

Connecting Science to Innovation

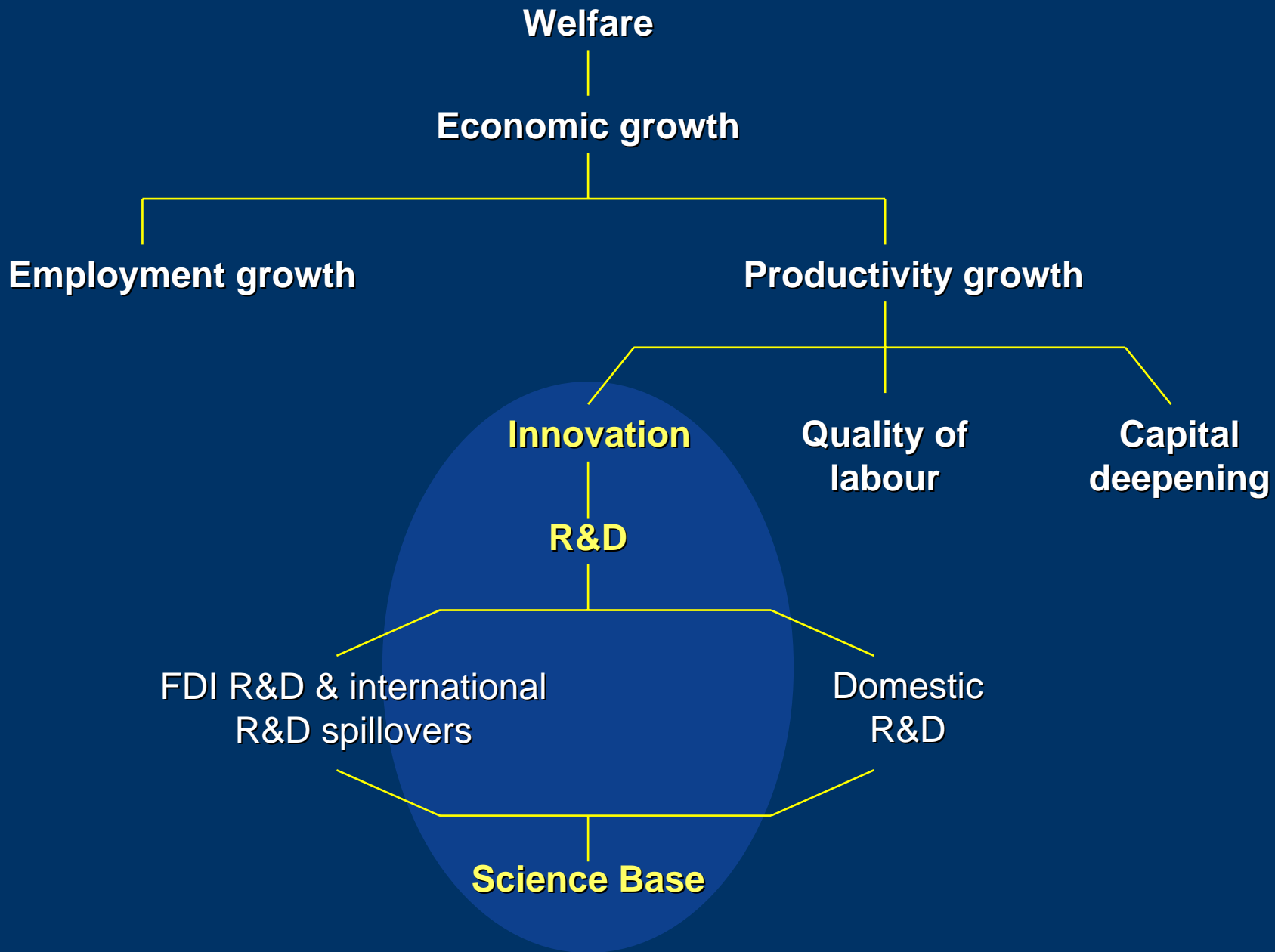
A key Task for Achieving Sustainable Growth

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OECD

Outline

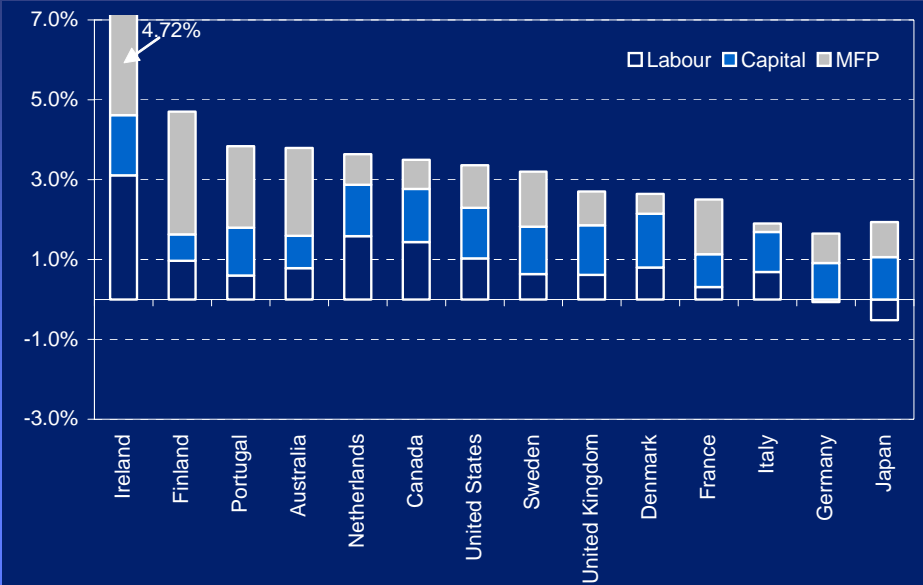
- Innovation and economic performance
 - Innovation, a more powerful driver of economic growth
 - Changing determinants of innovation performance
 - The importance of industry-science relationships (ISRs)
- Connecting science to innovation
 - Policy approaches in OECD countries
 - Public-private partnerships
- Implications for catching-up strategies
 - ❖ *Postscriptum: The OECD project on China's innovation system and policy*

