

German University-based Science: From Model to Contemporary Reality?

1. Introduction

- The enormous potential of a knowledge society depends on continued production of scientific knowledge, but also its specification and enhanced quality.
- While global production has grown substantially, a few nations still produce the overwhelming majority of new science (see fig. 1).
- Our preliminary research suggests that differences in key aspects of institutional models of higher education development and science capacity-building are associated with cross-national differences in scientific knowledge production over time.
- Scientific publications (especially journal publications) are the fundamental way of allocating and ascribing reputation.

2. Project description

Science Productivity, Higher Education Development, and the Knowledge Society: China, Germany, Japan, Taiwan, Qatar, United States (NPRP No.: 5-1021-5-159) funded by the QNRF (2012-2014)

This project is a cross-national investigation of the influence of higher education development and science capacity-building on scientific knowledge production. Measuring science on the basis of published papers in selected STEM disciplines, we identify factors behind national differences and global similarities. How does variation in national models and strategies to develop higher education and research universities explain different long-term national trajectories in science productivity since 1900? Observing unprecedented growth in scientific knowledge productivity, we selected six cases that represent different phases of higher education development and science-based societies: a major European precursor model (Germany's "Humboldtian" research university), broad institutionalization of the currently dominant model (American "super research university"), and a range of innovators in Asia (Japan, China, Taiwan) and the Middle East (Qatar).

The German "Humboldtian" university model

Preeminence in modern science since 19th century into the 20th

Characteristics: Freedom to teach and to study, autonomy of and commitment to science, monopoly on granting doctoral degrees

Foundational principle of a research university: nexus of research and teaching

Equipped with enormous prestige and receiving sustained attention worldwide

Rise of extra-university research institutes in Germany

Massive educational expansion in the 1960s

Characteristics: Well-resourced, cutting-edge facilities, limited teaching duties

Determined by federal interdependence, as both the Federal and *Länder* governments jointly provide the funds for these institutions

International collaborations were animated by major research associations (HGF, MPG, WGL, FhG)

3. Research question

To what extent is higher education development in Germany a model for expanding higher education systems in other countries?

4. Hypotheses

H1: The foundational principle of the modern research university, established in Germany, is the nexus of research and teaching.

H2: Massive tertiary educational expansion over the post WWII period, the rise of extra-university research institutes, and establishment of praxis-oriented universities of applied sciences challenge the foundational principle.

H3: Today, the dual structuring of German science – research universities and specialized extra-university research institutes – affects research capacity and may threaten this globally popular model.

5. Data and methods

Qualitative study: Historical study of each nation's model of university-based science of higher education development, and of science capacity-building – and comparison of these.

Quantitative study: Stratified representative sample of published papers in journals in science and technology disciplines, relying on a unique raw dataset from Thomson Reuters' Web of Science (1900-2010).

