Science-Industry Interaction and the Commercialization of Research

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- PhD candidate
- Projects:
  - "Potentials and barriers of knowledge and technology transfer using the example of the innovation system Thuringia“
  - “Building African capacities for the development of clusters“
- Teaching:
  - Basics of Microeconomics
  - Basics of Innovation Economics
  - Supervision of Bachelor theses and Master theses
- Research Interests:
  - Economics of Innovation
  - Knowledge and Technology Transfer
  - Regional Economics

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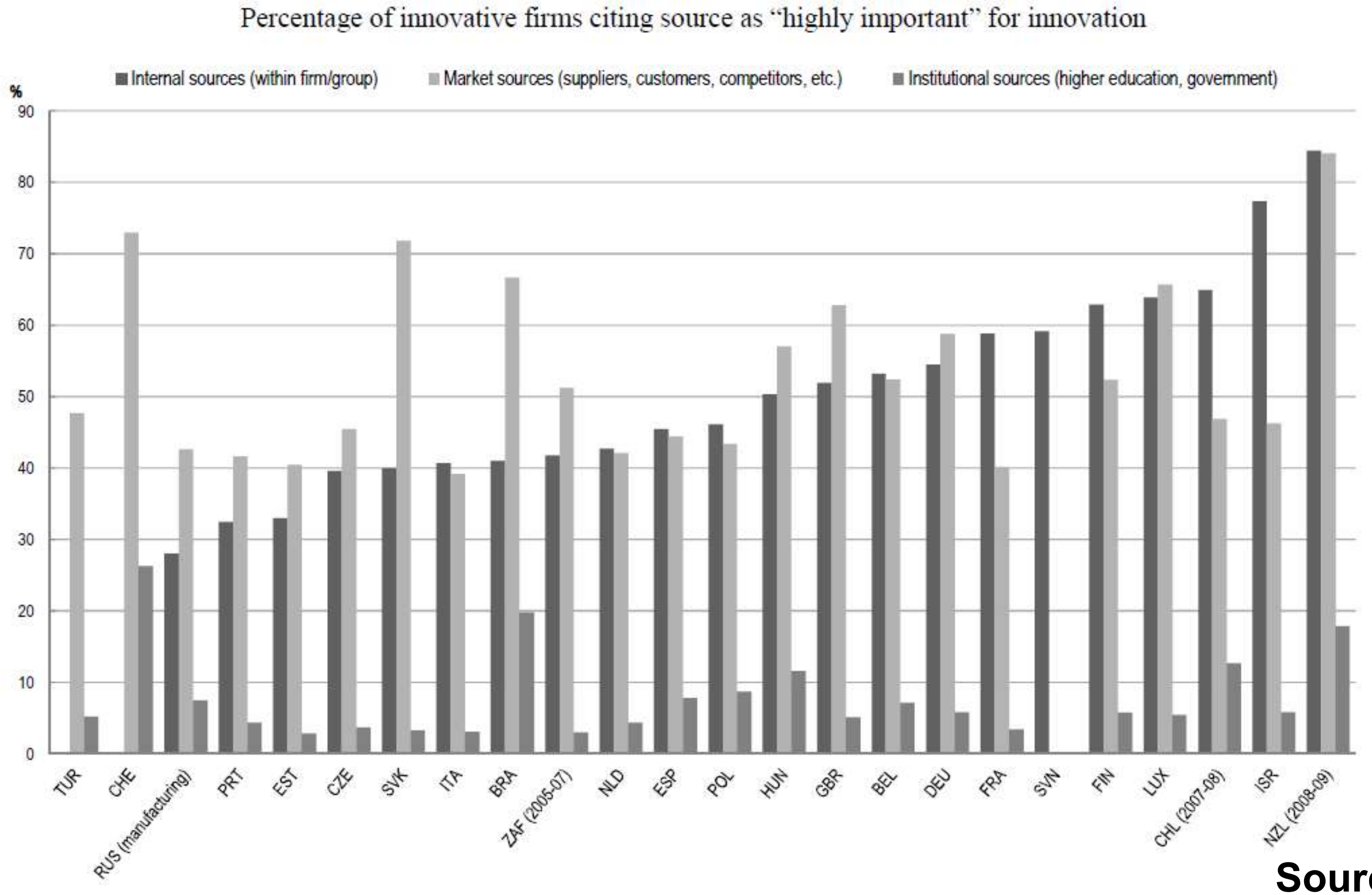
Introduction

- Increased importance of commercializing of research
  → valorization of research and intellectual assets by industry
- Public research institutions and universities as source of new technologies
- Breeding ground for start-ups
  - → increase innovation in the economy
  - → raise productivity
  - → create job opportunities
  - → address societal challenges (e.g. climate change, food security)