Innovation and economic performance

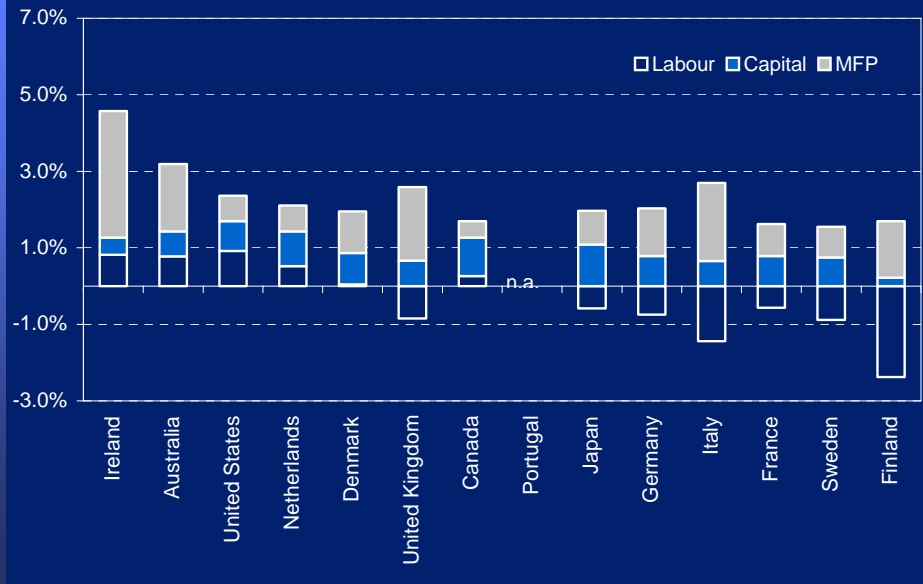


Multifactor productivity (MFP) as a driver of growth

Growth Accounting 1995-2001

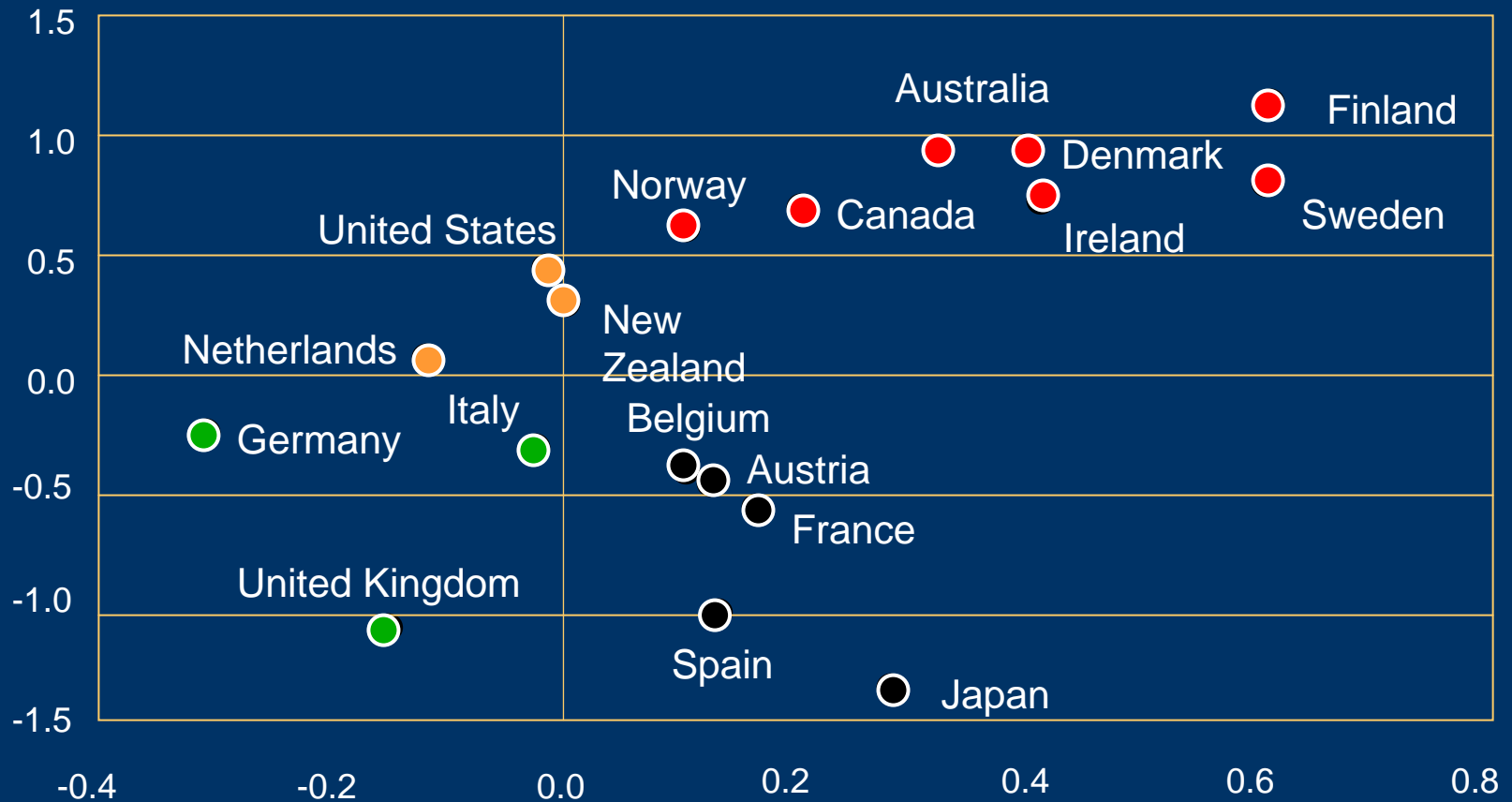


Growth Accounting 1990-1995



Uneven innovation performance underlies uneven MFP and economic growth

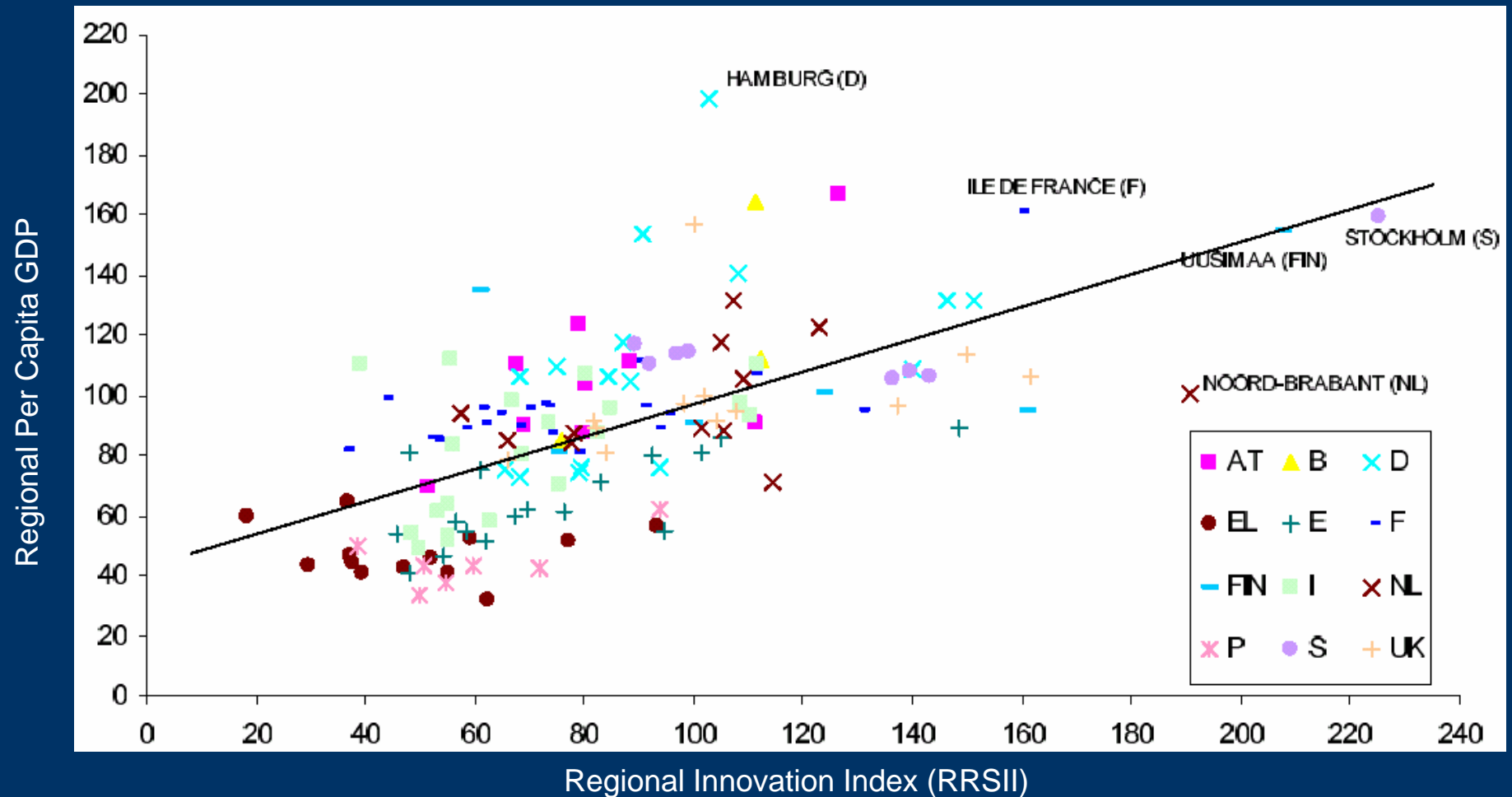
Change in MFP, 1980s to 1990s



Change in average intensity of business R&D, 1980s to 1990s

The correlation between innovation and economic performance is even higher at the regional level

In Europe, 40% of the variation in *per capita* regional income is explained by differences in innovation performance



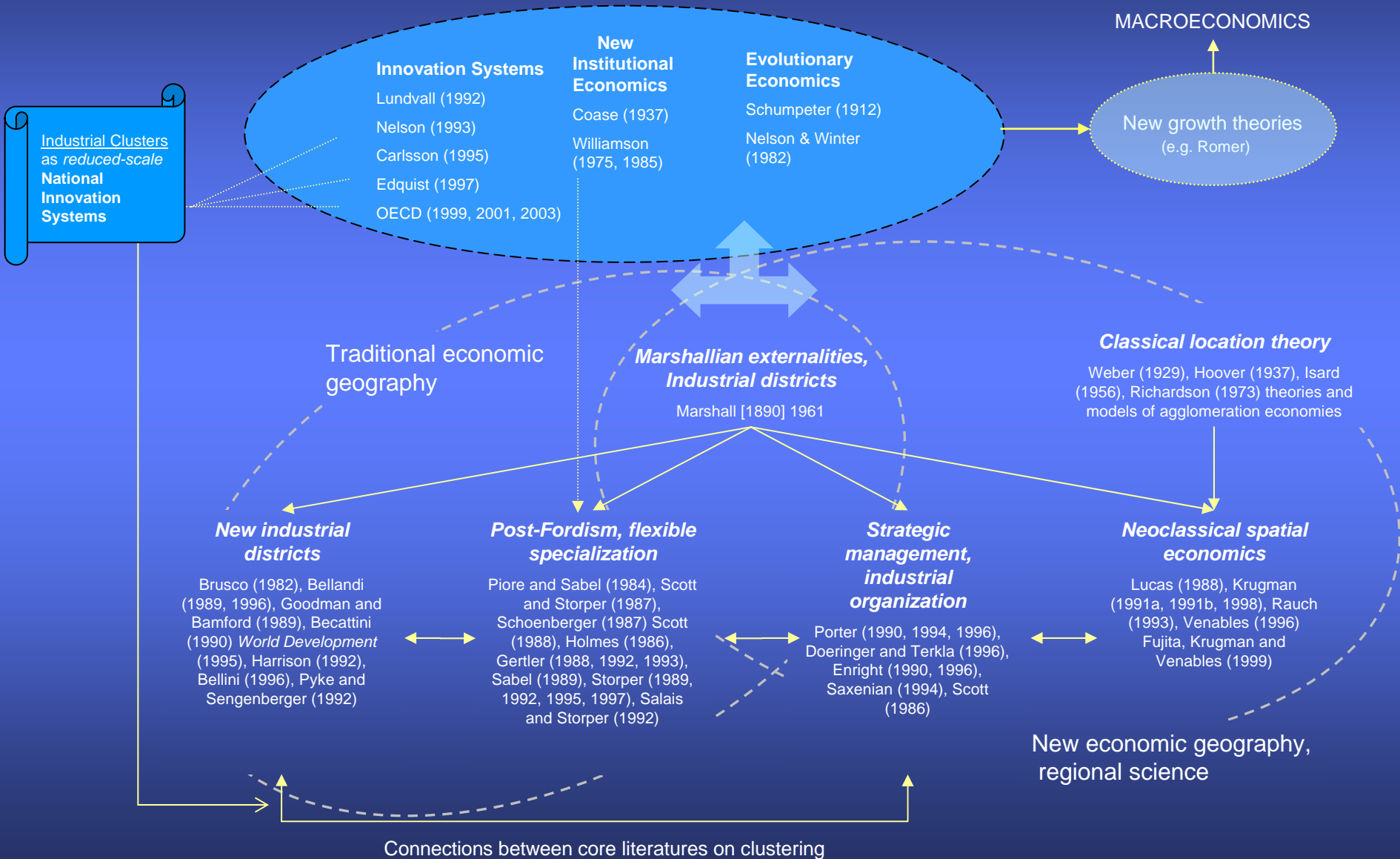
But what is really new?

- Simply a better understanding of the mechanisms of growth?
- Or real changes in these mechanisms?

