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Welcome to the guest lectures

Faculty of Business Studies and Economics
Institute for Institutional and Innovation Economics (iino)

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Part 1
Clusters, milieaux, and innovation

Jutta Günther
September 2014, HSE Moscow

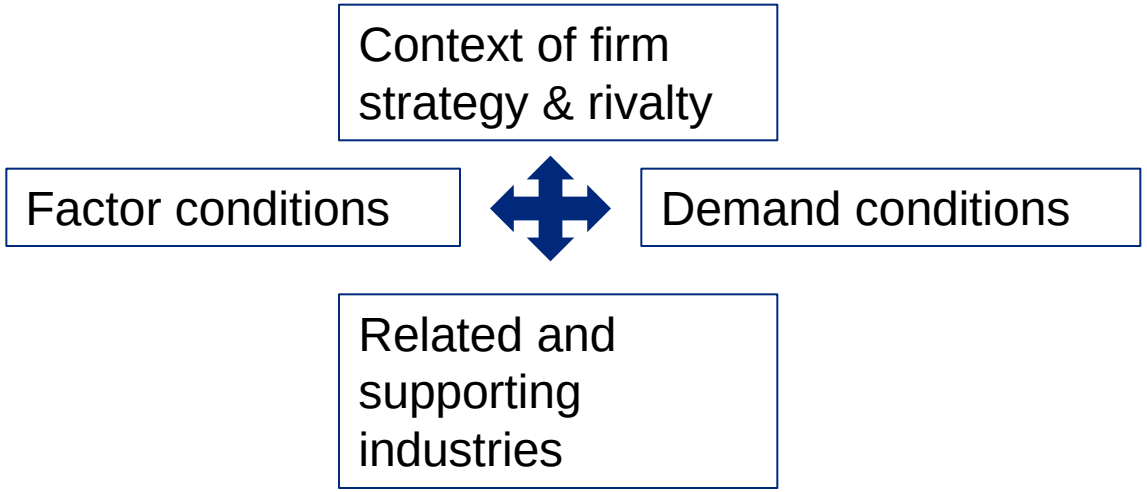
Content

- Definition
- Theory
- Measuring issues
- Policy examples

Definition

Porter's concept of "Cluster"

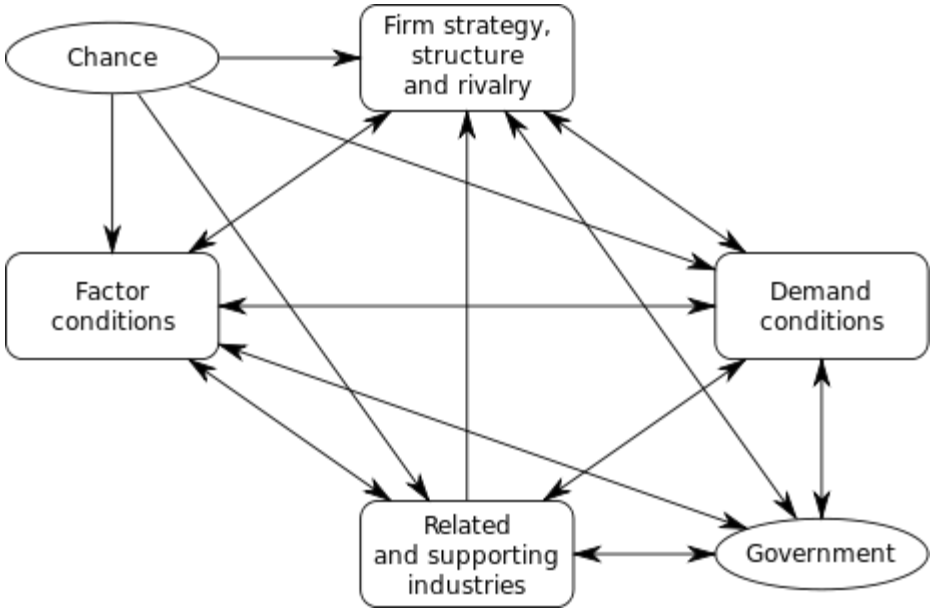
- Porter (1998: p. 199) defines industrial clusters as 'a **geographically proximate group** of **interconnected companies** and **associated institutions** in a particular field, linked by commonalties and complementaries'.
- Diamond Model of Porter (1999):



Porter's diamond model

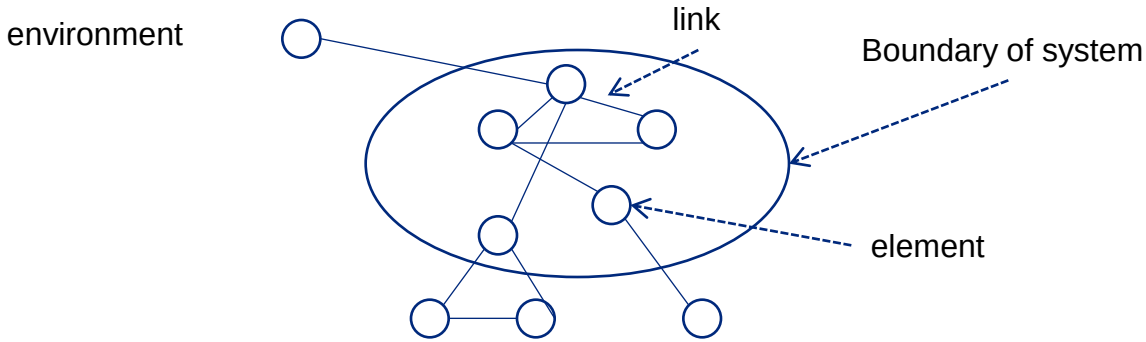
Porter's diamond model

- Why particular industries become competitive in particular locations
- „The competitive advantage of nations"

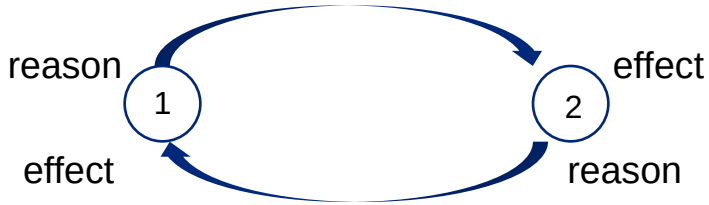


Systemic perspective of clusters

- Features of industrial cluster?
- Ulrich and Probst (1995, S. 30) define a system as ‘a **dynamic ensemble** which consists of certain properties and behaviour patterns. It consists of **interconnected elements** that all elements are **dependending** on each other and the behaviour of the ensemble is affected by the interconnectedness and interaction.’



Feedback effects in systems



Theory

What does theory tell us?

Cluster are explicitly and implicitly subject to economic theory, i.e. **regional economic theory**, but also play a role at the interface to **economic geography** as well as **social sciences** in gereral (urban studies, sociology, planning studies etc.)

➡ Interdisciplinary subject!

Regional economics theories

- Marshall (1890) – specialisation advantages
- Jacobs (1969) – urbanisation (diversification) advantages
- Vernon (1966) – Product life cycle applied to regional production/location decision

Sociological or socioeconomic theory

- Florida (2002) – creative milieauxs and creative class

Marshall (1890) : specialization advantages

Classical theory of agglomeration

Firm‘s objective:

Realization of internal economies of scale

-vs-

Marshall

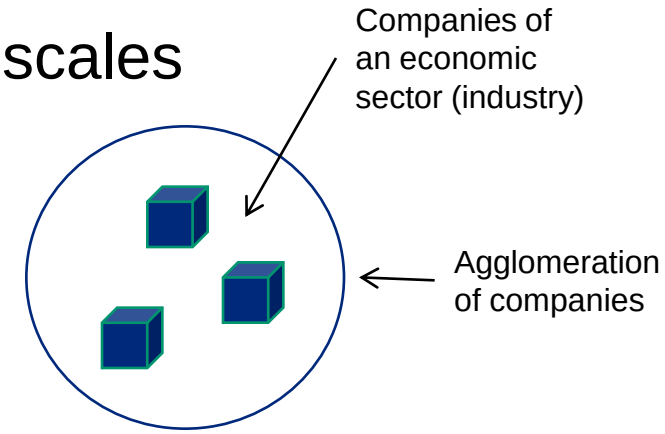
Firm‘s objective:

Realization of external economies of scale

Marshall (1890) : specialisation advantages

Firm‘s objective:

• Realization of external economies of scales



1. Existence of **specialized labour markets**
2. Industry-specific **suppliers** of intermediate goods and services
3. probability of **spillovers** of knowledge

‘Marshall-Arrow-Romer-Hypothesis‘

Marshall (1890) : specialisation advantages

What does it mean for today – knowledge based economies?

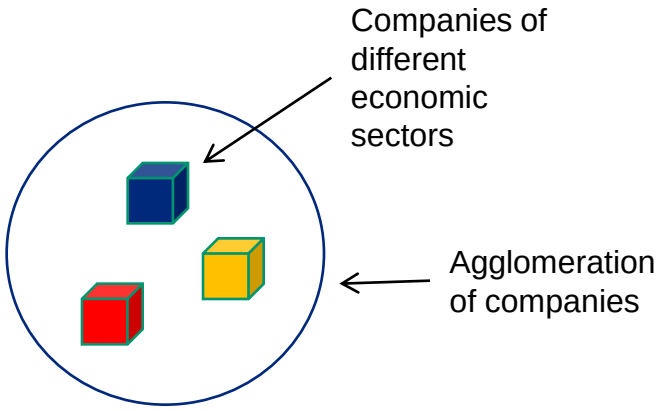
- acquisition of **tacid knowledge** by workforce from other companies
- networks of **knowledge intensive suppliers** in complex value chains
- faster **transfer of knowledge via spillovers** because of proximity

Jacobs (1969): diversification (urbanization) advantages

• External effects from the agglomeration result from concentration of **companies of different sectors**

• the larger the agglomeration of different companies, the more diversification (urbanization) advantage will appear

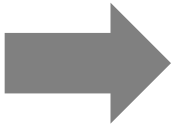
‘Jacobs-Hypothesis‘



Jacobs (1969): diversification (urbanization) advantages

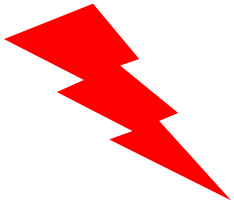
Assumption: combination of knowledge from **different sectors** for diversification advantages

Advantageous condition for the foundation of **new companies**



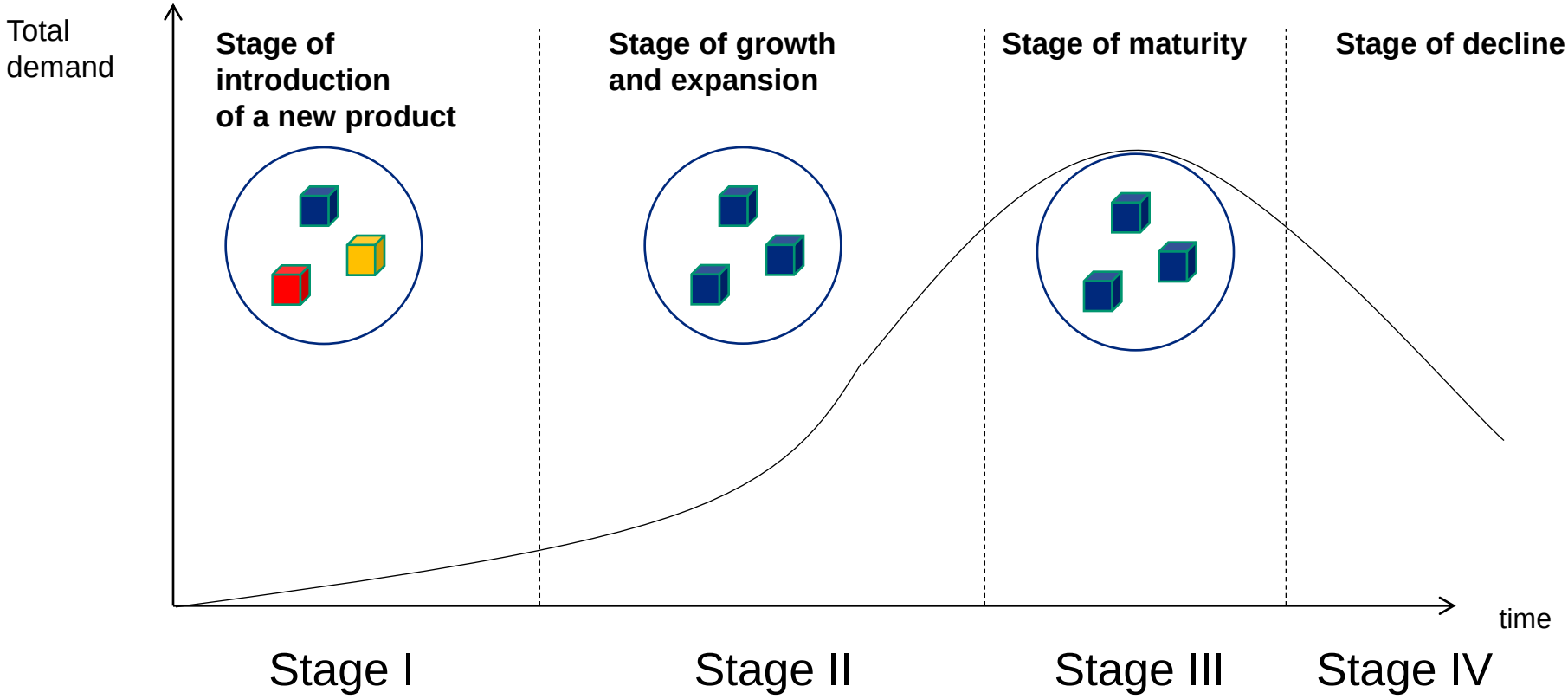
Inkubator-Model

Marshall-Arrow-Romer-Hypothesis



Jacobs-Hypothesis

Vernon (1966) – Product life cycle applied to regional production/location decision

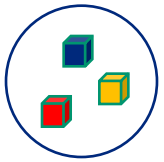


According to Vernon (1966) and Duranton & Puga (2001).

Vernon (1966) – Product life cycle applied to regional production/location decision

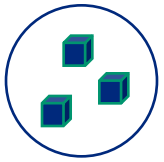
Stage I

• Newly created companies with innovation and high uncertainty benefit from a **diversified economic sector**



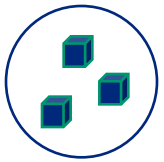
Stage II

• Standardization of production
• Specialized workforce and supporters become important



Stage III

• Foundation of subsidiaries (abroad)
• Shifting of the standardized production process



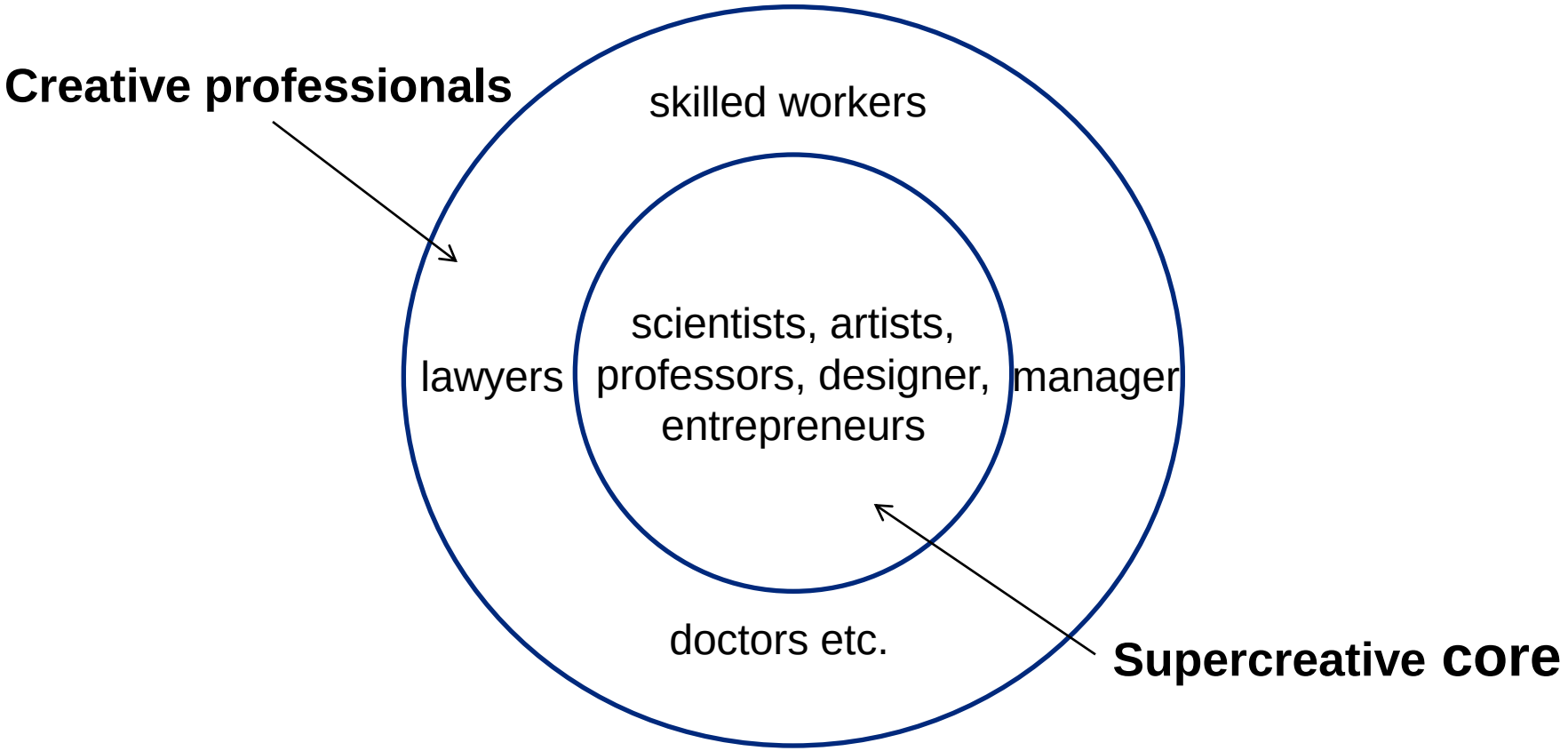
Vernon (1966) – Product life cycle applied to regional production/location decision

Criticism

- not all products pass the whole process of the product life cycle
- service sector is not considered

Florida (2002) – creative class

„Creative Class“: creative people from a variety of fields (all jobs)



Florida (2002) – creative class

- **mobility** of the creative class
- geographical proximity of **interactive** partners
- **clustering** of human resources

Assumption:
- cluster-specific constellation of competitiv companies or connected by value chain
- increase of organizational interaction
- special infrastructure

→ **Competitive advantages!** e.g. San Francisco, Berlin

See: Florida, Richard (2002), The Rise of the Creative Class. And How It's Transforming Work, Leisure and Everyday Life, Basic Books

Florida (2002) – creative class

Critique:

- does not explain the formation of mileaux or cluster
- not all centres of innovation include all characteristics
- cultural differences make the expansion of successful models to other regions more difficult

„Creative industries“

No generally accepted definition (yet)!

Howkins (2001) … comprises **advertising, architecture, art, crafts, design, fashion, film, music, performing arts, publishing, R&D, software, toys and games, TV and radio, and video games** (pp. 88–117).

See: Howkins, John (2001), The Creative Economy: How People Make Money From Ideas, Penguin

Areas of the „creative industry“ according to the BMWi

Source: Federal Ministry for Economic Affairs and Energy (BMWi), Germany

Measuring issues

Measuring clusters for economic research

Possibilities for the measurement, esp. **inter-connection**?

