Giants in small worlds? Innovation and nanotechnology development in China and Russia

Evgeny A. Klochikhin[a] and Philip Shapira[a,b]

a. Manchester Institute of Innovation Research, MBS, University of Manchester, UK
b. School of Public Policy, Georgia Institute of Technology, USA

Research questions

- How Russia and China can exploit their science and technology (S&T) history to promote indigenous innovation development and resolve the weaknesses of the former state planning system?
- Are there any particular complementarities between the Russian and Chinese innovation that can contribute to their socioeconomic development?
- What are the current and emerging opportunities for mutual leaning between the two countries?
- What is the role of technology-based (nanotechnology) growth strategies in this process?

Nanotechnology

- Can it be implemented bypassing the major system weaknesses and path dependencies?
- Can it help resolve the major challenges and break the existing lock-ins in the construction of effective national innovation systems in transition economies?

State planning S&T system

Strengths

- High profile and continuity of science
- Support of highly-qualified S&T personnel
- Good level of theoretical research
- Massive resource allocation to S&T
- Block system of science funding
- Prioritization of most important S&T projects
- Knowledge as a public good that can be freely used by all agents

Weaknesses

- Lack of S&T equipment in research institutes
- Inhibited information flows
- Separation of research and teaching
- Technological 'backwardness'
- Low productivity and rates of ROI
- Weak technology diffusion
- Risk averse culture
- Weak computing capability
- Poor training of researchers
- Rampant departmentalism and political involvement
- Emphasis on the military
- Corruption and nepotism
- Lack of enterprise autonomy
- Reluctance to dissolve unsuccessful SOEs
- Imbalance between risk and reward for innovating
- Lack of mission-oriented approach
- Low patenting activity

(Klochikhin, 2012)

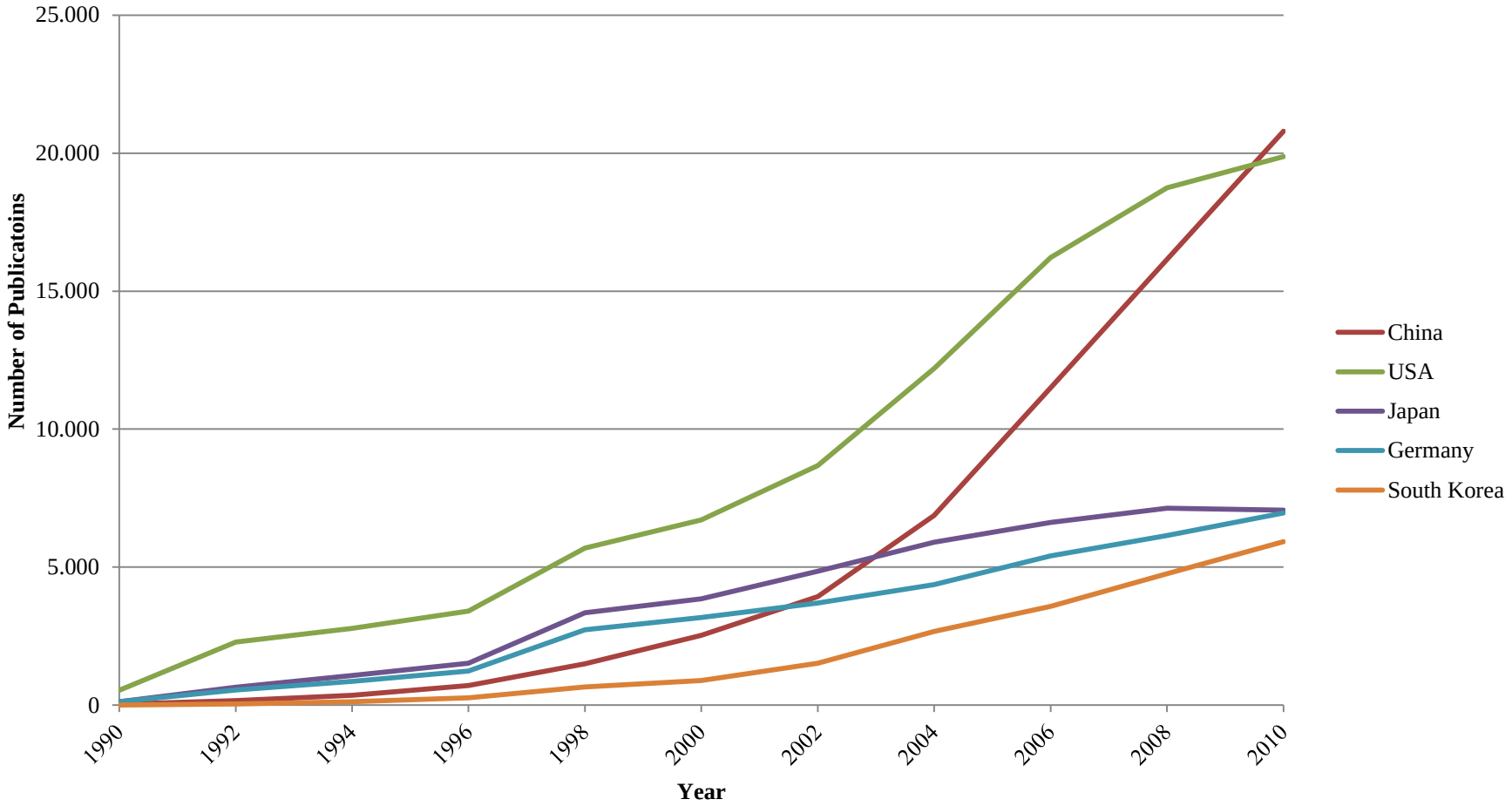
Context

- Nano – next transformative technology like electricity or Internet?
- Who will get the most benefits from nano ‘revolution’: the poor or the rich, the smaller or the larger?