BOTH

- There has been important theoretical advances in the understanding of the microeconomic foundations of growth
- But cross-country benchmarking provides additional, more concrete lessons

Theoretical advances in the understanding of the microeconomic foundations of a knowledge-based growth



Successful countries have characteristics in common

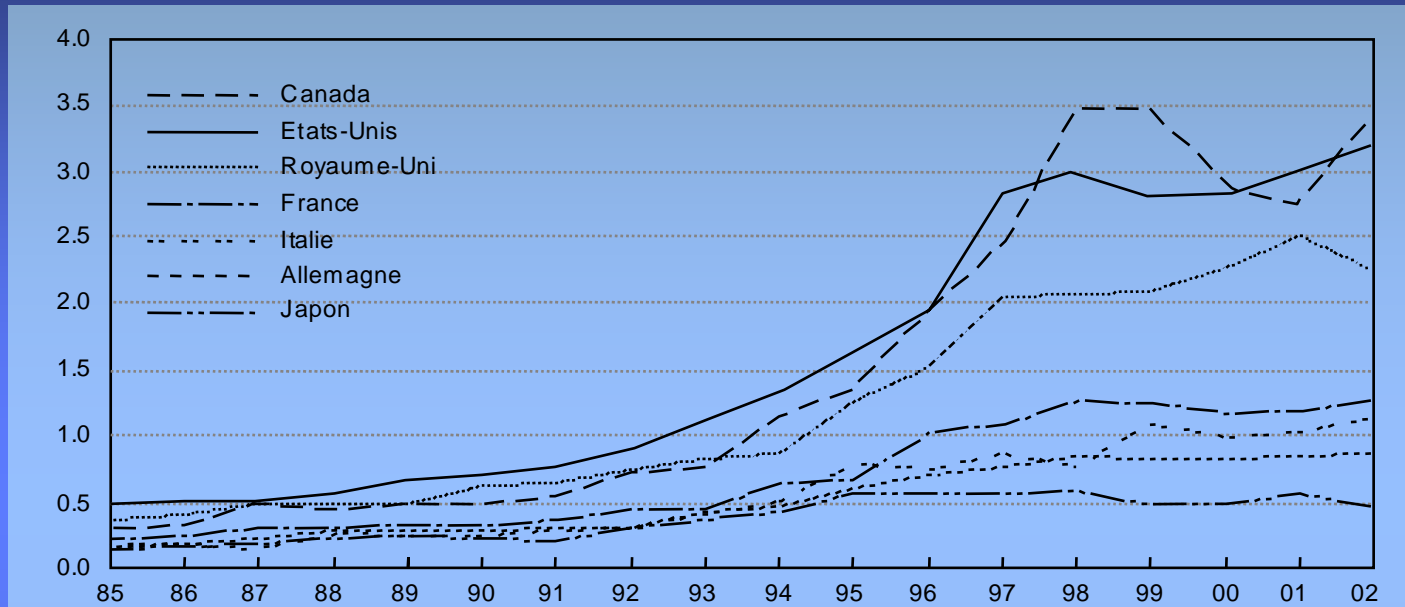
- Good fundamentals, including international openness
- Above average improvement in innovation performance due to:
 - High rate of investment in education, ICTs and R&D
 - High share of business in financing R&D
 - An increasingly diversified base of innovators, with a greater role for SMEs, thanks *inter alia* to a supportive financial system
 - Solid regional pillars of national development, i.e. vibrant innovative clusters
 - High level of networking among innovators, **especially improved linkages between science and industry**

Industry-Science Relationships (ISRs) are becoming increasingly important for the following reasons:

- Science-based technologies such as electronics, pharmacology, biotechnology and nanotechnology have moved to the forefront of innovation.
- The rise of computer-aided design and computer-aided manufacture (CAD/CAM) has resulted in a move away from craft-based technology to technology based on more formal bodies of knowledge in many traditional engineering sectors.
- The horizontal spread of science-based technologies such as new materials, new coatings and adhesives, advanced analytical and measurement methods, catalysts based on nanoscience, including to many traditional industrial sectors.
- Individual products and processes are incorporating an increasing range of technologies and even the largest firms are having to source technological knowledge and research from outside.

Science contributes increasingly and more directly to innovation

Links between science and innovation – measured by the average number of scientific articles quoted in patents




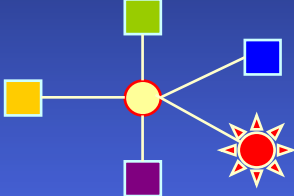




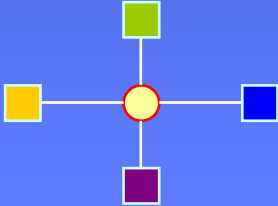



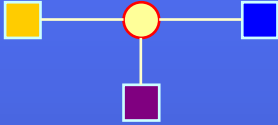


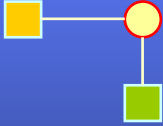



Patenting in Biotechnology -- Changes in the role of actors (between 1995 and 2003)

	Universities	Research institutes	Biotech firms	Pharmaceutical firms
Finland	+	-	+	-
Germany	+	-	+	-
Japan	+	+	-	-
Netherlands	+	+	+	-
Norway	+	+	+	-
Spain	+	+	+	-

Source: OECD case study on biotech innovation systems.

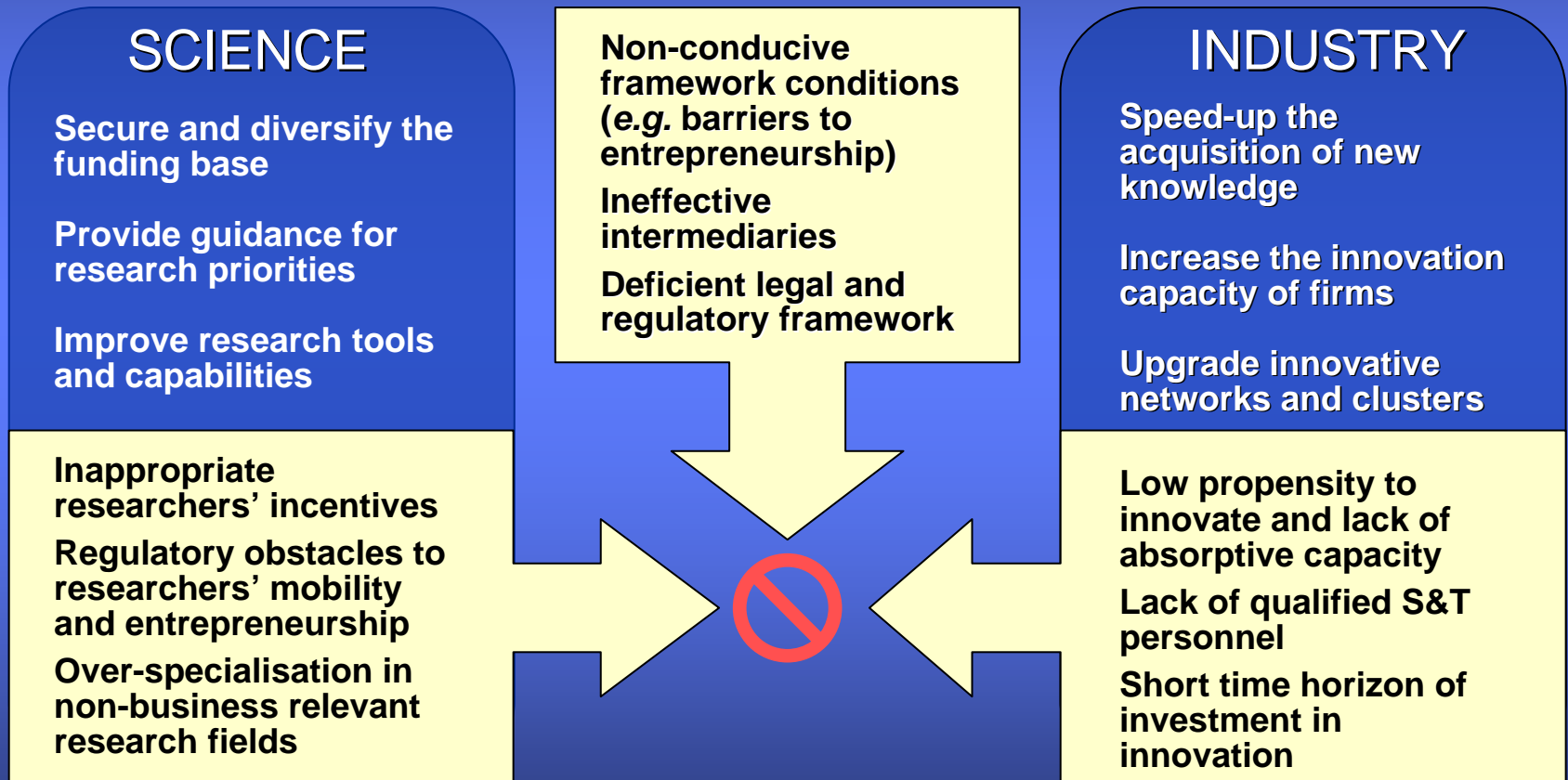
Innovation networks in Europe

Types of innovation networks, % share based on a survey of eight European countries

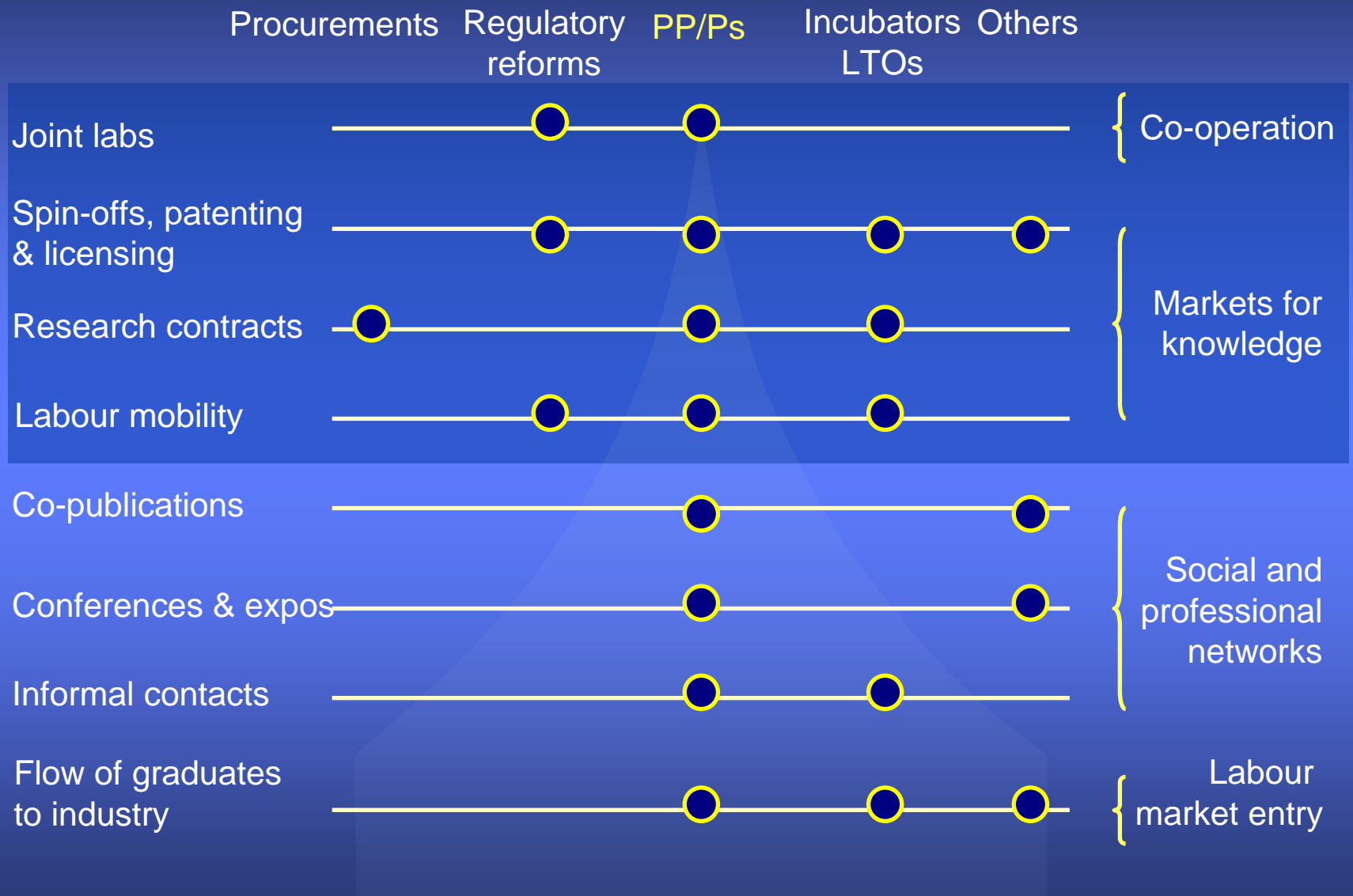
<p>Complete innovation networks including universities and public laboratories </p>		<p>19.1</p>
<p>Marketing-oriented networks involving users  competitors  suppliers of equipment  & components </p>		<p>21.9</p>
<p>Marketing-oriented networks involving users  and suppliers of equipment  & components </p>		<p>15.8</p>
<p>Marketing-oriented networks involving users  and competitors </p>		<p>16.0</p>
<p>Equipment supplier  dominated networks</p>		<p>14.4</p>
<p>Weak or no linkages</p>		<p>12.9</p>