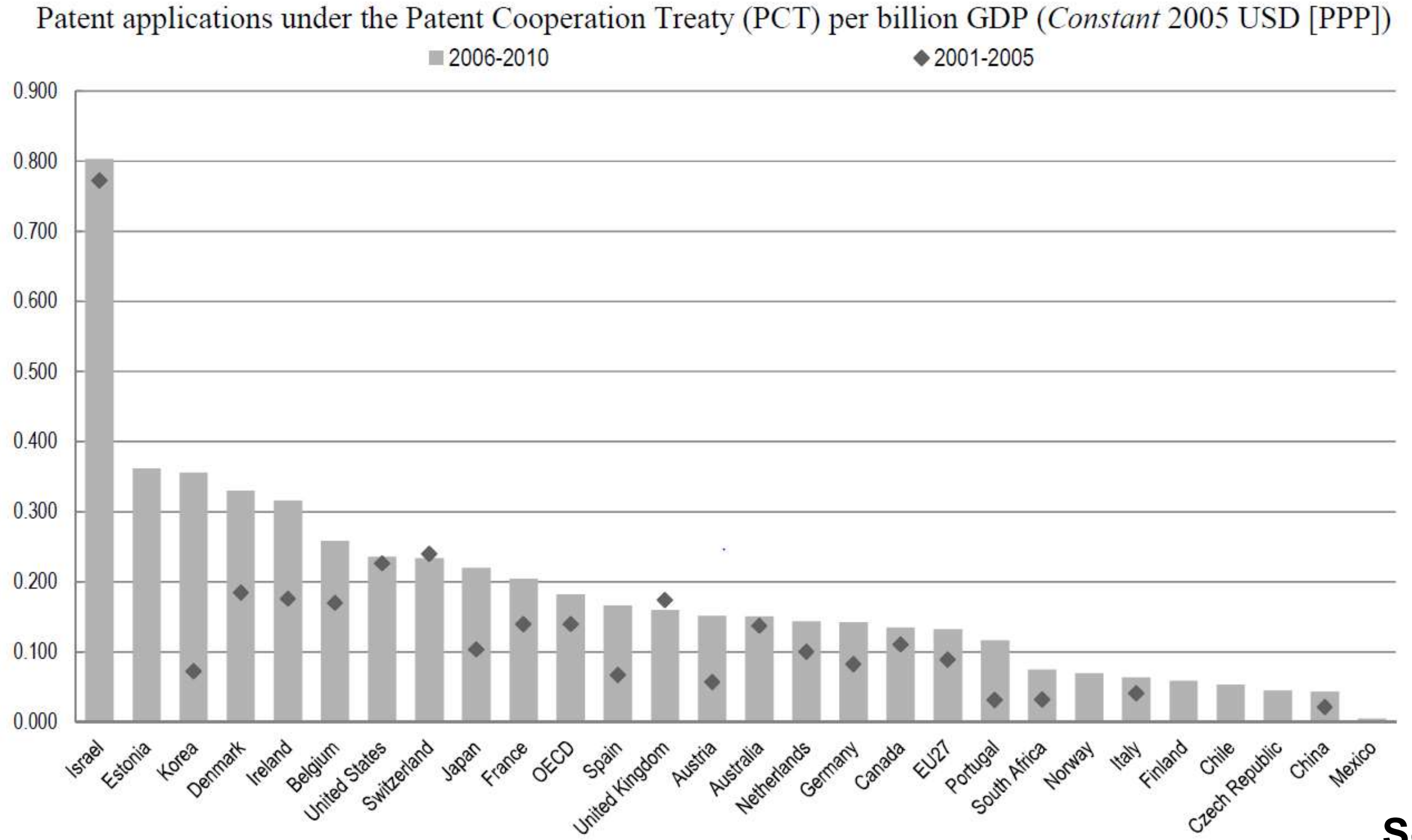
- Trigger for a stronger focus on commercialization activities by researcher and policy-maker

Important sources for innovative firms 2006-08



Source: OECD (2013, p. 30)

Patent applications by universities
2001-05 and 2006-10



Source: OECD (2013, p. 35)