Policy

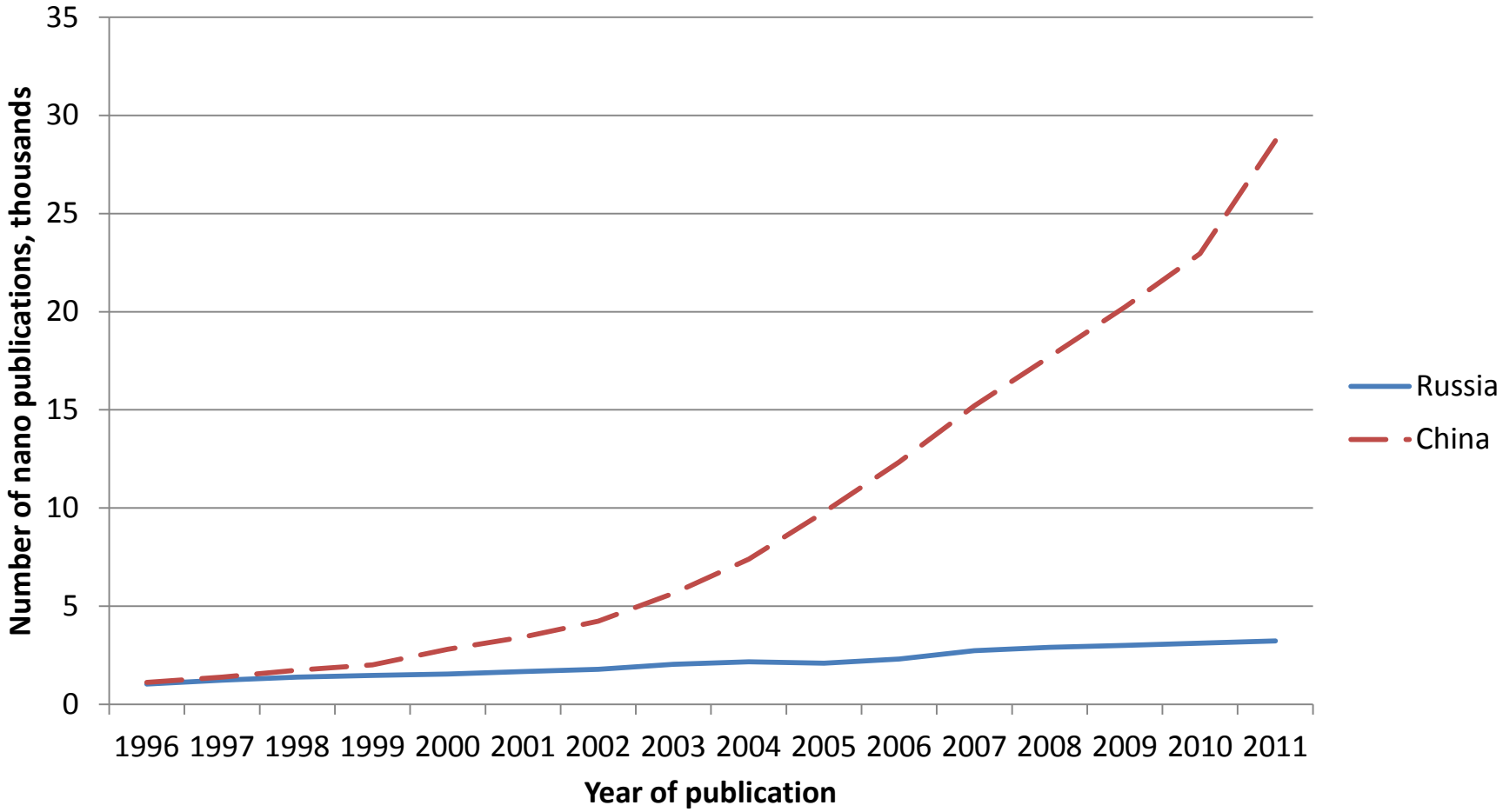
	Russia	China
Launch of the national nano program	2007	2001
Significance of nano component in STI policy	Highly important	One of the areas to support
Policy design	Highly centralized	Dispersed among diverse programs and institutions, center and regions
Scale	Several fields (mostly nanomaterials)	'Across the board' (but mostly nanomaterials)
Regional spread	Across the country	Concentrated in several key regions
Commercialization mechanism	Rusnano	Tianjin Nanotech Industrialization Base; Shanghai Nanotechnology Promotion Center; Nanopolis Suzhou, and others
Regular evaluations	Annual, carried out by the Ministry of Education and Science	Varied (basically part of larger S&T policy evaluations)

Top-5 nanopubs producing countries, 1990-2010



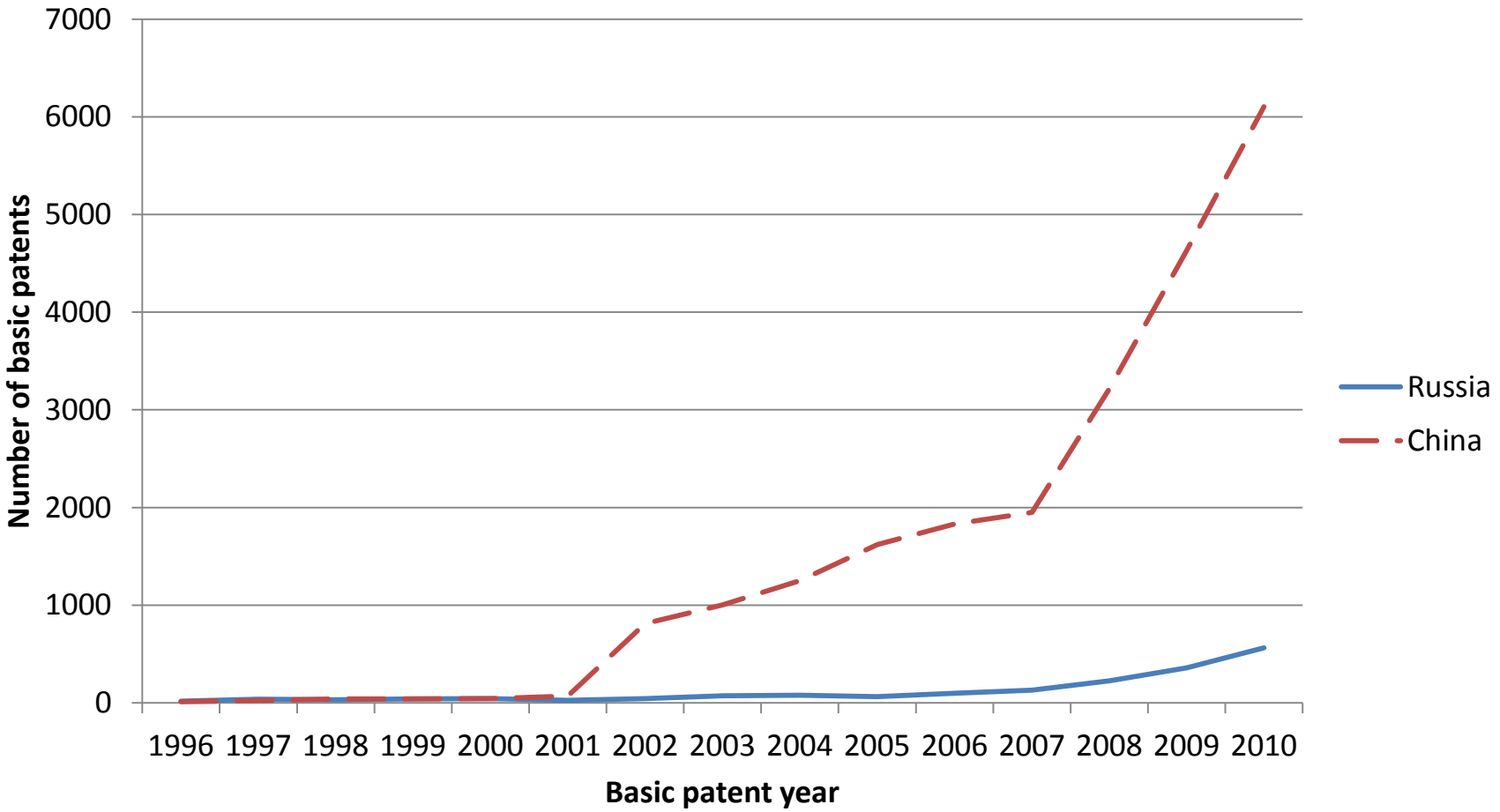
Source: Arora et al. (2012)