Connecting science to innovation

- Despite obvious potential mutual benefits ISRs face a number of obstacles that governments must lower

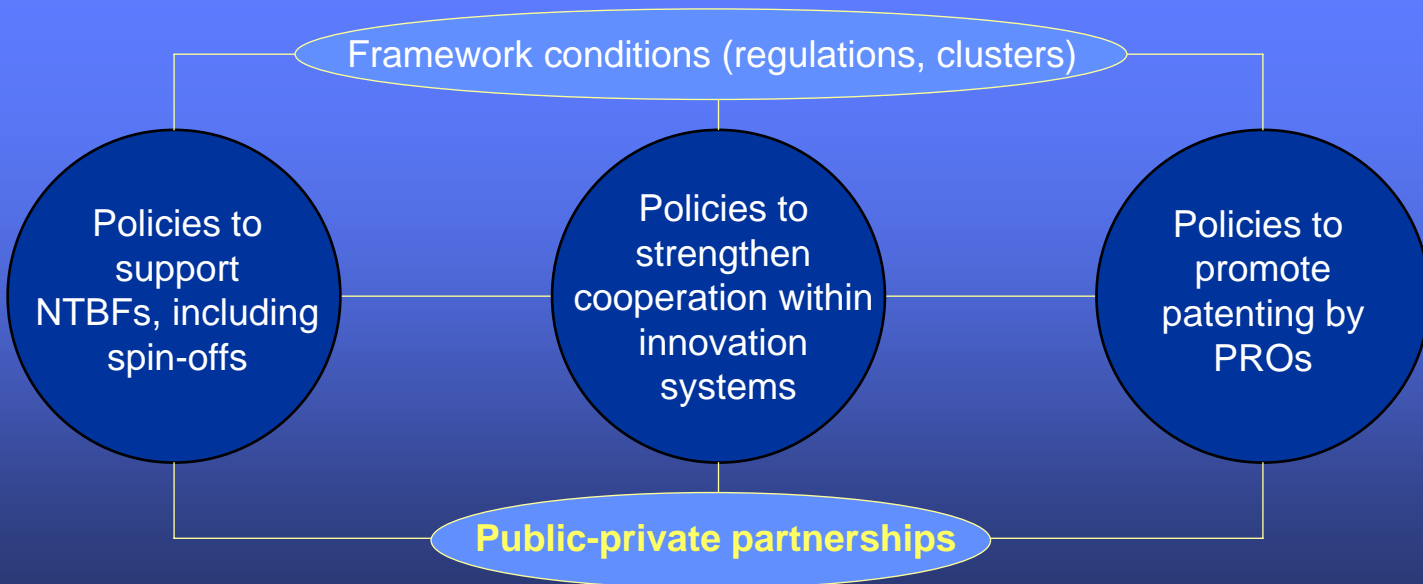


Connecting Science to Innovation – the need for an overall strategy



Priority channels of ISRs to be promoted

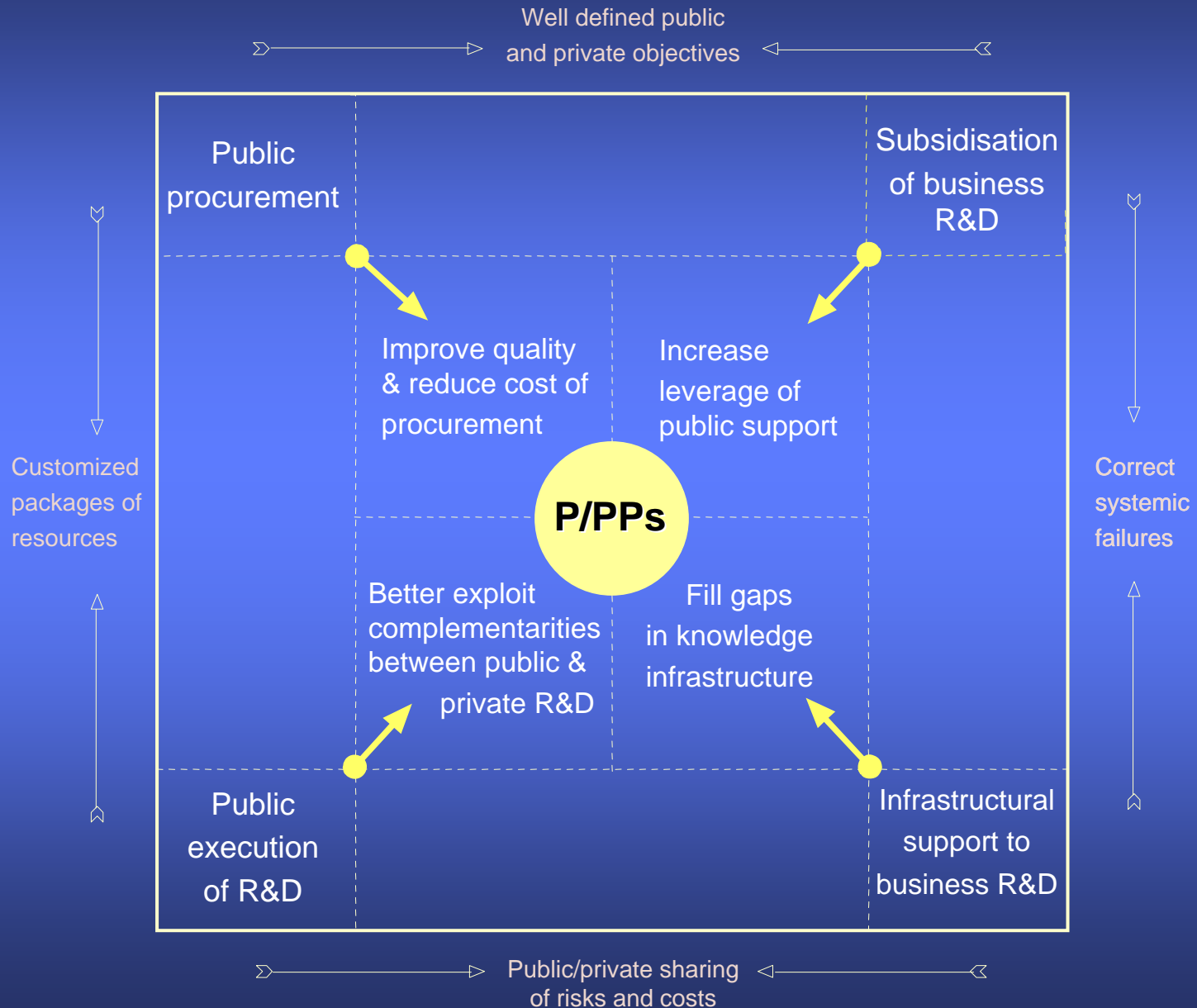
- The entrepreneurial route (new technology-based firms, including spin-offs)
- The patenting route (licensing IPR that results from publicly-funded research)
- The co-operative route (joint projects involving scientists and innovators)
- At cross-roads: **Public-Private partnerships for Research and Innovation (P/PPs)**



P/PPs to promote innovation: Definition

- “Any formal relationship or arrangement over a fixed-term/indefinite period of time, between public and private actors, where both sides interact in the decision-making process, and co-invest scarce resources such as money, personnel, facility, and information in order to achieve specific objectives in the area of the area of science, technology, and innovation”
- A public-private partnership -- as opposed to more casual, arms length or hierarchical relationships – is characterised by the following:
 - Institutionalisation
 - Government as a partner.
 - Shared objectives and a clearly defined public interest
 - Active involvement and co-investment of resources

P/PPs for innovation – Potential benefits



- P/PPs play an increasing role within the innovation policy toolkit of most OECD countries
 - Pioneering programmes in the late 1980s (e.g. United States, Australia) Many new initiatives at the end of the 1990s
- They are the preferred tools to build innovative networks in strategic new research fields such as nanotechnology and genomics, either as standalone initiative or as part of broader PP/P programmes
- Their share in Public R&D funding is now already sizeable

