
SCIENCE-INDUSTRY CO-PUBLICATIONS IN CHINA AND GERMANY

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Foto: W. Zöller, Fraunhofer

Structure of the talk

1. Conceptual framework for science-industry linkages
2. Co-Publications and co-patents in an international comparison
3. Empirical findings from previous studies
4. Empirical findings for China (and Germany in comparison)
5. Summarizing Conclusions



Knowledge creation effects of science-industry collaborations

- Knowledge production in companies is one of the most important factors to **enhance the competitiveness** of industry (Nonaka and Takeuchi, 1999)
- A knowledge advantage can help to better **assess (risky) situations and decisions** in an uncertain environment (e.g. Rosenberg, 1990; Fleming and Sorenson, 2004)
- **First-mover advantages** based on self-conducted fundamental research (Rosenberg, 1990)
- There is an intrinsic motivation of firms to collaborate with public research; analyses prove a positive effect of the collaborative activities (Narin et al. 1997)
- Access of firms to different types (social, technological and positional) of “academic” capital (Wang and Shapira (2012)
- Collaborations with universities enable companies to outsource and/or enhance research activities
- Companies strive to increase the collaboration effort (e.g. Liebeskind et al., 1996; Powell et al., 1996; Vallas and Kleinman, 2008) while downsizing their own R&D departments (Chesbrough, 2003)

Signaling effect of science-industry collaborations

- Scientific publications as a **signal to other organizations** (Hicks 1995)
 - main targets of scientific publications by companies are research partners
- Nowadays publications can also be used as a **marketing tool** sending signals about current assets and potentials to
 - venture capitalists
 - prospective partners
 - consumers and also
 - competitors
- It was shown (Simeth and Cincera 2013) that an existing signaling effect **positively affects the market value**
- In the case of the new **foundation of companies**, scientific publications can act as important bargaining chips and signals (Kulicke and Schleinnkofer 2011)

Science-Industry-Linkages: What for?

- The linkage between science and industry was long seen as a **simple problem of organizing the transfer** from science to industry
- Policy makers meanwhile are equipped with a bundle of **tools to foster science industry linkages**, technology transfer and collaborations (e.g. D'Este, Patel 2007; Perkmann, Walsh 2007)
- Distinction between **top-down policies** to support the implementation and commercialization of inventions and rather **bottom-up driven approaches** that provide positive framework conditions and seedbeds for the collaboration of actors with common and complementary interests (Frietsch, Schubert 2012; Goldfarb, Henrekson 2003)
- Basic idea: commercializing and implementing the knowledge generated by public science organizations adds to the **competitiveness of national/regional industry**
- In the context of established (Schwartz, Hornyk 2010; Tijssen 2006; Wang, Shapira 2012) as well as emerging (Bodas Freitas et al. 2013; Wu et al. 2010; Wu, Zhou 2012) countries the role of science-industry collaboration and exchange has been discussed intensively

Science-Industry-Linkages: What for?

- There are at least two reasons from a social or political point of view for setting up **policies to improve technology transfer** or science-industry linkages:
 - increase of the **competitiveness** of firms in the country or region
 - **Financial benefits** for universities and public research institutes in **commercializing** their knowledge
- **Three paradigms** that legitimate policy making with the aim of improving technology transfer Bozeman (2000) :
 - market failure
 - Mission
 - cooperative technology (
- In addition: access to knowledge and the entrance of new actors, especially SMEs, to R&D and innovation via the collaboration with public research (**competitiveness and structural change**)

Empirical findings in a previous study*

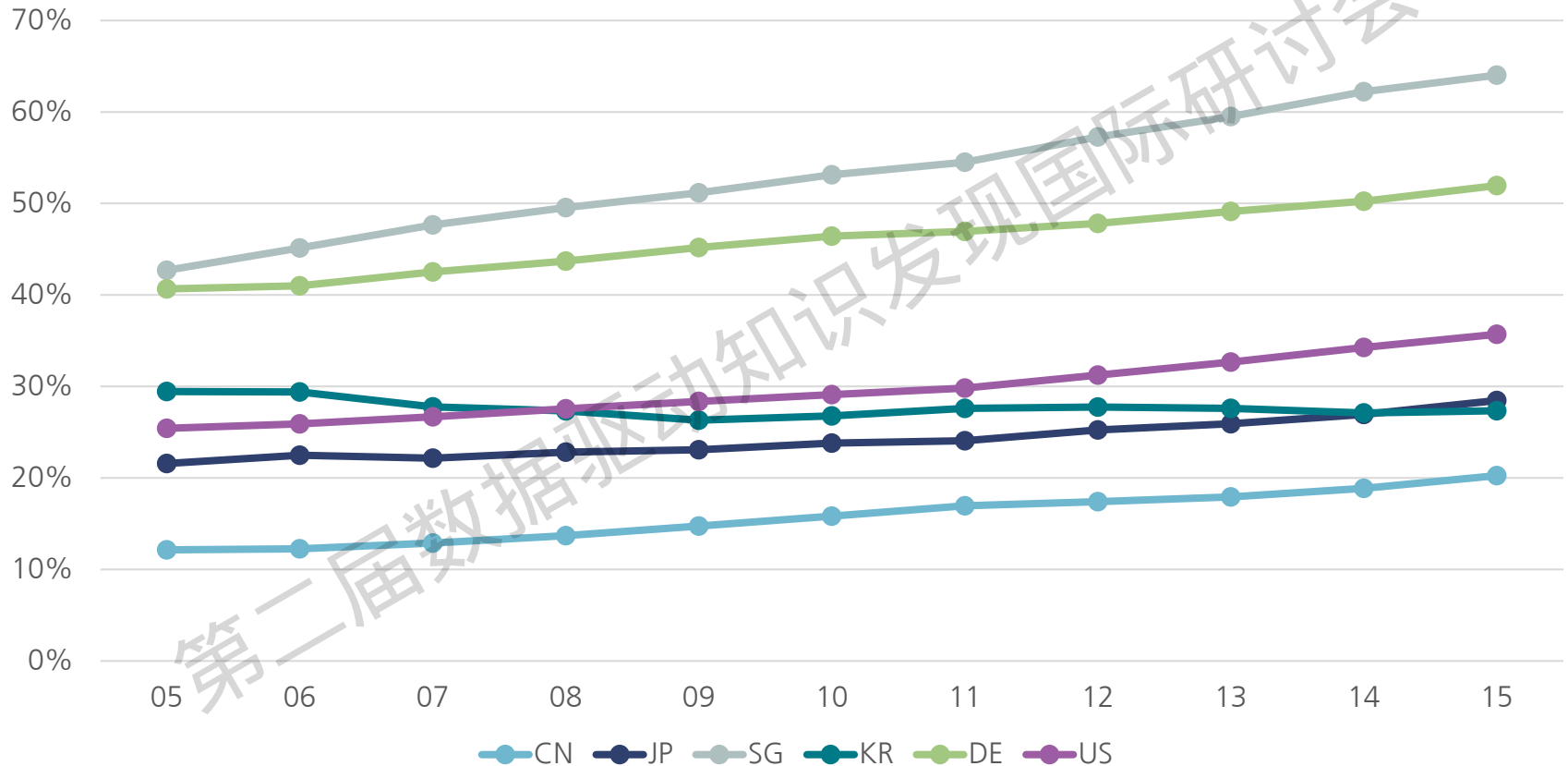
- Typically, **older firms publish more** than younger firms
- **Larger firms publish more** than small and medium sized firms
- Publications are more **common in manufacturing** than in most other sectors
- No (significant) difference between high-tech and medium/low-tech firms
- German companies are – in comparison with other organization forms – more prone to publish in German
- Companies are most active in **Life Sciences** (medical instruments and pharmacy) as well as in **engineering** fields (electrical, chemical, specific engineering) and in **optics and measurement/control**