Relevance for clusters

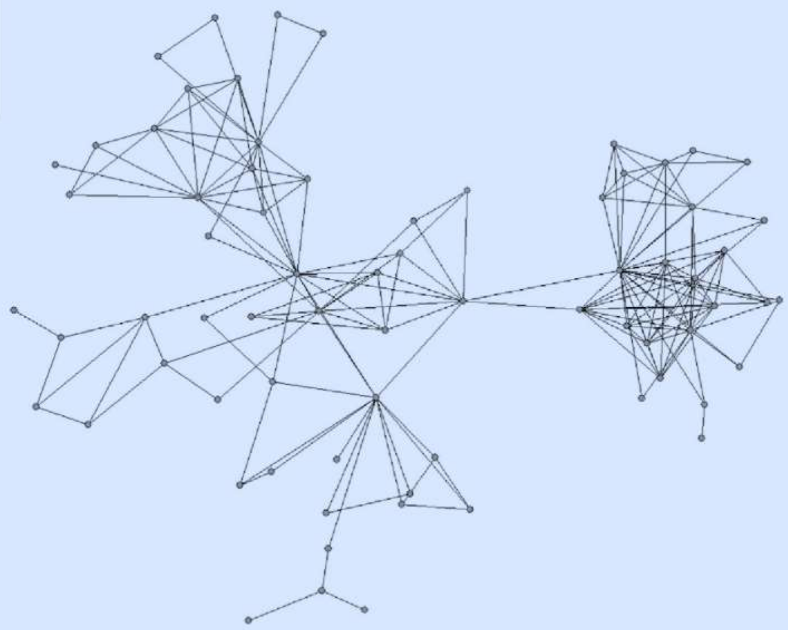


Fig. 2. Main component of Los Angeles inventor network, 2002.

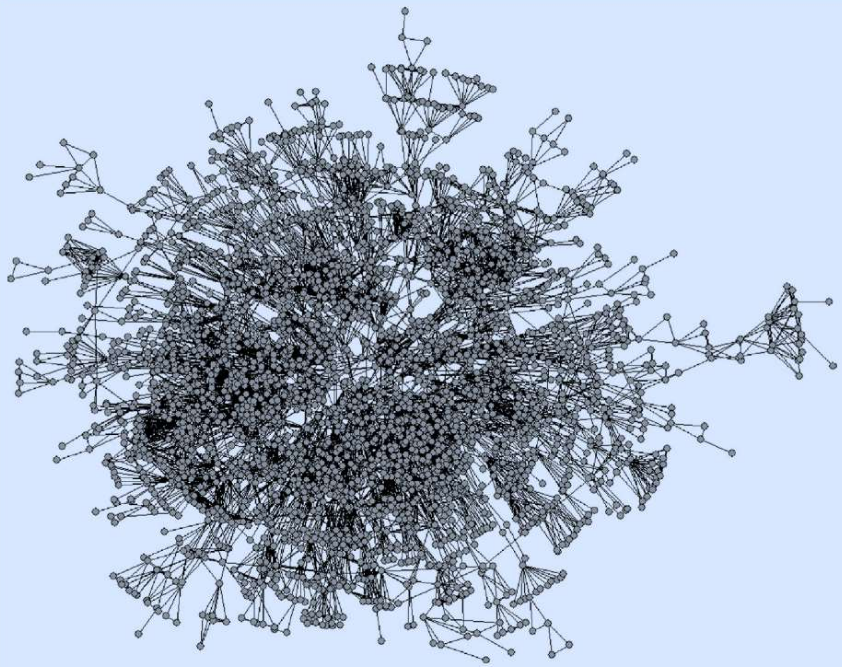


Fig. 3. Main component of San Francisco inventor network, 2002.

Source: Casper (2013)

	Percent of academic inventors in network main component	
	SF	LA
1980	0%	22%
1981	0%	23%
1982	0%	16%
1983	0%	12%
1984	0%	5%
1985	3%	5%
1986	3%	5%
1987	3%	6%
1988	3%	5%
1989	4%	7%
1990	5%	5%
1991	9%	4%
1992	10%	3%
1993	14%	2%
1994	16%	3%
1995	28%	0%
1996	25%	0%
1997	28%	0%
1998	36%	0%
1999	35%	0%
2000	43%	0%
2001	37%	1%
2002	39%	1%
2003	37%	2%
2004	41%	2%
2005	29%	1%

- Two Biotechnology clusters with similar research endowments
- Size of inventor network in SF increased
- Also the share of academics within the network increased in SF, while it decreased in LA

→twice as many Biotech patents and three-times more university spin-offs in SF with only 30% more sponsored funding compared to LA

→Interactions between inventors in clusters seem to have reciprocal effects on cluster itself and commercialization activities by academics

Source: Casper (2013)

Outline

Part I	**General aspects regarding science**
Part II	**Modelling science-industry interactions**
Part III	**Knowledge and technology transfer from academia to industry**

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1. Conducting science: Scientists and the science system
2. Financing science: Who finances science?
3. Ownership: Who owns scientific results?