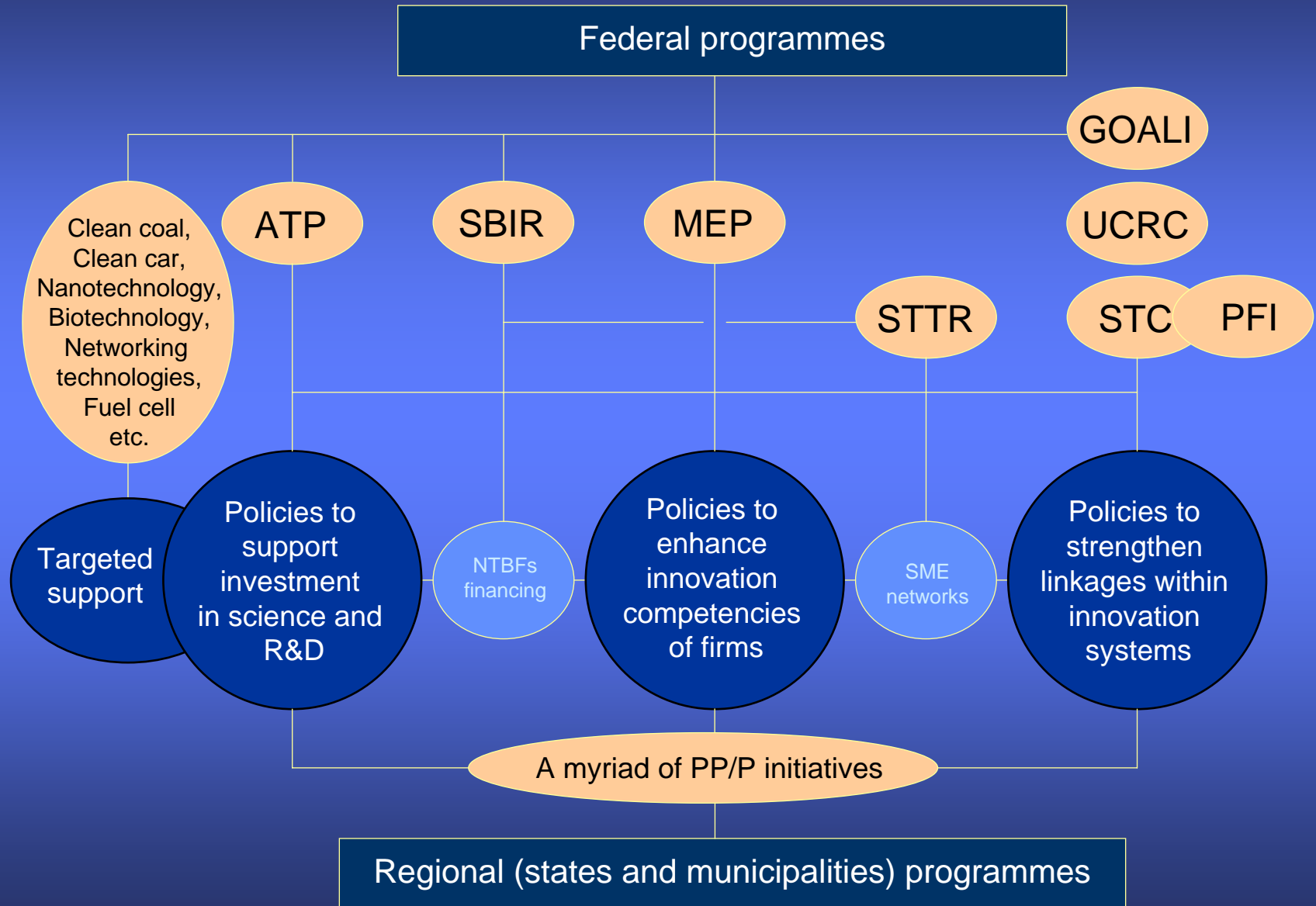
Share of total S&T budget

Australia	9.1%
Netherlands	6.3%

Increasing share of competitive funding of research in France

1998	2002
37%	78%

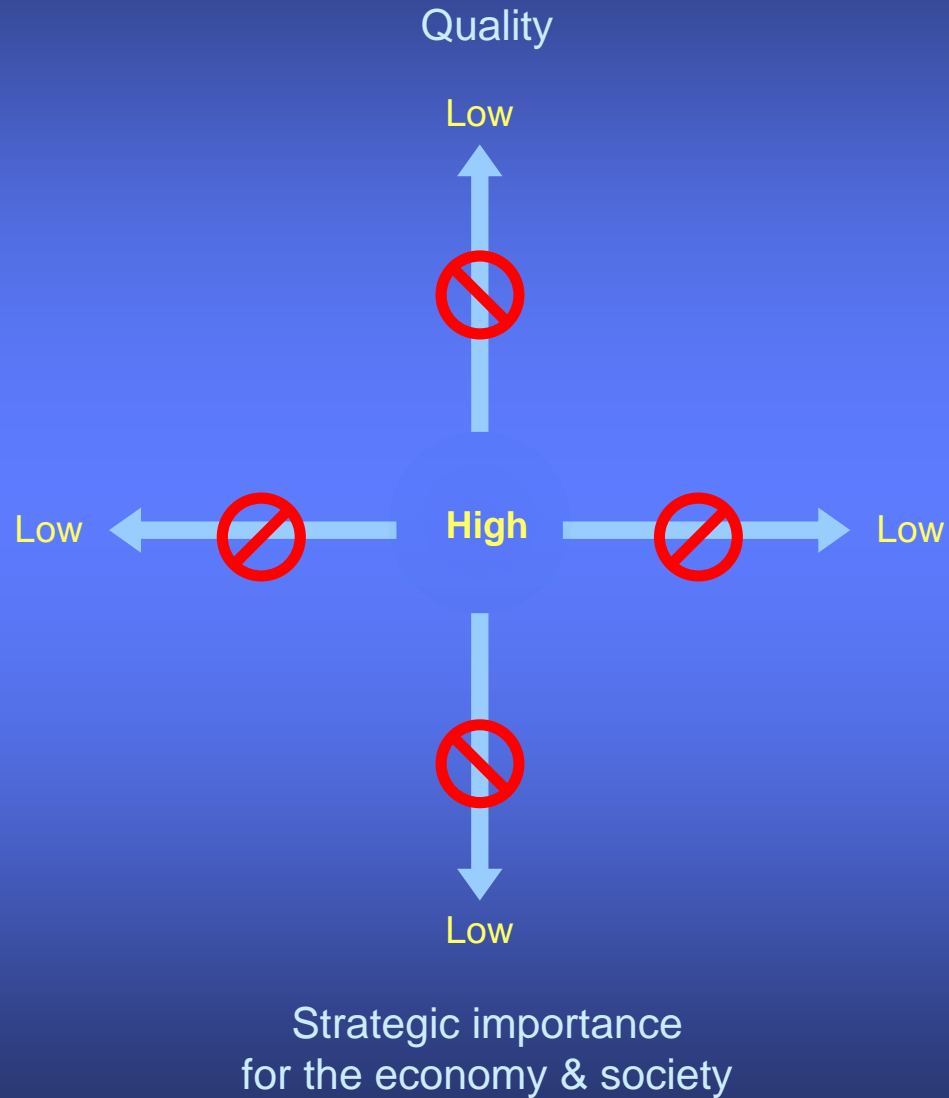
P/PPs for research and innovation in the United States



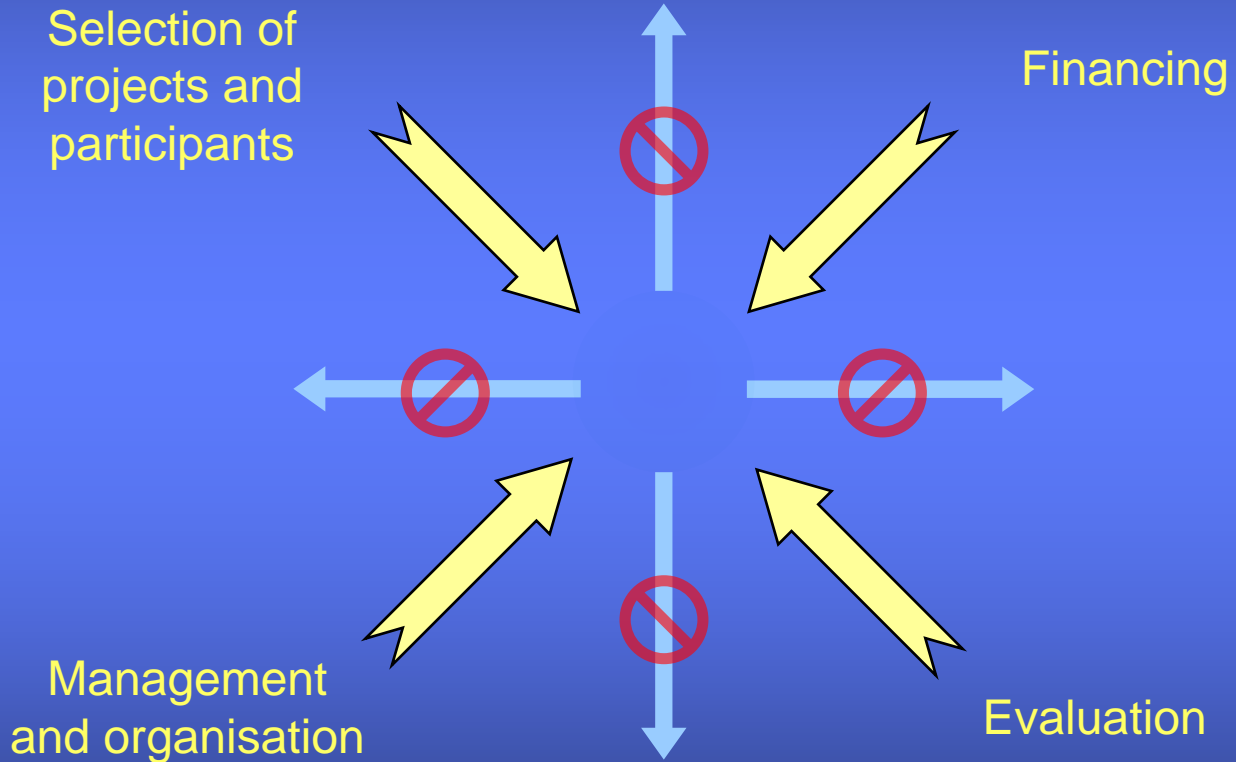
Efficient design and management of P/PPs: Lessons from case studies

- The key factors of success are:
 - Long-term commitment from both Government and Industry, based on a shared vision
 - Achieve critical mass but also deep reach within the National Innovation System
 - Build on existing networks but do not neglect areas where potential actors are still dispersed (e.g. multidisciplinary research) and/or inexperienced in accessing government support
 - **Implement efficient selection and steering mechanisms** that ensure a sustainable balance between public and private interests