* (Mund, C.; Frietsch, R.; Neuhäusler, P. (2015): Performance and Structures of the German Science System 2014, Studien zum deutschen Innovationssystem Nr. 7-2015, Berlin: Expertenkommission Forschung und Innovation (EFI))

Methods

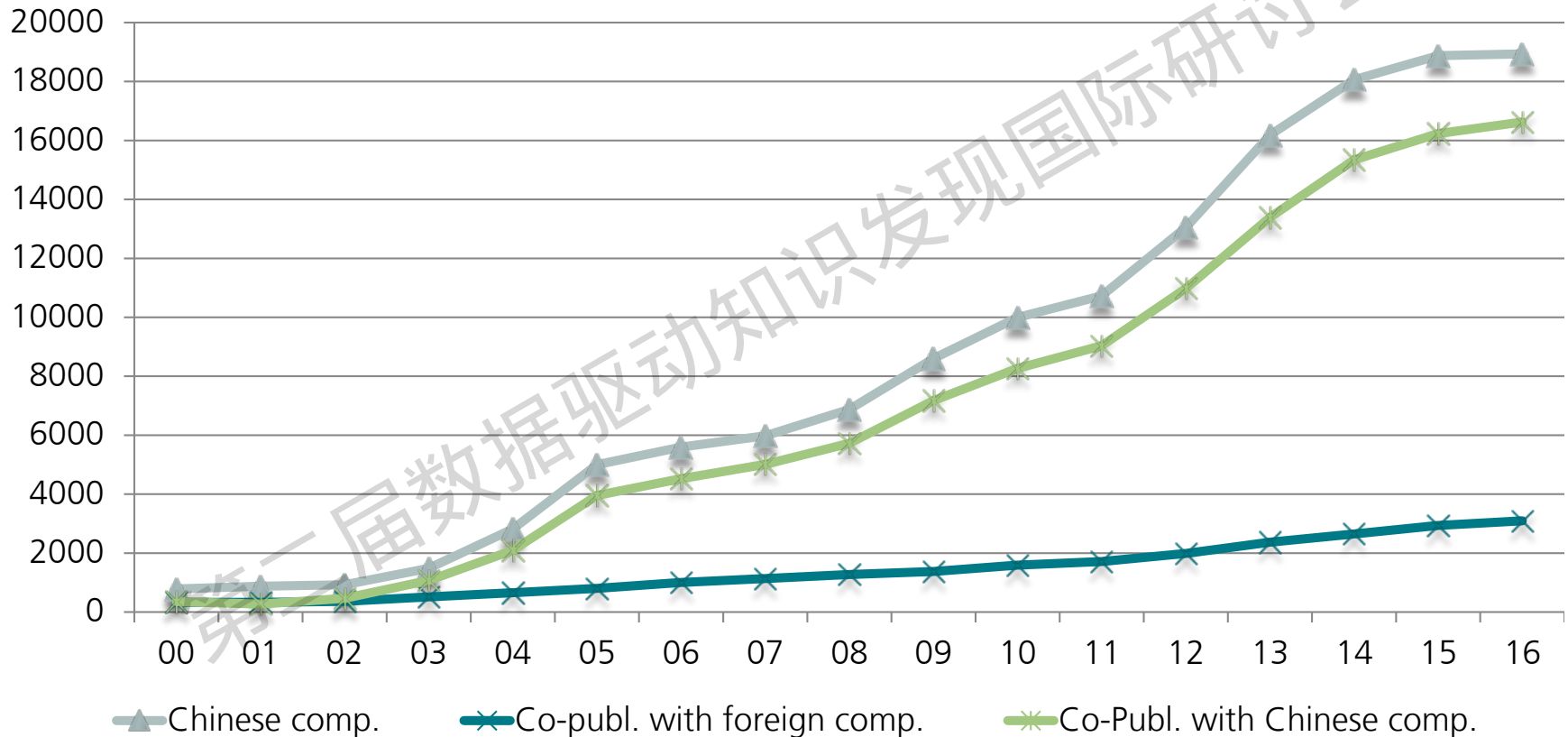
- **Scopus** data (article, letter, note, review)
- Identification of companies in the „affiliation“ field using **legal extensions** (e.g. LLC, AG, GmbH etc.)
- Analyzing **publication and citation output** of companies collaborating with Chinese research organizations between 2000 and 2016
 - Same analysis for Germany as a comparison
 - Differentiation also by field

Shares of international co-publications



Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Absolute number of publications and co-publications by companies in China