Conducting science

Ethos of science

- Four norms of scientific conduct (Merton 1973)
  - Communism: knowledge generation and sharing (scientific results as public good)
  - Disinterestedness: independent work of scientists only for the contribution to the knowledge stock as an end in itself (integer without any influences due to the aim of money-making)
  - Universalism: verifiability of research and its results' independence of the investigator
  - Organized skepticism: scientists' approach of critical reflection regarding theorizing and conceptualizing

Reward system and incentives

- Scientists are rewarded by
  - Peer recognition and reputation based on their scientific contribution (Dasgupta & David, 1994)
  - Evaluation of research performance by publications and citations

  → Publication orientation and „publish-or-perish“ culture (Ndonzuau et al., 2002)
- Incentive to:
  - Disclose research results as soon as possible via publications
  - Extend common knowledge stock

Research orientation

- Basic Research
  - Investigation into fundamental mechanisms without an application in mind („Know why“)
  - Rather geared towards discoveries than inventions

- Applied Research
  - Answering of a specific problem/question with scientific methods
  - Closer to inventions, usually motivated by an application

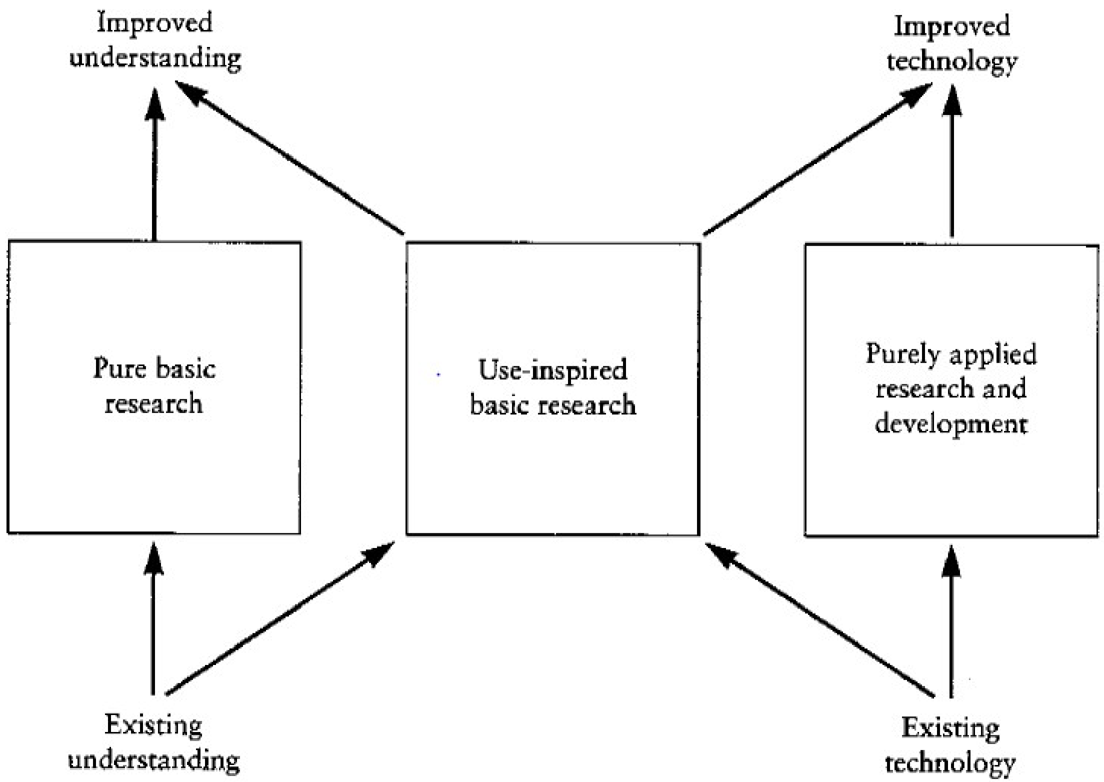
Quadrant model of scientific research

Research is inspired by:

Quest for fundamental understanding?		Considerations of use? No	Considerations of use? Yes
	Yes	Pure basic research (Bohr)	Use-inspired basic research (Pasteur)
	No		Pure applied research (Edison)

Source: Stokes (1997, p. 73)

Dynamic model of scientific research



Source: Stokes (1997, p. 88)

