Brazil reported the highest level of R&D intensity (1.0%), followed by Chile, Argentina and Mexico (0.7%, 0.5% and 0.5% respectively). Spending levels in Costa Rica, Cuba and Uruguay were around 0.4% of GDP.
- In the Pacific, Australia and New Zealand invested 2.2% (in 2006) and 1.3% of GDP in R&D respectively.
- R&D intensity in sub-Saharan Africa was generally less than 0.5% (0.3% excluding South Africa), with the exception of South Africa, which invested almost 1.0% of GDP in R&D.

### How has R&D intensity changed over the last ten years?

Figure 8 illustrates trends in R&D expenditure between 1996 and 2007.

**Figure 8. The evolution of R&D intensity**

GERD as a percentage of GDP, 1996 (or earliest available year) and 2007 (or latest available year), countries with R&D intensity below 1.5% in both years.



Source: UNESCO Institute for Statistics, September 2009

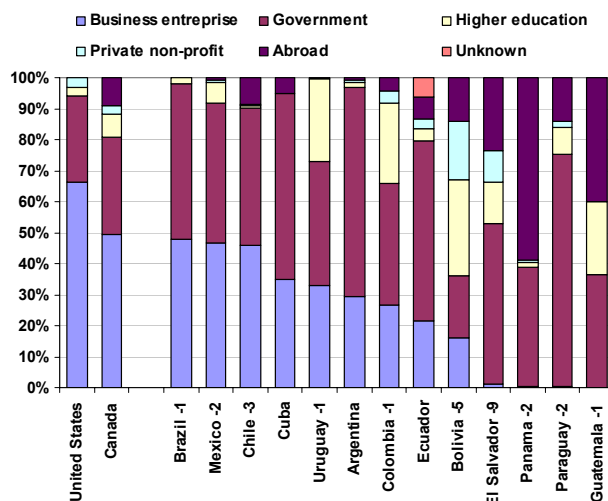
The data in Figure 8 show that:

- Globally, the percentage of GDP devoted to R&D has significantly increased in most countries (for 62 out of 106 countries with available data; 58%).
- R&D intensity has more than doubled in 14% of the countries surveyed, including China, Malaysia, Morocco, Pakistan, Thailand and Tunisia.
- In around 20% of the countries, R&D intensity has been generally stable, although it has significantly fallen in 24 countries (23%).

### Which sectors invest the most in R&D?

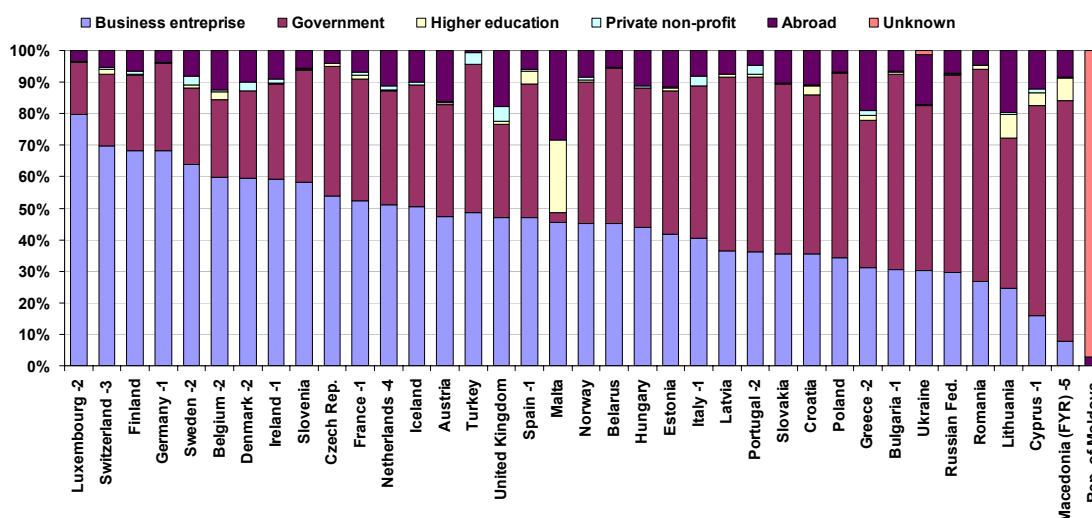
Figures 9, 10 and 11 provide regional perspectives on the sources of R&D investment. The indicator reflects the percentage of total investment originating from the business sector, government, higher education institutions, private non-profit organizations or from abroad.