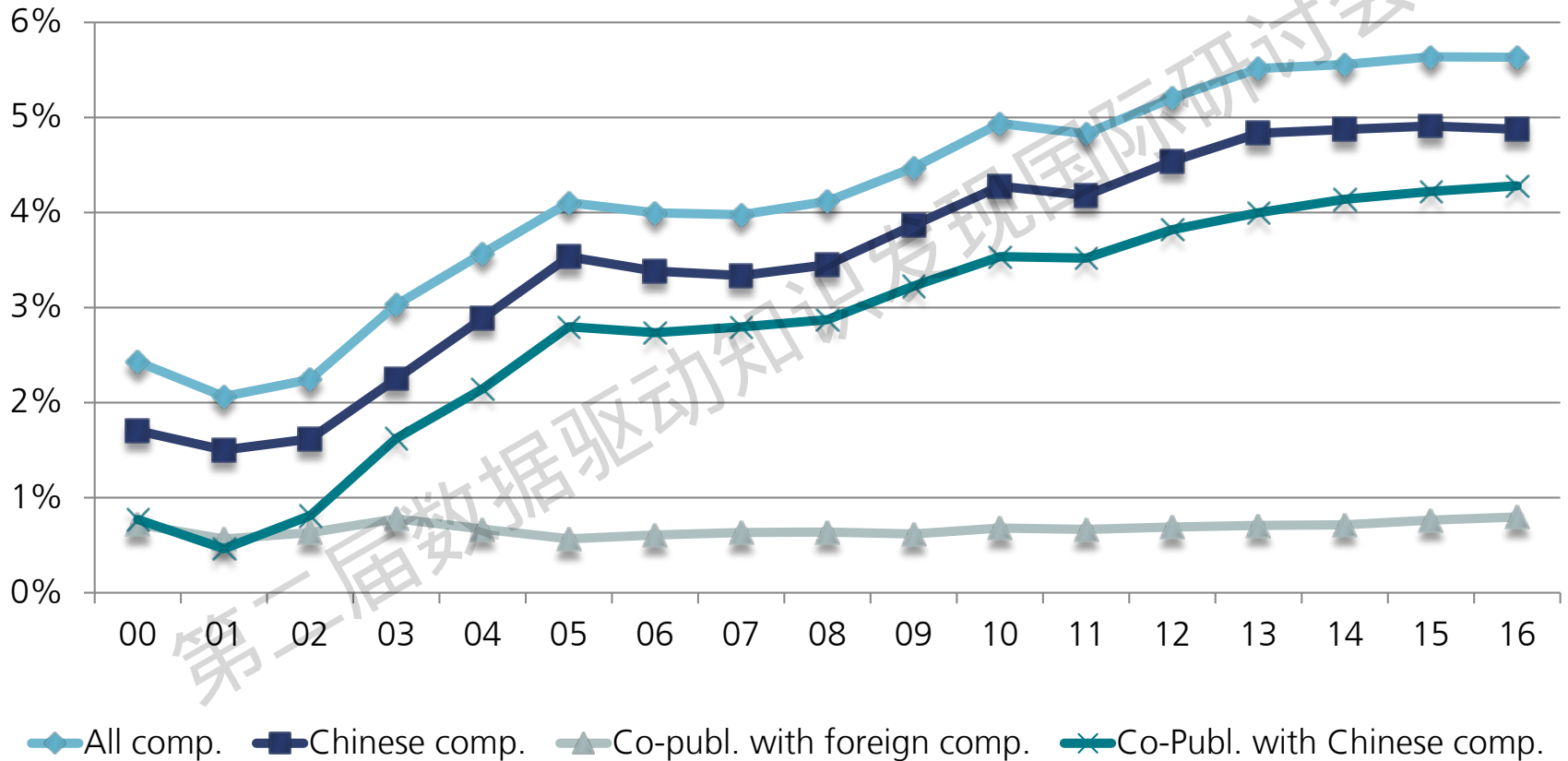
Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Top20 companies collaborating with public research organizations in China

Rank	ORGANIZATION	COUNTRY	PUB
1	26th Institute of China Electronics Technology Group Corporation	CN	1330
2	Baoshan Iron and Steel Co. Ltd.	CN	1084
3	PetroChina Tarim Oilfield Company	CN	955
4	Cleveland Clinic Foundation	US	827
5	Electric Power Research Institute of Guangdong Power Grid Corporation	CN	781
6	Capital Aerospace Machinery Company	CN	671
7	Wuhan Iron and Steel Co	CN	637
8	China Southern Power Grid Co. Ltd.	CN	591
9	China Aerospace Science and Technology Corporation	CN	495
10	Huawei Technologies Co., Ltd.	CN	491
11	PetroChina Company Limited	CN	480
12	PetroChina Dagang Oilfield Company	CN	440
13	China Shipbuilding Industry Corporation	CN	435
14	China FAW Group Corporation R and D Center	CN	409
15	China Petroleum and Chemical Corporation	CN	368
16	SINOPEC	CN	346
17	Nuclear Physics Institute AS CR	CZ	346
18	China National Nuclear Corporation	CN	327
19	China Railway Eryuan Engineering Group Co. Ltd	CN	306
20	ZTE Corporation	CN	284

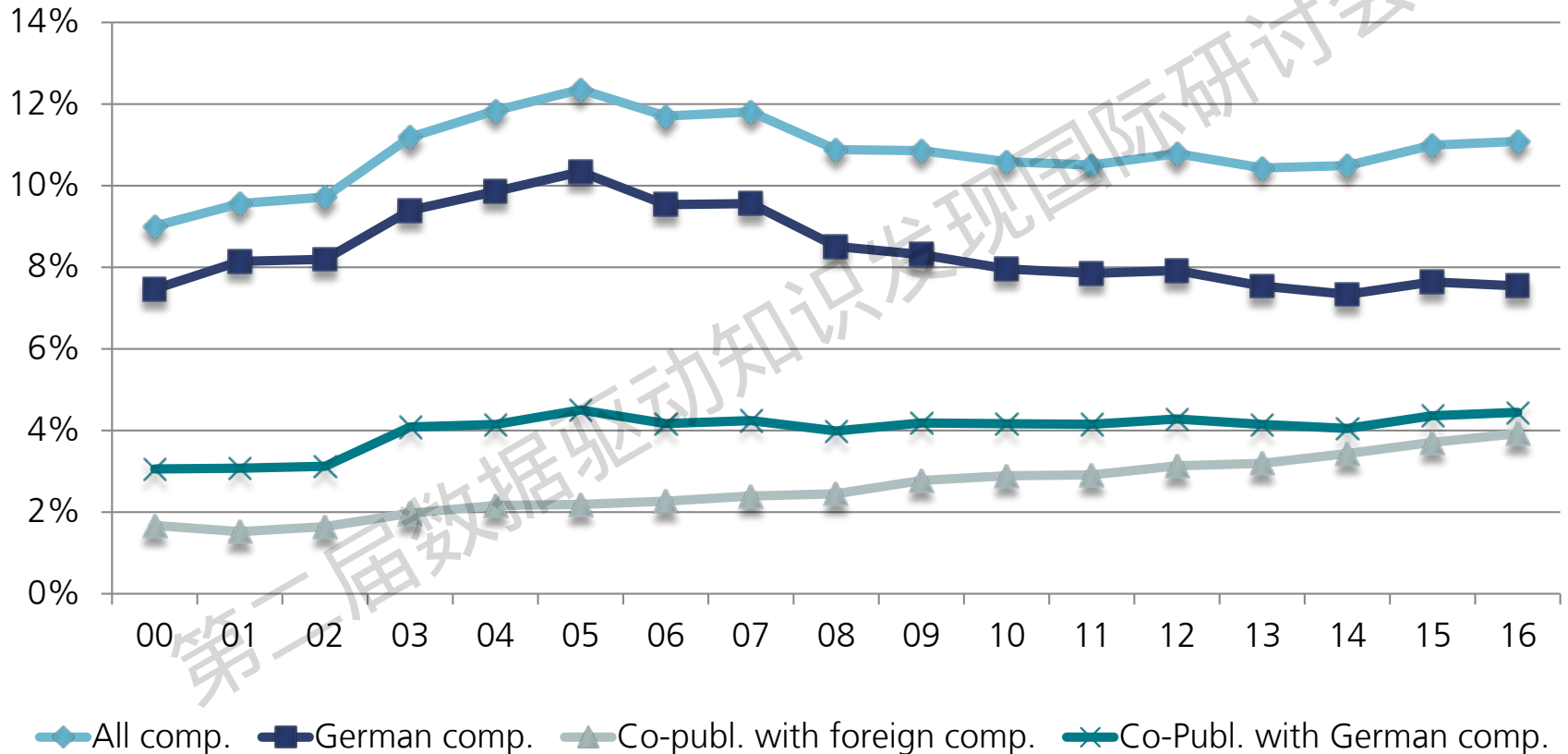
Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Shares of publications and co-publications by companies in China