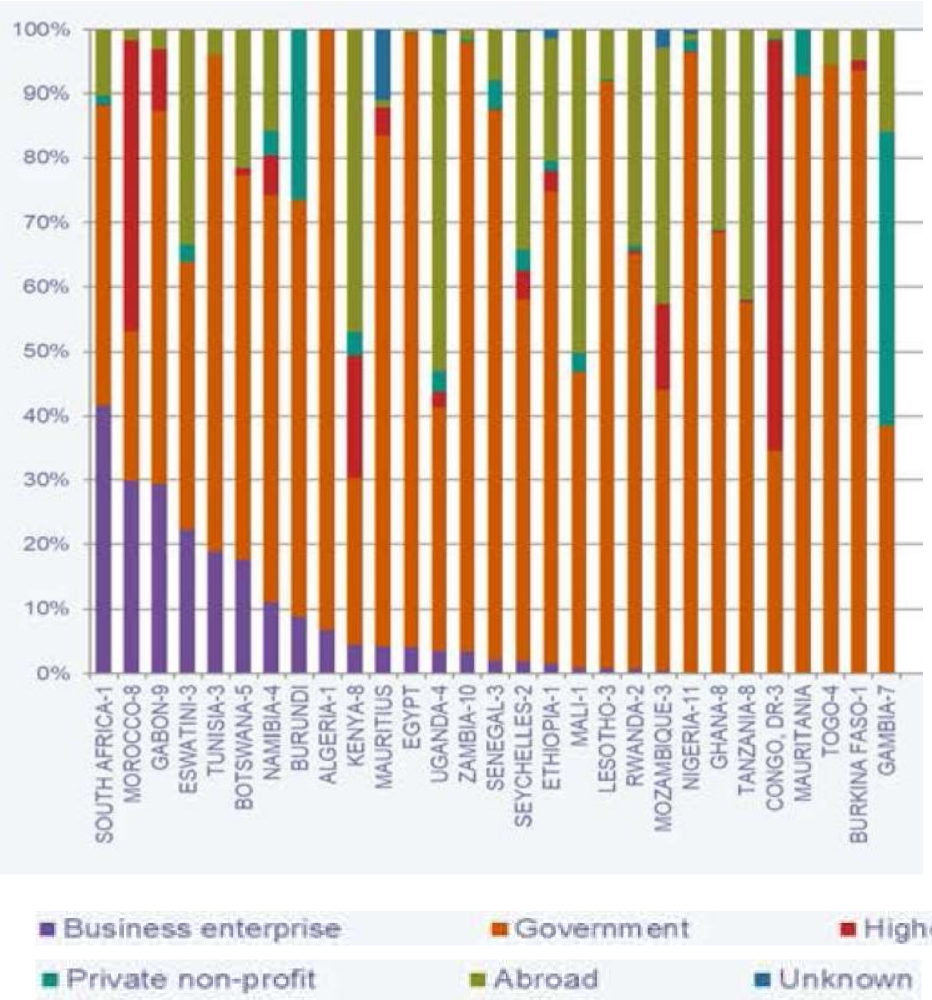
Who finances science?

Who finances science?

- Should research/science be a private or a public endeavor?
- Pro private:
  - Inventions can lead to competitive advantage → beneficial to invest
  - Individuals/firms often highly specialized → posses knowledge, „know best“ what seems promising
- Pro public:
  - Knowledge has certain properties of a public good (non-excludibility, non-appropriability) → risk of „leakage“ may cause underinvestment
  - Progress of society at large may depend on certain knowledge to be publicly available (and „non-blockable“) → no „knowledge monopolies“

Funding by sources

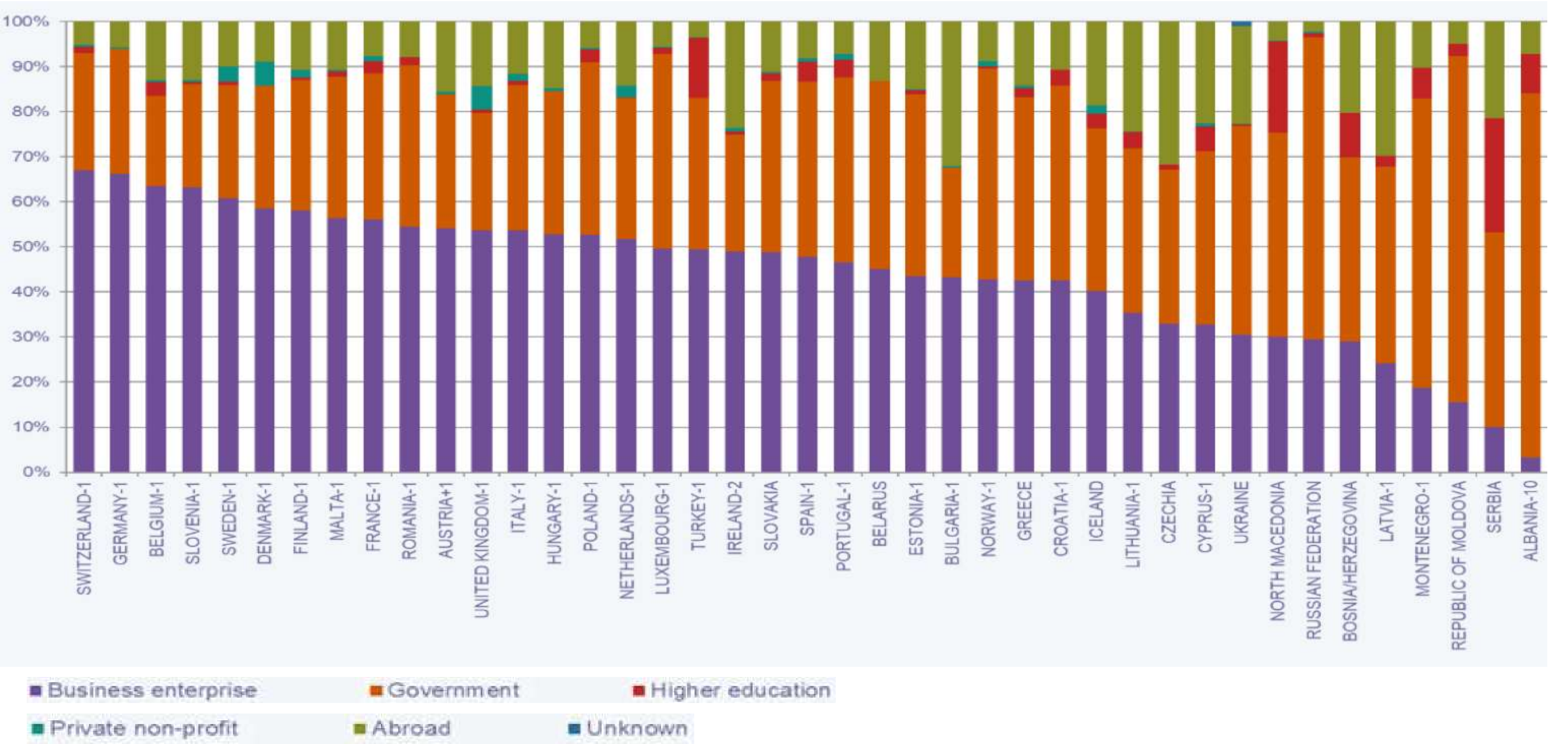
Total gross expenditure on R&D for latest given year