Type of actor	Type of **interaction**	Possible data sources
Producing company	Supplier relationships	Employment statistics, input-output statistics
Scientific or technically trained employees	Co-authorship in professional publications	Publication database
Inventors	Co - patent application	Patent database
Scientific organisations or firms with own R&D	collaborative R&D projects	Project statistics

Measuring clusters for economic research

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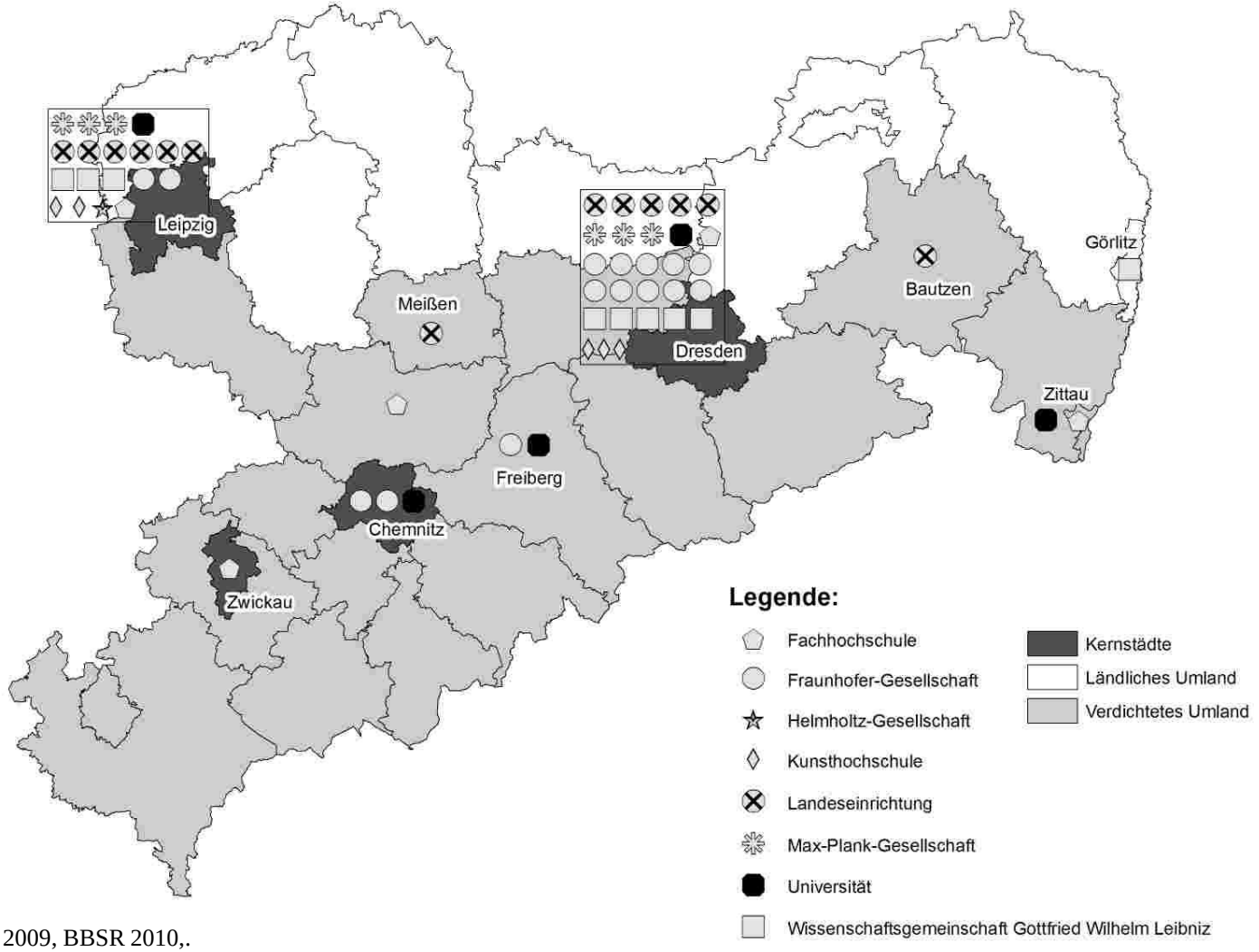
Scientific organisations or firms with own R&D	collaborative R&D projects	Project statistics

Example I

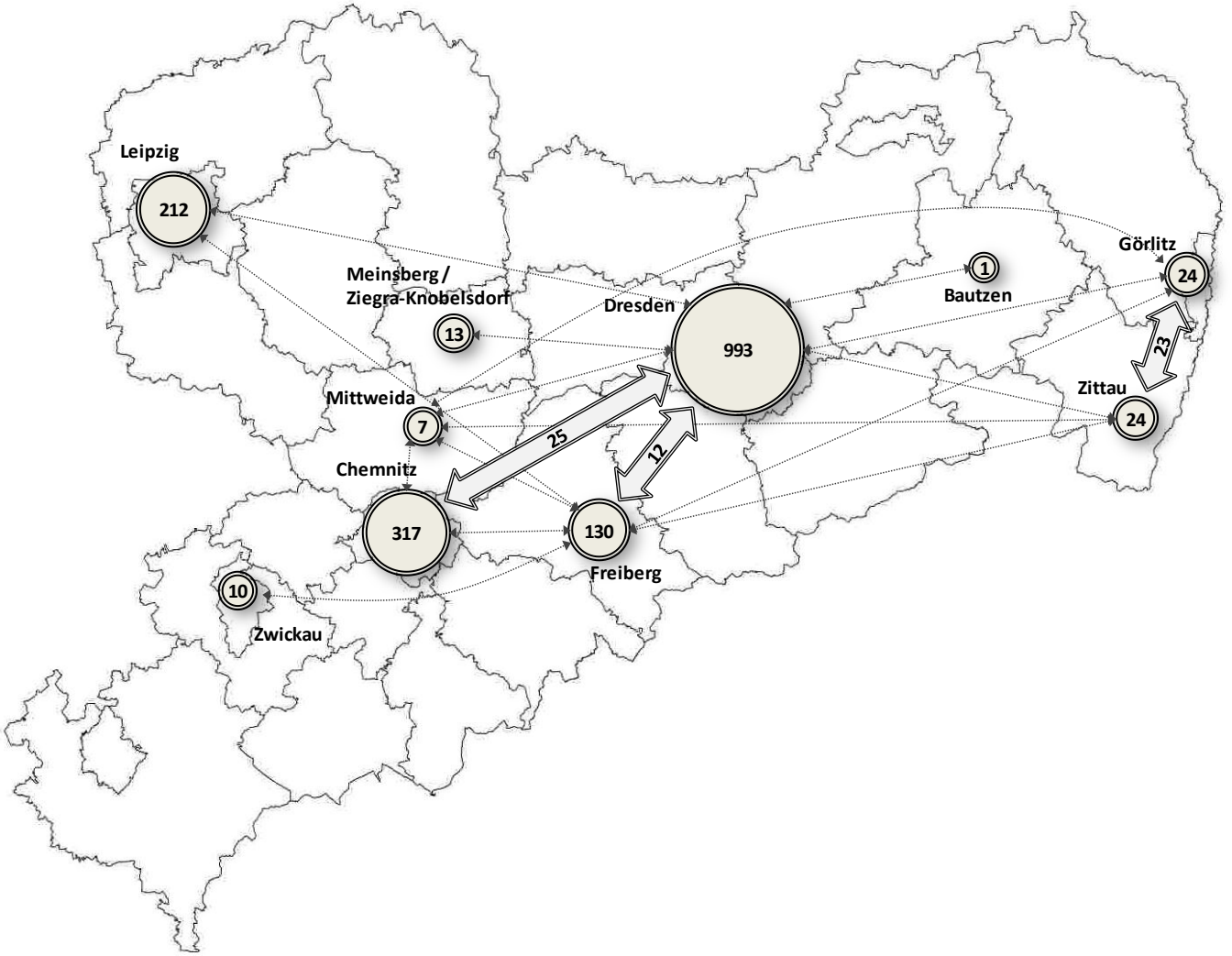
Scientific organisations in *Sachsen*, 2010 (East German region with high R&D potential)



Source: SMWK 2009, BBSR 2010,.

Example II

Centres of research of publications and co-publication relationship in the field of „Engineering“ in *Sachsen* 1990-2010

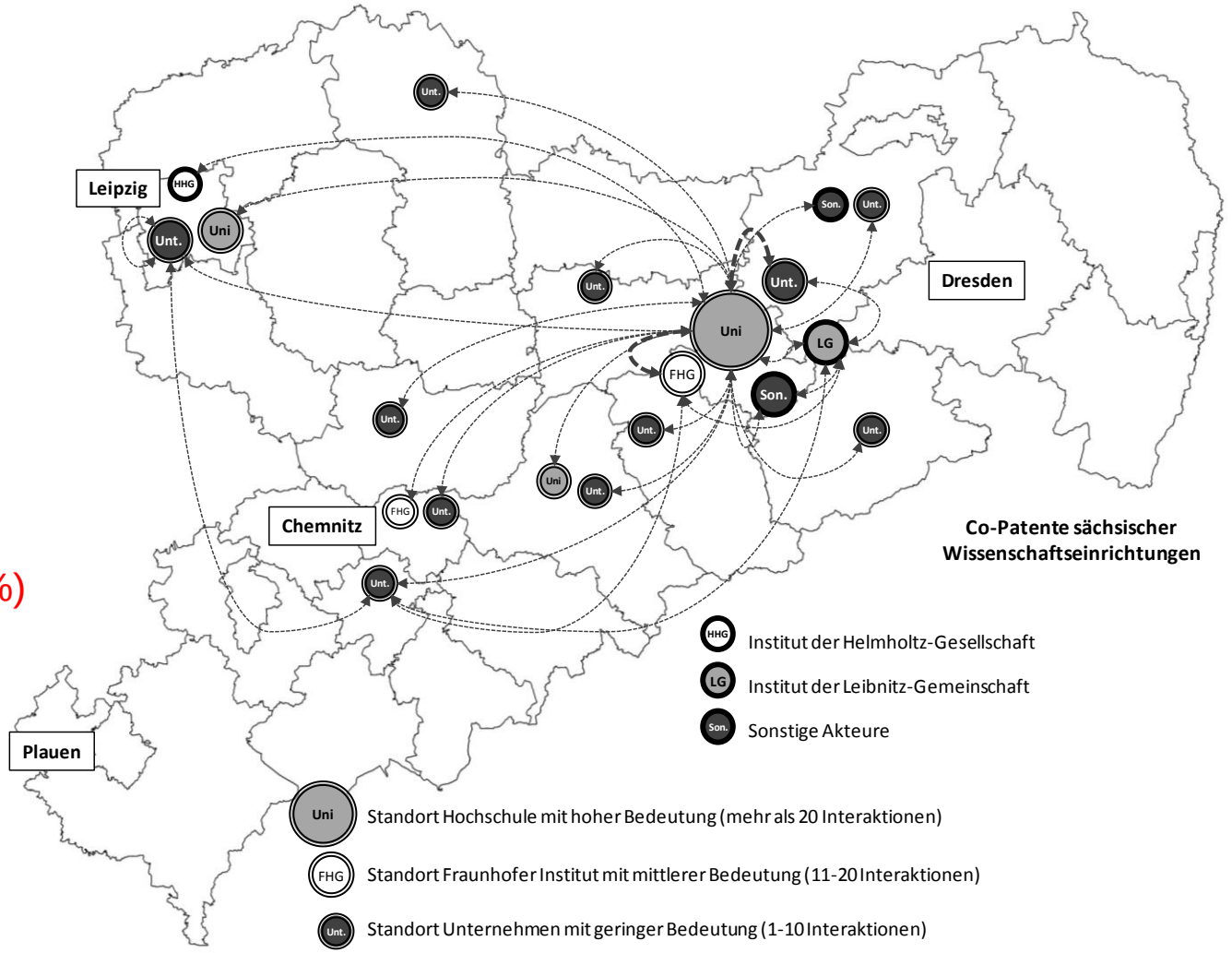


Source: data from Science Direct.

Example III

Patent applications of the TU Dresden 1994-2009

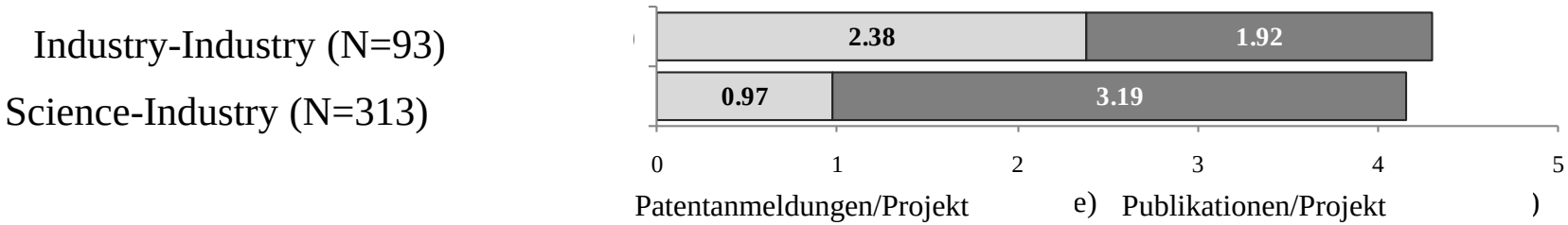
592 patent applications;
thereof: 72
co- patents (12%)



Source: data from DEPATISnet; see: Titze/Brachert/Günther/Schwartz 2010

Subsidized R&D projects in *Sachsen*

R&D projects in *Sachsen* 2000-2006



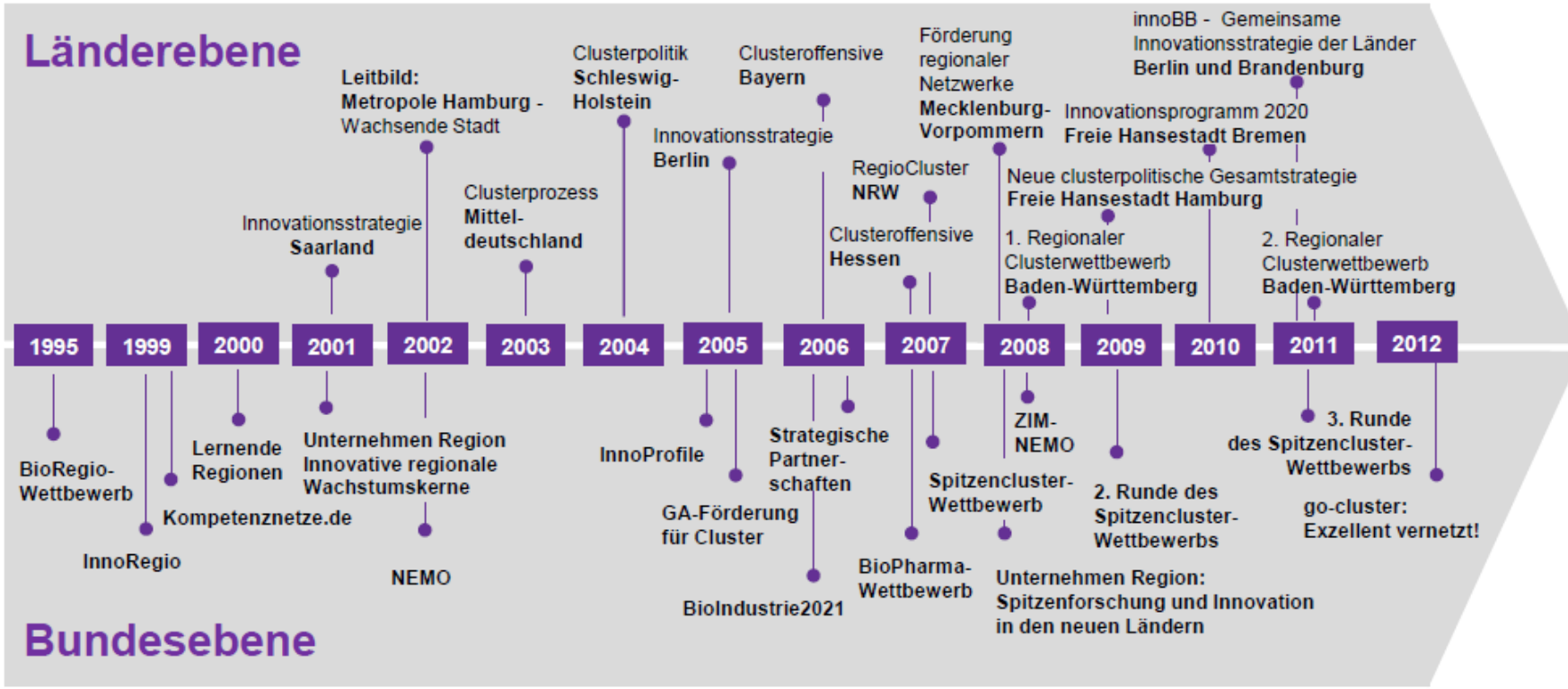
Determinants of output (patents, publications)

- Size of funding
- Combination of the project team
  - large firms
  - participation of universities

See: Schwartz/Peglow/Fritsch/Günther (2010)

Policy examples

Cluster related policies of *Länder* (federal states) and federal government in Germany



Source: VDI/VDE Innovation + Technik GmbH

Clusters in Germany

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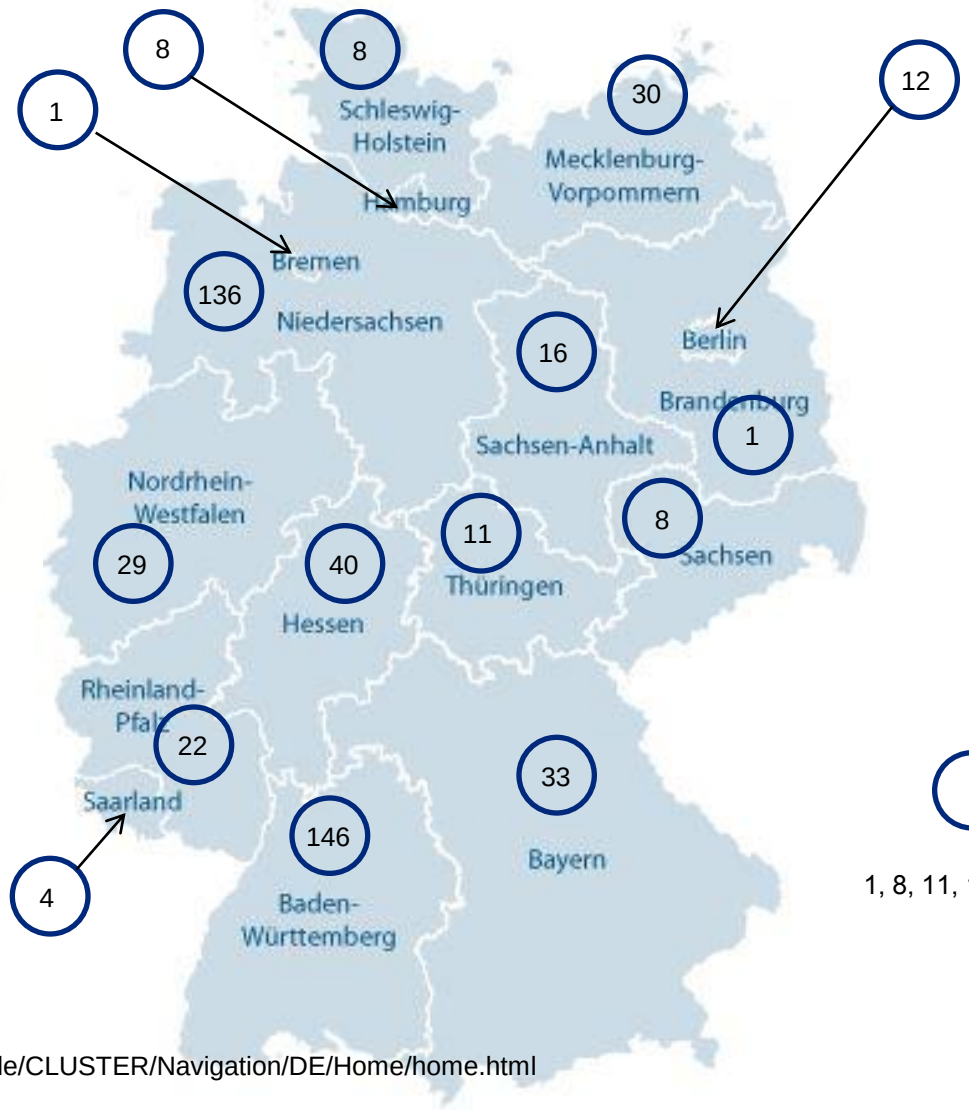

Clusterplattform Deutschland

Cluster

1, 8, 11, 12 …

Quantity of clusters in a federal state

http://www.clusterplattform.de/CLUSTER/Navigation/DE/Home/home.html

Leibniz-Association

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Leibniz-Gemeinschaft

- Institutes of the Leibniz-Association

http://www.bmbf.de/de/6716.php

Leibniz-Association
- Applied Research-

Leibniz-Gemeinschaft

New policy: Leibniz Research Alliances

Leibniz-Institutes co-operate:

throughout Germany (topics, interest vs. space)
throughout diciplines (diversity)

Leibniz Research Alliances

Leibniz-Gemeinschaft

Fields

- **Education Research**
- Biodiversity
- Energy Transition
- Health and Ageing
- Historical Authenticity
- Crises in a Globalised World
- Medical Technology: Diagnosis, Monitoring and Therapy
- Sustainable Food Production and Health Nutrition
- Nanosafety
- Bioactive Compounds and Biotechnology

Leibniz Research Alliances
Example: Education Research

Leibniz-Gemeinschaft

Partners:

- Deutsches Institut für Erwachsenenbildung – Leibnitz-Zentrum für Lebenslanges Lernen e.V. (DIE), **Bonn**
- Deutsches Institut für Internationale Pädagogische Forschung (DIPF), **Frankfurt** a. M. und **Berlin**
- Deutsches Institut für Wirtschaftsforschung (DIW Berlin), Sozio-oekonomisches Panel (SOEP), **Berlin**
- Georg-Eckert-Institut - Leibniz-Institut für internationale Schulbuchforschung (GEI), **Braunschweig**
- GESIS - Leibniz-Institut für Sozialwissenschaften, Köln, Mannheim, **Berlin**
- ifo-Institut – Leibniz-Institut für Wirtschaftsforschung an der Universität **München**
- Leibniz-Institut für Agrarentwicklung in Transformationsökonomien (IAMO), **Halle/Saale**
- Leibniz-Institut für Bildungsverläufe (LIfBi), **Bamberg**
- Leibniz-Institut für Wissensmedien (IWM), **Tübingen**
- Leibniz-Institut für Neurobiologie (LIN), **Magdeburg**
- Leibniz-Institut für die Pädagogik der Naturwissenschaften und Mathematik (IPN), **Kiel**
- Leibniz-Zentrum für Psychologische Information und Doku-mentation (ZPID), **Trier**
- Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI), **Essen**
- Wissenschaftszentrum Berlin für Sozialforschung (WZB), **Berlin**
- Zentrum für Europäische Wirtschaftsforschung (ZEW), **Mannheim**

Leibnitz-Research Alliances
- Education Research -

Themes of research:

- Context of educational institutions

- Context of family

- Context of work environment

- Context of informal education

http://www.portrait.uni-bremen.de/bilder/Glashalle1.jpg

Sources

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Thank you for your attention!