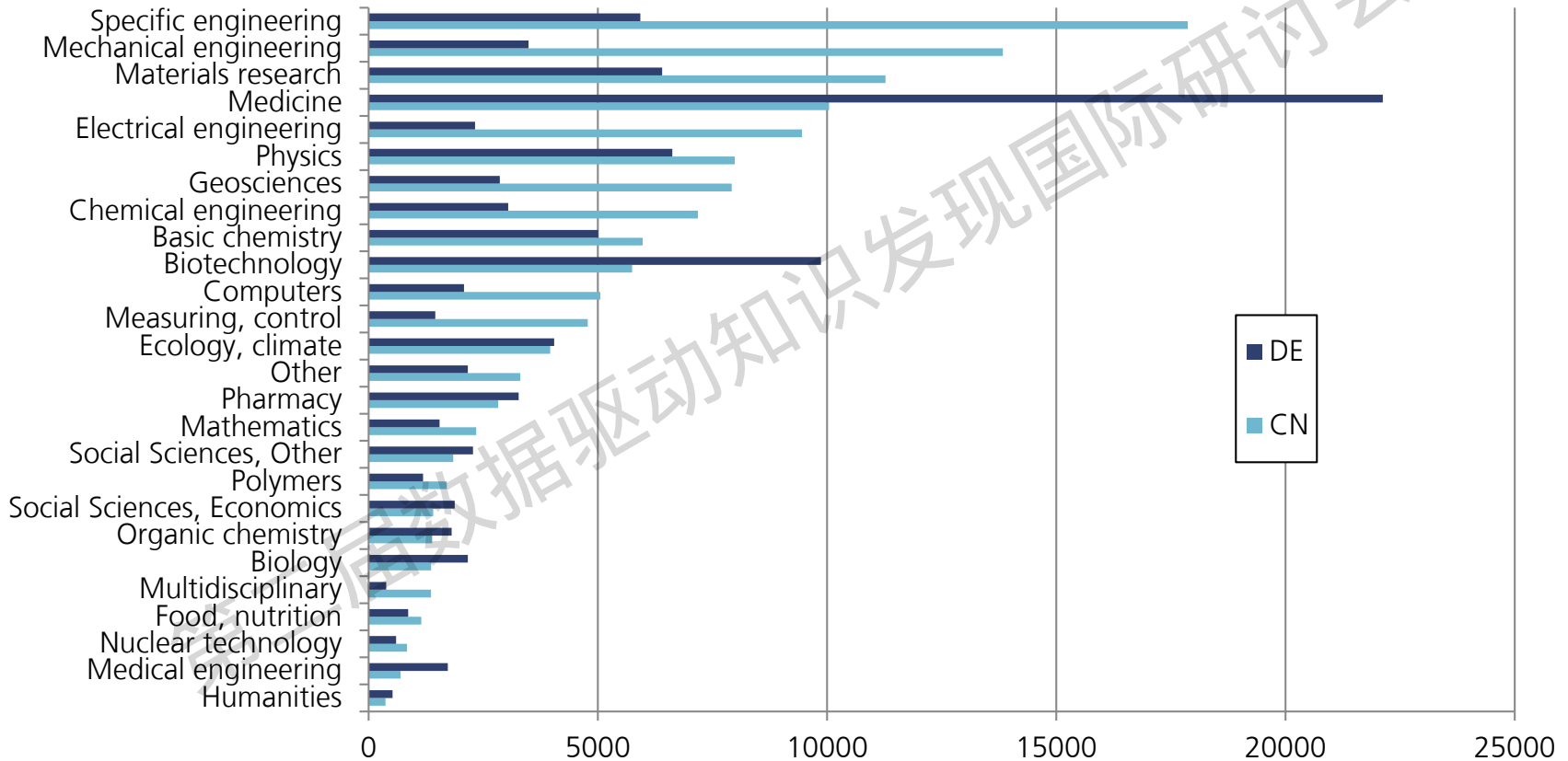
Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Shares of publications and co-publications by companies in Germany