Avoiding drifts in the research agenda of P/PPs



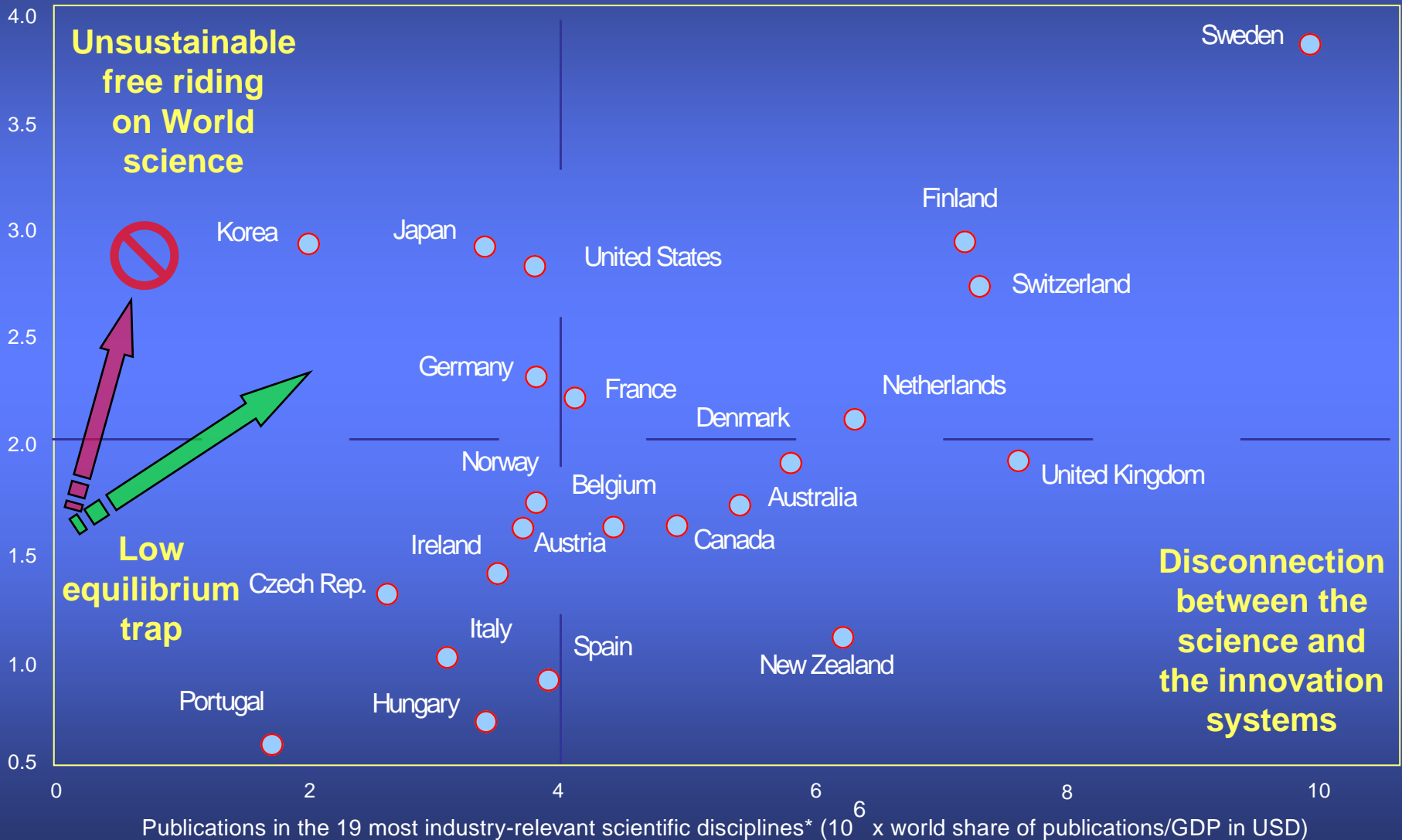
Efficient steering of P/PPs – Four key mechanisms



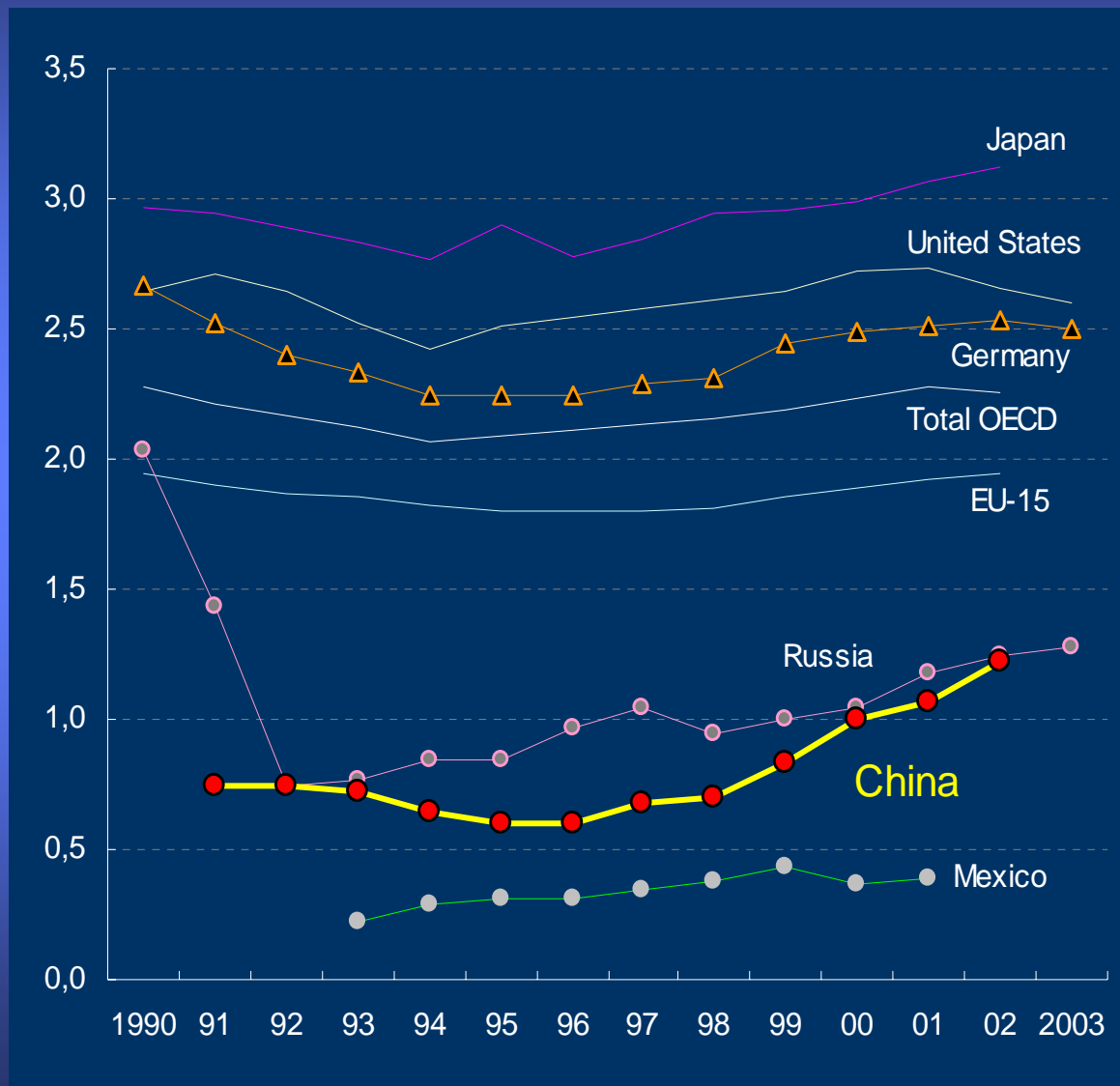
Implications for catching-up strategies

R&D intensity and scientific output

R&D intensity (total R&D expenditures as % of GDP)