Russia and China - nanopubs



Source: own calculations based on Thomson Reuters Web of Science

Russia and China - nanopatents

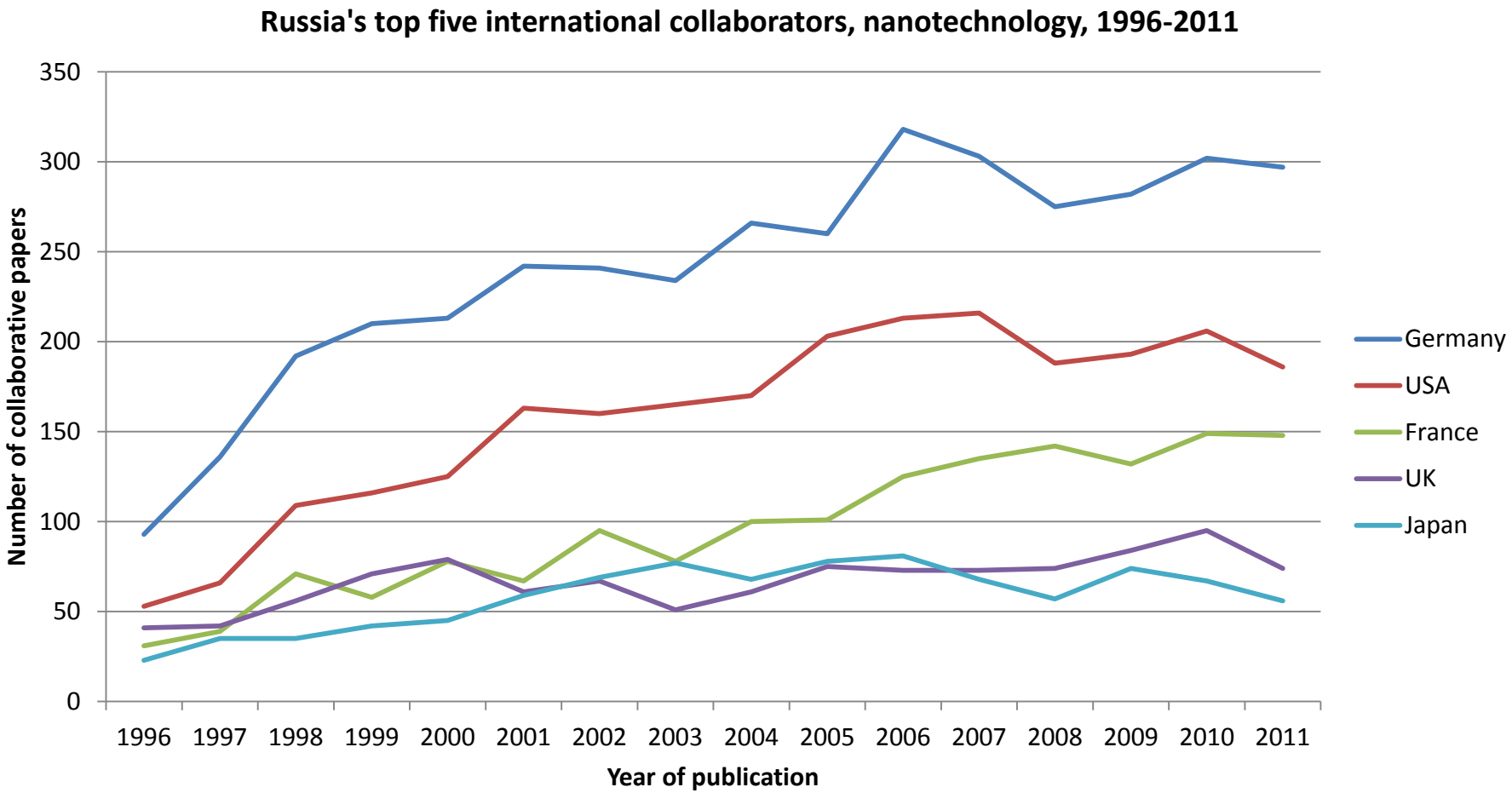


Source: own calculations based on Thomson Reuters Derwent Innovations Index

Methodological framework: six impacts

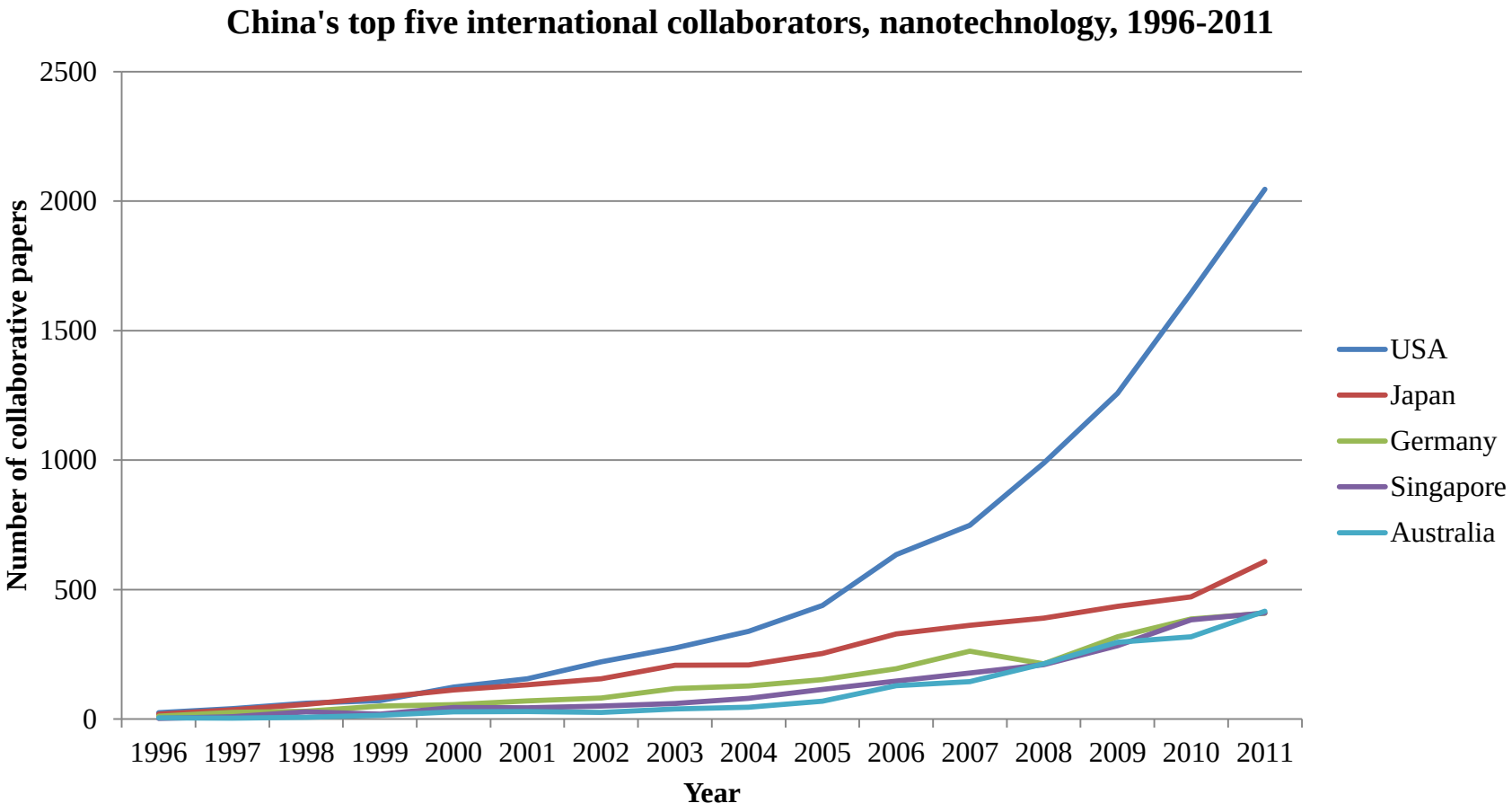
- Institutional development, knowledge flows, and network efficiency
- Research and education capabilities
- Industrial and enterprise development
- Regional spread
- Cluster and network development
- Product innovation and market growth

Nanopubs: cross-country collaboration (Russia)