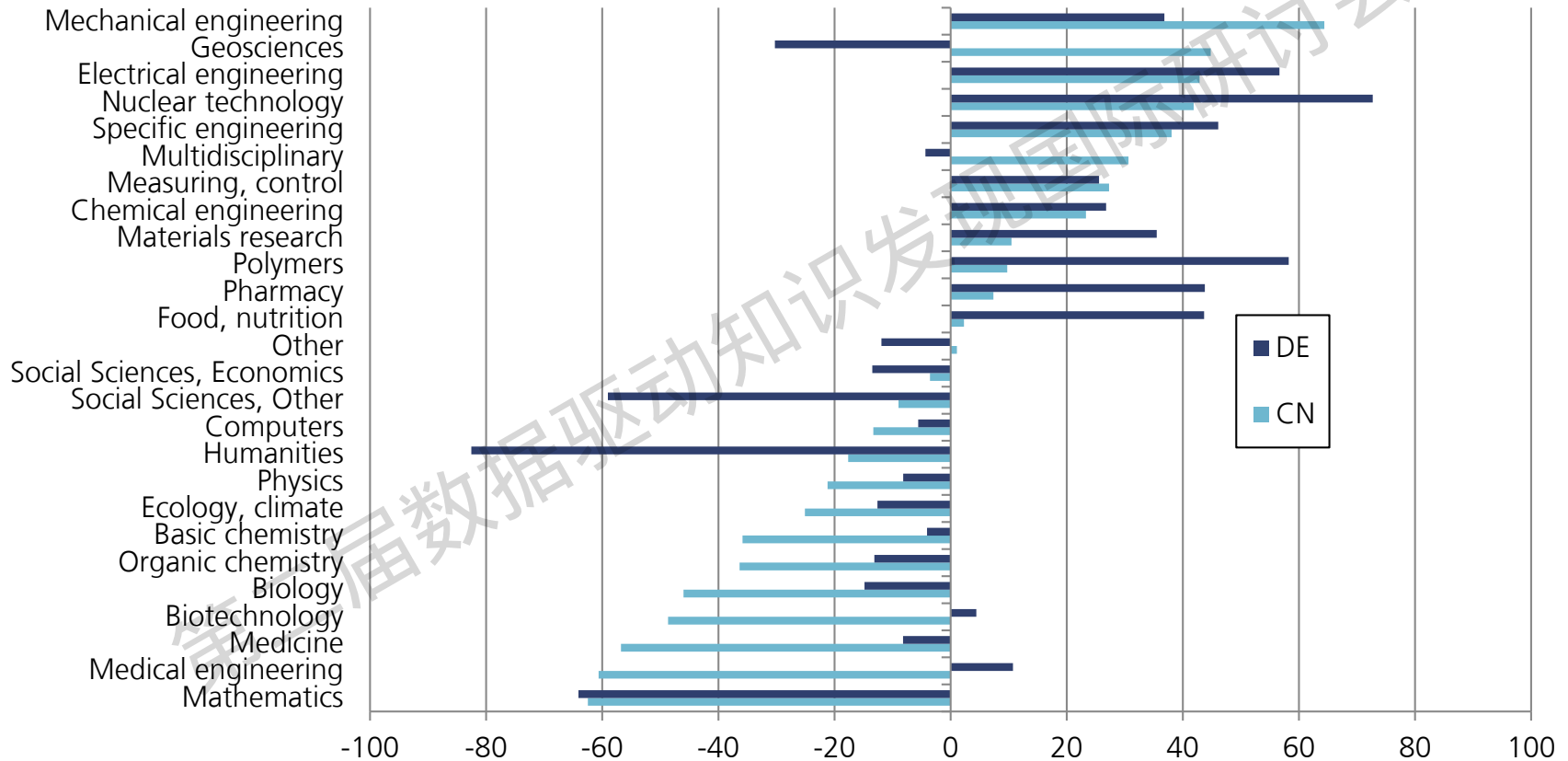
Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Absolute number of co-publications of companies and public research, 2012-2014



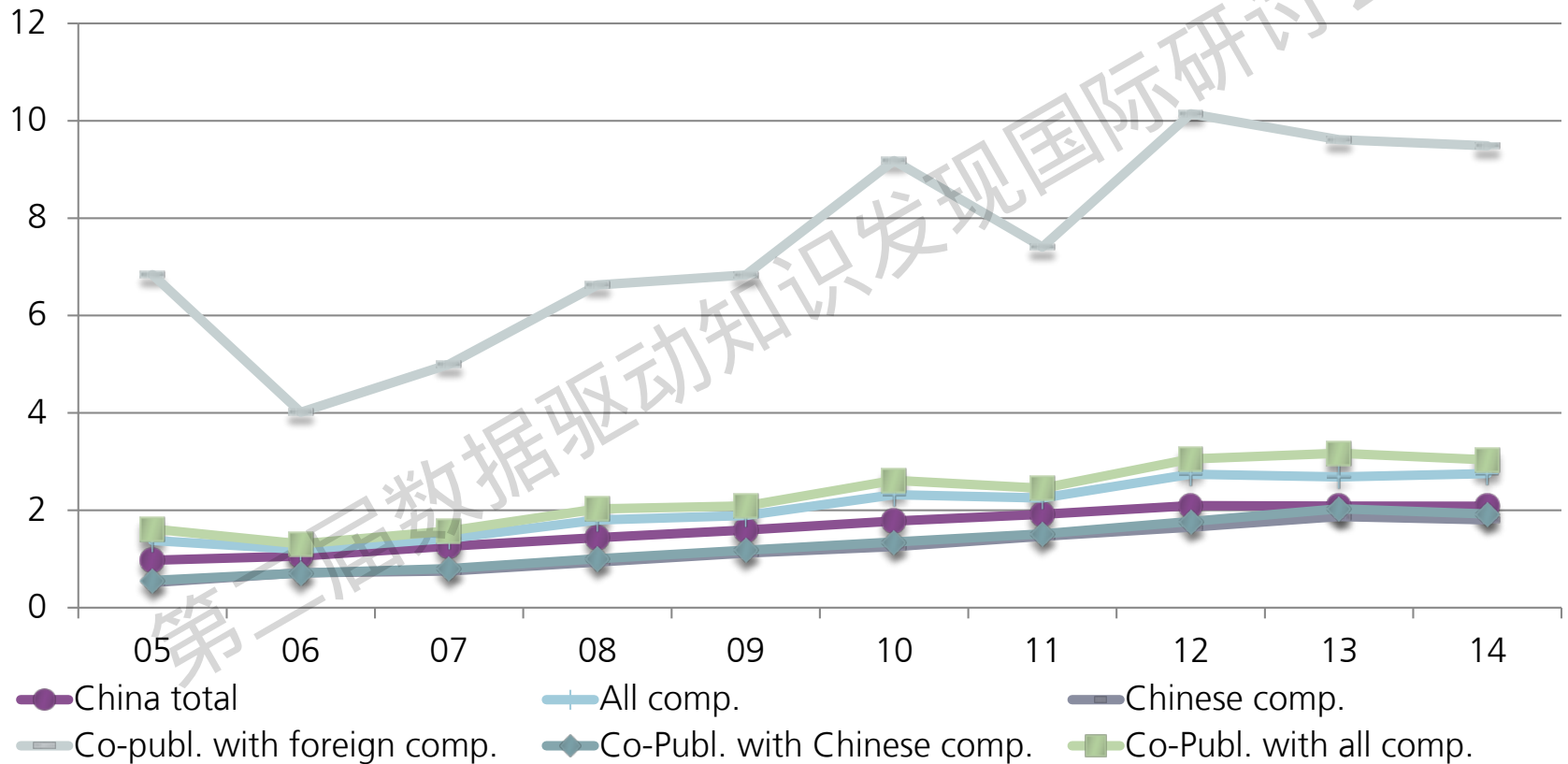
Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Specialization Index of co-publications of companies and public research, 2012-2014