*
-1: 2017
-2: 2016
…
-7: 2011
…
-16: 2002

→South Africa in 2017:
~ 42% Business enterprises
~ 46% Government
~ 2% Private non-profit
~ 10% Abroad

Source: UNESCO (2020), p. 6



*
-1: 2017
-2: 2016
…
-7: 2011
…
-16: 2002

Who finances science?

Kenneth Arrow (1962)

Paradox situation regarding pricing if an individual/organization/firm would like to acquire information/knowledge/technology on a market:

- the buyer would like to know details to evaluate the usability
- as soon as the seller conveys knowledge, the incentive for the buyer to pay decreases because valuable information has been disclosed

→ No (or less than optimal) transactions, because the price cannot be determined ex-ante

→ Very important theoretical argument for Intellectual Property Rights (IPR)

Who owns the results of science?

Who owns the results of science?

Patents are the most prominent example
(trademarks, Copyright, …)

What is a patent?

It is the official, formal right to exclude others from the use of an invention:

- In exchange for public disclosure (description, drawings, etc.)
- For a certain period of time (up to 20 years)
- In a certain jurisdiction/country

→ Patents allow to gain a temporary monopoly

Excursus: Patent application

Where?

- Patent Offices:
  - CIPC = „ Companies and Intellectual Property Commission“ (South Africa)
  - EPO (European Union)
  - USPTO (US)
  - DPMA (Germany)

How?

- Include filing, drawings, state-of-the-art research and claims
- Non-publication: period of investigation
- Decision and grant (or refusal)

Further information (application process, costs, …) for patent filing at CIPC: Link

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Triple Helix Model

Image: Link

Multi-Stakeholder Model of Innovation

- Pioneered by Etzkowitz/Leydesdorff

Initially clear roles of components

- University: conduct (basic) research
- Business: produce/commercialize
- Government: regulate

Hybridization

- Bi-lateral interactions: University-Business, University-Government, Business-Government

Triple Helix Model: Actors and Roles (simplified)