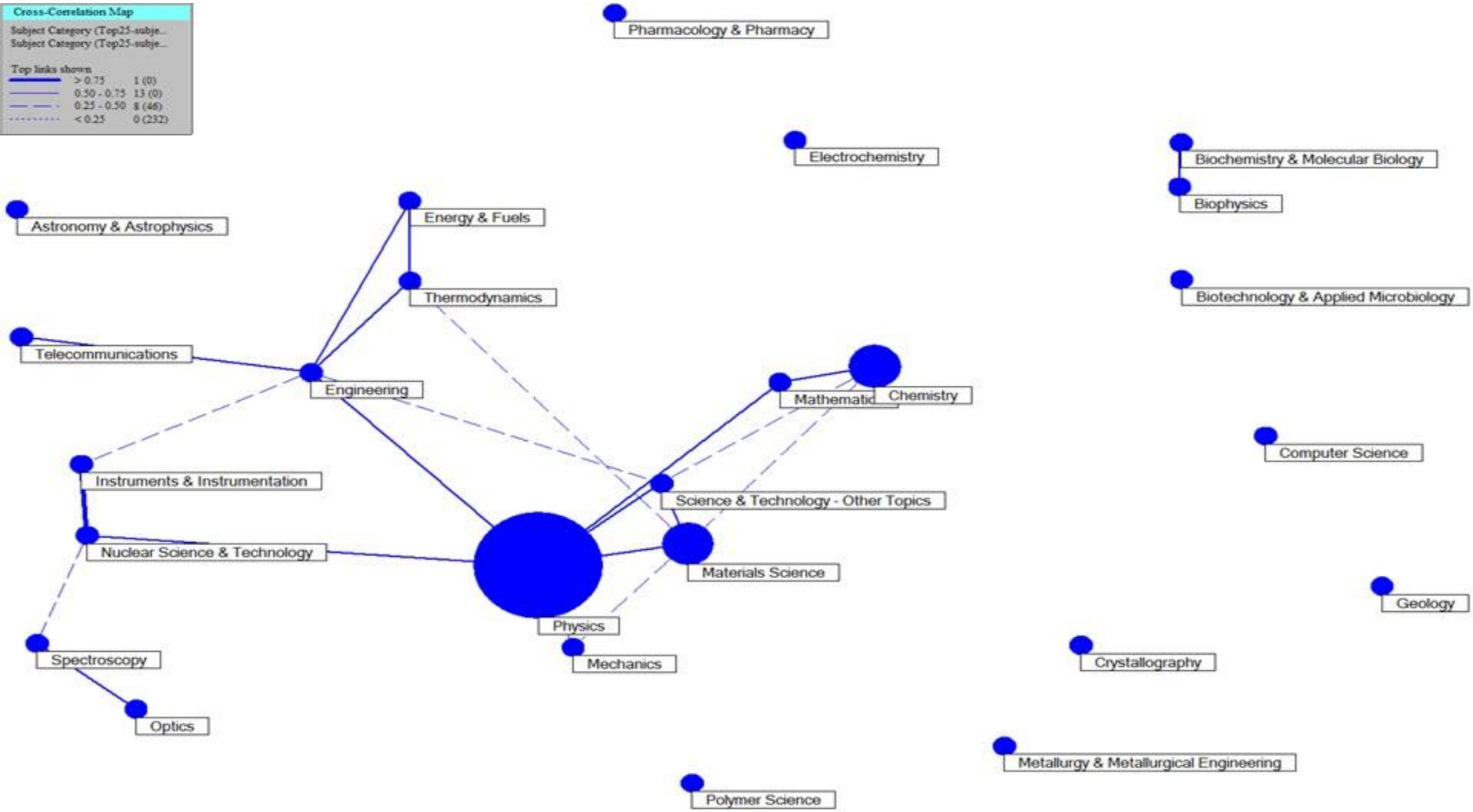
Source: own calculations based on Thomson Reuters Web of Science

Nanopubs: cross-country collaboration (China)



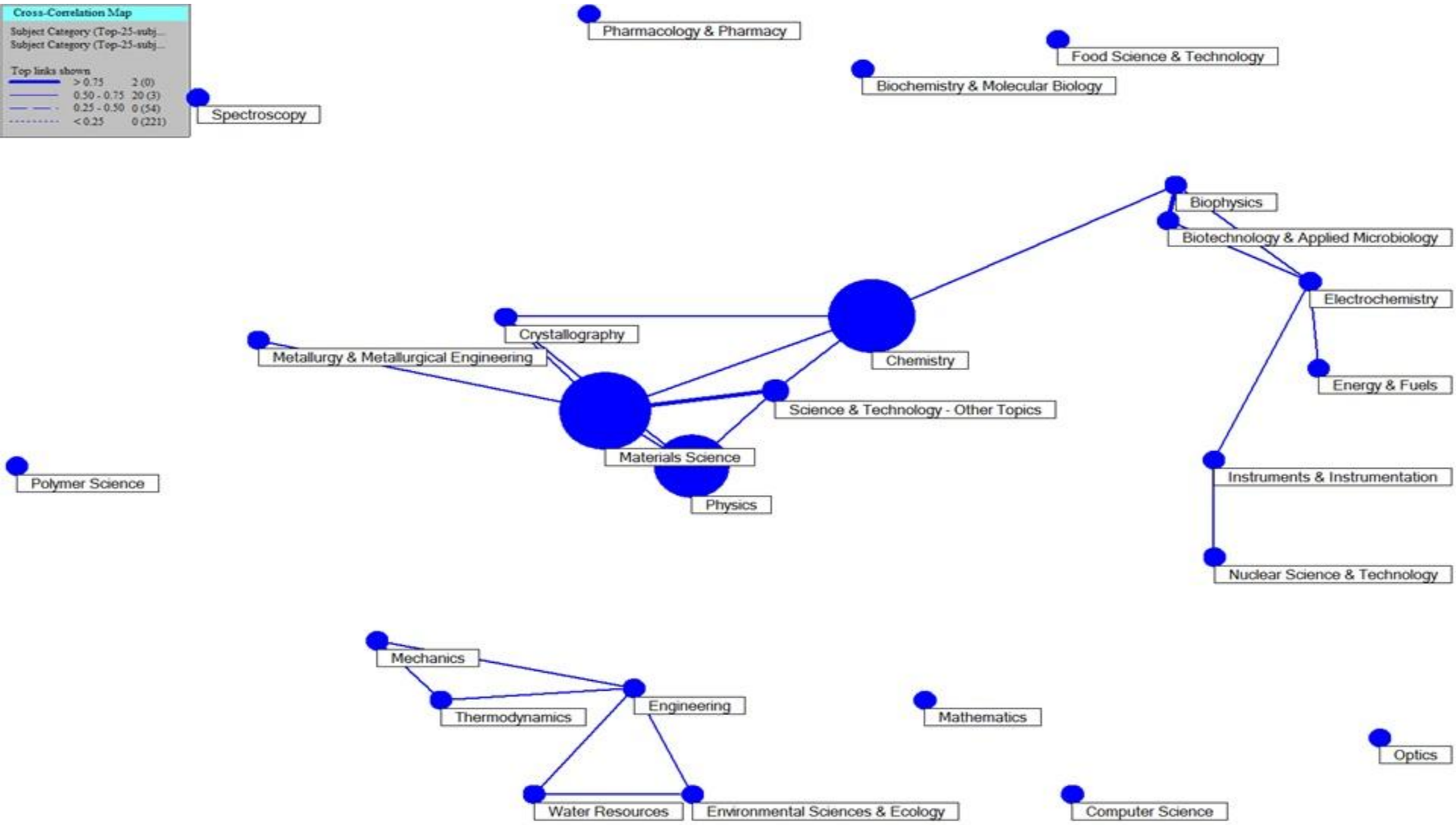
Source: own calculations based on Thomson Reuters Web of Science