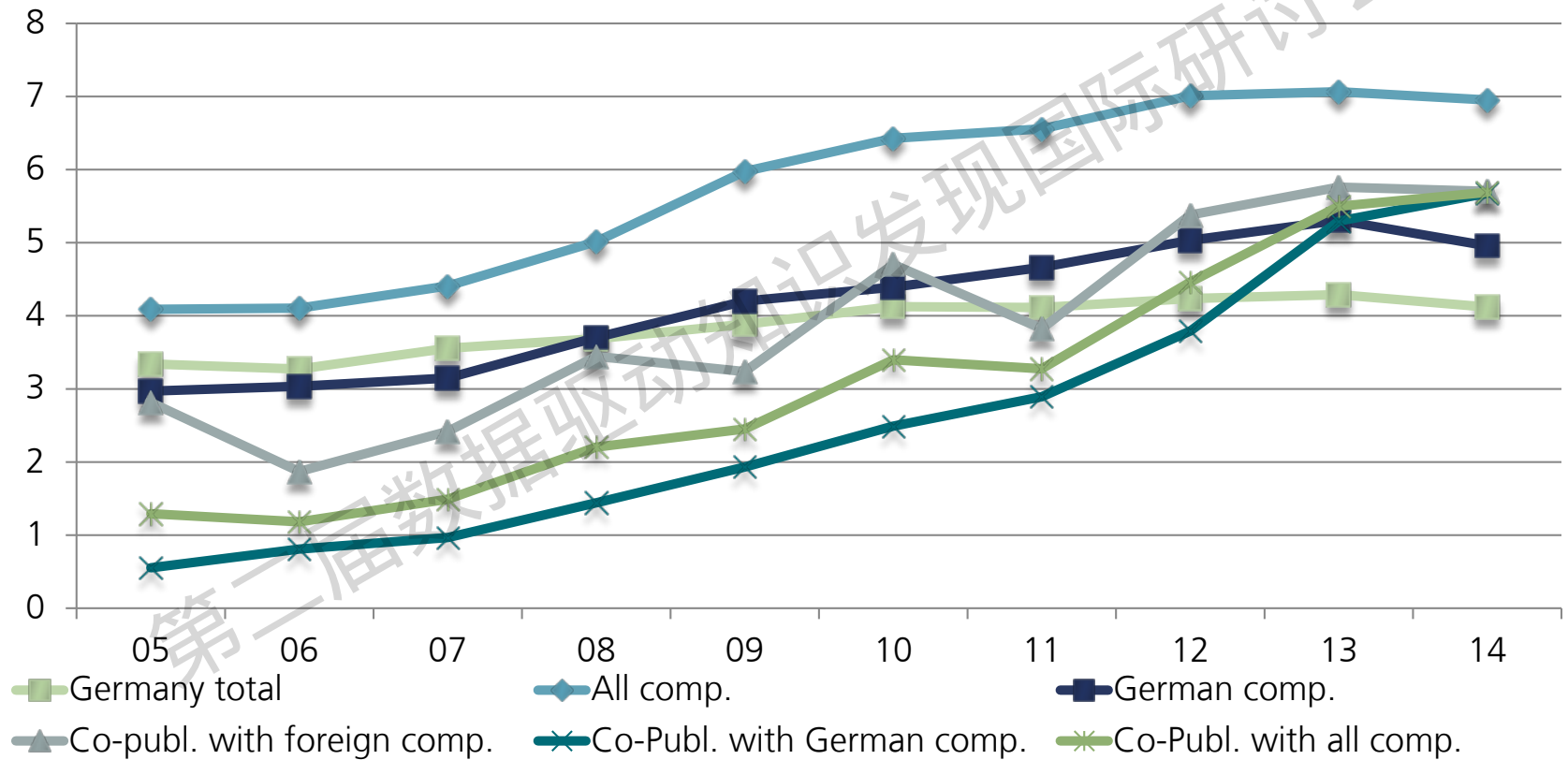
Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Average citations received per paper - China



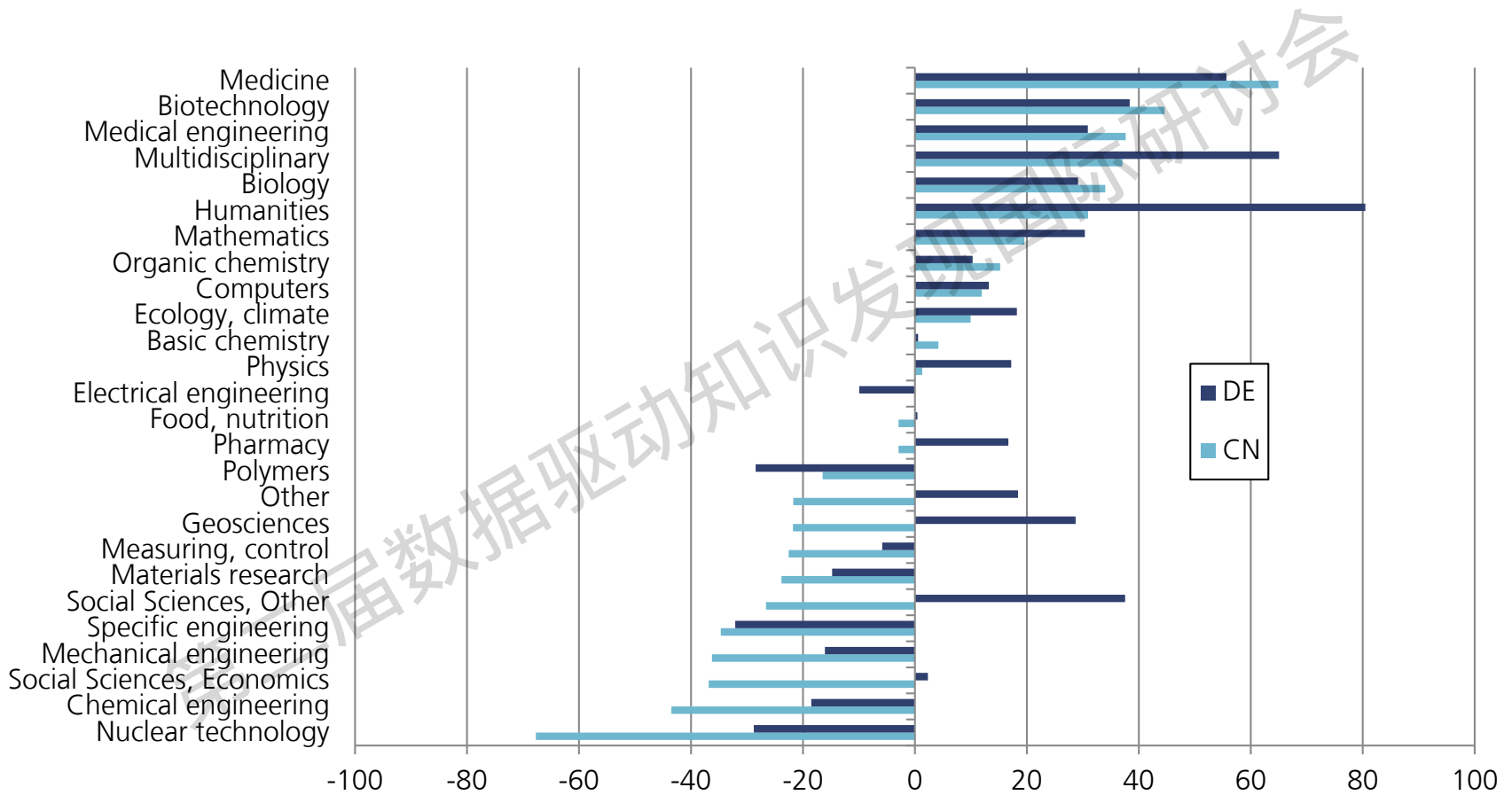
Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Average citations received per paper - Germany



