

# Universities and Research Institutes: A Comparative Historical Analysis of Scientific Productivity from 1900 to 2011

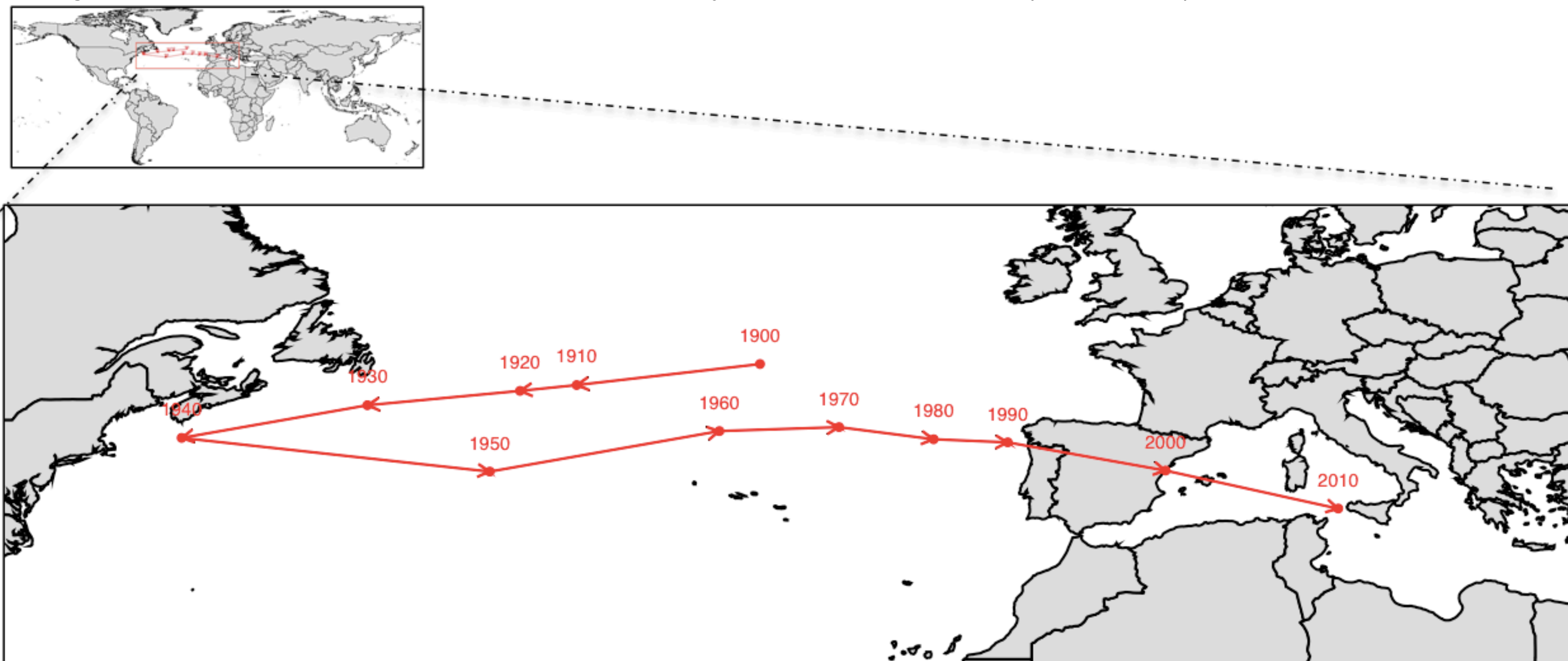
## Project description

**Science Productivity, Higher Education Research & Development, and the Knowledge Society: China, Germany, Japan, Taiwan, Qatar, United States (NPRP No.: 5-1021-5-159) funded by the QNRF (2012-2015)**

My dissertation, part of an international research project in the field of HE and science research, focuses on a cross-national investigation of the influence of HE development and science capacity-building on scientific knowledge production. Investigating patterns of scientific productivity and networks in science and technology disciplines (STEM+), I emphasize how differences in national models in developing research universities and institutes can help to explain long-term cross-national trajectories in scientific productivity since 1900. Measuring science on the basis of published papers in selected STEM+ disciplines, I identify factors behind national differences and global similarities. My study uniquely includes a systematic analysis across an extensive historical scope and selected countries to chart unprecedented growth in scientific knowledge productivity and HE development.

I am particularly interested in the eminent model of modern science: the German Humboldtian model of university-based science (established at the beginning of the 19th century) built upon its basic principle—the unity of research and teaching—that enjoys sustained attention worldwide. But with massive tertiary educational expansion (1960s), the rise of powerful extra-university research institutes, and establishment of praxis-oriented universities of applied sciences, this model has come under pressure.