Interdisciplinary networks – Russia



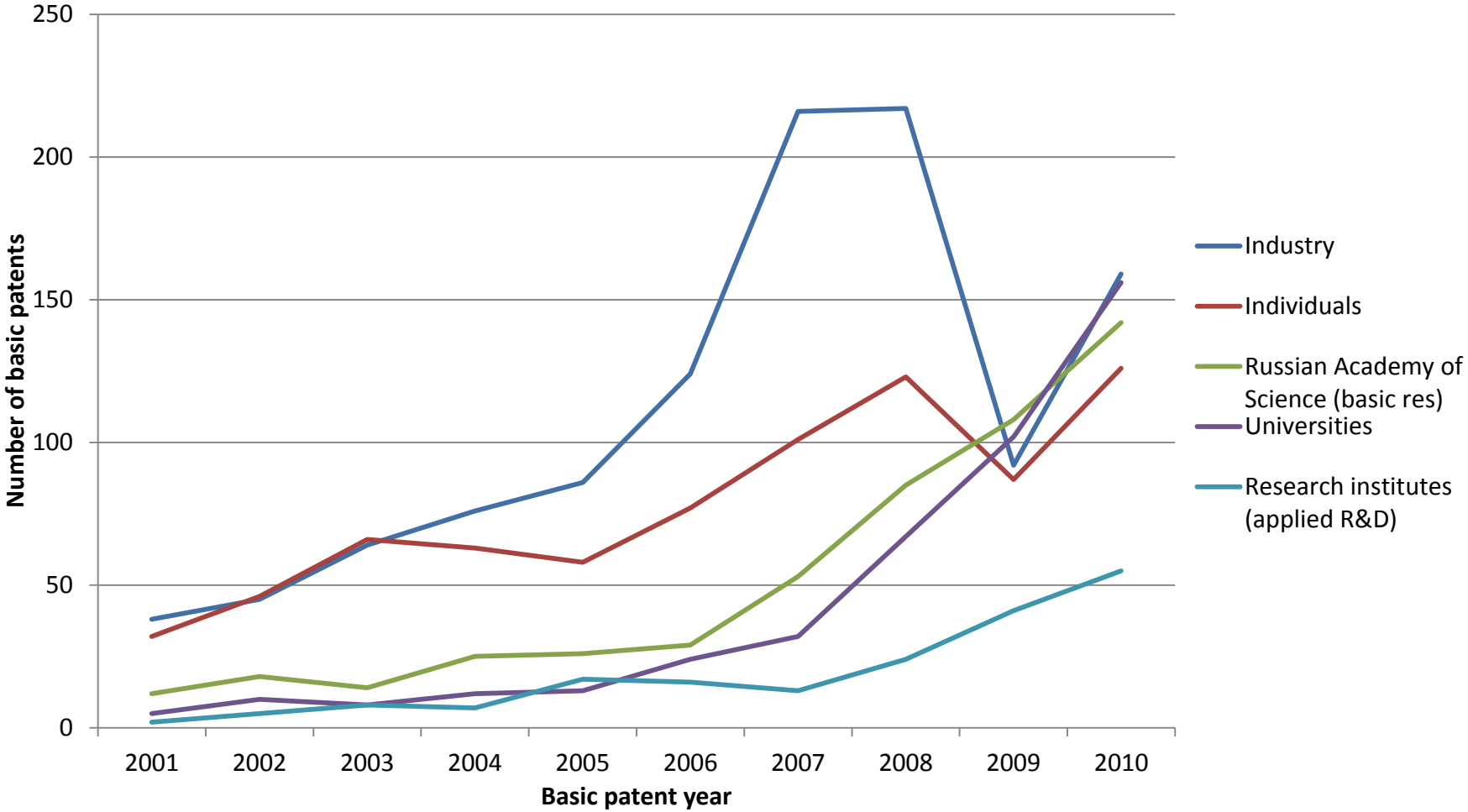
Source: own calculations based on Thomson Reuters Web of Science

Interdisciplinary networks – China



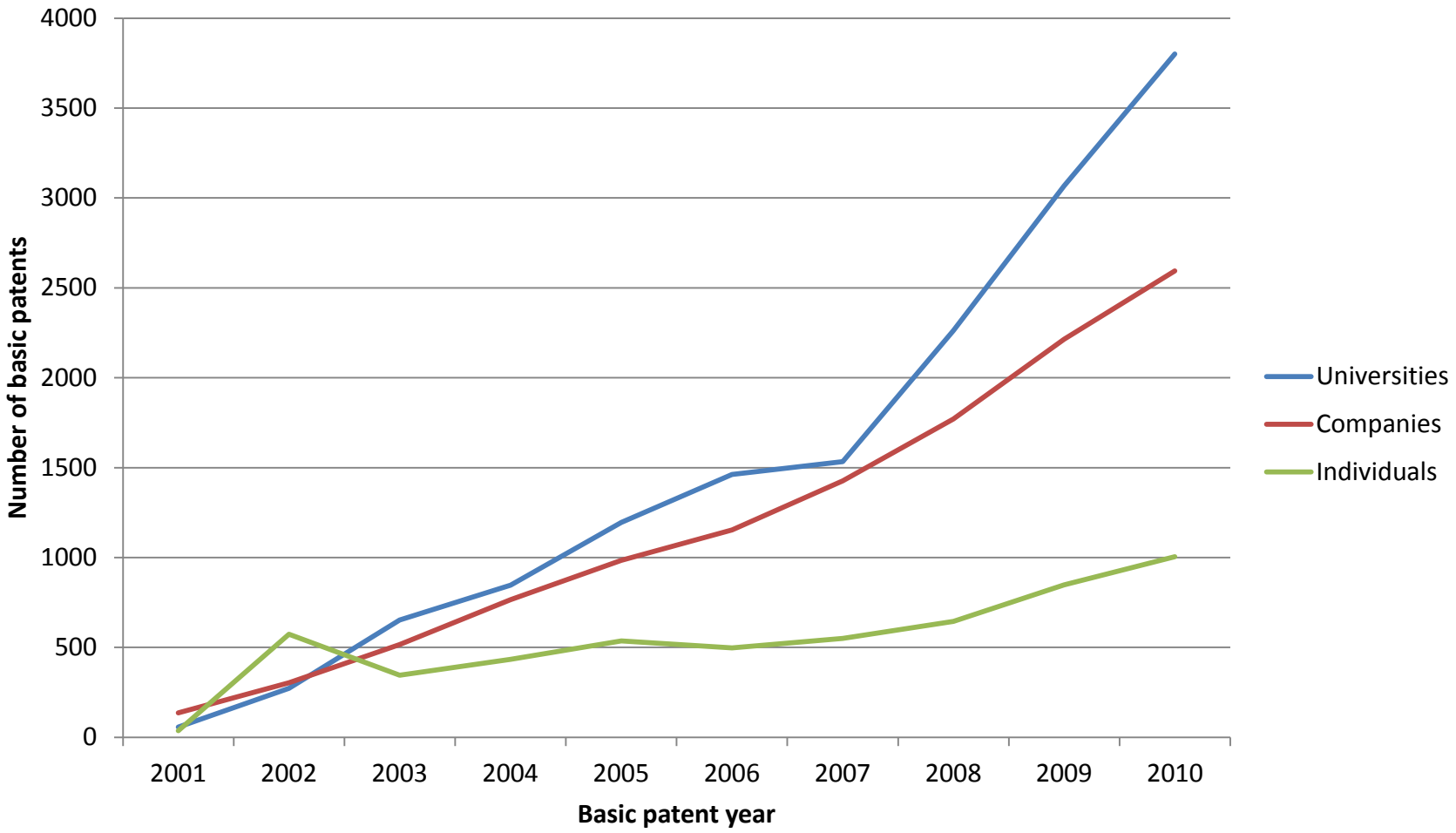
Source: own calculations based on Thomson Reuters Web of Science

Nano patents: how close to market? (Russia)