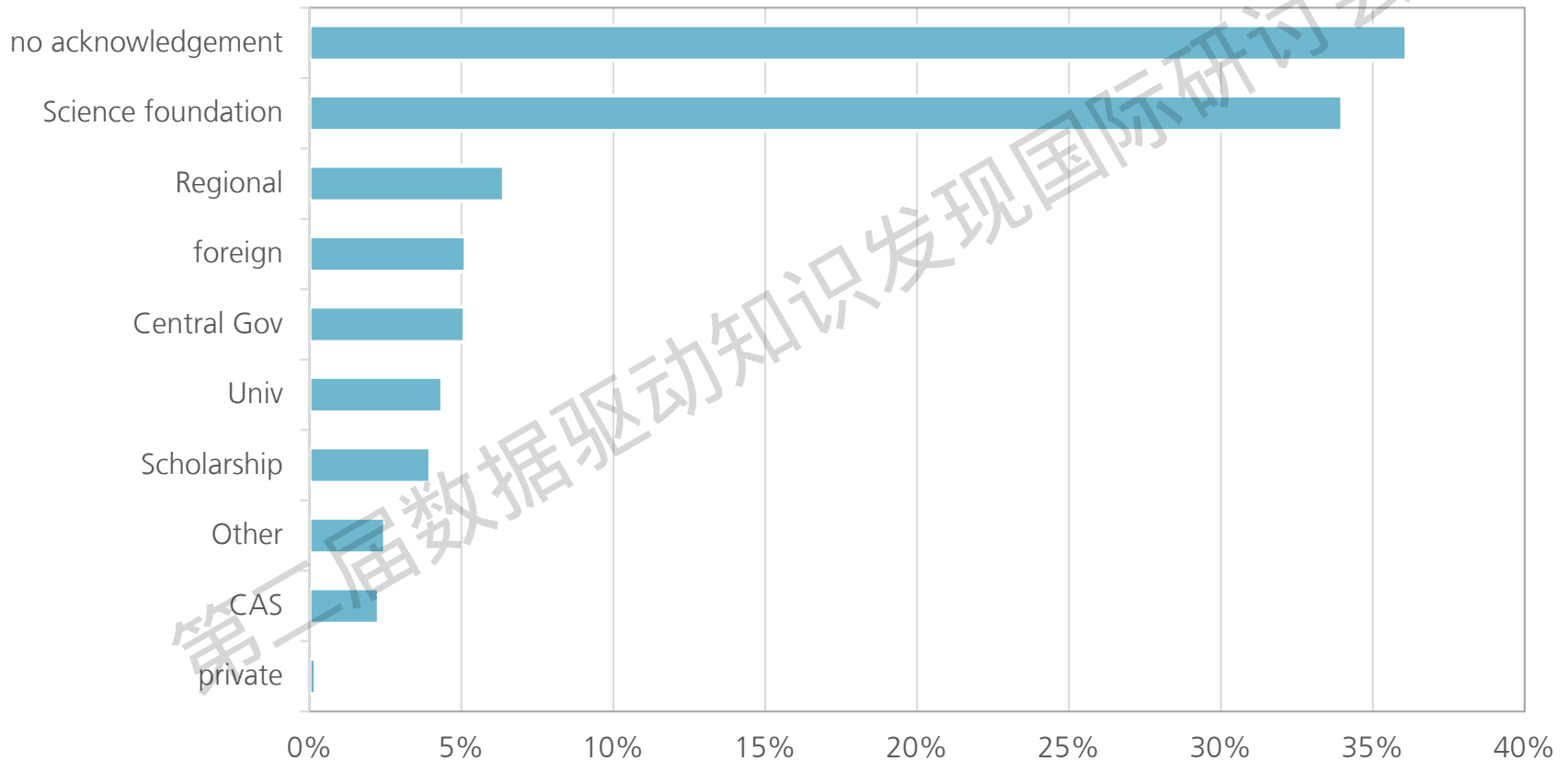
Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Citation Index of co-publications of companies and public research, 2012-2014



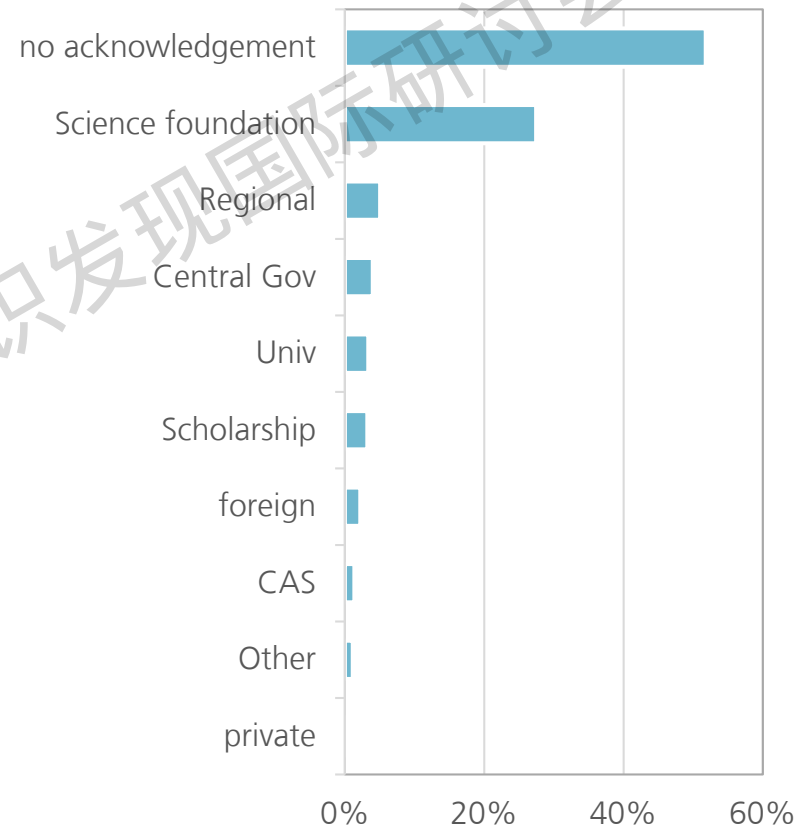
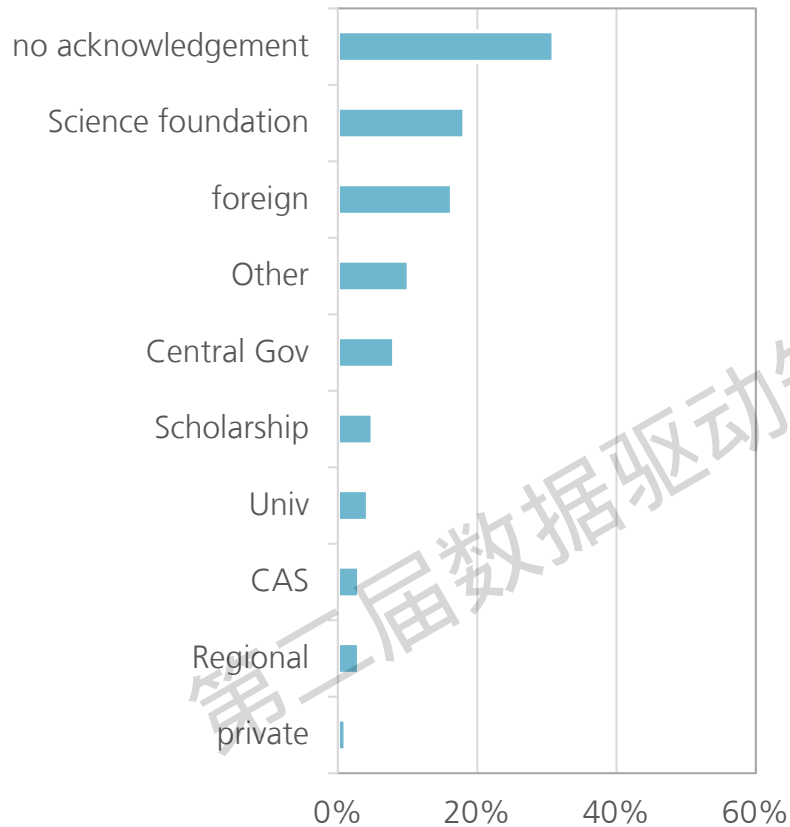
Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Shares of acknowledged authorities for total Chinese co-publications