**Figure 9. Funding in the Americas**  
GERD by source of funds, 2007 or latest available year



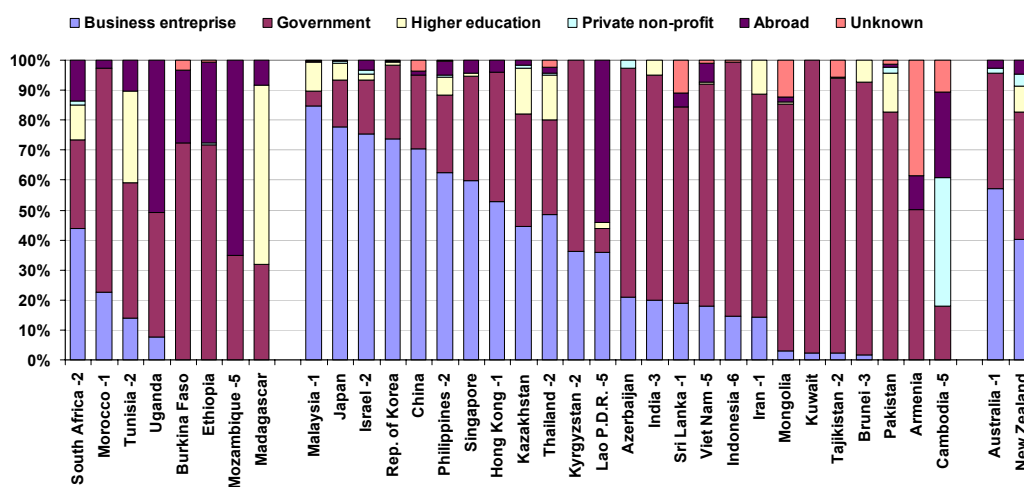
Source: UNESCO Institute for Statistics, September 2009.

**Figure 10. Funding in Europe**  
GERD by source of funds, 2007 or latest available year



Source: UNESCO Institute for Statistics, September 2009.

**Figure 11. Funding in Africa, Asia and the Pacific**  
GERD by source of funds, 2007 or latest available year



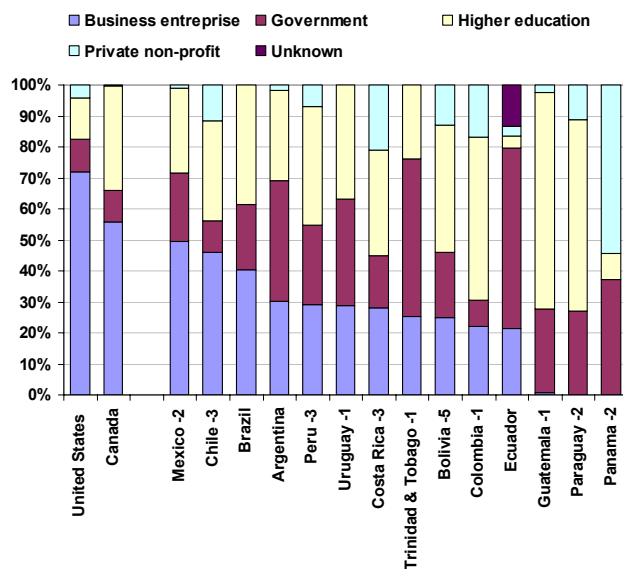
Source: UNESCO Institute for Statistics, September 2009.

### Which sectors receive the most investment?

Are financial resources concentrated in the private or public sector? What about research conducted by higher education institutions?

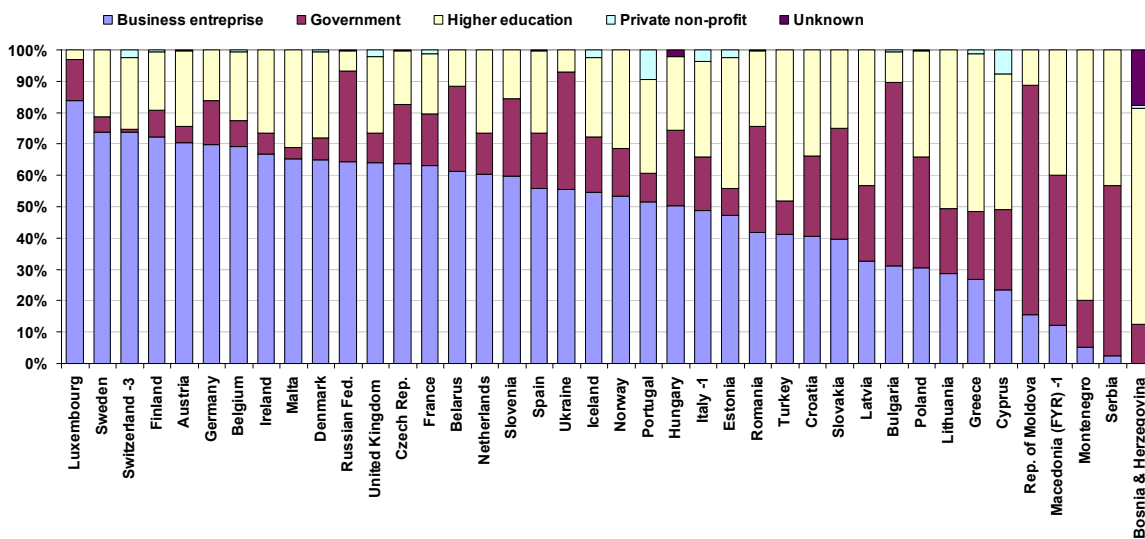
Figures 12, 13 and 14 show how R&D investment is spent by key sectors: business, government, higher education institutions and private non-profit organizations. The figures are based on total available resources, irrespective of their source.