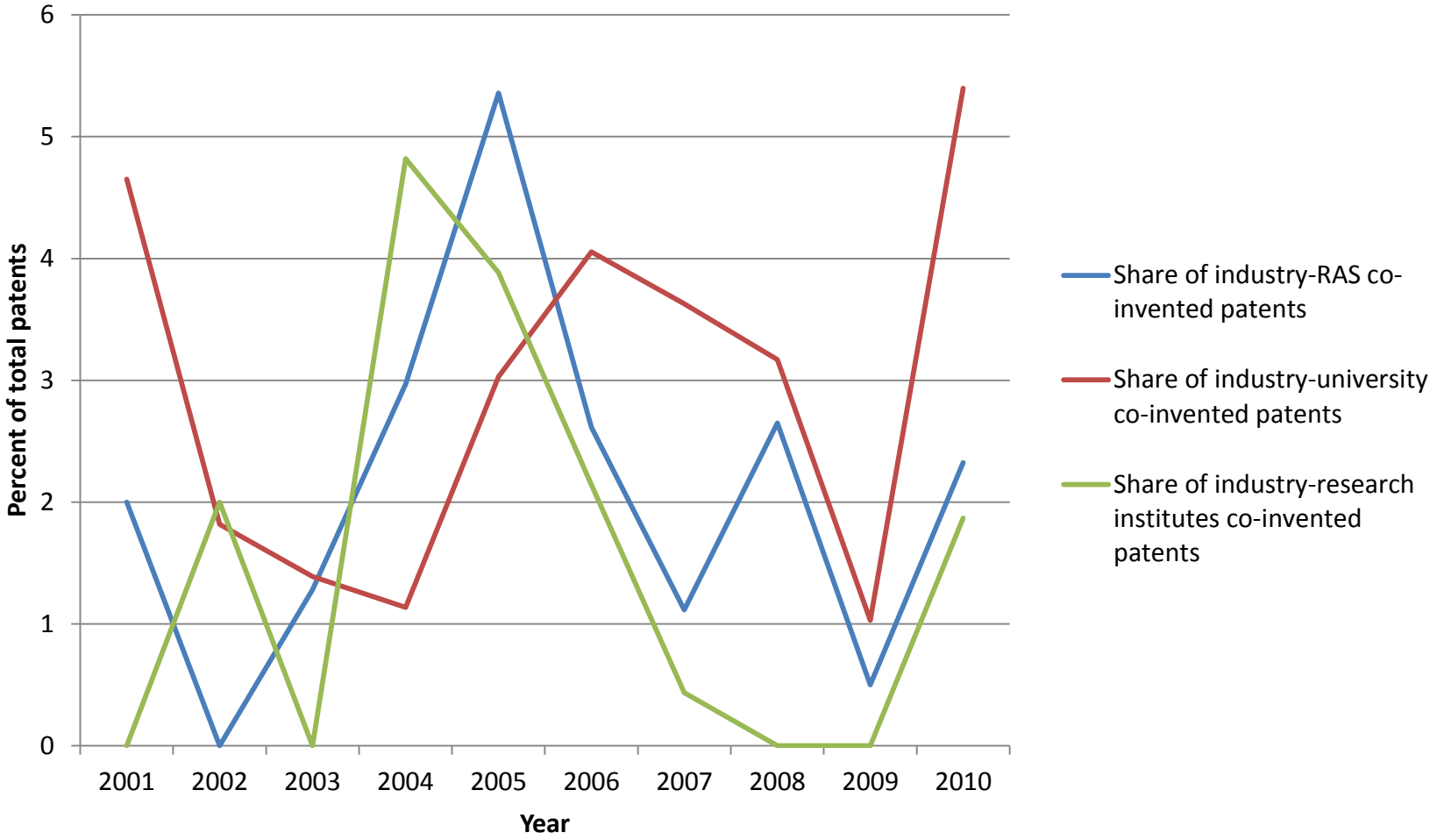
Source: own calculations based on Thomson Reuters Derwent Innovations Index

Nano patents: how close to market? (China)



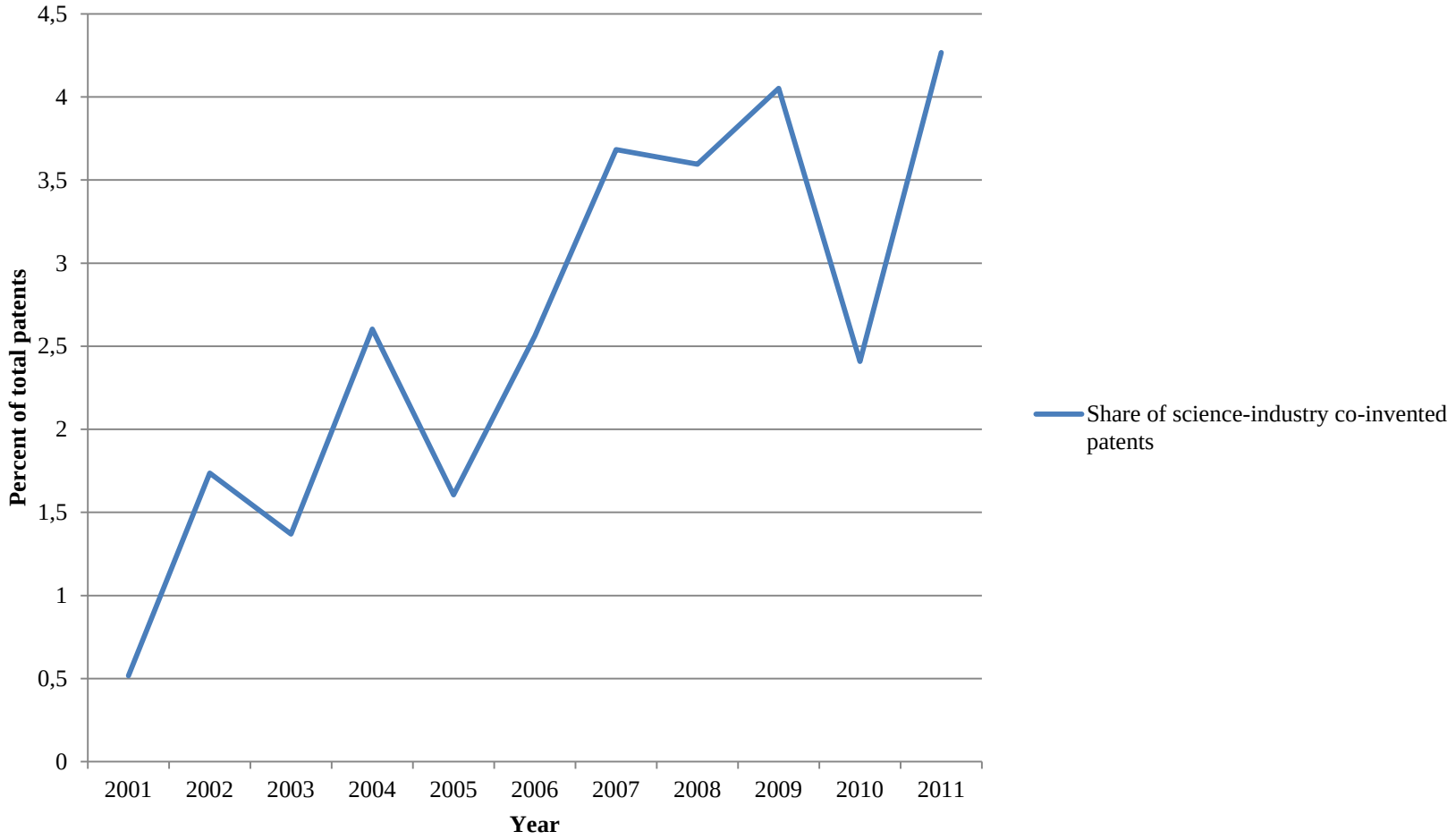
Source: own calculations based on Thomson Reuters Derwent Innovations Index

Industry-science links: evidence of technology transfer (Russia)