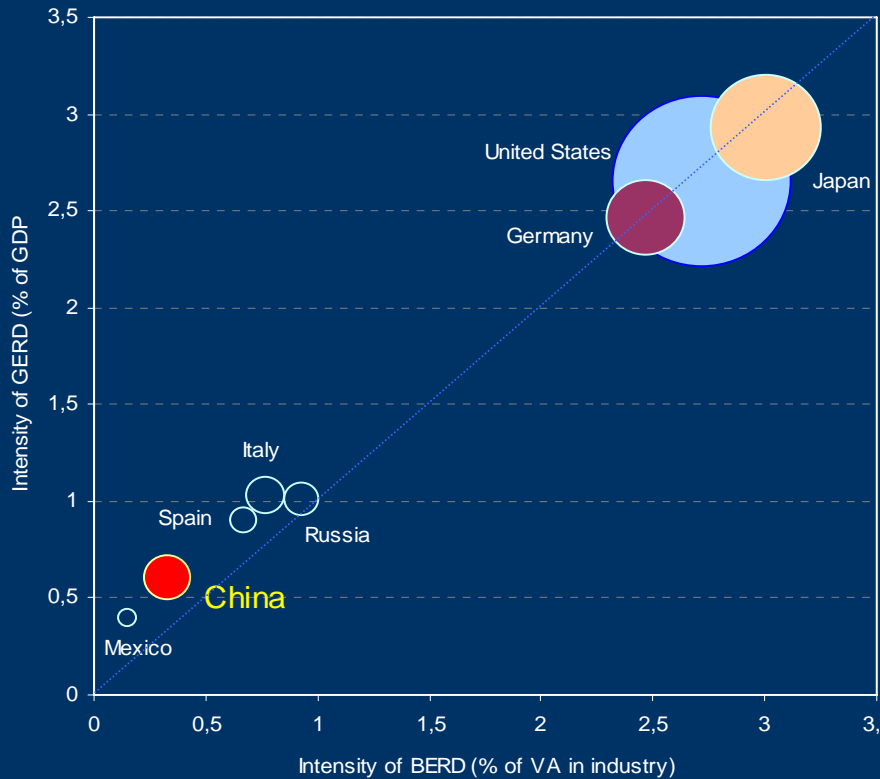


Trend in the intensity of national R&D expenditures

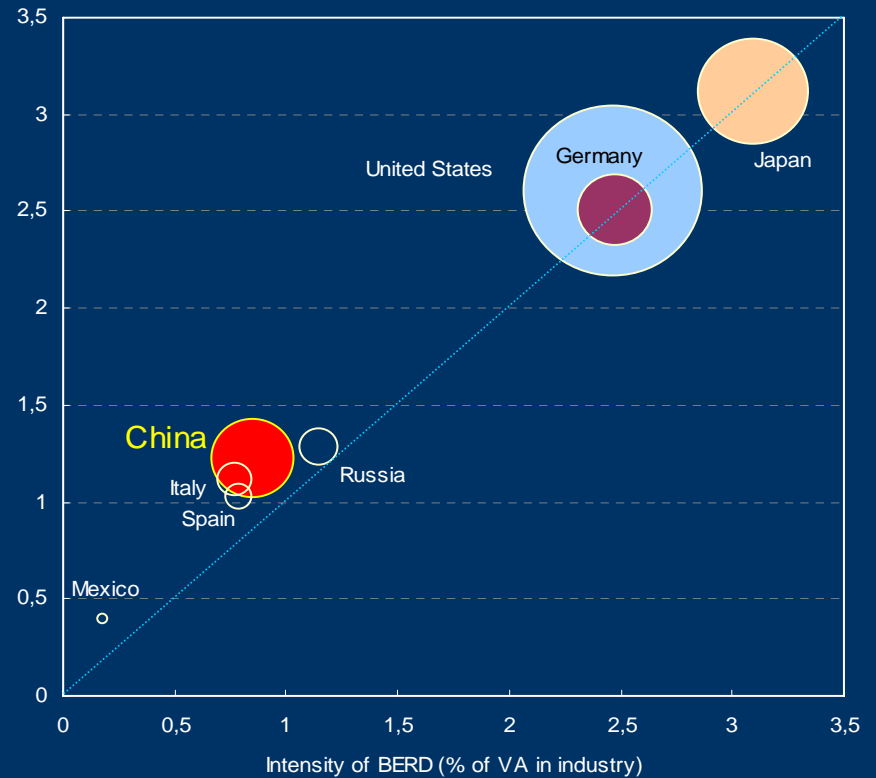


Total and Business R&D intensity

Late 1990s

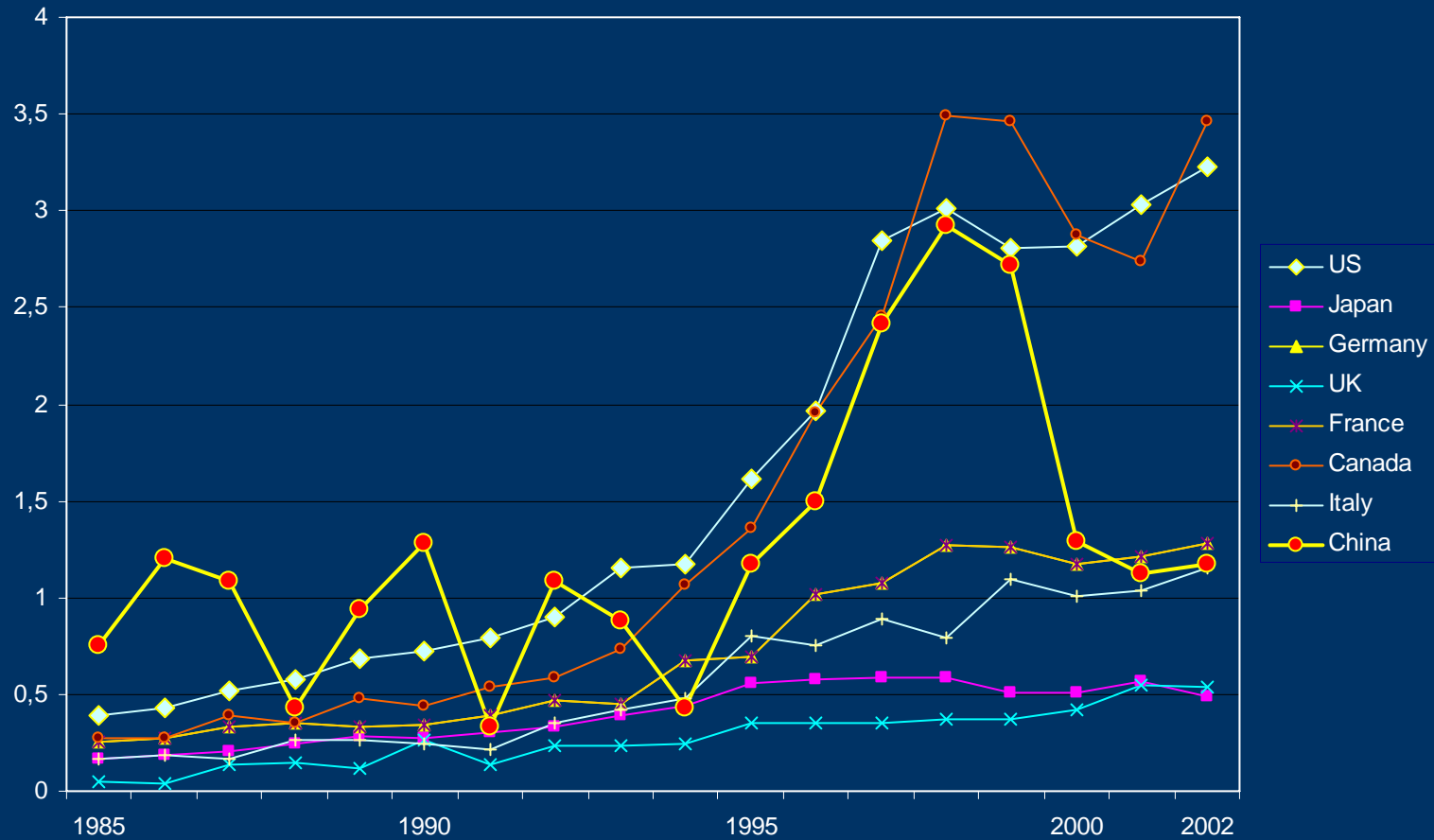


2003

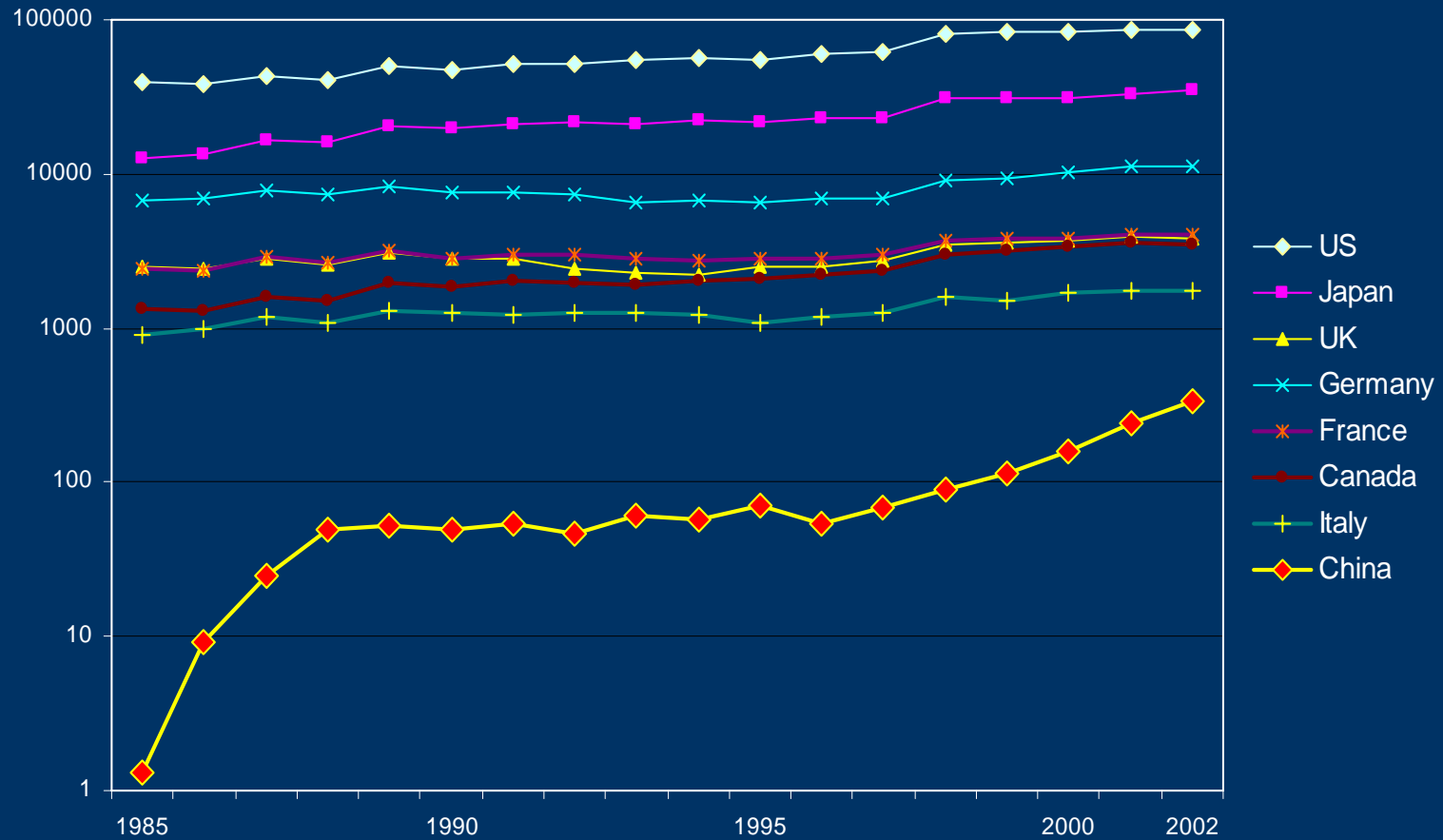


Science-Innovation Linkage

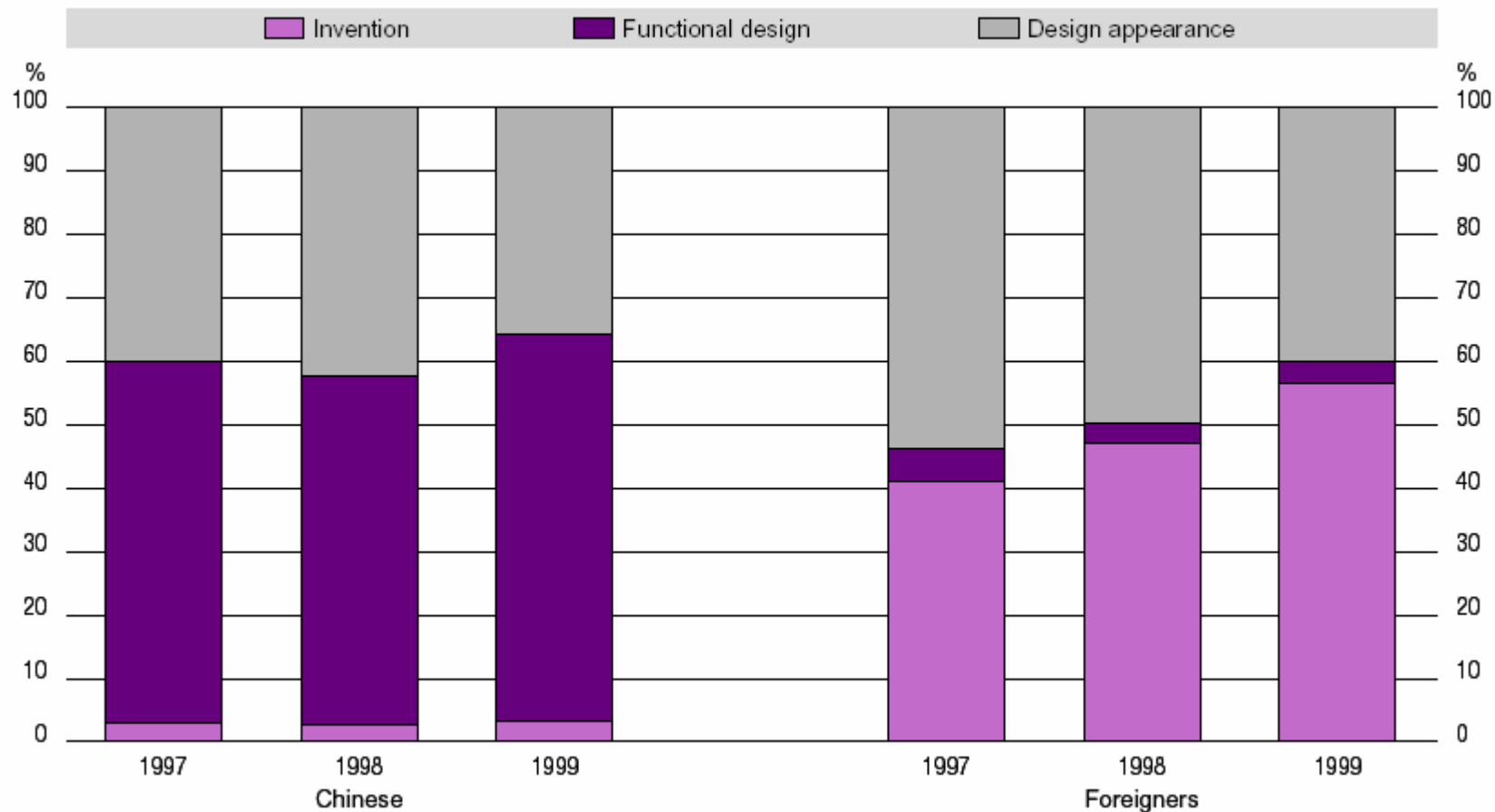
Measured by the average number of scientific articles quoted in patents applied at US Patent Office



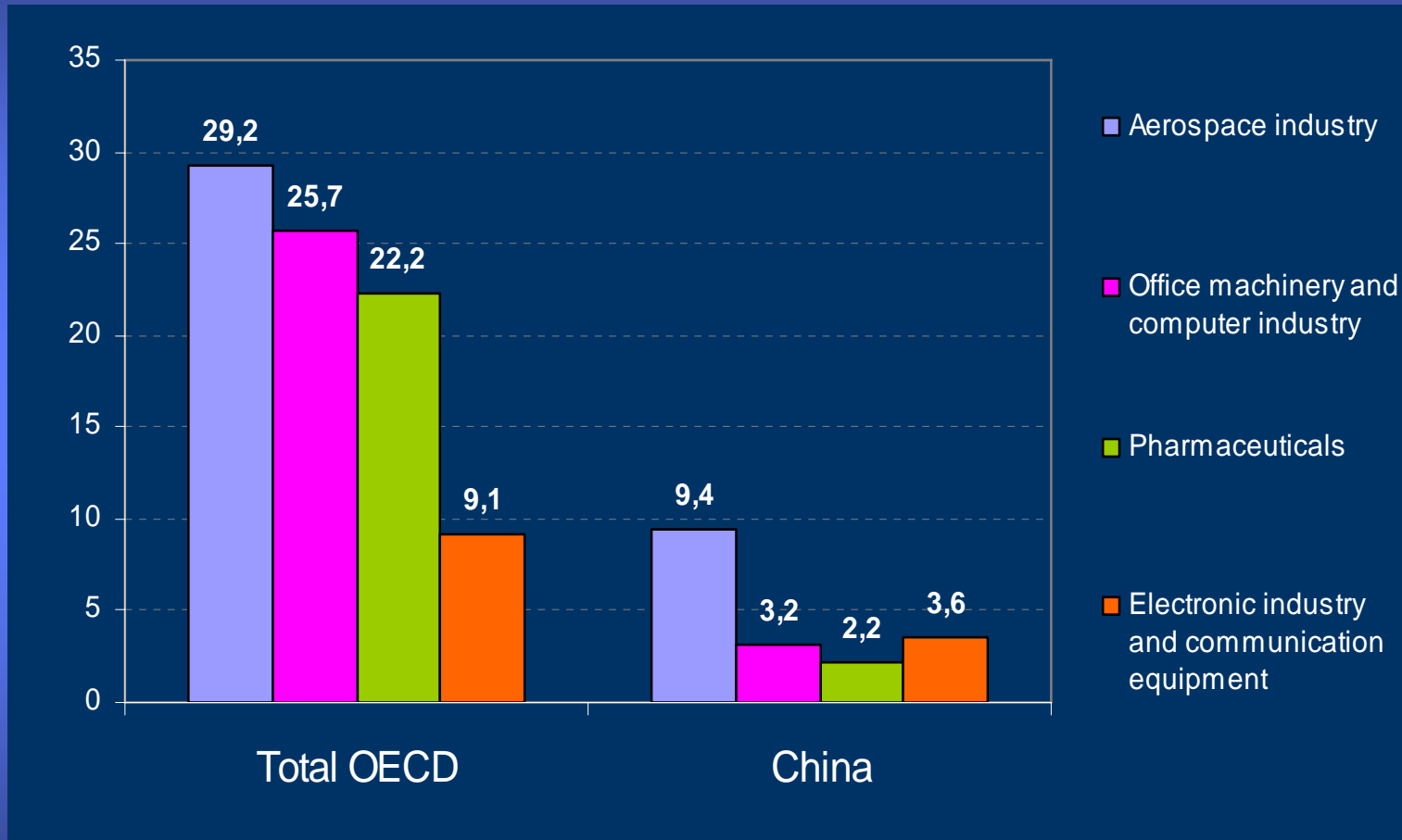
Number of patents applied at US Patent Office



Types of patents granted to Chinese and foreign applicants



R&D intensity in high-tech sectors, 1999



Total OECD includes Canada, Denmark, Finland, France, Germany, Italy, Japan, Norway, Spain, Sweden, the United Kingdom and the United States.

Learning from whom on what? A matrix

	Australia	Denmark	France	Finland	Germany	Ireland	Korea	UK	US
Conducive framework conditions				●				●	●
Comprehensive national P/P programmes	●	●	●	●			●		●
Involving foreign firms and FDI	●					●			
Involving SMEs in P/PPs	●	●		●	●				●
Cluster-based P/PP policy		●	●	●	●		●		●
P/PPs in strategic technological areas			●		●		●	●	●

Examples of specific lessons relevant for China

- Good fundamentals, international openness and sustained public and private investment in knowledge *(US)*
- Attract knowledge-intensive foreign investment in export-oriented sectors but knitt linkages with domestic firms through active and broadly-based innovation policy *(Ireland)*
- A strong policy governance of the innovation system, including an effective coordination between policy instruments and institutions *(Finland, Korea)*
- Develop a diversified set of innovative clusters around large firms or knowledge institutions *(Finland)*
- Promote market-friendly cooperation among SMEs to compensate for the lack of large firms as engines of innovation *in some sectors (Denmark)*
- Exploit innovation synergies between services and manufacturing to create competitive advantages in fast growing global market niches *(Australia)*

Learning also from others' failures

Not to do

- « High-tech or manufacturing myopia »
- Exclusive focus on technological innovation and applied research (“free riding” model of basic research)
- Build « knowledge cathedrals » in desert or attempt to create new sources of competitive advantages from scratch
- « Water unprepared soils » through top-down subsidisation policies