Part 2
Comparative analysis of STI and performance

Jutta Günther
September 2014, HSE Moscow

Content

- Theory: Innovation and economic development (growth)
- Empirics: relationship of R&D and growth in international comparison
- Excursion: Innovation and business cycles (economic crisis)

Theory

Neoclassical Theory

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Traditional neoclassical growth theory (Solow 1956)

Labor and capital are the central factors to explain economic growth, technological progress incorporated in fixed capital (exogenous factor)

New Growth Theory (Romer 1986 and 1990; Lucas 1988)

R&D / knowledge production as an independent (endogenous) growth factor directly determines economic growth

Investment in new knowledge → **enlarged production potential** through new products and production processes („*Kapazitätseffekt*“),

Innovation → **growth** as a **long term effect** through technologically new products, production processes, and spillovers.

New Growth Theory

Firms' investment in human capital and R&D → innovations which increase productivity of labour and capital at firm level

NGT – innovations **not only private returns** (firm) – public returns too (economy)

How is that possible?

Non-excludability of knowledge → technology diffusion via positive external effects → benefits at the level of economy

Technology spillovers

e.g. Grossman/Helpman (1997)

Limitations of New Growth Theory

- Assumption of **homogenous firm**
- Assumption of **perfect information** (predictability of innovation success) – in reality many uncertainties …
- Technology **spillovers are not frictionless** – implementation often difficult and expensive (imitation is usually not a simple process!)
- "**Institutional vacuum**" in New Growth Theory
- No consideration of **path dependencies** (firms' learning history)

Schumpeter

Early Schumpeter

Innovation (radical), **entrepreneur**, swarms of firms, leads to cyclical development, monopoly (at least temp.), imitation, highly competitive markets (1911, 1939) – **creative destruction**

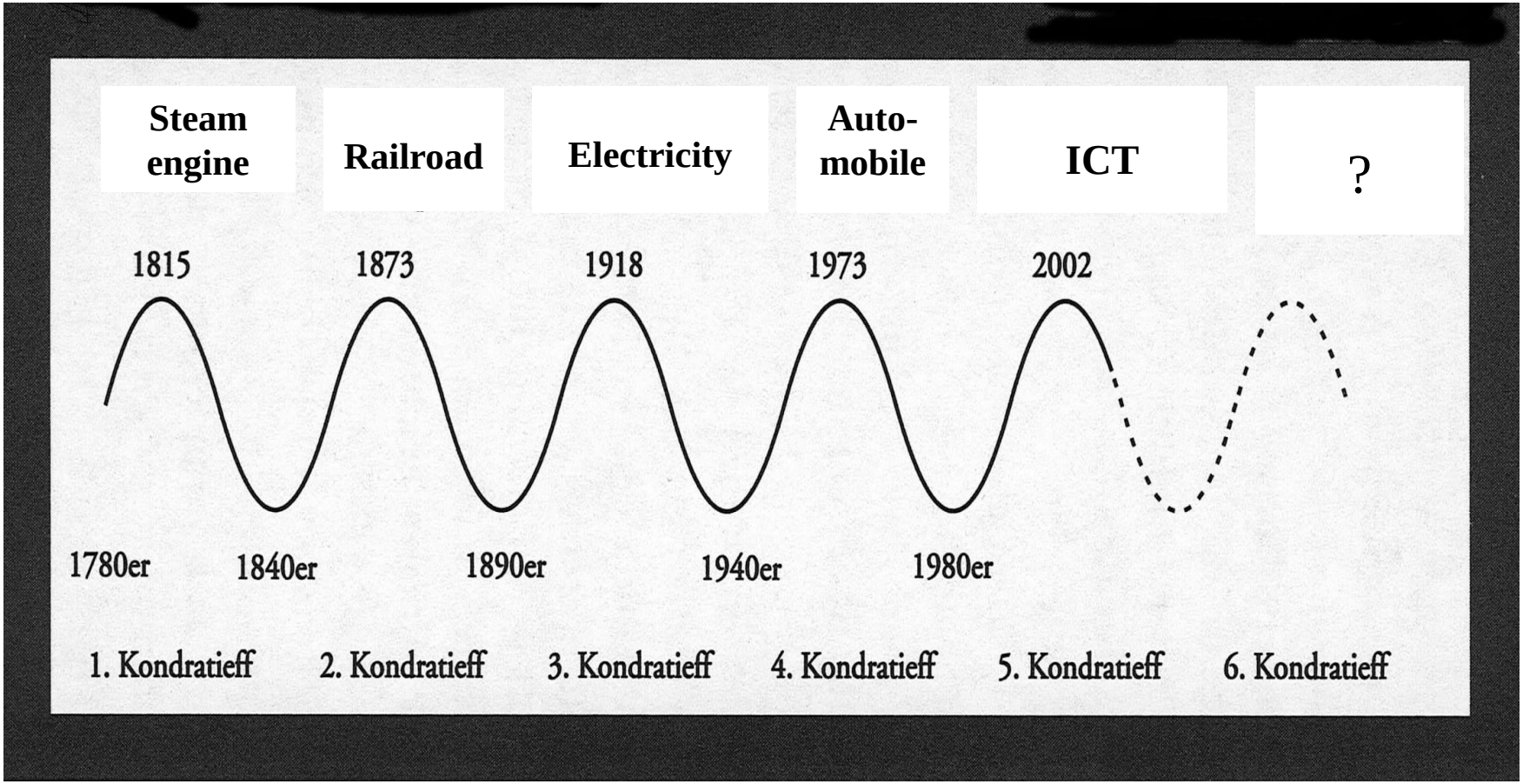
Today: Typical for new industries (swarms of new firms in a new field etc.)

Late(r) Schumpeter

Innovation of **large firms**, innovation persistent/structural, not so disruptive, firms able to survive, oligopolistic markets (1942) – **creative accumulation**

Today: firms manage to adapt and survive major tech changes (e.g. IBM from a typewriter to computer/software producer or Nokia from a producer of rubber boots to an electronic company)

Kondratieff - Long Waves of Economic Development



Are there (repeating) patterns of change?

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“Long wave” theory: yes

Kondratieff – 1920s statistical observation of “long waves” in capitalistic economies; later Schumpeter picking up the argument …

… but (critique)

Each big transition (beginning with first industrial revolution) is different

First industrial revolution – later on “innovation in services” – today many “networks of innovative firms” …

Causality? (growth and innovation)

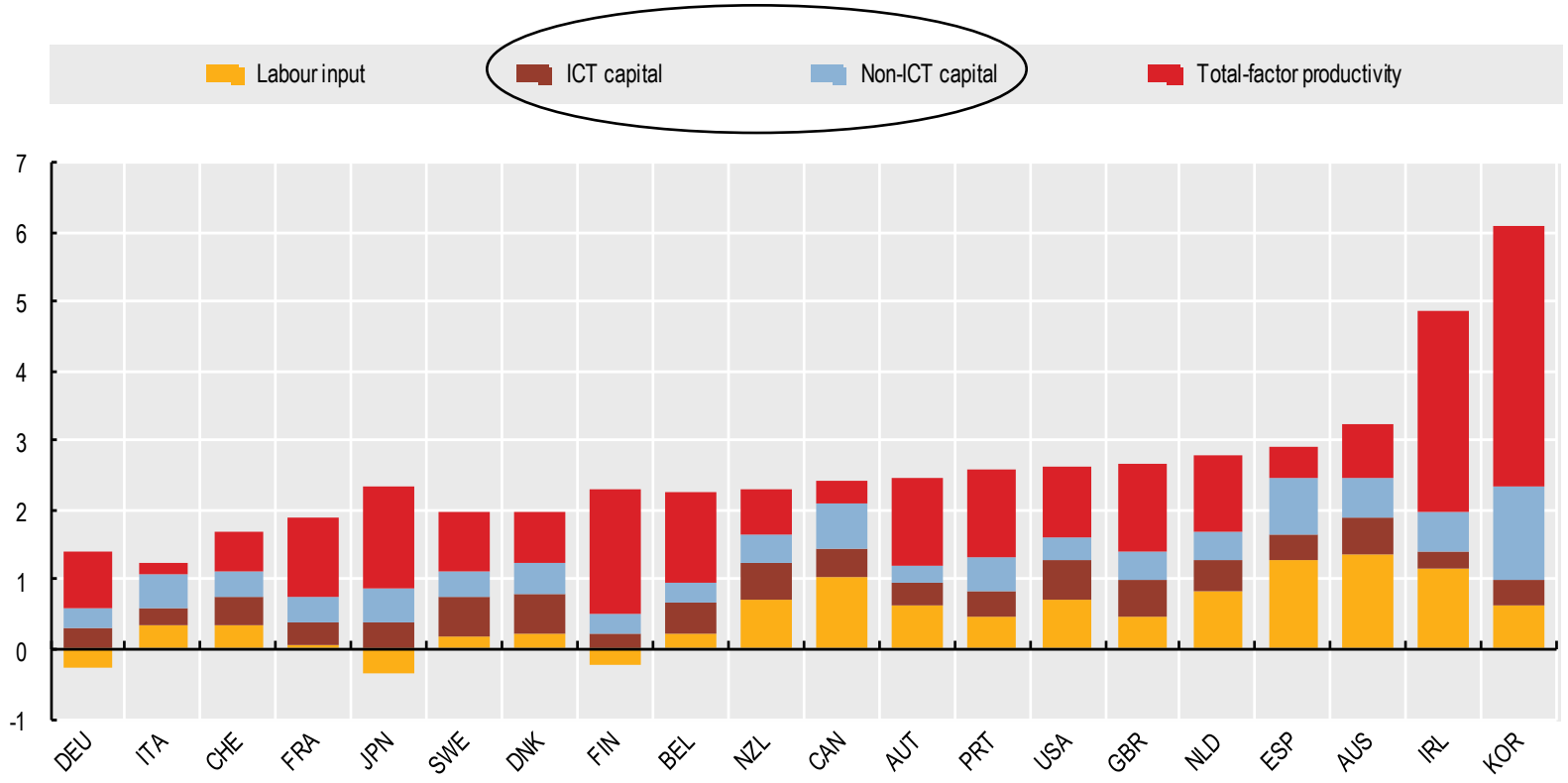
For **Schumpeter** and long wave theorists technological innovation is like an **external shock** to the economy; causal link whereby **growth is the dependent** and innovation the independent variable.

Innovation drives economic development (growth)!

Different question: How does growth or stagnation affect innovation?

Empirics:
R&D and innovation in international comparison

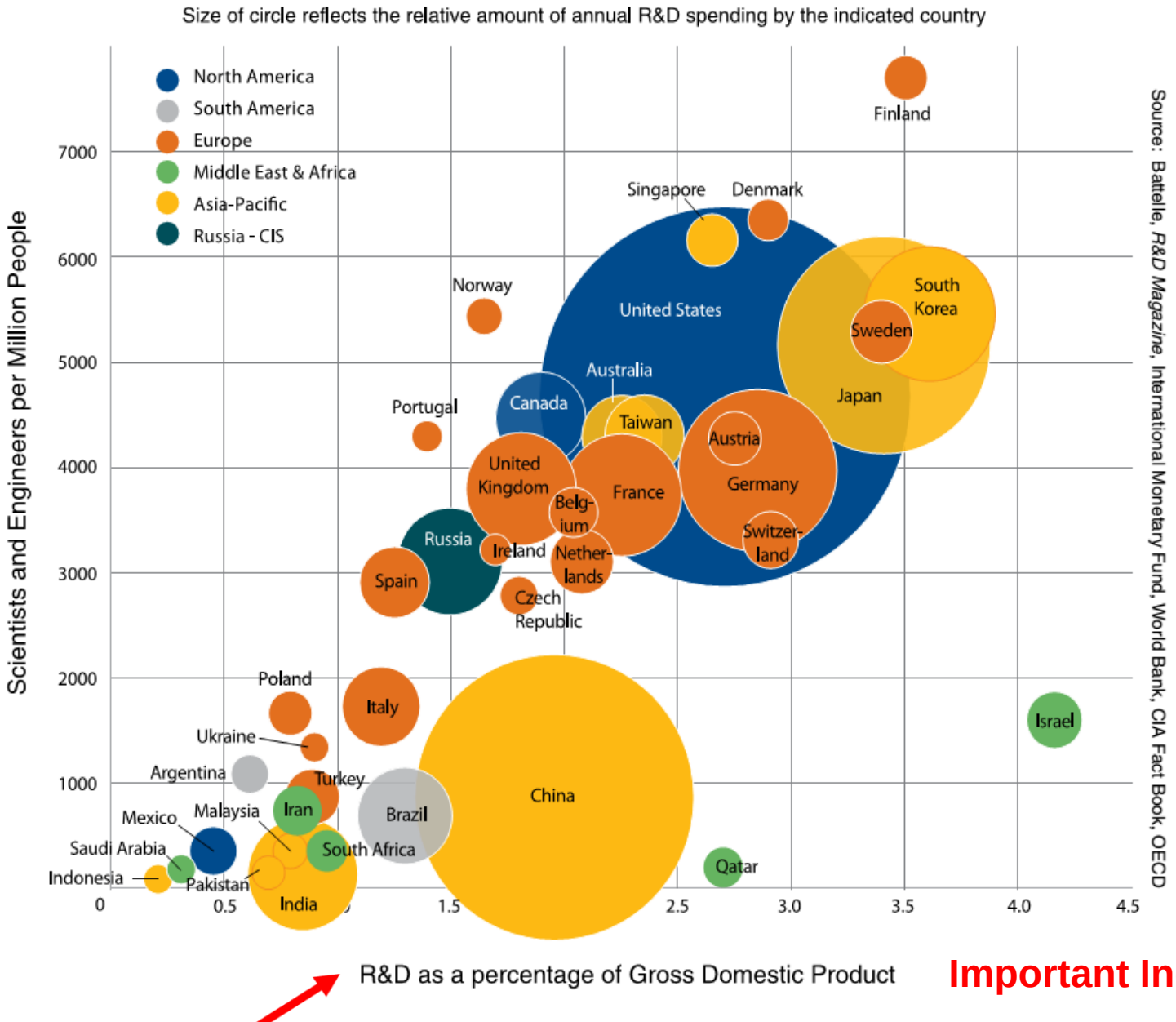
Contribution of the factor „technological progress“ (TFP) to GDP - average yearly growth in % 1985-2009* -



⇨ High importance of innovation (TFP) for economic growth!

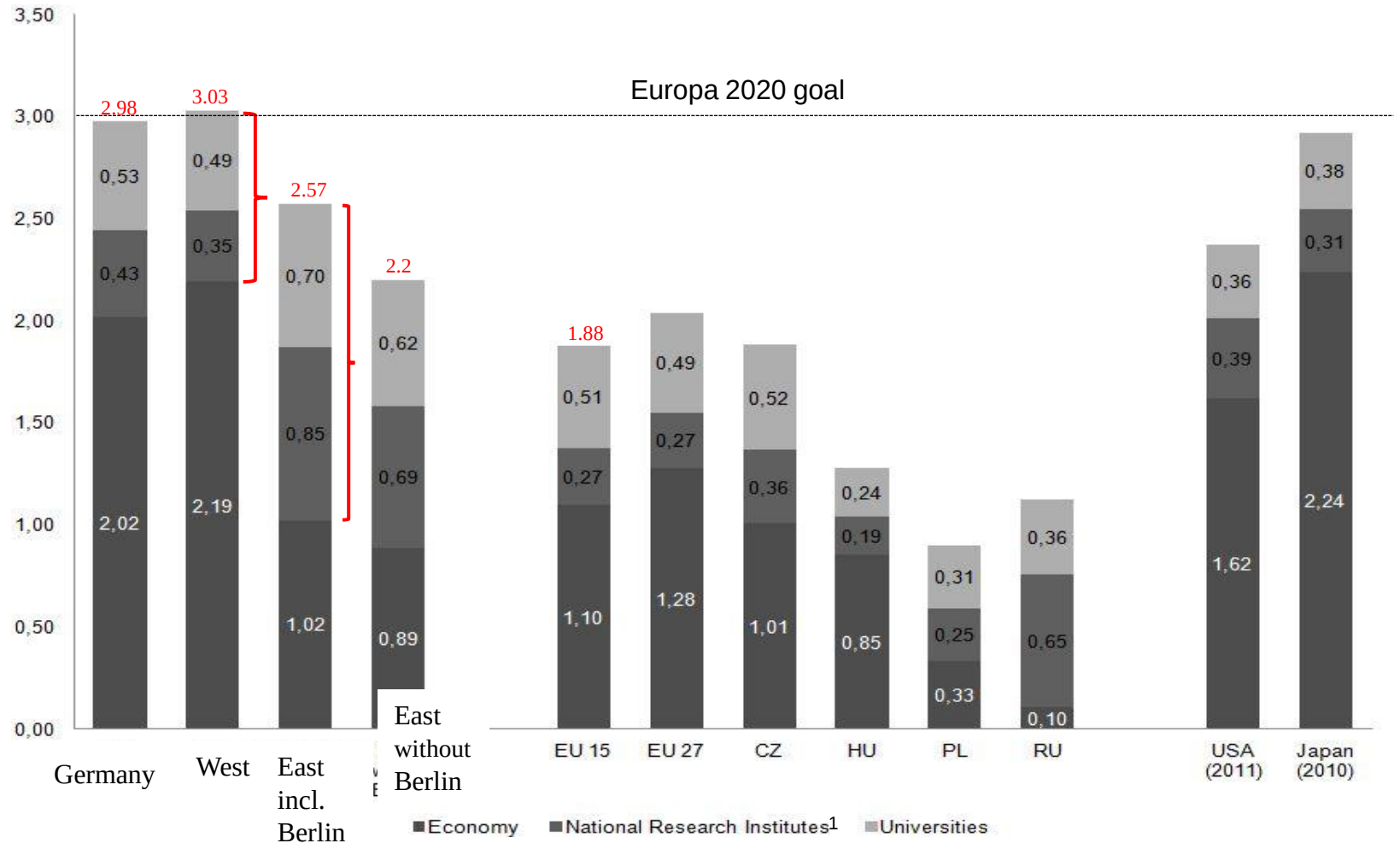
Source: OECD Factbook 2011, *1985-2009 or nearest available time period
TFP = total factor productivity, ICT = Information and communication technology

International R&D spending and number of scientists 2013



Important Indicator!

R&D expenditure in % of GDP in 2012, Germany (East and West), EU and CEEC



[1]The figures include non-profit organisations

Source: Federal Statistical Office, Eurostat; own calculation.

GDP and R&D expenditure in European countries 2012

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Central & Eastern Europe	GDP in bn €	Total R&D expend. in bn €	Symbol
Russian Federation	1.563,00	17,53	
Poland	389,70	3,43	
Czech Republik	149,49	2,88	
Romania	142,25	0,64	
Hungary	97,95	1,24	
Slovakia	72,13	0,59	
Croatia	43,13	0,33	
Bulgaria	39,94	0,25	
Slovenia	35,27	0,99	
Lithunia	34,63	0,30	
Serbia	31,99	0,29	
Latvia	23,37	0,15	
Estonia	18,61	0,38	
Cyprus	16,50	0,08	

Western Europe	GDP in bn €	Total R&D expend. in bn €	Symbol
Germany	2.737,60	79,38	
France	2.059,85	46,55	
United Kingdom	1.899,10	33,26	
Italy	1.560,02	19,83	
Spain	1.022,99	13,39	
The Netherlands	602,66	12,93	
Switzerland	489,67	0,00[1]	
Sweden	420,85	13,89	
Norway	385,75	6,44	
Belgium	382,69	8,41	
Austria	313,07	8,71	
Denmark	248,97	7,32	
Finland	193,44	6,83	
Greece	182,05	1,34	
Portugal	165,69	2,47	
Ireland	164,05	2,83	
Luxembourg	45,48	0,63	
Malta	7,26	0,06	

Source: Eurostat.