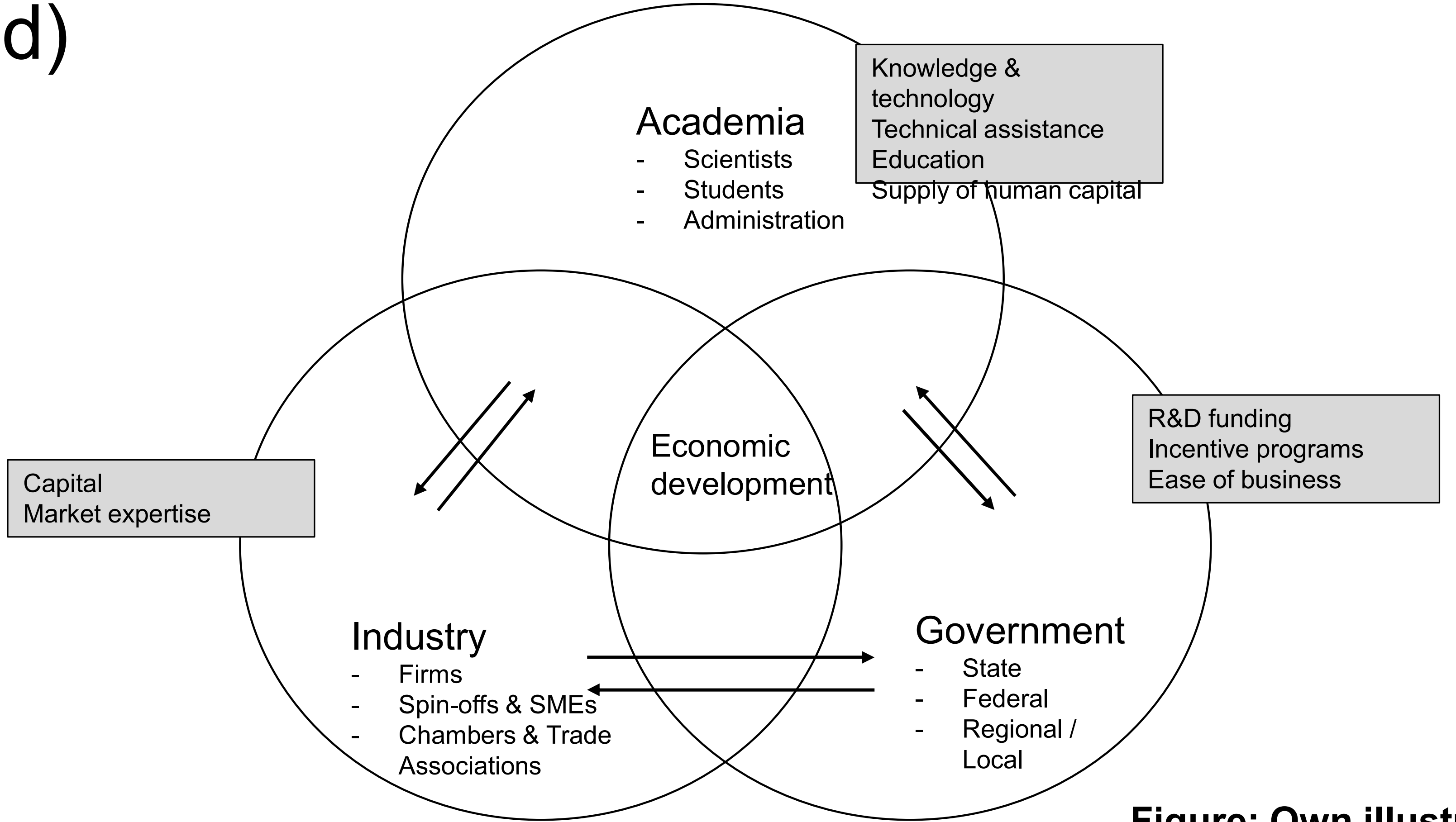
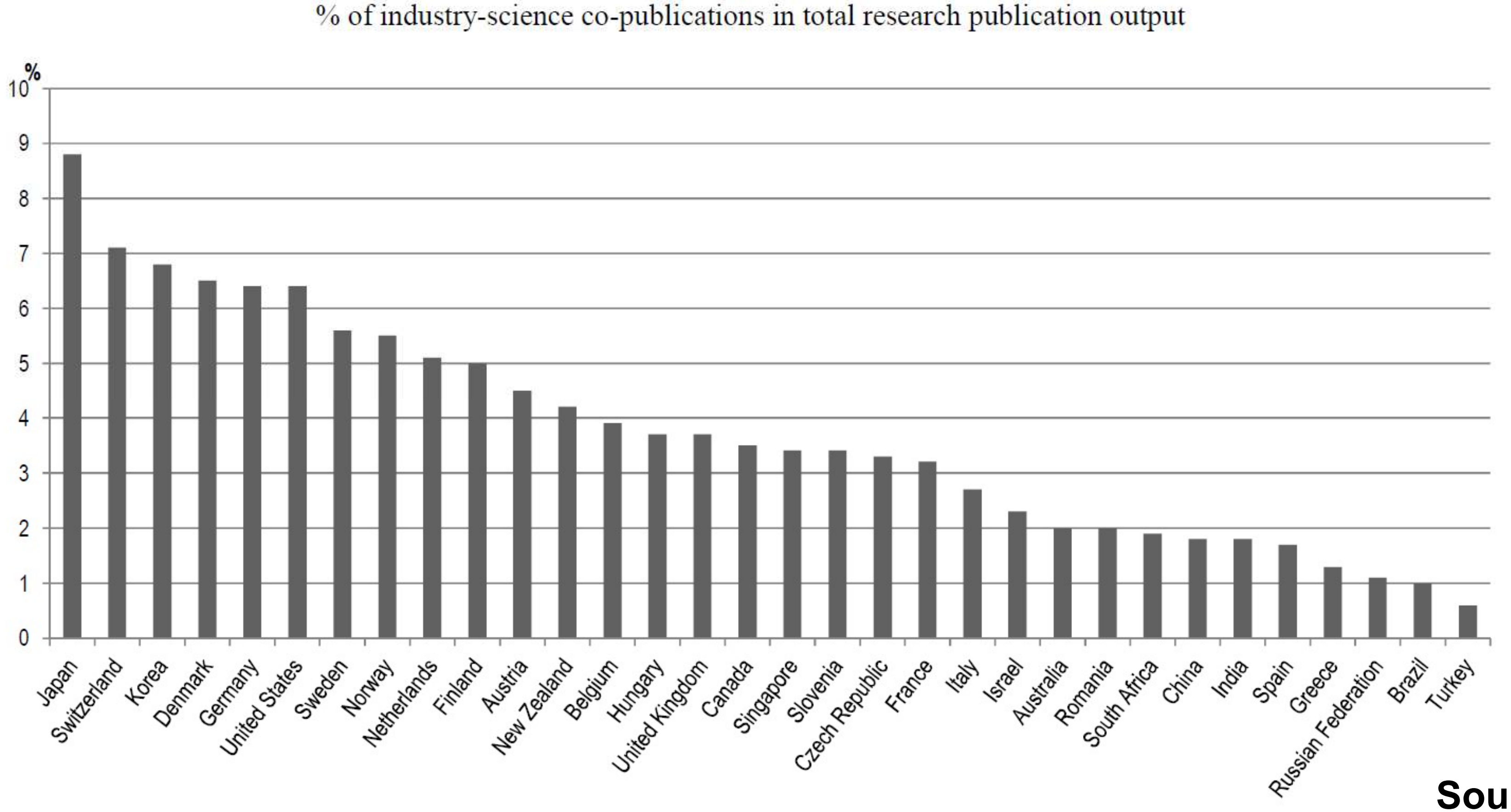