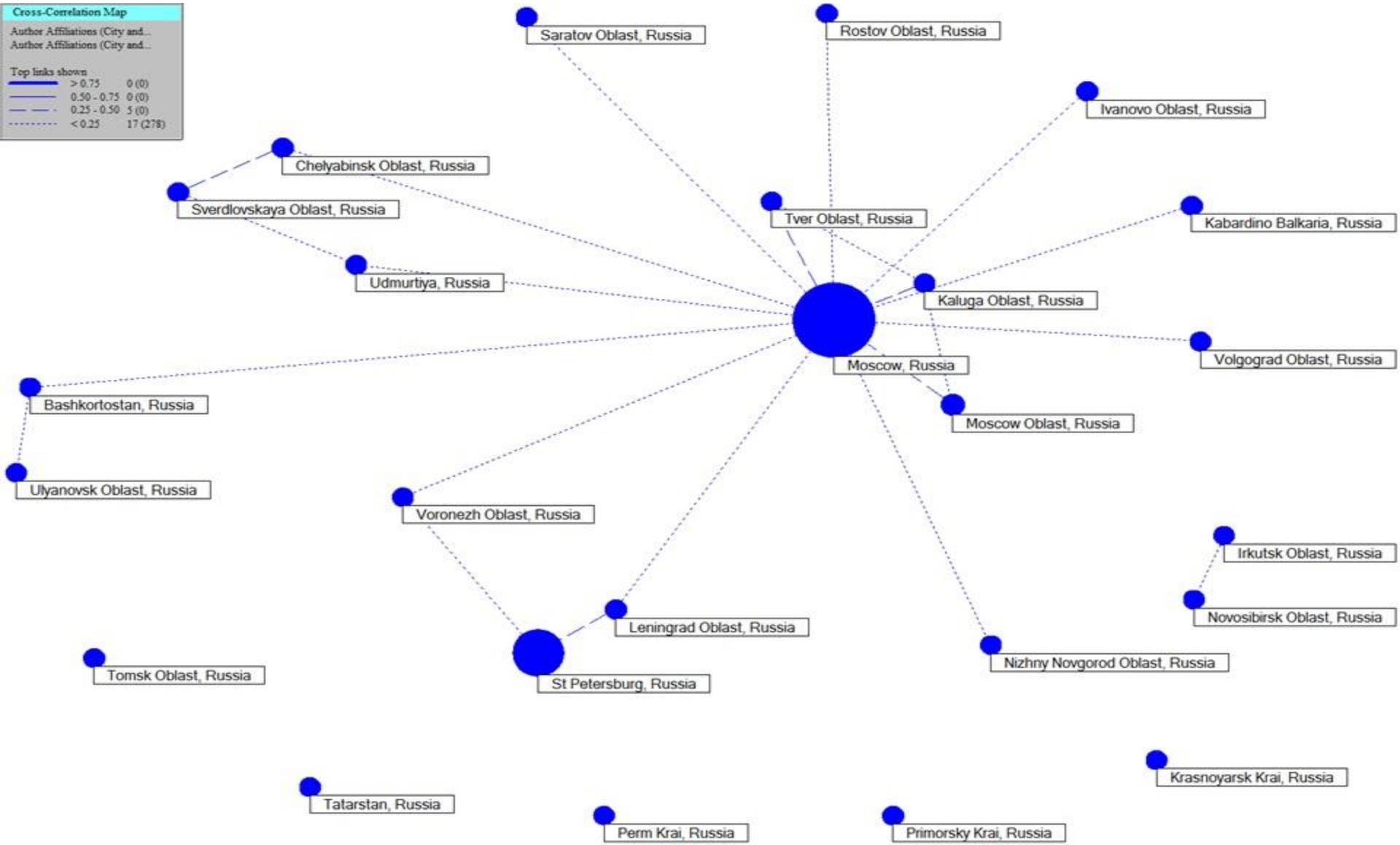
Source: own calculations based on Thomson Reuters Derwent Innovations Index

Industry-science links: evidence of technology transfer (China)