Relationship between GDP and R&D 2012
Central and Eastern Europe

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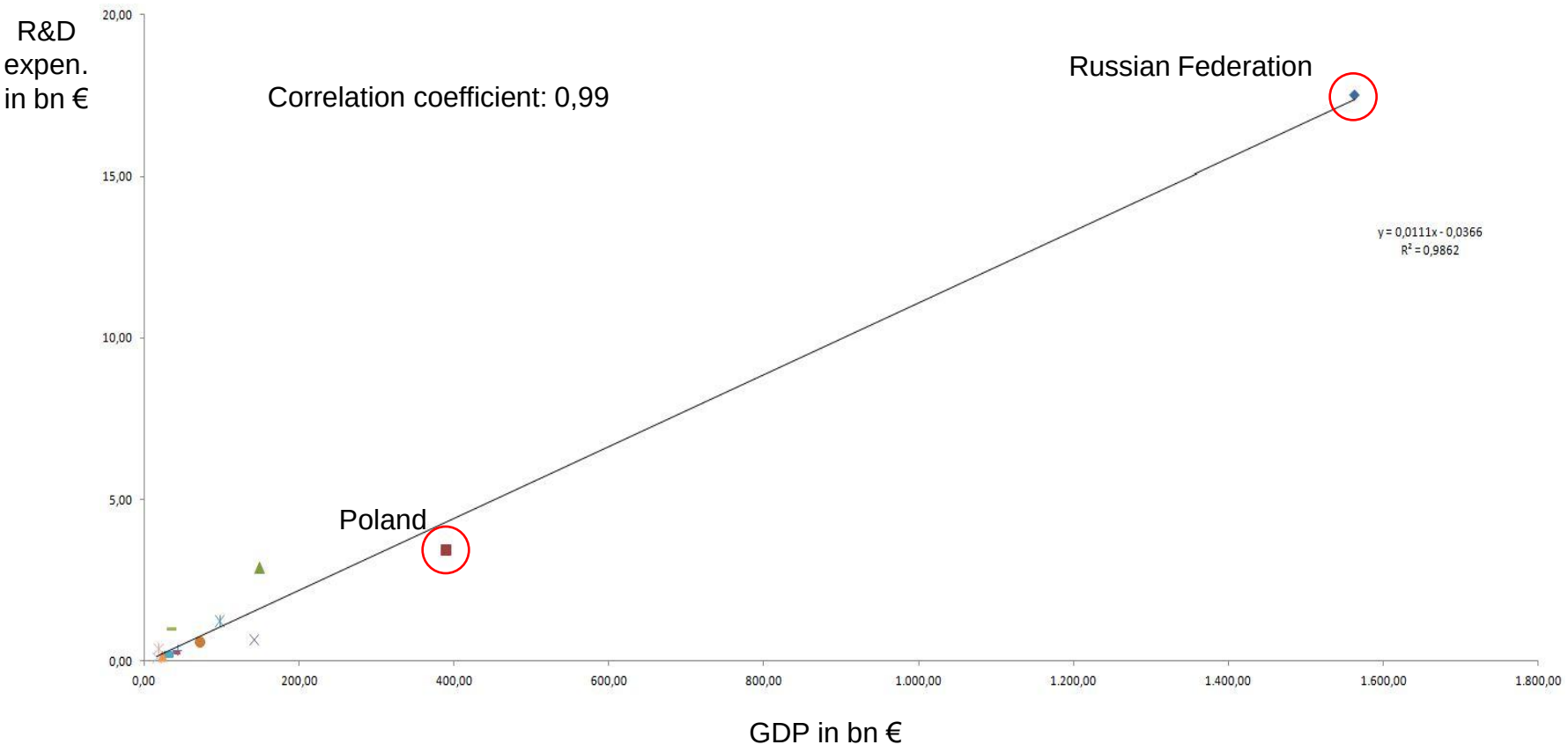
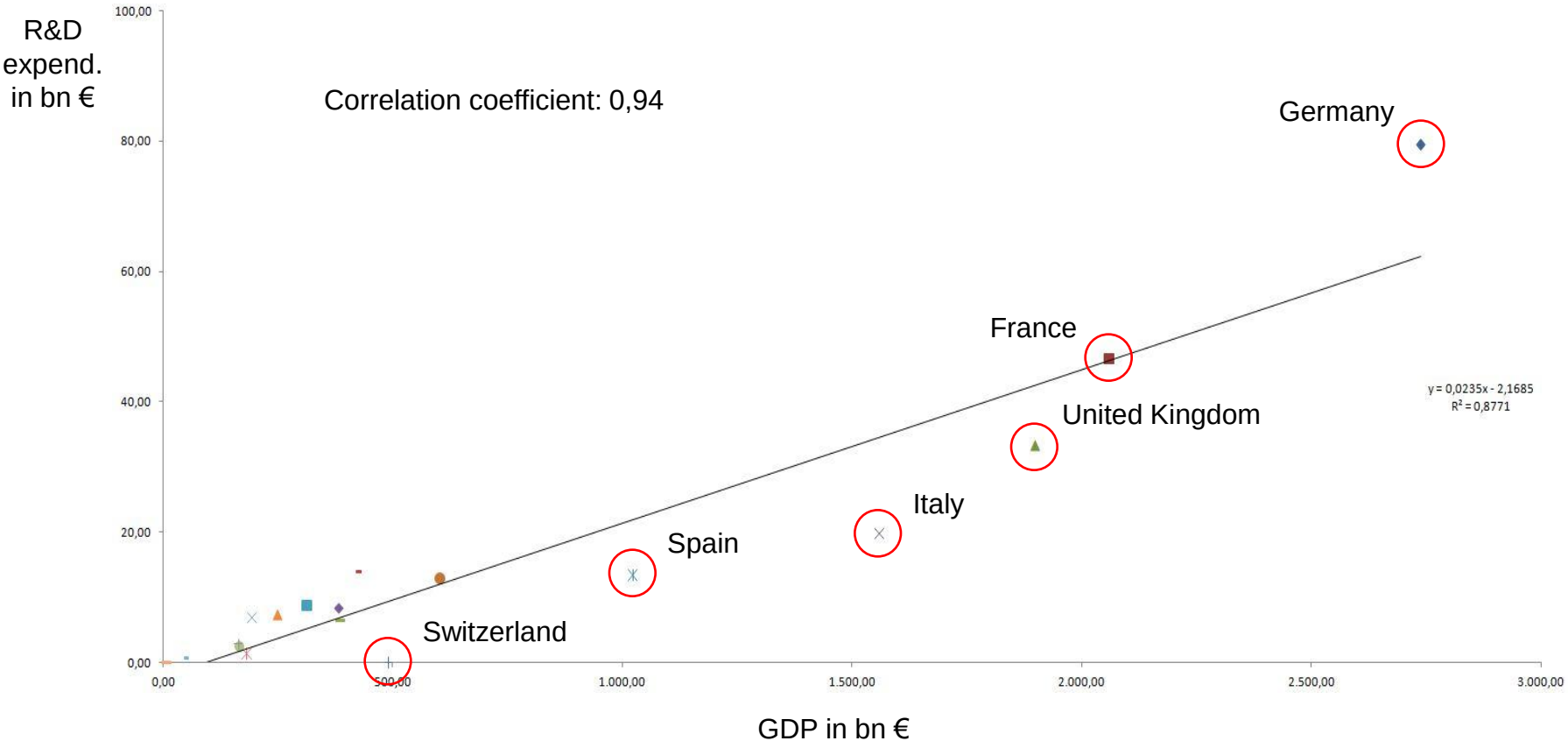


Source: Eurostat, own calculations.

Relationship between GDP and R&D 2012
Western Europe



Source: Eurostat, own calculations.

Excursion:
Innovation and business cycles

Cyclicality of R&D (3 questions)

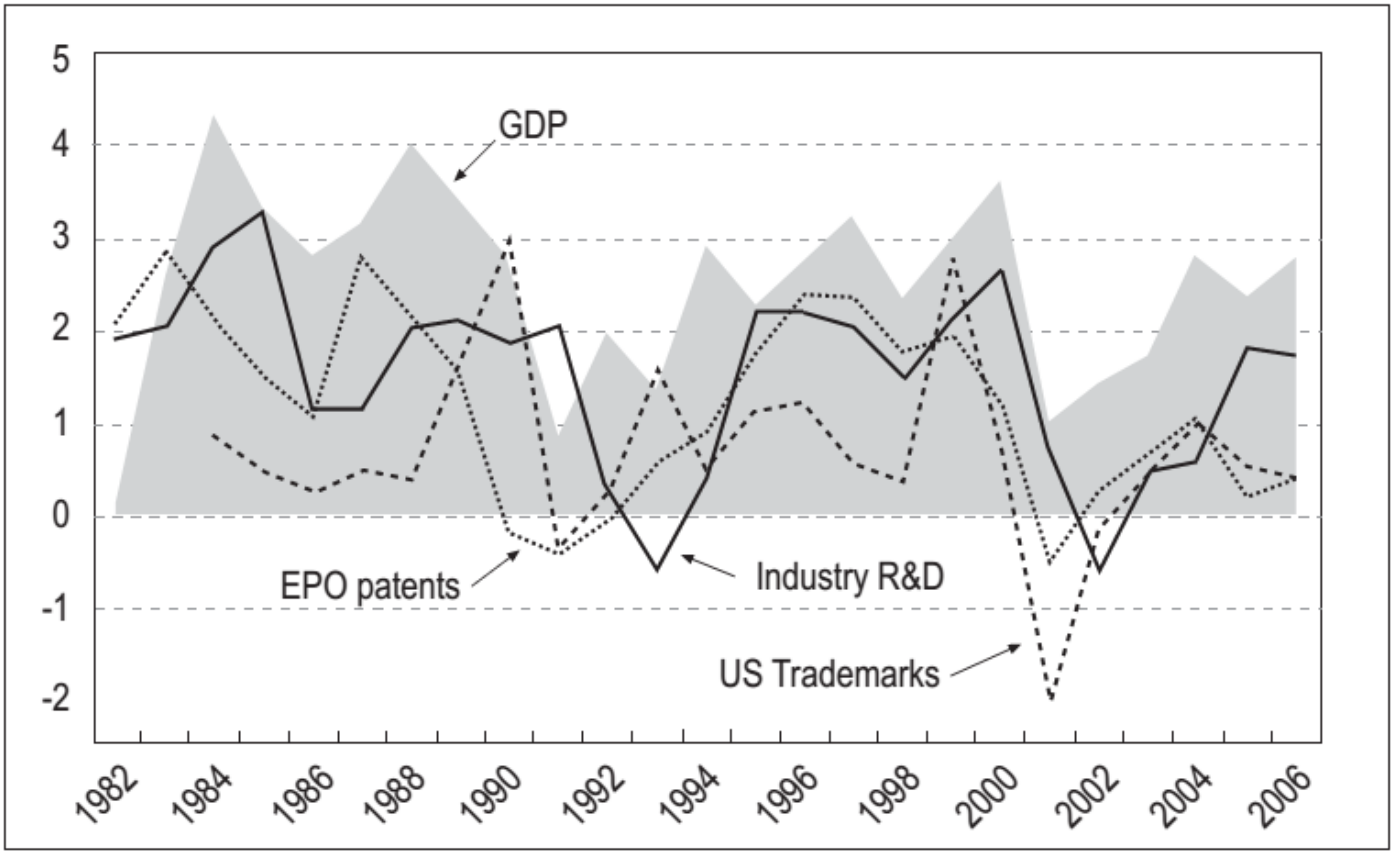
What is the relationship between innovation (R&D, knowledge creation) and **business cycles**?

Is a high growth rate associated with high investments in innovation (R&D, knowledge creation) **in the same period** (year)?

In other words: Is innovation (R&D, knowledge creation) **pro- or contracyclical**?

Cyclicality of R&D in OECD countries

Growth of **private R&D** expenditure, **patent** applications (EPO), **trade marks** (PTO) und **GDP** of the OECD countries*



Quelle: OECD (2009), *yearly, average growth rate of the OECD countries, divided by standard deviation

What does the literature tell us?

- *Economics and Management* literature: Research and Innovation show largely **cyclical development**

  Decrease of R&D and innovation in an economic crisis because …

  - Lack of internal means, smaller *cash flow* for R&D (Harhoff 1998, Rafferty/Funk 2004)
  - Hesitation of external financiers, general increase of risk aversion (Aghion et al. 2012)
  - Demand for innovative (expensive) products decreases (Devinney 1990, Shleifer 1986, Barlevy 2004, Le Bas 2000)

- Alternaive perspective: **crisis gives birth to new technology** (early Schumpeter, Kondratief), ground for new technology already in the crisis (e.g. Perez 2009, Archibugi/Filipetti 2012)

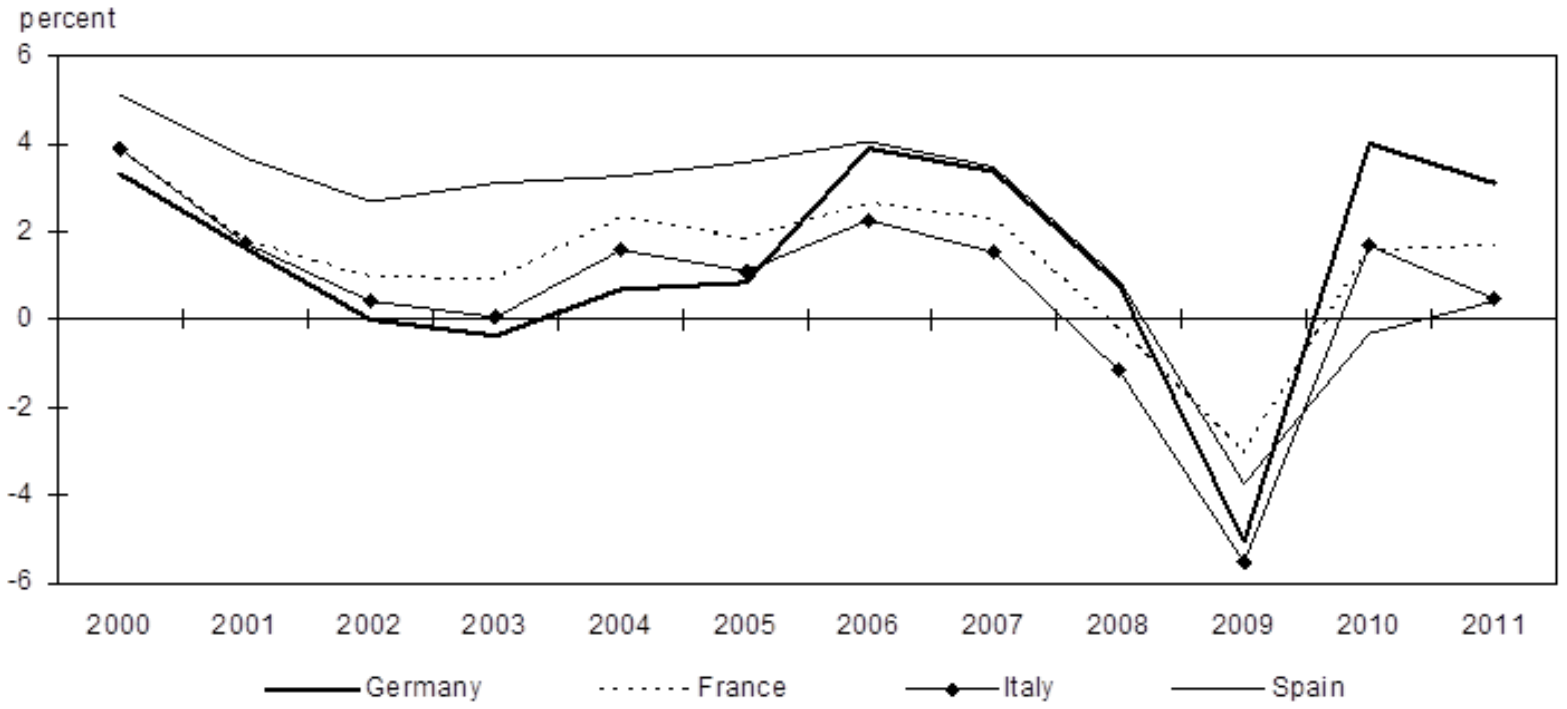
Is a crisis a fertile ground for new innovations?

Kondratief argued that

"… during the **recession** of the long wave, … **discoveries and inventions** are made, which, are usually applied on a large scale only at the **beginning of the next long upswing**"

Economic Crisis 2008/2009 I

Yearly growth of the GDP (as compared to the year before) in %, selected EU countries



⇨ Deep recession in the year 2009 / financial crisis / business cycle!

Quelle: Eurostat.

Economic Crisis 2008/2009 II

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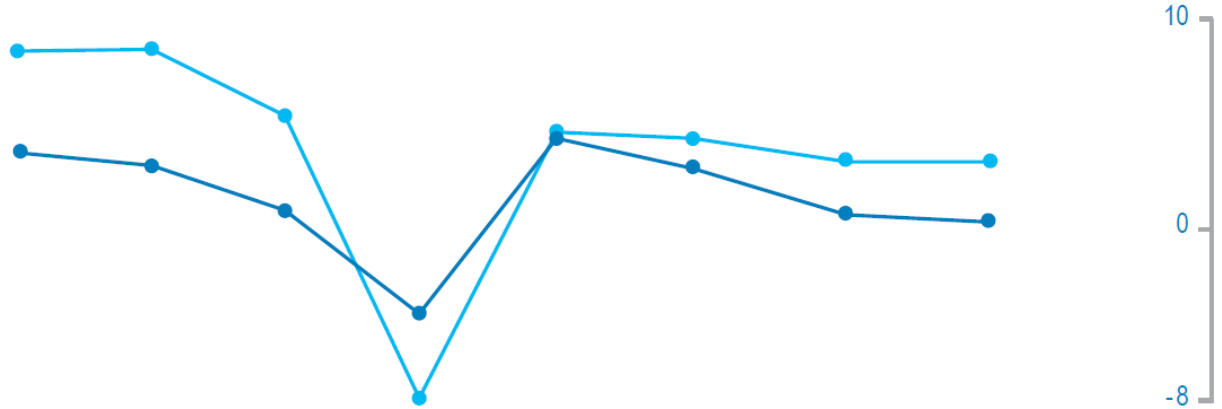
Yearly growth of the GDP (as compared to the year before) in %, Russia and Germany

GDP growth (%)

de ru



	2006	2007	2008	2009	2010	2011	2012	2013*
Russland	8,2	8,5	5,2	-7,9	4,5	4,3	3,4	3,6
Deutschland	3,7	3,3	1,1	-4	4,2	3	0,7	0,4

Quelle: Statistisches Bundesamt, Rosstat

* Prognose: Regierung der RF, Bundesregierung

Origin of 2008/2009 economic crisis?

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Financial markets!

Technology

Long term root of crisis in the real economy, “long wave” approach; **since 1980s ICT** revolution as the fifth “long wave”, end of this wave began with dot-com bubble of 2000; **what will follow … ?**

Literature:

Perez 2009: The double bubble at the turn of the century: technological roots and structural implications. In: Cambridge Journal of Economics, Vol. 33, pp. 779-805.

Archibugi/Filipetti (2012): Innovation and Economic Crisis. Lessons and prospects from the economic downturn. London: Routledge. [beziehen sich auf Perez 2009, Antonelli 2009]

Impact of the crisis on innovation expenditure in Germany

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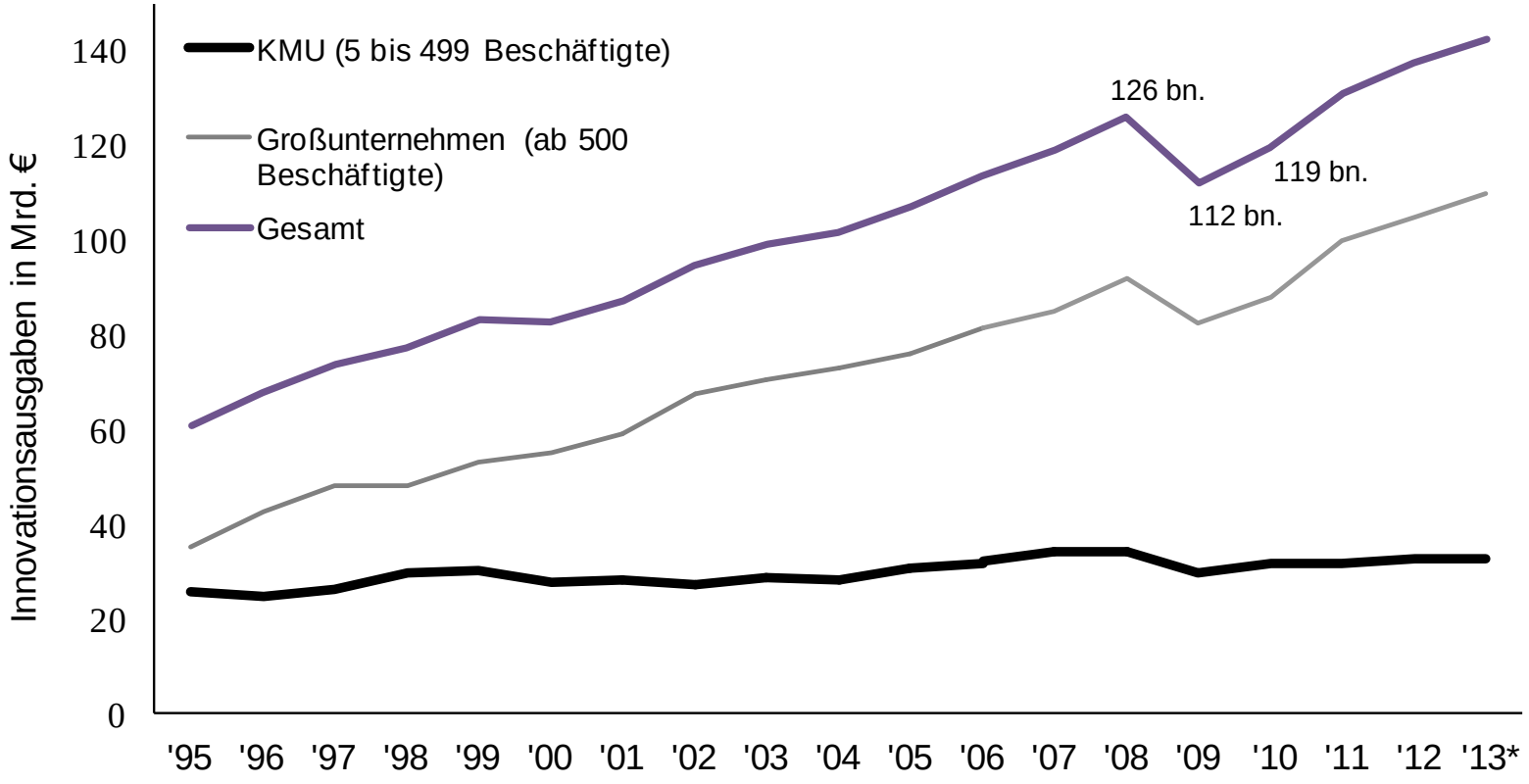
Innovation expenditure of firms in Germany in billion Euro 1995-2013



Source: Mannheim Innovation Panel, *preliminary figures (planned figures by firms)

Crisis and economic policy (I)

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- Should the state intervene?