Figure 1: Evolution of the Global Center of Gravity of SCIE Publications (1900-2010)



Source: Zhang, Powell, Baker. 2015. "Exponential Growth and the Shifting Global Center of Gravity of Science Production, 1900-2011." Change: The Magazine of Higher Learning 47(4): 46-49.

## Research questions

1. How was/is the German model of university-based science embedded in global developments of HE and science over time?
2. Among all science producing organizational forms—universities and research institutes—contribute to scientific productivity? Which structures provide the best conditions for scientific productivity?
3. How and why has the competition (and collaboration) between universities and research institutes affected university-based science in Germany?

## Data and methods

Historical study of Germany's model of university-based science of HE development, and of science capacity-building.

Stratified representative sample of published papers in journals in science and technology disciplines, including medicine (STEM+). My measure is the number of published research articles in peer-reviewed scientific journals alongside an extensive historical scope, relying on a unique raw dataset from Thomson Reuters' Web of Science (1900-2011).

Figure 2: Exponential Growth of Scientific Publications

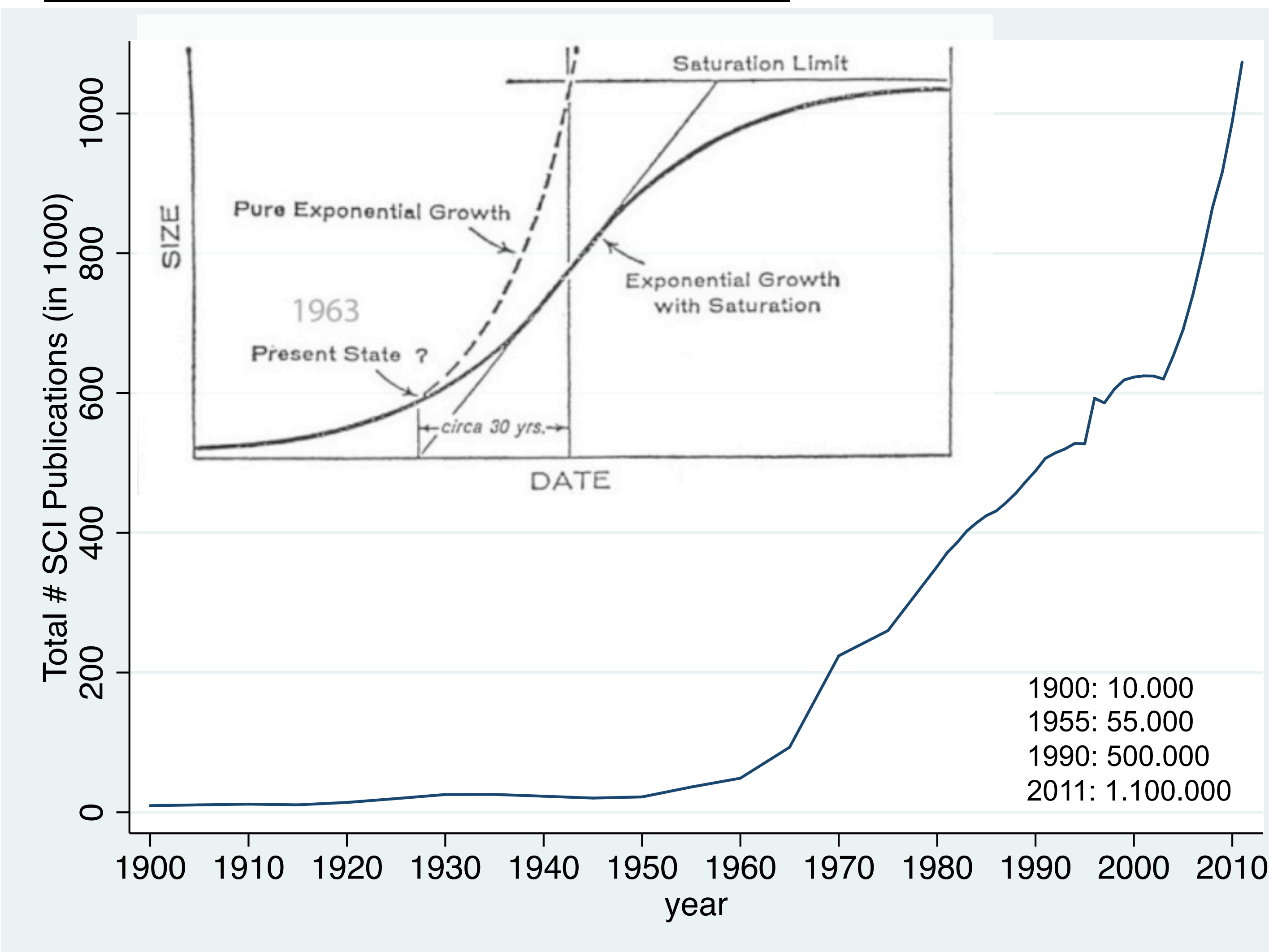
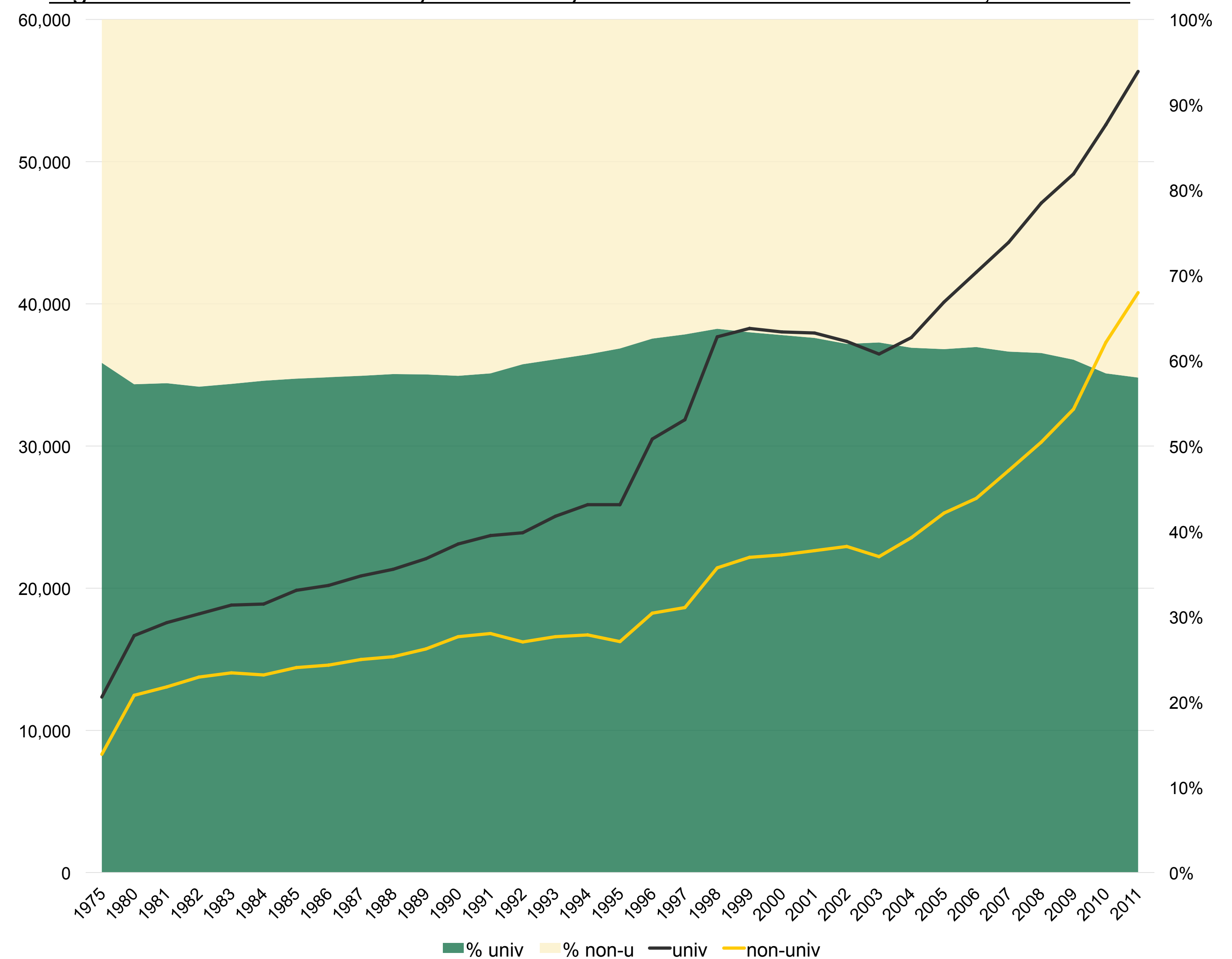


Figure 3: Scientific Productivity in Germany: universities vs. non-universities, 1975-2011



Source: Derek J. de Solla Price. 1961. Science Since Babylon. New Haven: Yale University Press.; Derek J. de Solla Price. 1963. Little Science, Big Science. New York: Columbia University Press.; Zhang, Powell, Baker. 2015. "Exponential Growth and the Shifting Global Center of Gravity of Science Production, 1900-2011." Change: The Magazine of Higher Learning 47(4): 46-49.

## First results

- Germany successfully exported its educational model—the research university—worldwide
- Massive expansion and rise of scientific publications worldwide
- This rise was accompanied by shifts of the “global center of gravity of science production”
- No flattening or slow down of the worldwide growth
- The globalization of massive science production began earlier than commonly thought
- In Germany we find a symbiosis of established research universities and extra-university research institutes → remarkable and sustained growth of science, building on the institutionalization of both key organizational forms