- Remain captive of allies in past successes in bottom-up approaches to innovation policy
- Maximise national participation instead of national benefits in designing P/PP programmes

To sum-up

- A sustainable rate of economic growth that allow catching-up in terms of per capita income requires an above-average long term growth in multifactor productivity that allows:
 - From a national point of view, improvement in the terms of trade, as well as an economically sound and socially acceptable sharing of increased value added.
 - From a geopolitical point of view, a reduction of the “frictions of convergence” since increased competitiveness in knowledge –intensive industries cannot be achieved without contributing to the globally accessible stock of knowledge.
- This can only be achieved by shifting production patterns away from price-elastic towards income-elastic export markets, through both technological upgrading of traditional activities and the development of new ones, especially science-based innovative products and services
- Most of the later should come as “spill-overs” from the upgrading of existing areas of strength. But these “spill-overs” should be catalysed by appropriate government policies, including P/PP programme.

Postscriptum The OECD project on China's innovation system and policy

- China is now Observer in the OECD CSTP Committee
- A two-year project currently at the launching stage
- The project is carried out in partnership with the Chinese Ministry of Science and Technology (MOST), with the following main objectives:
 - Help MOST and enhance its policies to improve the Chinese innovation system.
 - Contribute to a better understanding by OECD countries of China's innovation potential and policies.
 - Strengthen the policy dialogue between China and OECD countries on issues related to international mobility of Chinese researchers, and to globalization of R&D.
- It comprises four modules
 - An international comparison of NIS indicator systems in China and in selected OECD countries
 - A (SWOT) policy analysis of the Chinese innovation system
 - Globalisation of R&D and implications for the design of national innovation systems
 - Supply, demand and mobility of Chinese human resource for S&T (HRST)

Thank you for your attention

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Web Resource:

www.oecd.org/sti/innovation