- When should the state intervene?

- How should the state intervene (means)?

2008/2009 economic crisis: **fical policy (*business cycle policy*) to stabilize the economy in nearly all countries of the word!**

Germany (fiscal policy: 3% of GDP): R&D as part of fiscal policy!

Crisis and economic policy (II)

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Size of fiscal policy packages during 2008-2010 (public spending and tax cuts), in % of GDP:

Germany: 3%

Russia: 8%

China: 19%

US: 5-6%

R&D spending part of it in many countries!

Source: OECD (2009)

Crisis and economic policy (III)

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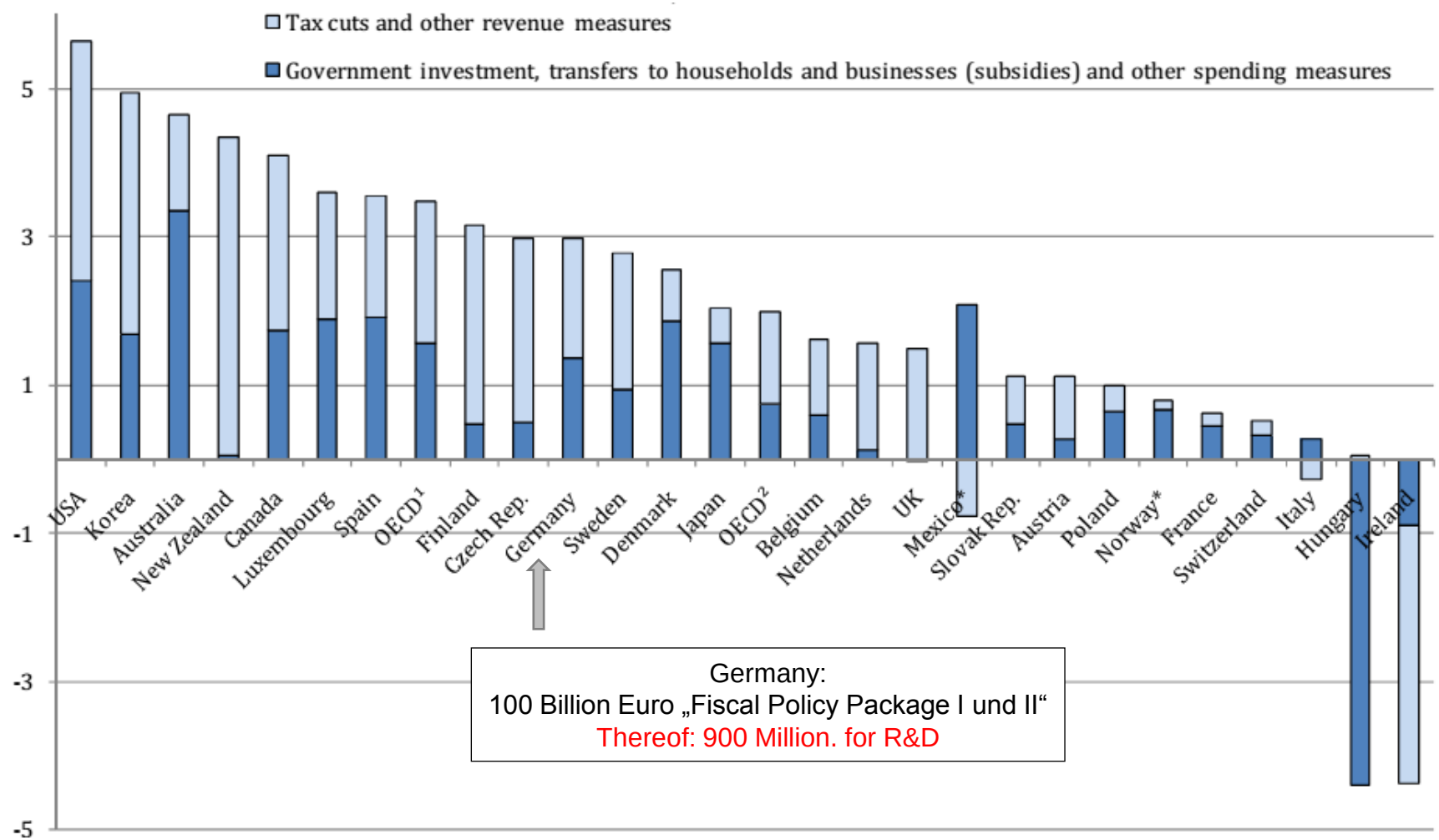
Fiscal policy (2008-2010) of OECD countries, Spending in % of the GDP 2008



Quelle: OECD (2009), Stand: 24. März 2009, [1]gewichteter Durchschnitt der Länder außer Griechenland, Island, Mexiko, Norwegen, Portugal und Türkei, [2]einfacher Durchschnitt der Länder außer (dto.), *Zeitraum 2008-2009.

Selected long term schemes and their size within fiscal policy packages in international comparison (as of May 2009)

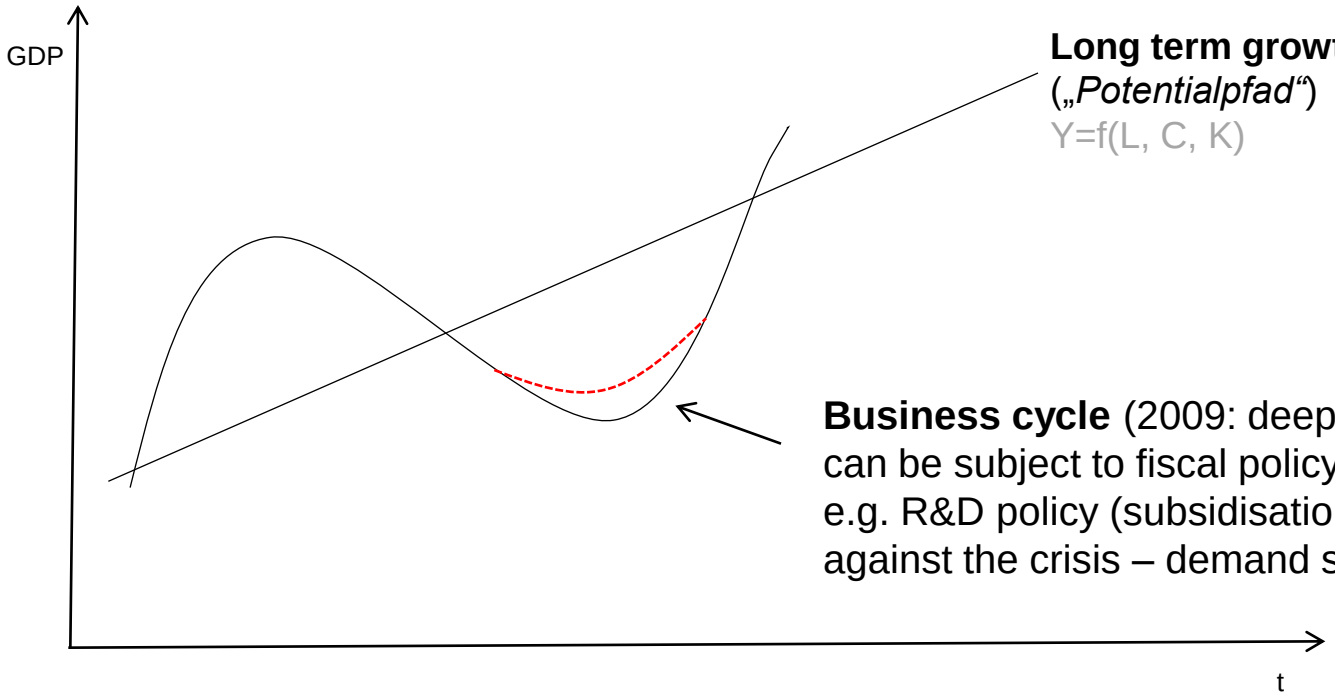
	Infrastructure	Science, R&D and innovation	Education	Green technology
Australia	AUD 9.7 billion	AUD 2.9 billion	AUD 15.7-17 billion	AUD 5.7 billion
% of GDP	0.82%	0.25%	up to 1.4%	0.48%
Canada	CAD 20.3 billion	CAD 800 million	1.9 billion	CAD 2.8 billion
% of GDP	1.27%	0.05%	0.12%	0.18%
Chile	USD 700 million	USD 8.8 million	USD 147 million	USD 0
% of GDP	0.50%	0.01%	0.10%	0%
Finland	EUR 910 million	EUR 25 million[1]	EUR 30 million	EUR 38 million
% of GDP	0.48%	0.01%	0.02%	0.02%
France	EUR 4.7 billion	EUR 46 million[2]	EUR 731 million	EUR 30 million
% of GDP	0.24%	0.00%	0.04%	0.00%
Germany[3]	EUR 11.5 billion[4]	EUR 1.4 billion	EUR 14.5 billion[5]	EUR 5.7 billion
% of GDP	0.5%	0.1%	0.6%	0.2%
Korea	KRW 50 trillion (USD 36 billion) of green investments (5.14% of GDP) – distributed throughout these categories although a detailed break-down is not yet available.			
Norway	NOK 3.8 billion	NOK 170 million[2]	NOK 270 million	NOK 1.6 billion
% of GDP	0.16%	0.01%	0.01%	0.06%
Sweden	SEK 8.6 billion	SEK 9 billion	SEK 500 million	SEK 2 billion
% of GDP	0.27%	0.29%	0.016%	0.06%
Poland	PLN 91,3 billion	PLN 16,8 billion	n.a.	PLN 2.5 billion
% of GDP	0.072%	0.013%	n.a.	0.002%
Portugal	EUR 50 million	EUR 224 million	EUR 682 million[6]	EUR 260 million
% of GDP	0.03%	0,13%	0.41%	0.16%
USA	USD 100 billion	USD 16 billion	USD 83 bill	USD 59 billion
% of GDP	0.70%	0.11%	0.58%	0.41%

Note: Based on 2008 GDP. Figures are only indicative as applying identical, clear-cut definitions to these categories and making them comparable across countries is very difficult. For instance, a certain degree of double-counting may still occur between spending on items such as infrastructure and education (*e.g.* building schools) as measures could fit in multiple categories.

1. Finland has high public R&D support outside of its stimulus package and has pledged to maintain it.
2. The R&D figures for France, Norway and Portugal do not include carrying forward their R&D tax credit payments.
3. In Germany, some expenditures remain to be determined on the sub-federal level.
4. This figure contains EUR 0.3 billion additional funding for a programme for modernising insulation of buildings and roughly EUR 0.8 billion for energy-use modernisation of federal buildings.
5. This figure contains EUR 8.6 billion of investments in energy efficient school and other education-related buildings.
6. In the case of Portugal EUR 500 million for the modernisation of schools is only included in "Education".

Source: OECD estimates based on publicly available data, replies to the OECD questionnaire and consultations with member countries.

Short term stabilization and long term growth effects of R&D programs



Long term growth
(„*Potentialpfad*“)
Y=f(L, C, K)

Business cycle (2009: deep recession) - can be subject to fiscal policy,
e.g. R&D policy (subsidisation) as a means against the crisis – demand stabilization!

Idea: R&D spending to increase/stabilize demand – induced production in a variety of sectors – income – demand for consumer goods etc. = **multiplier effect!**

Thank you for your attention!

Part 3
Connecting enterprises and the science base: university-industry links

Jutta Günther

September 2014, HSE Moscow

Content

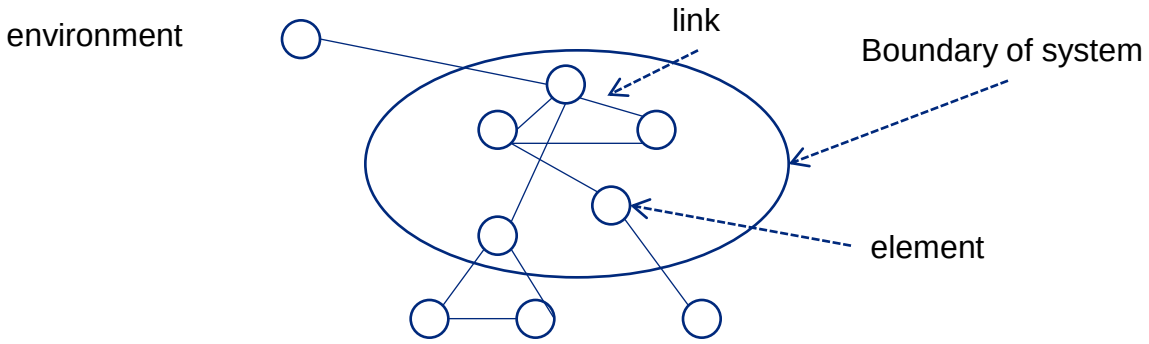
- Innovation Systems (IS)
- „Cooperation“ as central activity in IS
- Triple Helix concept
- Empirical insights

Innovation Systems

System Perspective

What does “system” mean?

Combination of **elements connected** with each other in order to fullfill a certain function.



“The whole is more than the sum of its parts.”

(Aristoteles, Greek philosopher)

System of Innovation: theoretical origin

Theory development since 1980s

- Freeman (1982, 1987) **institutional reasons** for the developmental gap, **history-friendly** economic analysis, Listian economics (1841), 'system' wide factors
- Lundvall (1985) criticises pure transaction cost theory, pronounces **user-producer relationships**
- Dosi et al. (1988) critical assessment of how orthodox economics treats **technical change**
- Nelson (ed) (1993) comparative analysis of different countries national innovation systems (NIS)

Systems of Innovation: Basic ideas

- Assumption: Innovation does **not take place in isolation** – interactive process of **various actors**
- Interdisciplinary non-formal approach
- Close to empirical work and policy
- Micro and macro perspective

  Micro - actor oriented (e.g. firms, universities, research labs)

  Macro - structure oriented (e.g. framework conditions)

- There is **no optimal system** of innovation!

System of Innovation: elements

Function: produce and implement **smth. New**

Main elements (components):

Organizations: actors or players, e.g. firms, universities, research institutes, ministries, venture capital agencies

+

Institutions: set of legal regulations, norms, values, common practices ... which influence organizations‘ activities e.g. IPR, tax system

(in the sense of Douglas North, 1990)

System of Innovation: types

Variants with respect to boundaries:

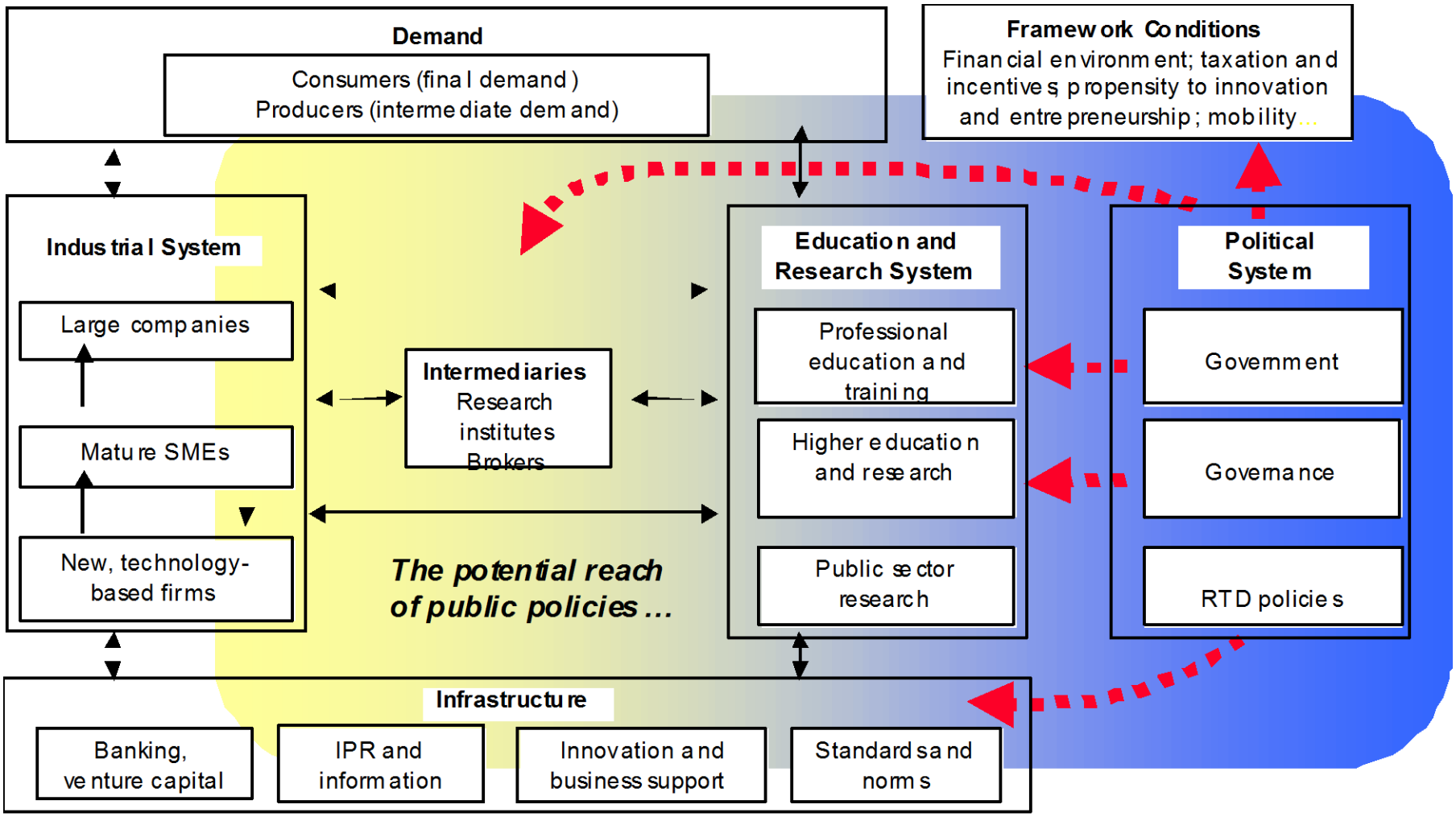
- **National innovation systems**

  e.g. Russian and German national innovation system
- **Regional innovation systems** (administrative or functional borders)

  e.g. German *Länder*, Silicon Valley
- **Sectoral innovation systems**

  e.g. automobile industry, biotechnology

Example: Norwegian National Innovation System



Source: Arnold/Kuhlman (2001)

System of Innovation: empirical insights

- Much **comparative research** (NIS, RIS, SIS)
  Activities differ less between countries than **organizations and institutions**
  e.g. science organizations in Germany and Russia

- Not only organizations and institutions as such differ, but also their **interaction**
  e.g. university – industry relations (USA vs. Europe)

For results of comparative research on NIS see e.g.:

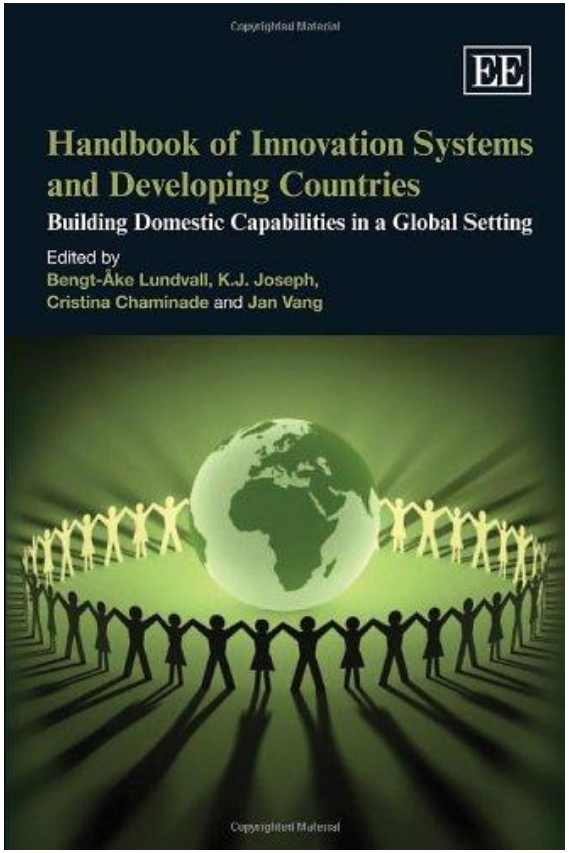
Nelson (1993): National Innovation Systems: A comparative Analysis. Oxford University Press.