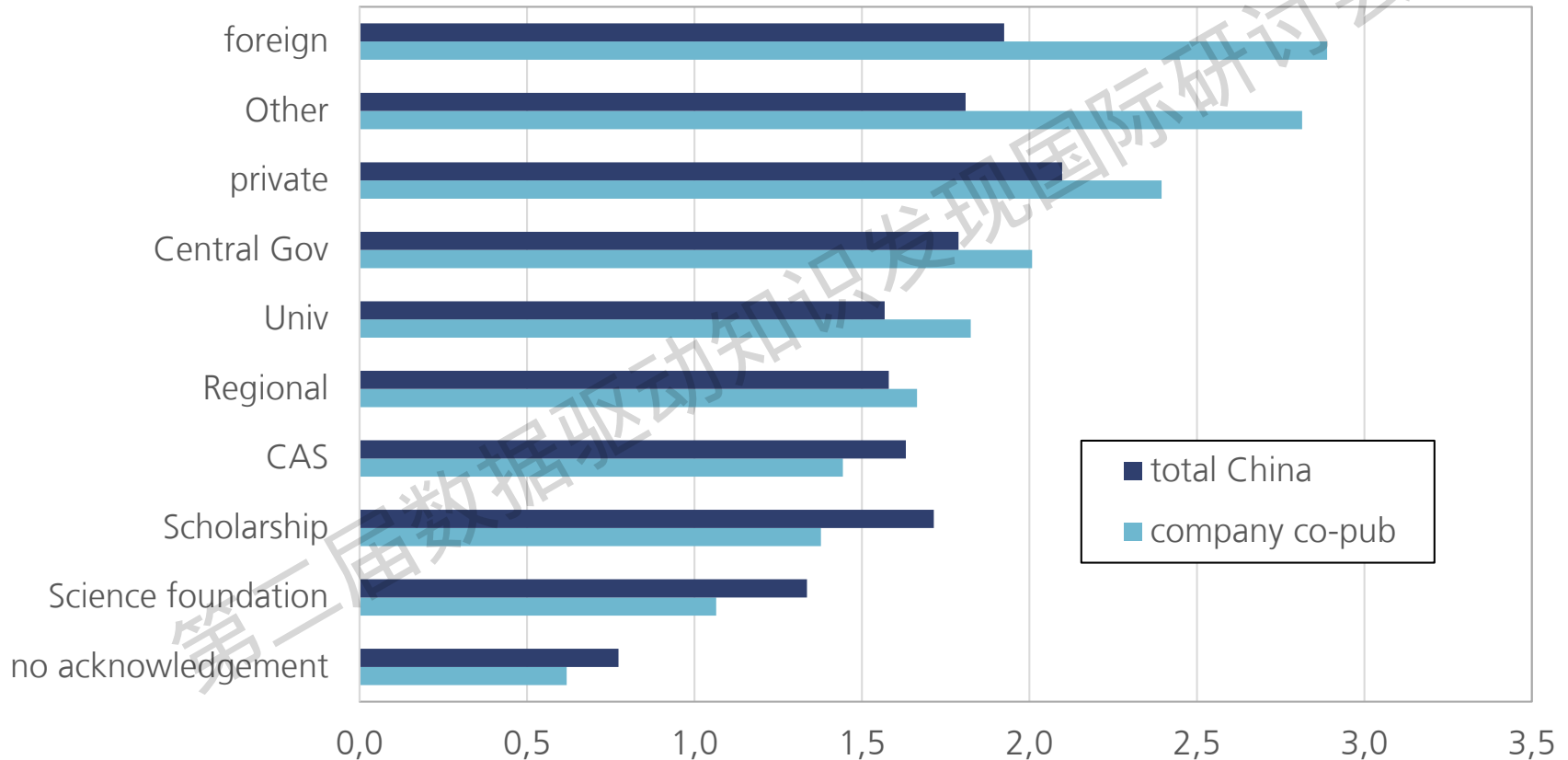
Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Shares of acknowledged authorities for int. (left) and national (right) s+i-co-publications



Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Average field-specific citation rate (Crown) for China, PY 2015



Source: Elsevier – Scopus; Fraunhofer ISI calculations.

Summarizing Conclusions

- It is possible to identify Chinese **publications and co-publications by companies**
 - However, we have no information on the “**motives to publish**” of these companies
- The absolute numbers as well as the shares have been **increasing** in the past years
 - The majority of these publications originate in **co-publications with public research**
 - The shares are still much **lower than in Germany**
- In China the **co-publications with national companies are cited below average**, whereas publications with foreign companies are strictly above the average
 - In **Germany** company publications are cited **above the average** nowadays, but co-publications were also cited below average before 2012
- Fields: China mainly focuses on **engineering and materials**, whereas life sciences are underrepresented; in Germany biotech and medical engineering also occur
- **Outlook:** Inquire about the motives and the context of these publications