**Figure 12. A breakdown of R&D investment in the Americas GERD by sector of performance, 2007 or latest available year**



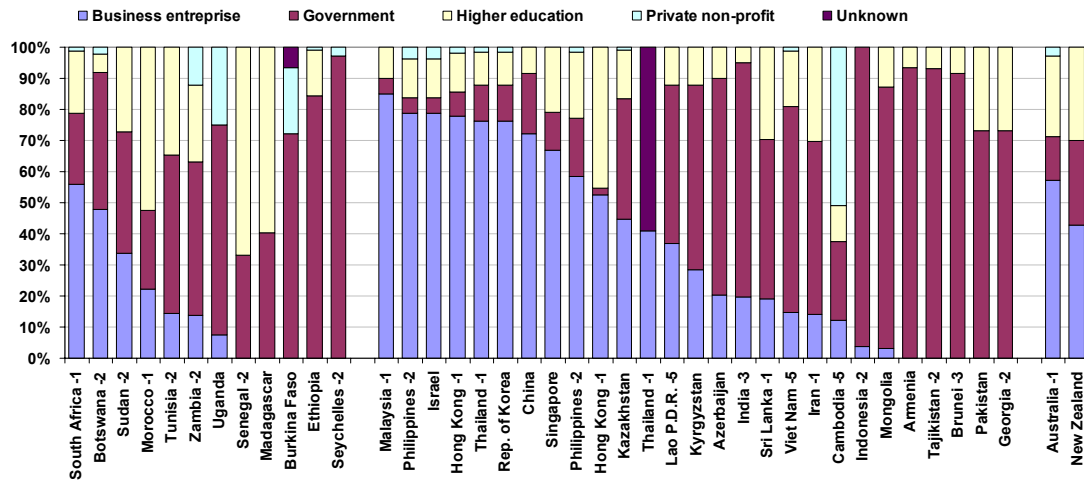
Source: UNESCO Institute for Statistics, September 2009.

**Figure 13. A breakdown of R&D investment in Europe GERD by sector of performance, 2007 or latest available year**



Source: UNESCO Institute for Statistics, September 2009.

**Figure 14. A breakdown of R&D investment in Africa, Asia and the Pacific**  
GERD by sector of performance, 2007 or latest available year



Source: UNESCO Institute for Statistics, September 2009.

According to the data illustrated in Figures 9 to 14:

- In North America, the business sector funded and performed more than 60% of all R&D activities.
- In Europe, more than 50% of R&D was funded and more than 60% performed by the business sector.
- In Oceania, these shares of expenditure funded and performed by the business sector were somewhat less, between 40% and 60% for New Zealand and Australia.
- In Latin America and the Caribbean, the share of the business sector in the funding and performance of R&D was in most cases between 25% and 50%.
- In Asia, there is wide variation between countries in the share of the business sector, ranging from almost zero in the poorest countries, to over 80% in Malaysia.
- Finally, in Africa, the business sector plays a small part in most countries, with government being the most important funding sector and government and higher education institutions, the most important performers of R&D.

## Conclusions

- R&D expenditure and the number of researchers worldwide have grown significantly between 1996 and 2007.
- Most developing countries invest less than 1% of GDP in R&D, but there are some notable exceptions such as China and Tunisia, which have significantly increased their R&D investment during the last 10 years.
- In most developed countries, R&D activities are largely financed and conducted by the business sector. Yet, the public sector plays a major role in most developing countries.
- Globally, women account for slightly more than one-quarter of researchers.
- There is a clear need to collect and analyze quality R&D statistics, especially in developing countries, to support evidence-based policymaking at the national and international levels.
- The data available present only a partial picture. In order to increase the availability of R&D statistics worldwide, the UIS has been engaged in capacity building activities through regional workshops in developing countries.
- The UIS is working on producing guidelines on how to apply the global standards for the collection of R&D data in developing countries.
- Other than R&D data, there is also a clear perceived need in developing countries to collect broader data on their science and technology systems, going beyond the narrower concept of R&D alone.

### Notes and abbreviations:

The reference year is 2007 for all the figures (except for Figures 1 and 4) unless otherwise specified as follows: -1 = 2006, -2 = 2005, -3 = 2004, -4 = 2003, -5 = 2002, -6 = 2001, -9 = 1998.

C.I.S. Europe:	Community of Independent States in Europe.
C.E.O. Europe:	Central, Eastern and Other in Europe.
C.I.S. Asia:	Community of Independent States in Asia.
N.I.E. Asia:	Newly Industrialized Economies in Asia including Hong Kong; Indonesia; Malaysia; Philippines; Republic of Korea; Singapore.
Other Asia:	This excludes Japan, China, India and Israel.
Other Sub-Saharan:	This excludes South Africa.
L.A.C.:	Latin America and the Caribbean.
FTE:	Full-time equivalents.
HC:	Headcounts.
GERD:	Gross domestic expenditure on R&D.
PPP\$:	Purchasing Power Parity Dollars.

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