OECD (1999): Managing National Innovation Systems. Paris.

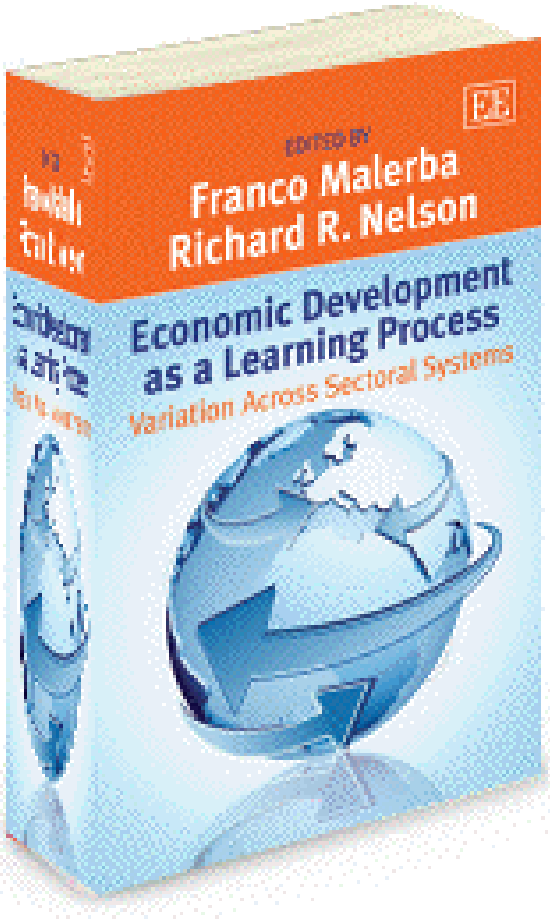
System of Innovation: Critical assessment

- Very **broad framework**, large set of possible determinants of innovation
- Difficult to implement all aspects in empirical research
- **“Under-theorized” concept**, too close to empirical observations, non-formal
- **Dynamic perspective** underdeveloped
- Mainly developed for established market economies in highly **industrialized countries**

Excursion: System of Innovation in developing and emerging economies



2009



2012

„Cooperation“ as central activity in innovation systems

Innovation cooperation over time ...

19th century – individual inventors – implementing new ideas into practice

e.g. T. A. Edison – light bulb patent 1880

20th century – professional R&D departments in (large) firms – e.g. Siemens, Ford, 3M etc.

21st century – growing importance of collaborative R&D – e.g. joint platform development in automobile industry

Why should firms engage in innovation cooperation?

- Reduce costs of R&D
- Reduce risk for development
- Generate economies of scale (esp. SME)
- Promote shared learning / synergy effects
- Access to (foreign) markets
- Growing complexity of new technologies
  e.g. automobile industry, chemical industry

– usually multiple objectives –

"*The future of R&D is C&D*"
(N. Sakkab, Senior Vice President* of R&D Dep. at Proctor & Gamble)

*retired in 2007

Forms of collaboration (Tidd/Bessant/Pavitt 2005)

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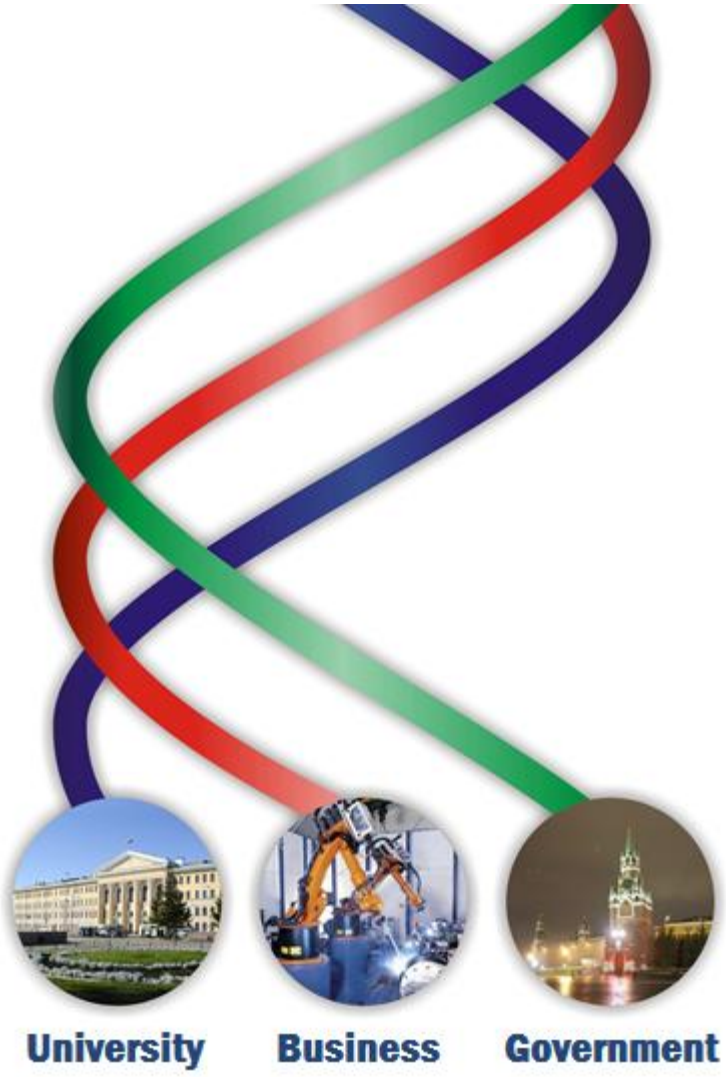
Type of collabor.	Typical characteristics	Disadvantages
Subcontracting	Outsourcing of R&D activities to spec. suppliers	Search costs, quality control
Licensing	Acquisition of technology (firm, institute etc.)	Constraints of licenser, contract cost
R&D consortia	Diff. partners for spec. project (e.g. joined R&D equipment) - basic research -	Knowledge leakage
Strategic alliance	Co-development of new prod. - close to market -	Knowledge leakage, potential lock-in
Joint venture	New company build between two or more partners	Long term engagem. (equity participation)
Networks	Hybrid form of cooperation, often science-industry relations	Depends …

What matters for the success of collaboration?

- Well defined goals
- Professional cooperation management
- Clear communication between partners
- Commitment with goals and flexibility
- Trust between partners!

(e.g. Nooteboom 2002, 2004)

Triple Helix



Source: http://www.tusur.ru/en/enterprise/triple-helix/

Triple Helix – Fundamentals

- Main focus: role of **universities** in innovation process
- University – Industry – Government **relations** and **changes within** these organizations
- Important work: H. Etzkowitz & L. Leydesdorff (1997, 2000)
- Important assumption: innovation is **not a linear process** – need to integrate “technology push” (university) and “demand pull” (industry)
- Focus: **Changing role of university?**

Changing Role of Universities (I)

Originally: teaching

Increased demand of industry for scientific knowledge / scholarly trained people – research

→ **„First academic revolution“** (end of 19th century) – combined the two function: research & teaching

First half of 20th century: **extension of universities** under the guidance of nation states

Second half of 20th century: increasing **demand for scientifically trained people**, further extension under the impression of emerging KBE and internationalization …

Changing Role of Universities (II)

Today: increased international competition, increasing complexity of technologies, need for cooperation ...

“Third mission” of universities?

Knowledge- and technology transfer to industry

Process under way – different countries with different pace and policies – USA (since 1970s) – Western Europe (since the 1980s) ...

→ **„Second academic revolution“**

Triple Helix Model

University – Industry – Government

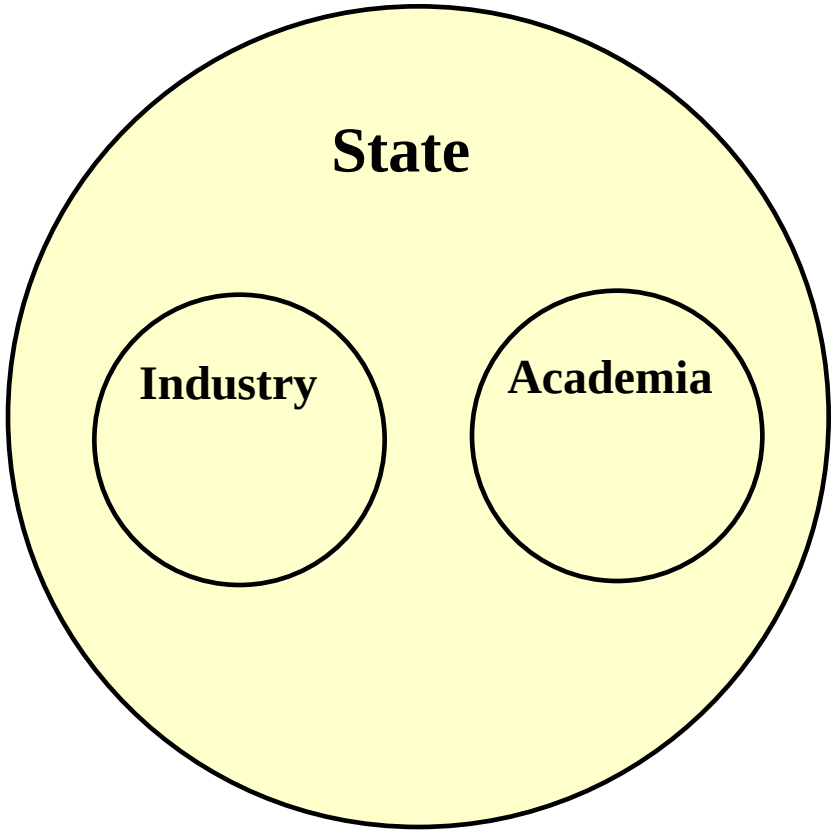
Three **ideal** types (Etzkowitz/Leydesdorff, 2000):

„Etatistic Model“

„Laissez-fair Model“

„Triple Helix Model“

Etatistic Model of University-Industry-Government Relations

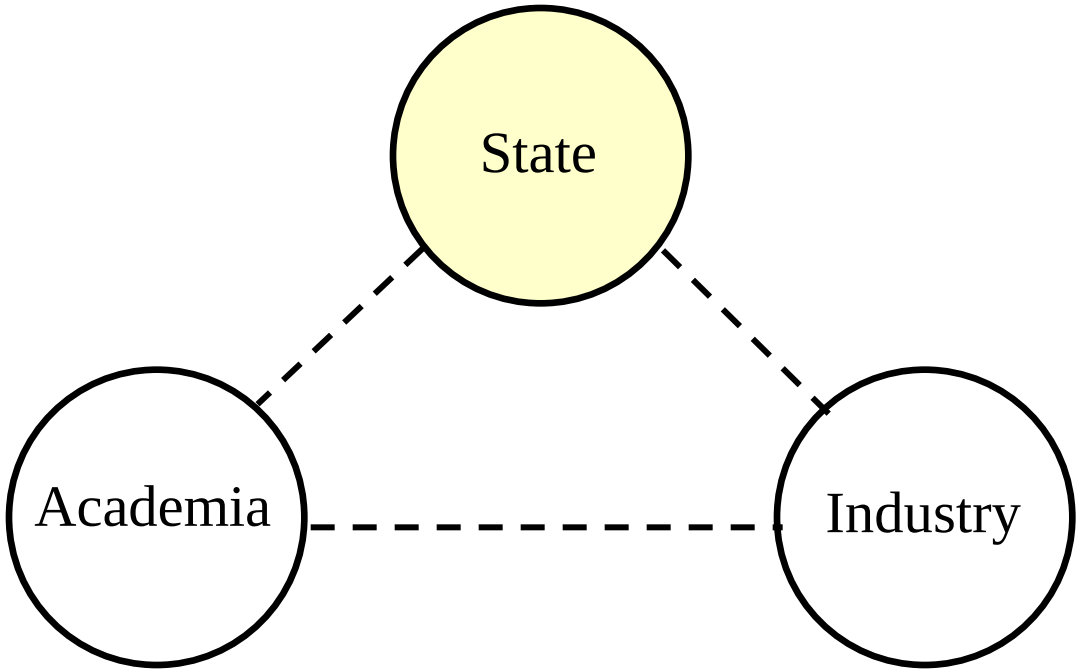


Nation state directs university and industry

Largely viewed as failed ...

Source: Leydesdorff, L./Etzkowitz, H. (2000): The dynamics of innovation: from National Systems and „Mode 2“ to a Triple Helix of university-industry-government relations, in: Research Policy, Vol. 29, pp. 111.

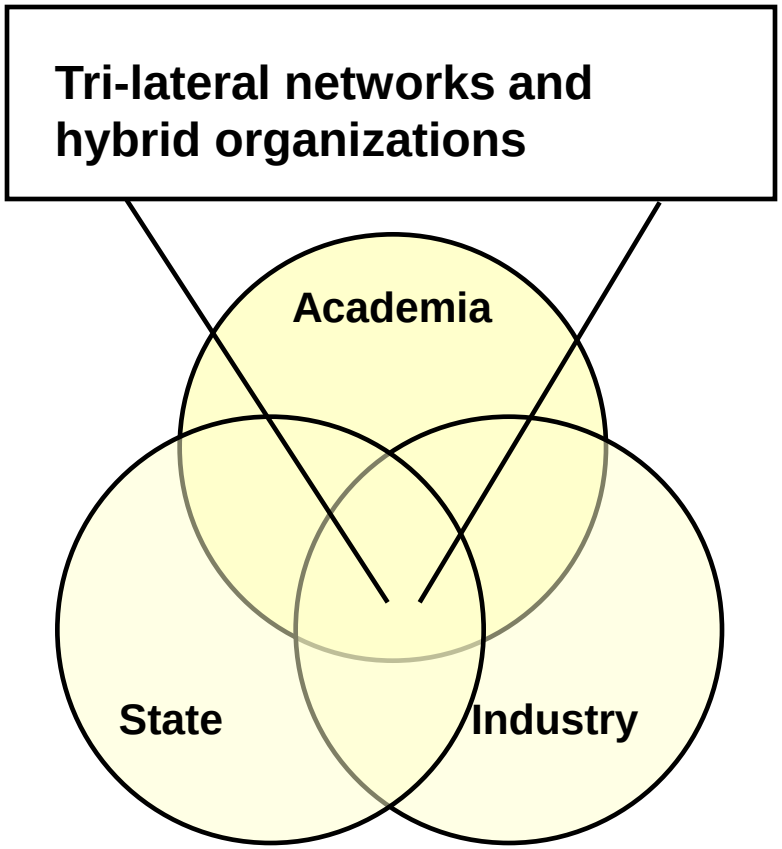
„Laissez-Faire“ Model of University-Industry-Government Relations



Separate spheres, loose ties between state, academia, industry

Source: Leydesdorff, L./Etzkowitz, H. (2000): The dynamics of innovation: from National Systems and „Mode 2“ to a Triple Helix of university-industry-government relations, in: Research Policy, Vol. 29, pp. 111.

The „Triple Helix“ Model of University-Industry-Government Relations



Overlapping spheres, each taking over roles of the others

High importance today ...

Source: Leydesdorff, L./Etzkowitz, H. (2000): The dynamics of nnovation: from National Systems and „Mode 2“ to a Triple Helix of university-industry-government relations, in: Research Policy, Vol. 29, pp. 111.

Practical Relevance of Triple Helix?

Industry taking over functions of universities (and vice versa)?

Examples:

Industrial enterprises as universities (teaching/research)?

e.g. „corporate universities“

Universities as industrial enterprises (production)?

e.g. spin-offs, technology transfer center, consulting firms on campus

“Capitalization of Knowledge”

„Capitalization of Knowledge“

„Capitalization of Knowledge“ – use of universities’ research results for industry (to strengthen economic development)

How does transfer of knowledge take place?

- originally very informal

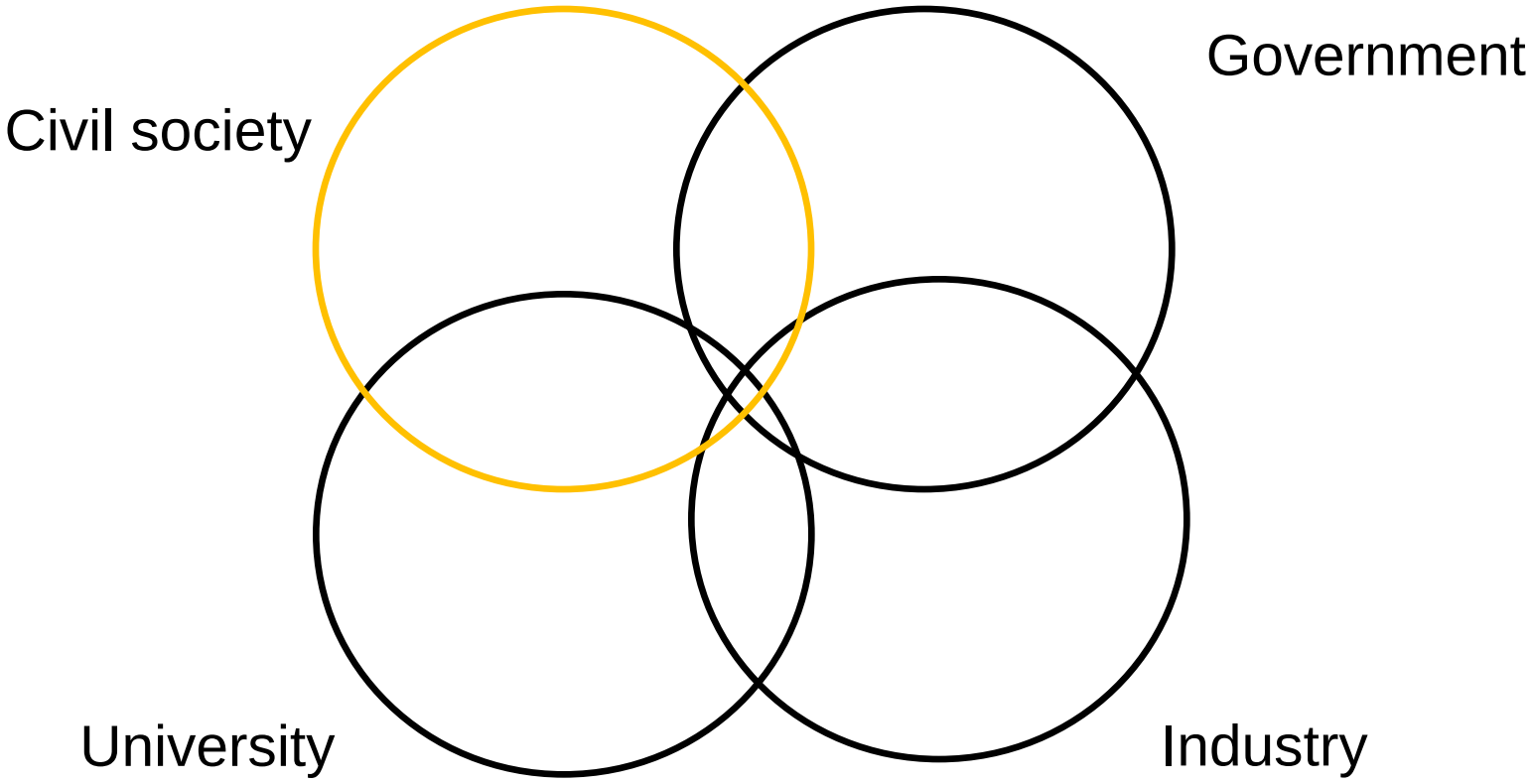
- today in a systematic way: IPR regulation (university patenting) and licensing to industry as potential users

Role of the state?

Supporting the technology transfer via policy programs, but not controlling it.

→ stronger orientation of universities towards the market and industry

Beyond Triple Helix



Quadruple Innovation Helix

See: E. Carayannis et al. (2010, 2011, 2013, 2014)

Relevance of quadruple helix?