Conclusion

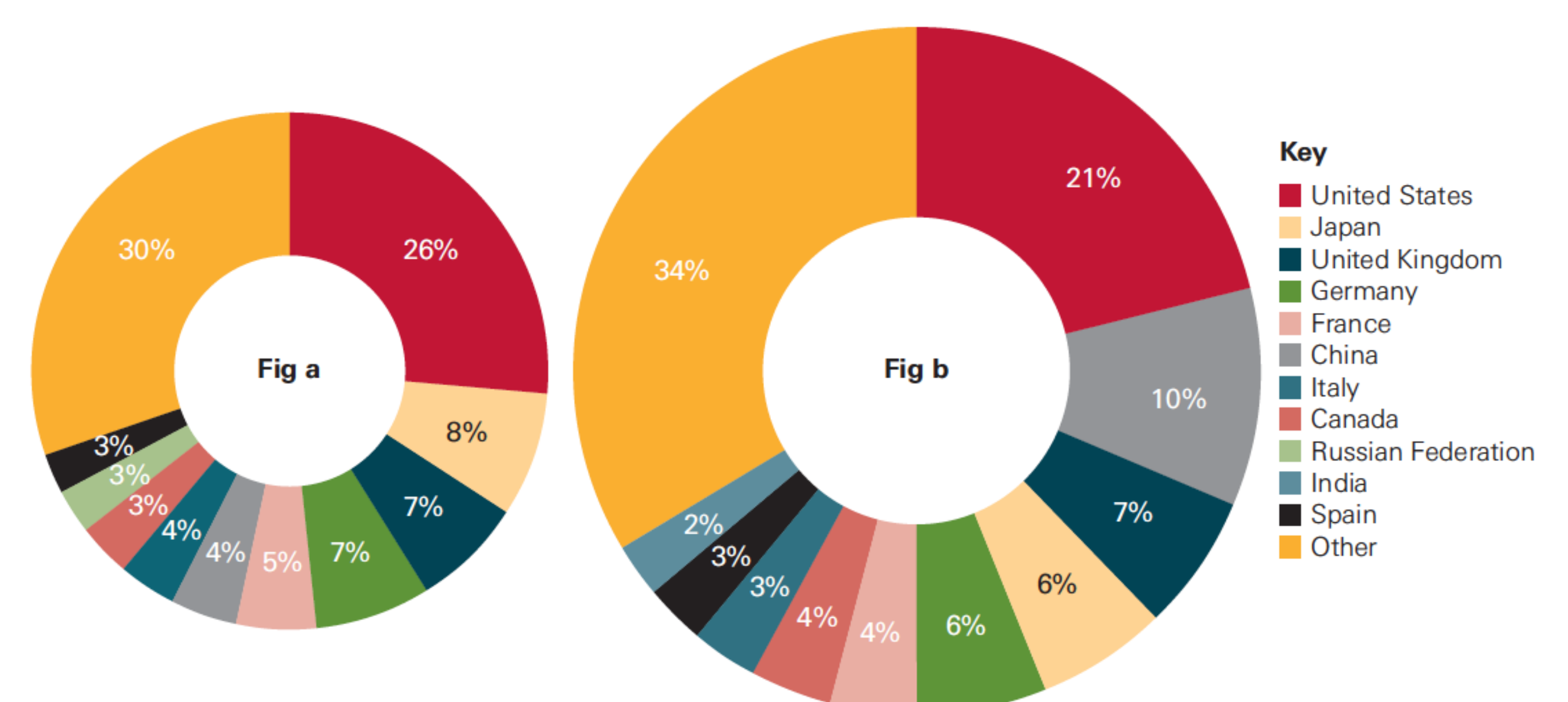
Germany successfully exported its educational model – the research university – worldwide. With substantial research capacity, the German "Humboldtian" university model inspired the American. The super research university is an achievement that takes the German model one step further. To some extent, Education City in Doha has indirectly incorporated the German "Humboldtian" university model with the establishment of branch-campuses of American and European universities.

6. Results

- Beginning of the 20th century: Germany experienced an alliance between representatives of science, research-intensive industry and ministerial bureaucrats of states (*Länder*), engaged in founding large research institutes independent of universities. As a result Universities lost their research monopoly.
- Massive tertiary educational expansion, the rise of extra-university research institutes, and establishment of praxis-oriented universities of applied sciences challenge the foundational principle of the nexus of research and teaching and the relatively equal status of German universities, threaten this globally popular model, and reduce university-based research capacity in Germany.
- Establishment of a structural duality: parallel worlds of independent research institutes and research universities.
- Successful R & D leads to scientific findings or technological inventions. Scientific findings are reflected primarily in scientific publications.
- Universities and research institutes ignore each other or compete, less than cooperate with each other.
- Universities have maintained their positional status, even if they lack the resources enjoyed by the diverse institutes of the four state-funded research associations (see fig. 2).
- Nevertheless, Germany's dual pillars of mass universities and prestigious independent research institutes continue to boast one of the largest national scientific outputs globally. With an annual R & D investment of 2.91% GDP (2011), Germany has among the highest levels of science investment in Europe.
- Measured in publications, Germany still competes at the very top of global science.
- Germany still provides a model for expanding higher education systems.