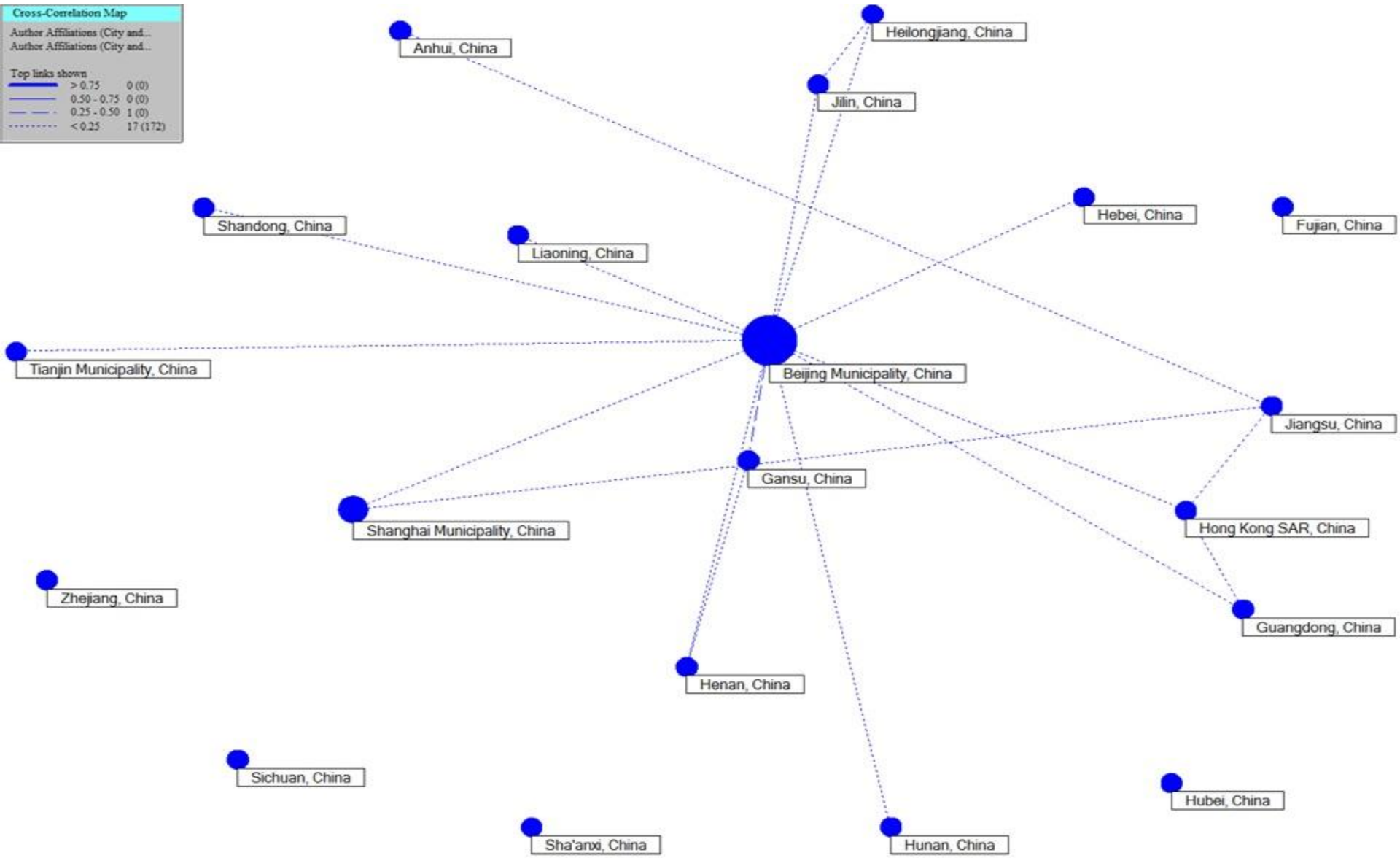


Source: own calculations based on Thomson Reuters Derwent Innovations Index

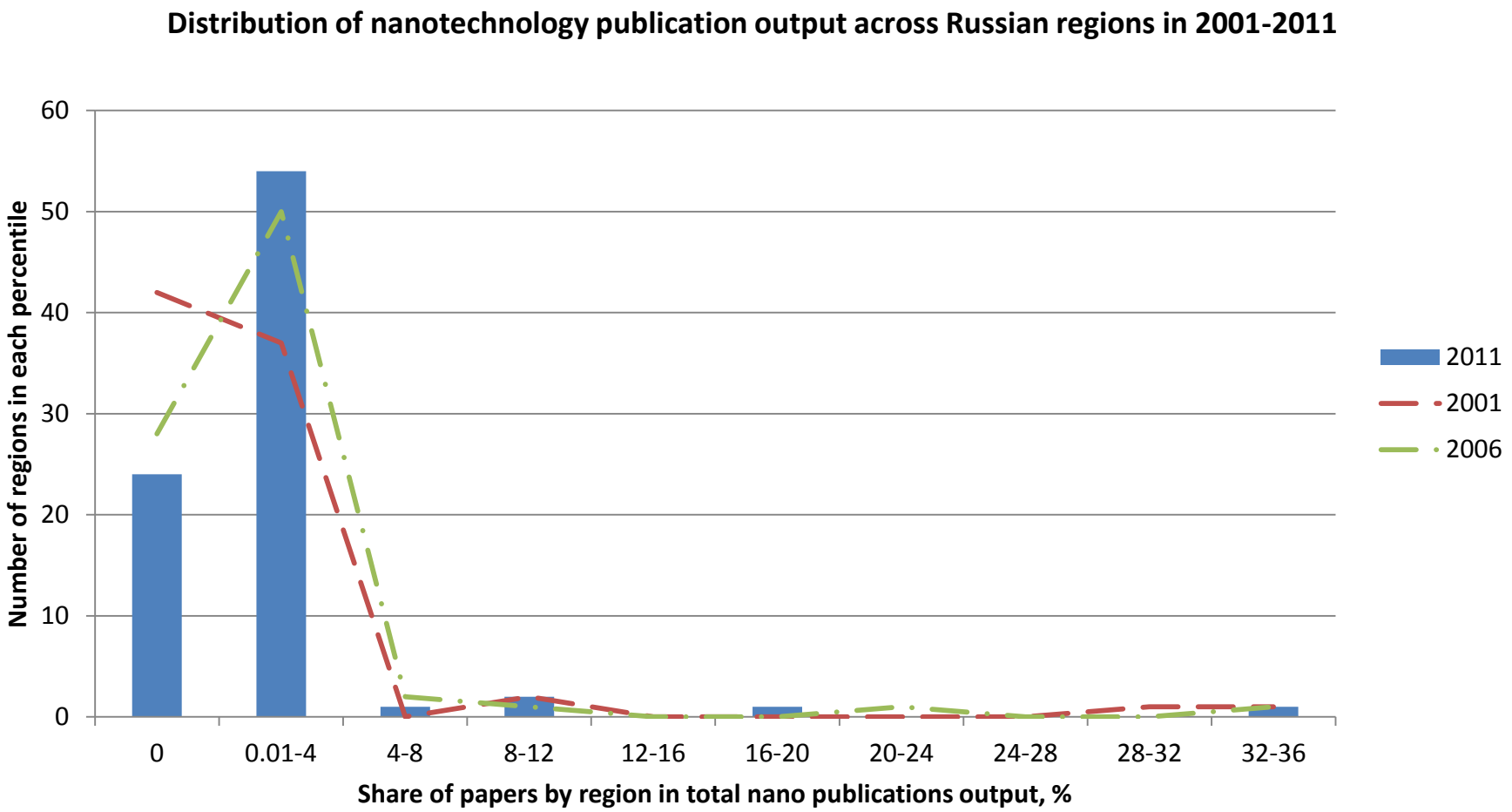
Cross-regional collaboration (Russia)



Cross-regional collaboration (China)

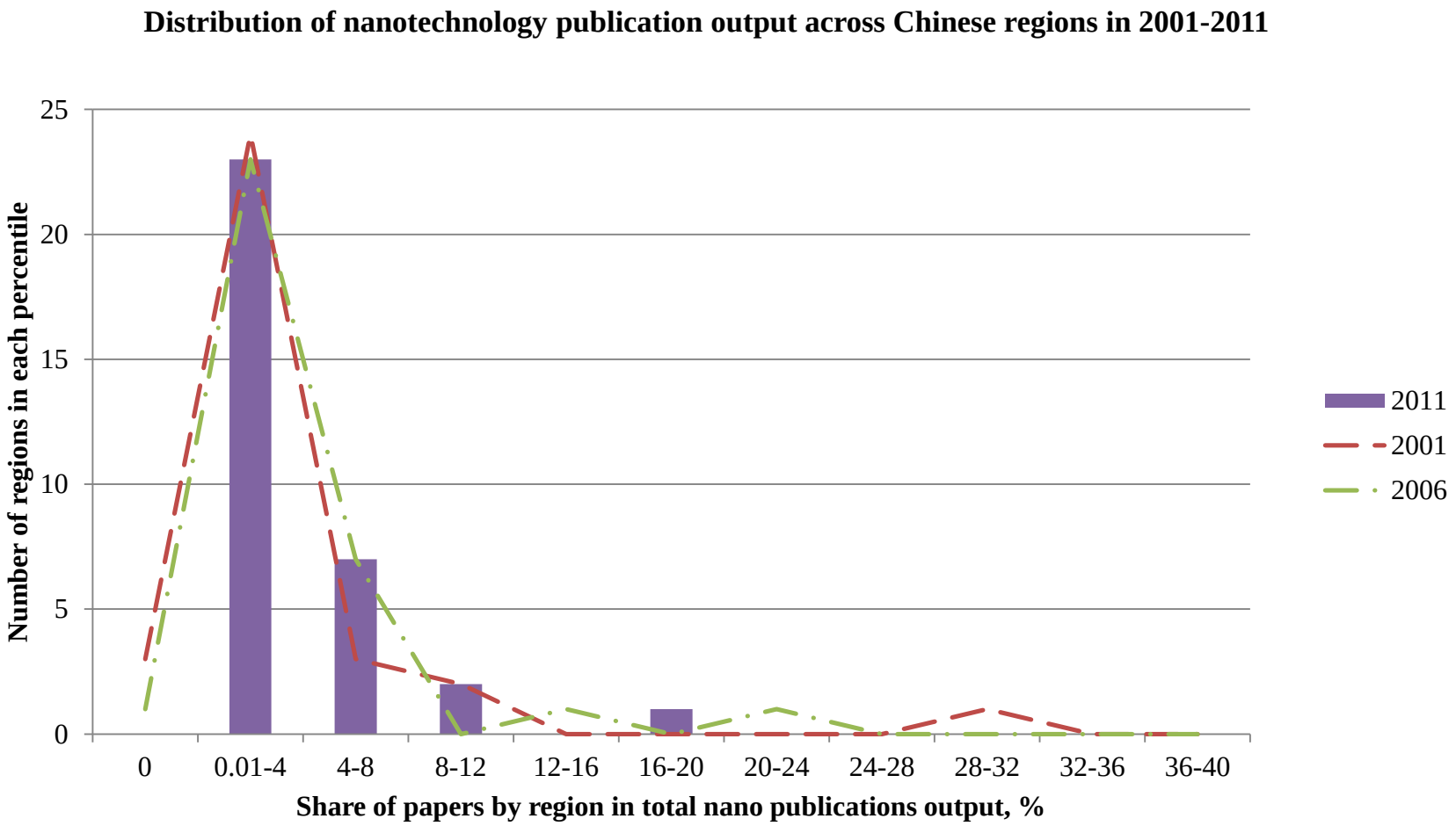


Regional spread (Russia)



Source: own calculations based on Thomson Reuters Web of Science

Regional spread (China)



Source: own calculations based on Thomson Reuters Web of Science

Summary

	Russia	China
Nano policy impact	Unstable progress	Remarkable progress with quick trends up
Interdisciplinary links	Physics and mechanics; biotech and pharma are quite weak	Chemistry; biotech and pharma are connected to the major clusters primarily chemistry
Theory and engineering	Physics and mechanics → engineering	Engineering → development?
Industrial growth	Sharp slowdown post-2008	Industrial patenting shows stable growth
Regional spread	Regional spread is improved in both countries	
Major clusters	Traditional cluster prevail: Moscow, St. Petersburg, and Novosibirsk	Most scientific knowledge is produced in Beijing and Shanghai plus Jiangsu, Jilin and Anhui. Shanghai seems to be self-contained & keeps distance

Conclusions

- Nanotechnology is a broad platform technology with multiple pathways for development. Every nation is exploring and exploiting differently
- Nano is historically, socially and culturally embedded
- Some nations – including Russia and China – seem to be able to construct the new policy and technological system bypassing some path-dependencies (e.g. regional bias or
- Transformative capacity is observable in some areas but no particular conclusions may be reached so far
- Externalities are critical in analysing national and regional nano systems