- Open Innovation

- „Citizen Science“
  - non-professionals in science process
  - long history before professional science!
  - re-discovered today: from high appreciation to scepticism …
  - Germany: BMBF financially supporting it …

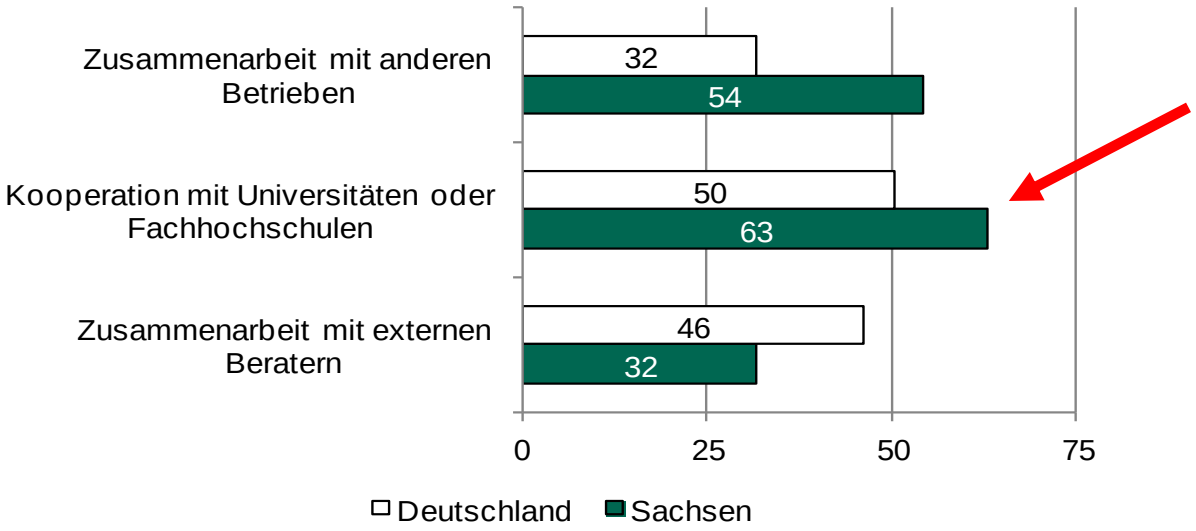
Empirical insights on science-industry cooperation

Cooperation activities of firms in Germany

Share of cooperating SME of all SME with R&D activity, 2009 (%)

East Germany	92%
West Germany	83%
Sachsen	91%

Cooperation partners of SME with R&D activity, 2009

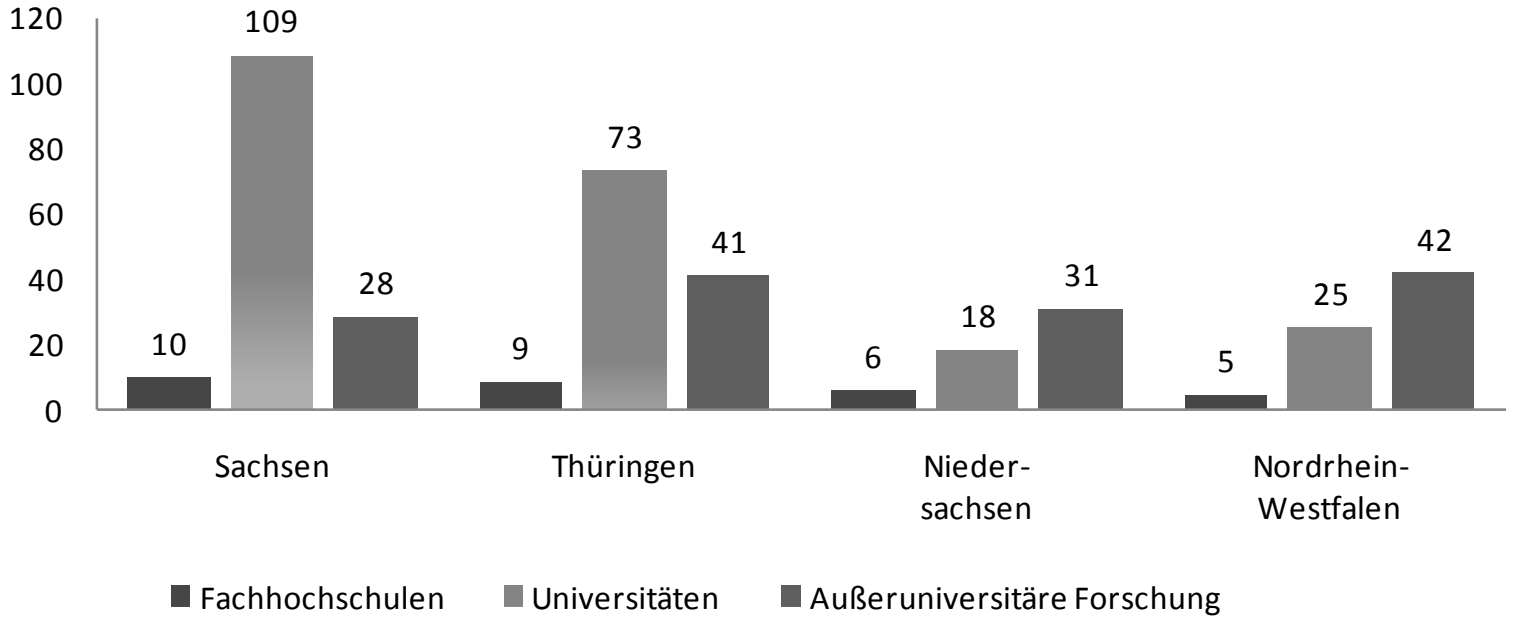


Source: Sächsischer Technologiebericht 2012

German firms strongly cooperate, especially with universities and other scientific organisations (Günther 2004, Günther et al. 2010)

Are science organisations inventive?

Number of patent applications 2002-2007 per patent active science organisation

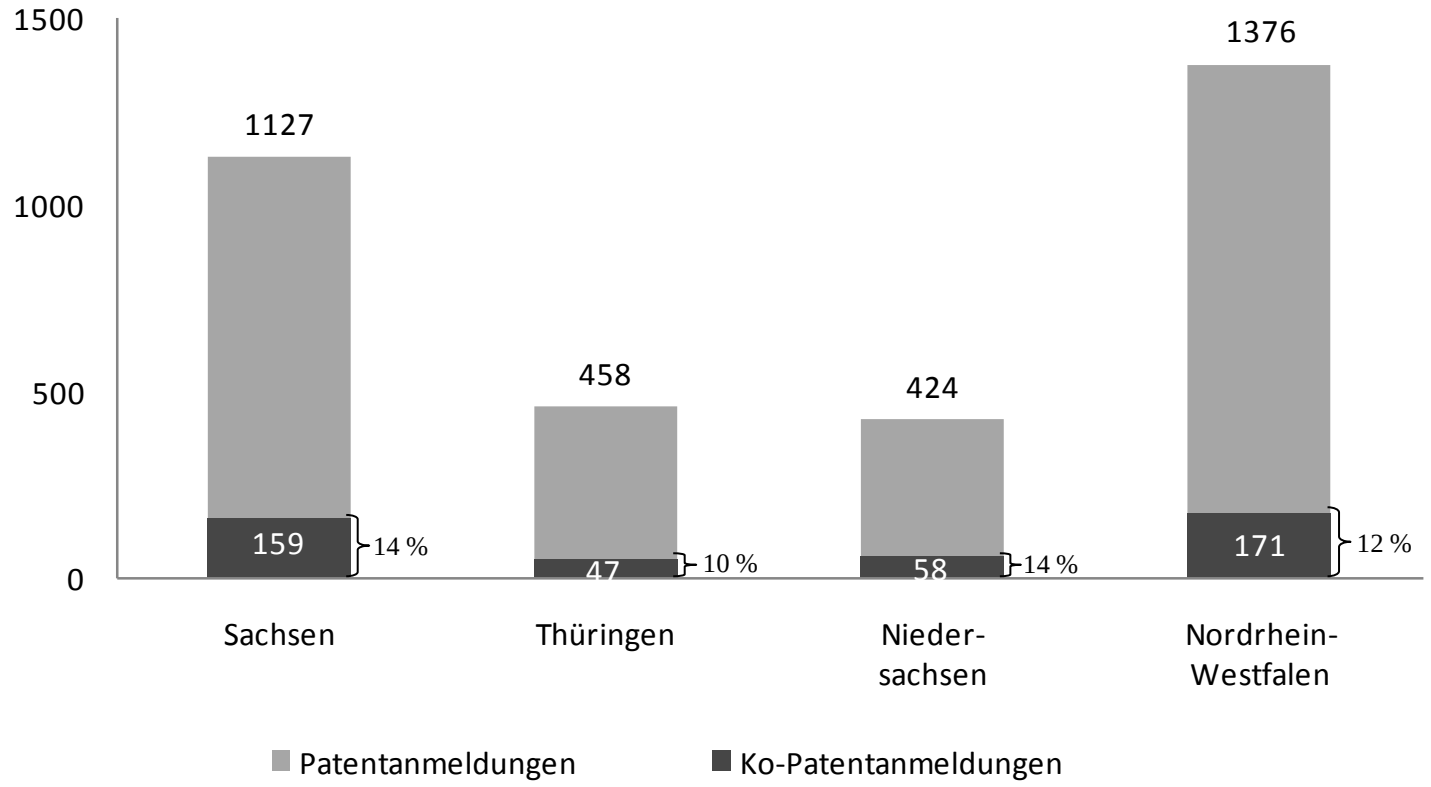


Source: DEPATISnet.

Strong patent activity in science organisations in Saxony and Thuringia

Science-industry cooperation?

Patent applications and co-patents of science organisations with industry 2002-2007



Share of co-patents (only) 10 bis 14%.

Source: DEPATISnet..

Example (Triple Helix)

BioRN Biotech Cluster Rhine-Neckar

Hightech-Strategy of the German government

- Cooperative work between **industry, science and governmental** authorities in the „*Biotech Cluster Rhine-Neckar*“
- medical products, diagnostic test systems etc.

Industry & science & government:

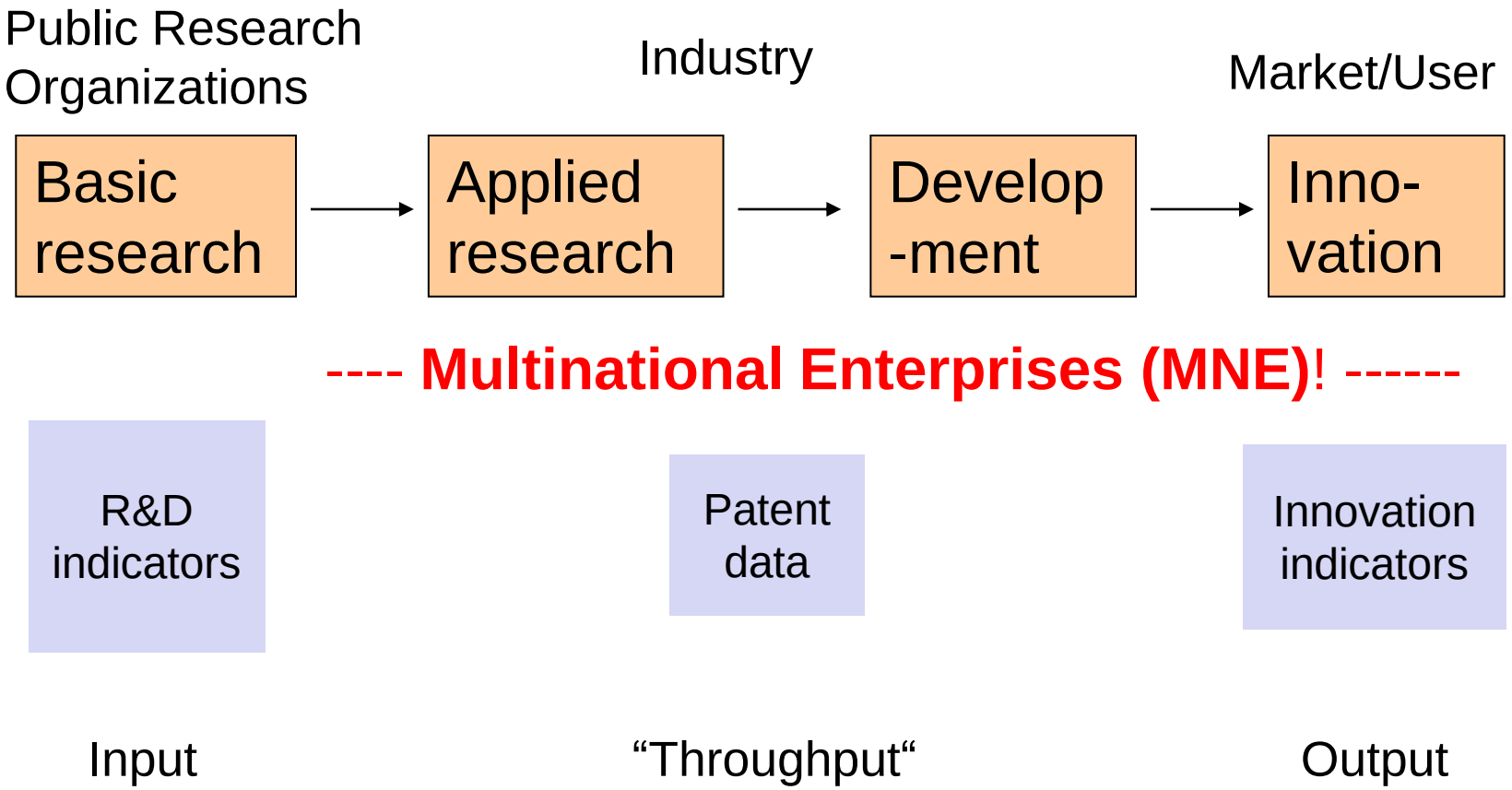
Life Science Companies (Abbott GmbH & Co. KG, BioCat GmbH etc.), Research and Academia (European Molecular Biology Laboratory, University Medical Center Mannheim etc.), Educational Institutions (Heidelberg University, University of Mannheim etc.), Local Affairs (City of Heidelberg, BioRN Network etc.), Service Provider (Meditcon GmbH etc.)

http://www.biorn.org/home

Part 4
Innovation behavior of STI actors: MNE as actors in national innovation systems

Jutta Günther
September 2014, HSE Moscow

Innovation process – linear model



System of Innovation and MNE

Cantwell (2001) states that multinational enterprises

*"… have become global **organizers of economic systems**, including systems for allied **technological development** in different parts of the world."*

(p. 438)

Content

1. Definition and theory (MNE)
2. Measuring technological activity of MNE
3. Empirical examples using patent indicators

1. Definition and theory of the MNE

Definition: Multinational Enterprises (MNE)

- Multinational enterprises are enterprises that carry out **production** (value added) in **more than one country** (Dunning/Lundan 2008)
  - Cross country capital flow!
  - Value added activities in the host country!
- MNU become true through **foreign direct investment (FDI)** activities in the sense of cross boder capital flow
- 10% foreign ownership or more
- FDI statistics serves as a measure for MNE activity

John Dunning (1977): OLI paradigm

Conditions (reasons) for internationalization:

*1. **O**wnership-specific advantages*

assets internal to a firm – competitive advantage over domestic firms

e.g. size, diversity, brand, technical characteristics

*2. **L**ocation-specific factors*

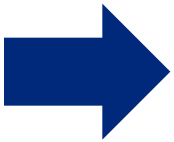
Factors related to **foreign location make it more profitable** to produce in the foreign locations

e.g. access to resources, production costs, taxes, legal framework

*3. **I**nternalization advantages*

more profitable to **use specific assets internally** instead of market transactions (e.g. licensing to foreign producer) – transaction cost argument

Why do MNE internationalize their R&D activities?



Theoretical explanations

John Cantwell

Cantwell (1989): Technological Innovation and Multinational Corporations, Oxford: Blackwell

„Technological Accumulation“ matters!

Why is **technology** developed in **international networks**, instead of separately owned plants?

Excursion: Assumptions in evolutionary theory

„**Bounded Rationality**“ (*Herbert Simon*)

- Firms do not constantly make cost-benefit-calculations
- Complex world (esp. technology) → firms react with typical behaviour pattern – „**routines**“ to reduce complexity and uncertainty – importance of **path dependencies**

„**Satisficing Behaviour**“ (*Herbert Simon*)

- Firms do **not maximize** any undefined profits, but they have business goals they intend to reach

“**Cumulative, interactive learning**” !

- Routines change over time because firms are **learning organisations, cumulative process**
- Relatedness and interaction

Cantwell: „Technological Accumulation“ (I)

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1. Capability based view of the firm

- The firm is an institution that constructs capabilities through **internal learning** processes in the form of **evolutionary experimentation** Corporate learning is gradual and **path dependent**.
  (Cantwell & Piscitello 2000; Cantwell & Fai 1999).

2. Technological accumulation

- … gradual building of **largely intangible assets**, and is reflected in the skills of the **workforce** and the design of capital equipment
  (Cantwell, 1989)

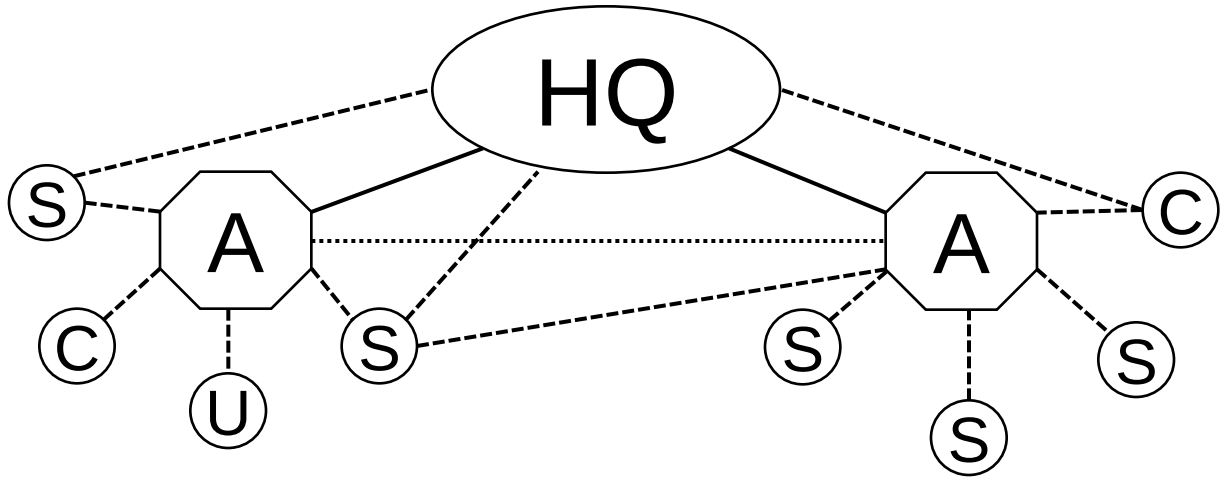
3. Geographical dispersion

- The geographical dispersion of technological development enhances **innovation in the network** of the MNE (Cantwell 1989)

Cantwell: „Technological Accumulation“ (II)

4. Complex network structure

- Internal networks
- External networks



HQ = Headquarter, A = subsidiary, S = supplier, C = customer, U = University

2. Measuring technological activities of MNE

Measuring technological activities of MNE

1. Survey (firm level) data
2. AMNE database of the OECD
3. Patent data (transnational patents)

1. Survey data I

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- Innovation surveys with information on the firms‘ ownership structure, e.g. in Germany
  - MIP (Mannheim Innovation Panel), part of the CIS – Community Innovation Survey
- MNE surveys among HQ and/or subsidiaries abroad, e.g.
  - BEEPS (Business Environment and Enterprise Performance Survey) of the EBRD and World Bank

1. Survey data (II)

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Example: Survey question on innovation*

...

4.1 During the three year period 1998-2000, did your enterprise introduce any new or significantly improved products (goods or services) which were new to your firm?

Yes ☐ **No** ☐ **Imitation**

...

4.4 During the three year period 1998-2000, did your enterprise introduce any new or significantly improved products (goods or services) which were new to your enterprise's market?

Yes ☐ **No** ☐ **Market novelty**

*according to Oslo Manual (CIS survey)

2. AMNE database of the OECD (I)

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International comparative data on MNEs

- AMNE Database – Activity of Multinational Enterprises
- Data collected at subsidiary (firm) level, e.g.
  - Inward / outward FDI
  - Employment, sales, investment
  - R&D expenditure
- data reported by countries to OECD
- data base with **aggregated figures** available online
- But no access to micro data!

2. AMNE database of the OECD (II)

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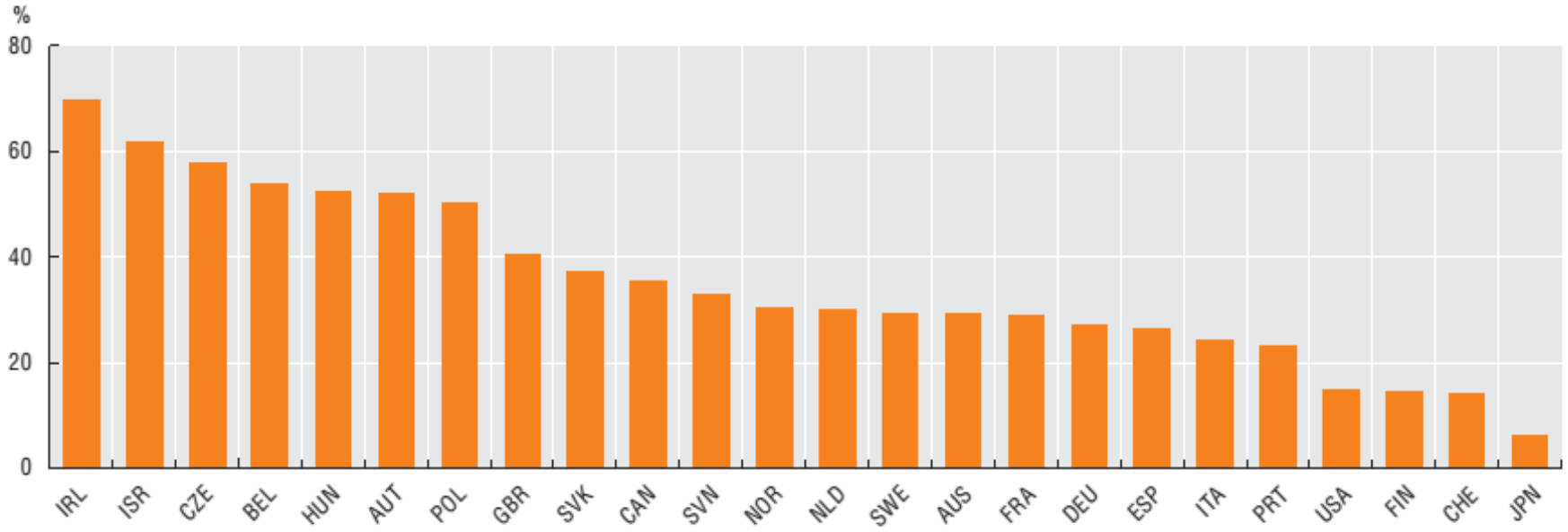
Example: AMNE database – R&D expenditure of MNE

R&D expenditures incurred by foreign-controlled affiliates, 2009

As a percentage of R&D performed in the business sector



Source: OECD, Activity of Multinational Enterprises Database, *www.oecd.org/sti/ind/amne.htm* and Eurostat Inward FATS Database, June 2013. See chapter notes.