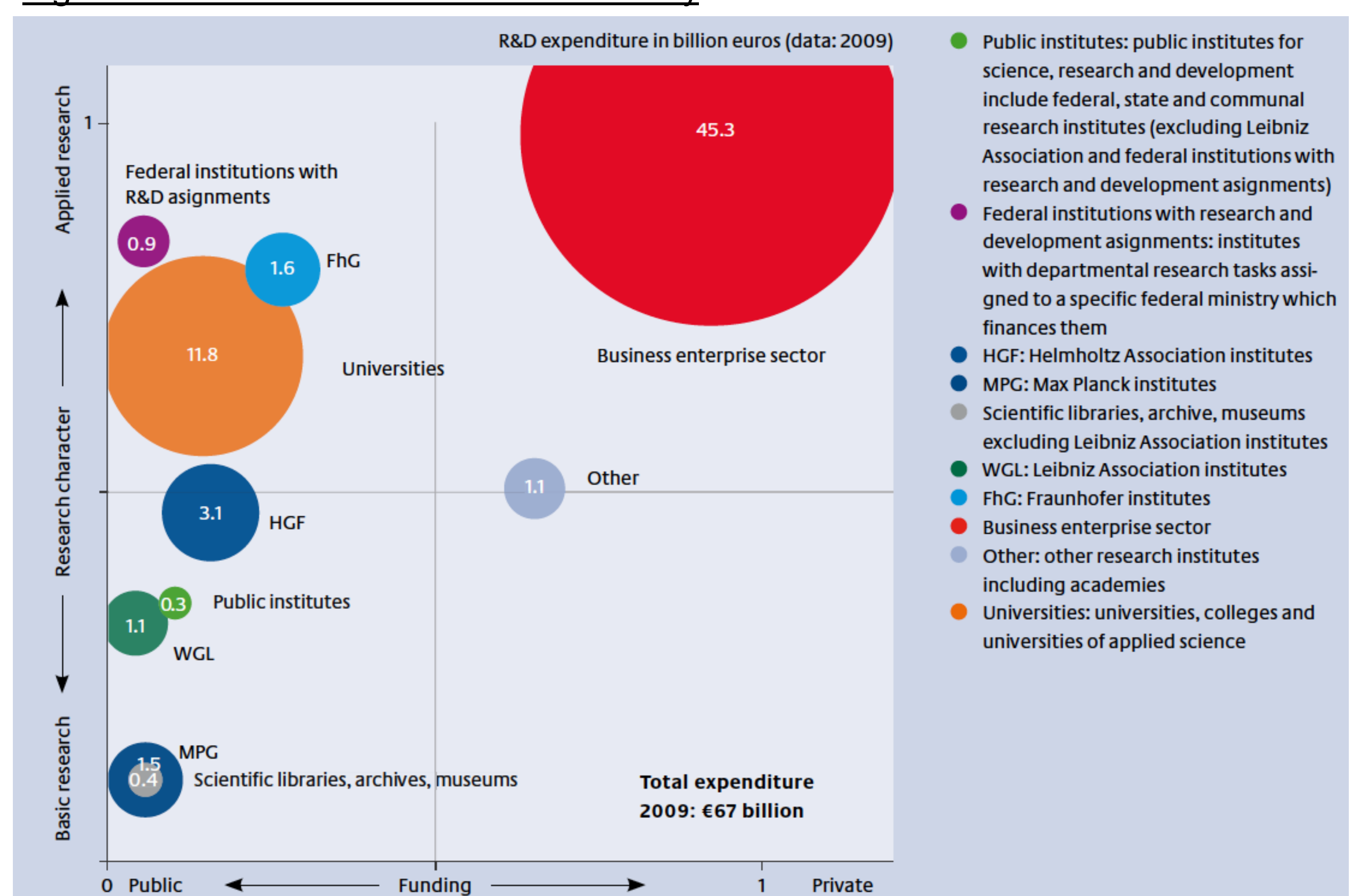
Figure 1: Proportion of global publication authorship by country

The top ten producing countries in each period are shown. **Fig a.** 1999-2003. **Fig b.** 2004-2008



Source: The Royal Society (2011): *Knowledge, Networks, and Nations: Global scientific collaborations in the 21st Century*. London, p. 17.

Figure 2: Investments in R & D in Germany



Source: Federal Ministry of Education and Research (2012): *Federal Report on Research and Innovation 2012*. Berlin, p. 36.