StatLink http://dx.doi.org/10.1787/888932891093

3. Patent data – transnational patents

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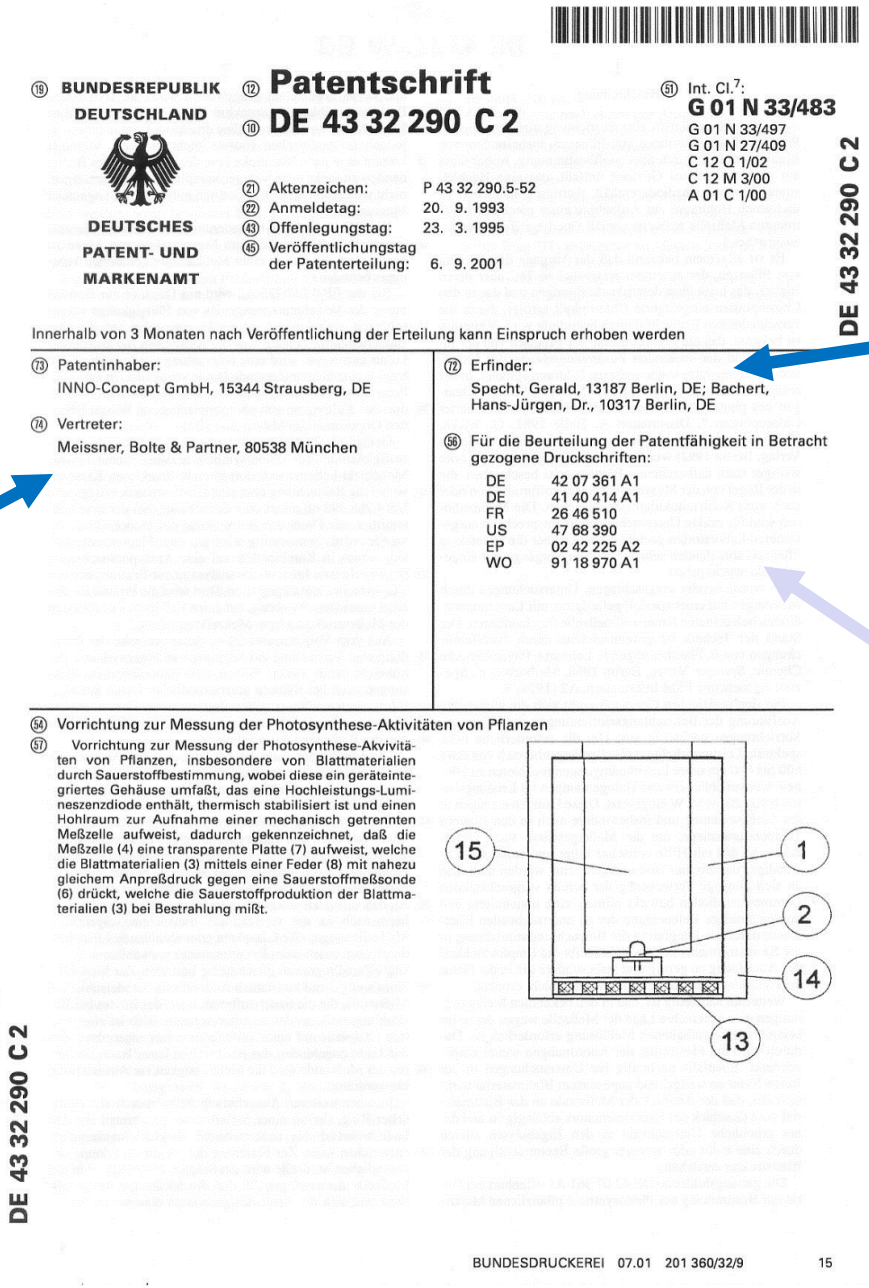
Paten data

- Applicant / inventor
- Location (address, zip code, country)
- Technology field etc.

Patent application with a **foreign applicant** and a **German inventor** (FAGI) – indicator for inward R&D activities in Germany (HQ abroad)

Patent application with a **German applicant** and (at least one) **foreign inventor** (GAFI) – indicator for outward R&D activities of Germany (HQ in Germany)

Source: IWH 2013



(19) BUNDESREPUBLIK DEUTSCHLAND
DEUTSCHES PATENT- UND MARKENAMT

(12) **Patentschrift**
(10) **DE 43 32 290 C 2**

(51) Int. Cl.[7]:
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(21) Aktenzeichen: P 43 32 290.5-52
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DE 43 32 290 C 2

Innerhalb von 3 Monaten nach Veröffentlichung der Erteilung kann Einspruch erhoben werden

(73) Patentinhaber:
INNO-Concept GmbH, 15344 Strausberg, DE

(74) Vertreter:
Meissner, Bolte & Partner, 80538 München

(72) Erfinder:
Specht, Gerald, 13187 Berlin, DE; Bachert, Hans-Jürgen, Dr., 10317 Berlin, DE

(56) Für die Beurteilung der Patentfähigkeit in Betracht gezogene Druckschriften:

DE	42 07 361 A1
DE	41 40 414 A1
FR	26 46 510
US	47 68 390
EP	02 42 225 A2
WO	91 18 970 A1

(54) Vorrichtung zur Messung der Photosynthese-Aktivitäten von Pflanzen

(57) Vorrichtung zur Messung der Photosynthese-Akvivitäten von Pflanzen, insbesondere von Blattmaterialien durch Sauerstoffbestimmung, wobei diese ein geräteintegriertes Gehäuse umfaßt, das eine Hochleistungs-Lumineszenzdiode enthält, thermisch stabilisiert ist und einen Hohlraum zur Aufnahme einer mechanisch getrennten Meßzelle aufweist, dadurch gekennzeichnet, daß die Meßzelle (4) eine transparente Platte (7) aufweist, welche die Blattmaterialien (3) mittels einer Feder (8) mit nahezu gleichem Anpreßdruck gegen eine Sauerstoffmeßsonde (6) drückt, welche die Sauerstoffproduktion der Blattmaterialien (3) bei Bestrahlung mißt.

DE 43 32 290 C 2

BUNDESDRUCKEREI 07.01 201 360/32/9 15

Inventor of the technology

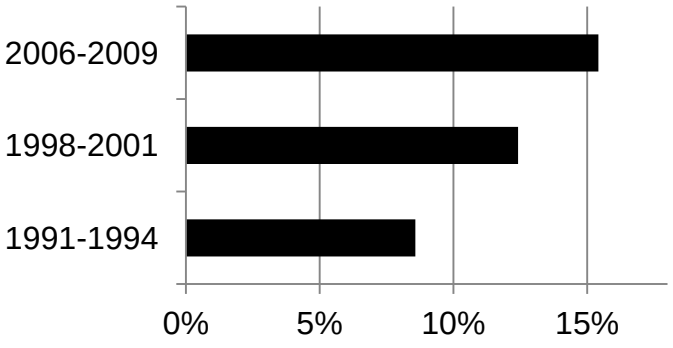
Applicant (owner of the patent; associated with HQ)

Citations of other patents

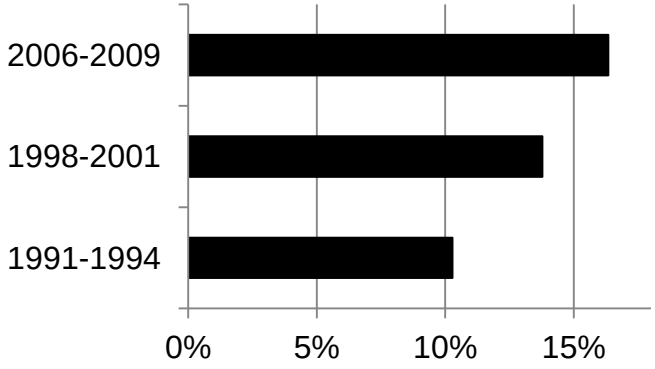
3. Empirical examples using patent indicators

Outward und Inward R&D activity (GAFI, FAGI) in Germany

Outward R&D
Share of patent applications with a German applicant and at least one inventor abroad (GAFI)

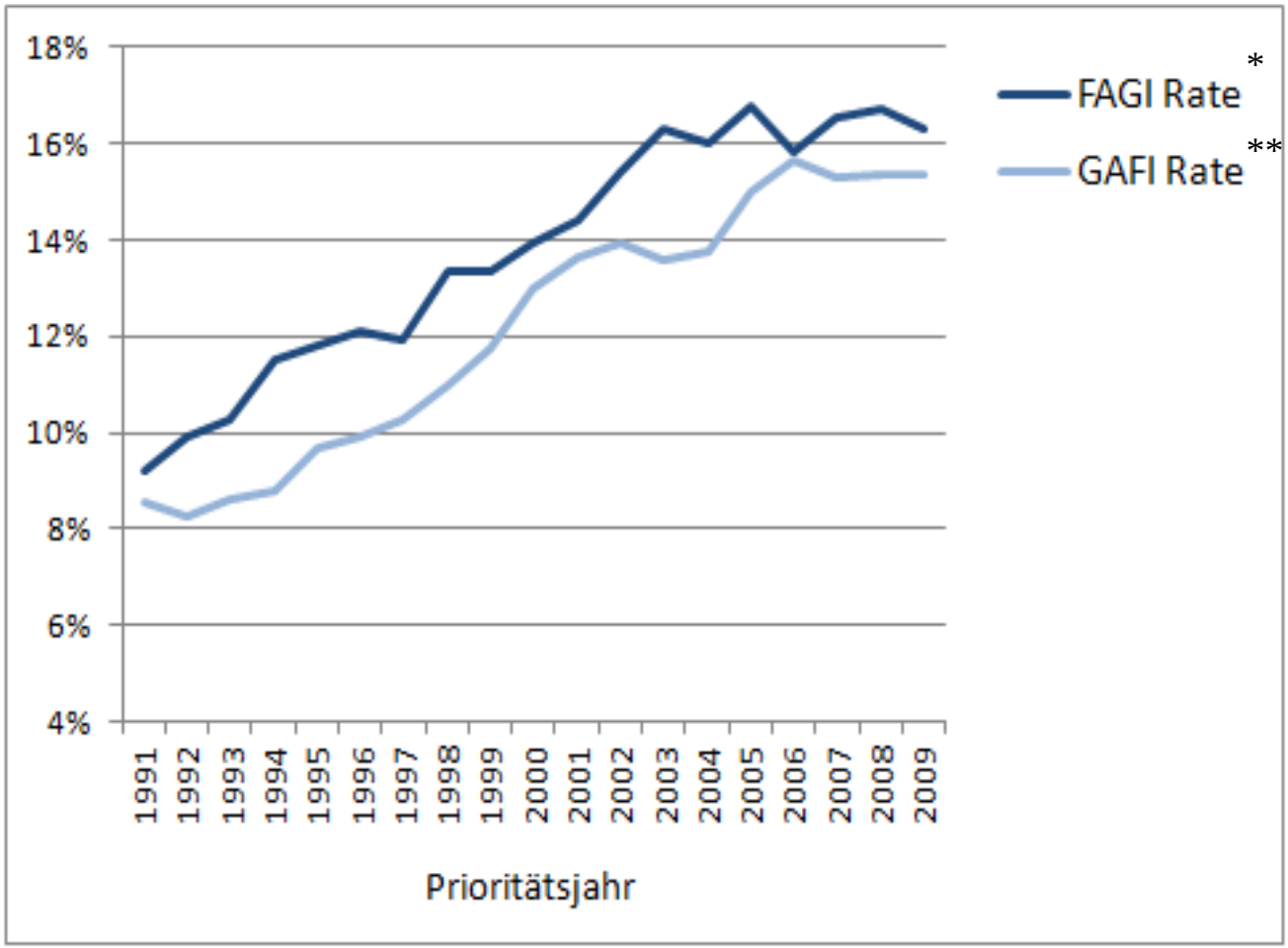


Inward R&D
Share of patent applications with an applicant from abroad and at least one inventor in Germany (FAGI)



⇨ Internationalization of R&D in Germany increased over time, measured by patent indicators (FAGI, GAFI).

Data source: OECD REGPAT Datenbank, Januar 2012.
Technologieklassifikation nach Schmoch (2008). Berechnungen des IWH.

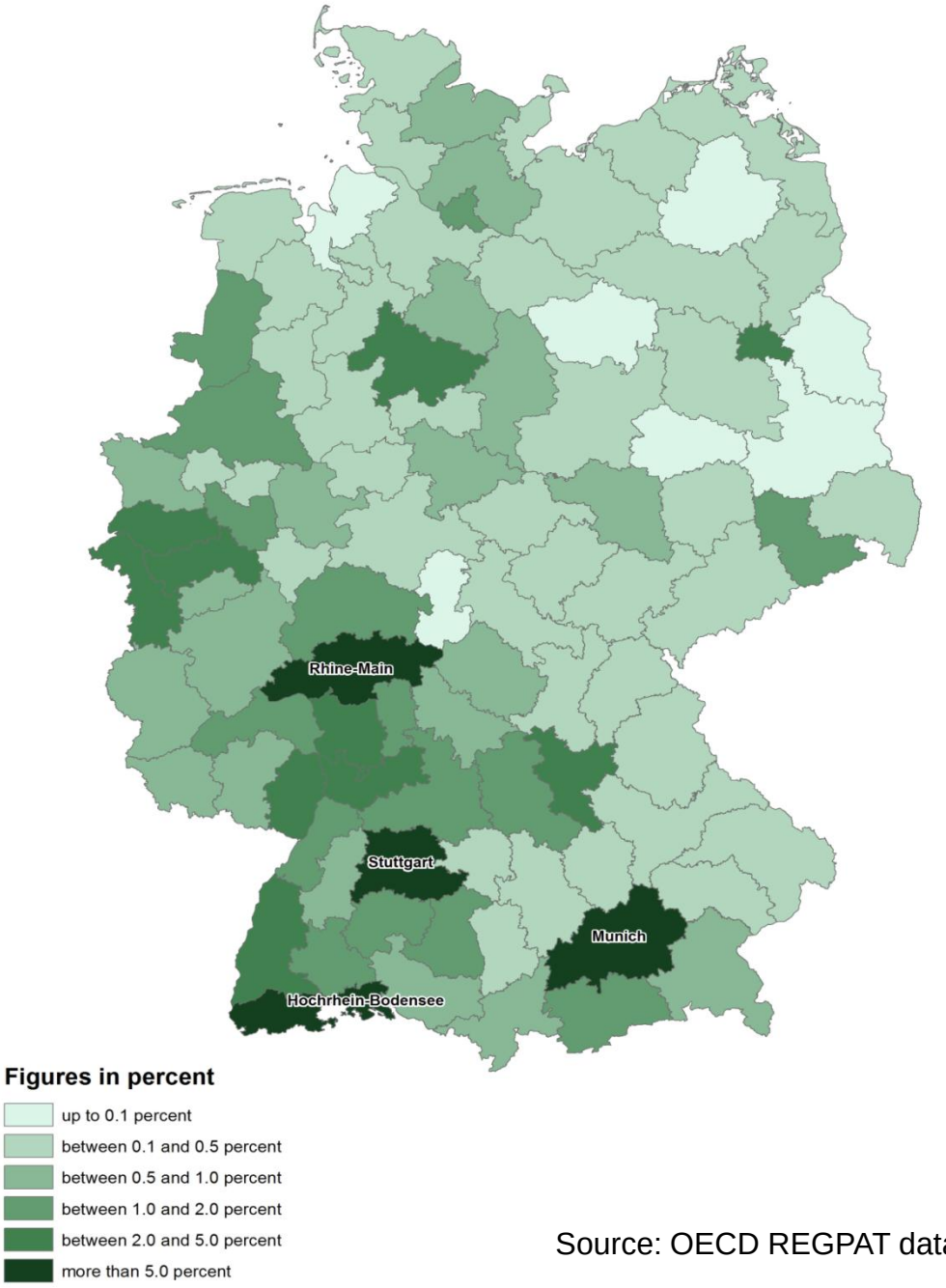


FAGI = **F**oreign **A**pplicant, **G**erman **I**nventor (*inward R&D*)

GAFI = **G**erman **A**pplicant, **F**oreign **I**nventor (*outward R&D*)

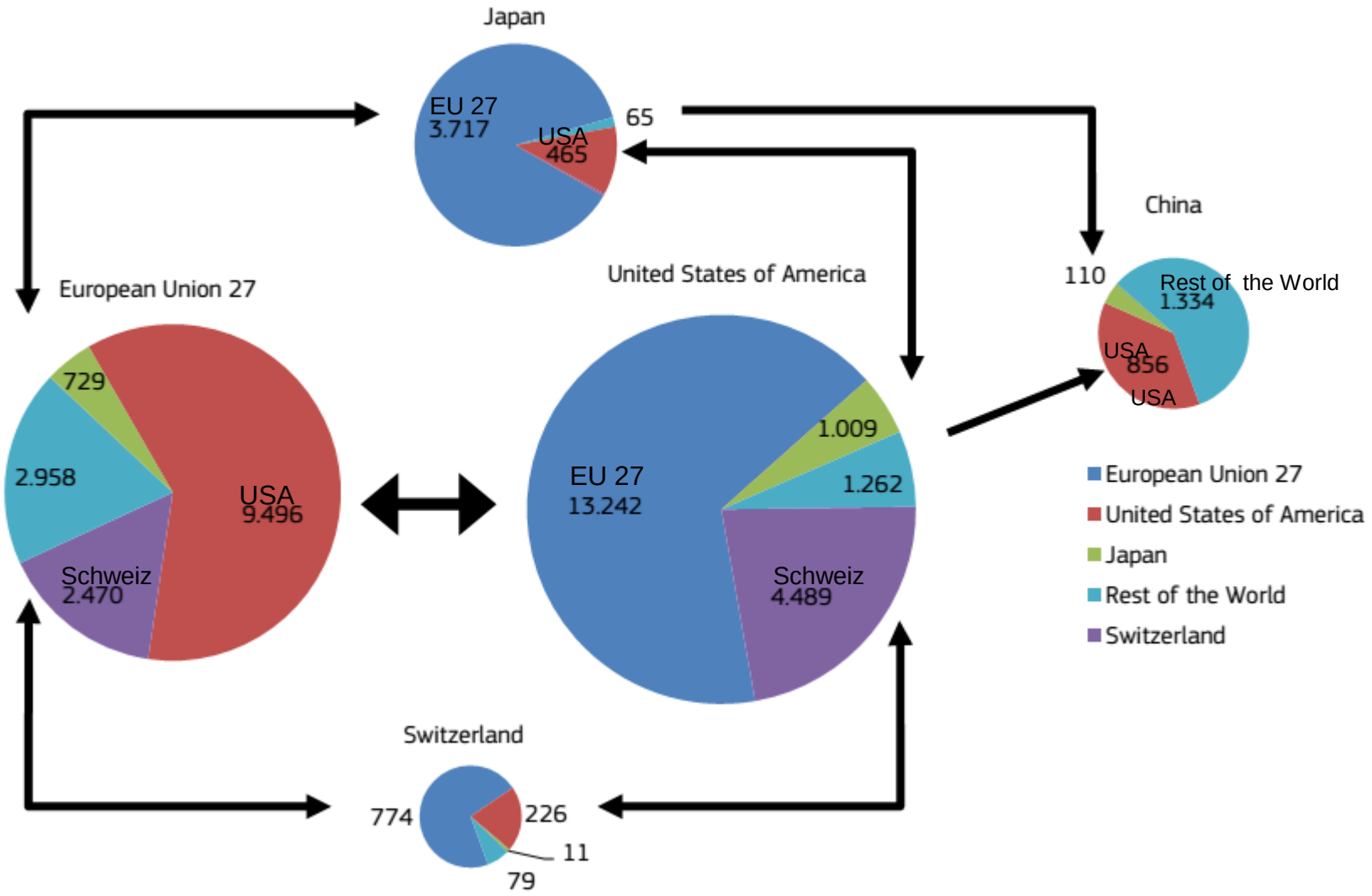
*FAGI (%) share of patents with at least one foreign applicant and at least one German inventor in total number of patents with at least one German inventor; **GAFI (%) share of patents with at least one German applicant and at least one foreign inventor in total number of patents with at least one German applicant
Source: IWH calculation, see: IWH et al. (2013).

FAGI patent applications per region in Germany (% of total) 2009



Source: OECD REGPAT database, see: IWH (2013)

International R&D flows:
R&D of foreign affiliates in several regions of the world (according to countries of orign, million Euro, 2007



Source: OECD, Eurostat, national Statistical Offices; Chart from: European Commission (2012, p. 29)

Thank you for your attention!