Figure: Own illustration

Industry-science co-publications, 2006-10



Source: OECD (2013), p. 47

Outline

Part I	General aspects regarding science
Part II	Modelling science-industry interaction
Part III	**Knowledge and technology transfer between academia to industry**

1. What is it about and why did it become important?
2. Transfer channels
3. Different logics and tensions
4. Benefits
5. Intermediary and bridging organizations
6. Conceptualizing knowledge and technology transfer

What is it about?

- What is Knowledge- and Technology Transfer?
  - Formal and informal movement of know-how, skills, technical knowledge or technology from one organizational setting to another (Roessner, 2000)
  - Pursuit to get inventions/discoveries „out“ of academia (universities, research institutes, …)
- Restricted view
  - With a commercial intent, into industry
  - Main channels: licensing, spin-offs
- More open view
  - Without a commercial intent, transfer into society at large
  - Main channels: (teaching), cooperative research, citizen science
- „In-betweens“: joint research with industry, use-inspired basic research

Why did it become important?

- US: Bayh-Dole-Act (early 1980s)
  - Who owns federally-financed research results?
  - Patenting of universities rose dramatically afterwards
- „European Paradox“
  - Observation that Europe is strong in research…
  - …but weak in application
  - Prime example: MP3-encoding
- Transfer as a solution to „push“ more research into industry

Transfer Channels

- Great variety of transfer channels
- Examples:
  - Publishing
  - Research collaboration
  - Contract research
  - Patenting and licensing
  - Spin-offs
- Differ in:
  - Degree of formalisation
  - Degree of knowledge finalisation
  - Relational intensity

Different logics and tensions

	Academic setting	Commercial setting
Norms	Ethos of science defined by the norms communism, disinterestedness, universalism, organized skepticism and originality (Merton, 1973; Ziman, 1984)	Market competition and rent-seeking under bureaucratic control, secrecy and restrictions on disclosure (Sauermann & Stephan, 2013)
Relation to knowledge	Knowledge production and scientific progress (Nelson, 1959; Rosenberg, 1974)	Appropriation of knowledge for commercial exploitation (Levin et al., 1987)
Motivation	Intrinsic: Quest for fundamental understanding, puzzle solving (Lam, 2011; Stokes, 1997) Extrinsic: reputation, peer-recognition and financial returns (Lam, 2011)	Intrinsic: passion for business ideas (Cardon et al., 2005) Extrinsic: financial gain and growth intentions (Cassar, 2007; Lam, 2011)
Reward system	Career progress and peer-recognition via publications, citations and rankings (Dasgupta & David, 1994)	Maximization of profit and market share
Competition	For journal publications, funding and research inputs (van Rijnsoever et al., 2008)	For markets and market share and for knowledge (Dosi & Nelson, 2010)
Competencies	Analytical thinking, methodological skills, technical skill, etc. (de Grande et al., 2014)	Ability to evaluate commercial potential, acquire resources, to lead a team and show a vision (Baldini et al., 2007; Shane, 2004)

- Subject to different logics
- Different understanding of the meaning of knowledge and its treatment
- Pursue different goals
- Speak different (technical) languages

Source: Cantner et al. (2021)

Benefits
(focus on University-Industry collaboration)

Industry perspective

- Monetary benefeits
- Recruiting
- Access to the latest research results and trends in research
- Complement lacking internal R&D
- Network access

University perspective

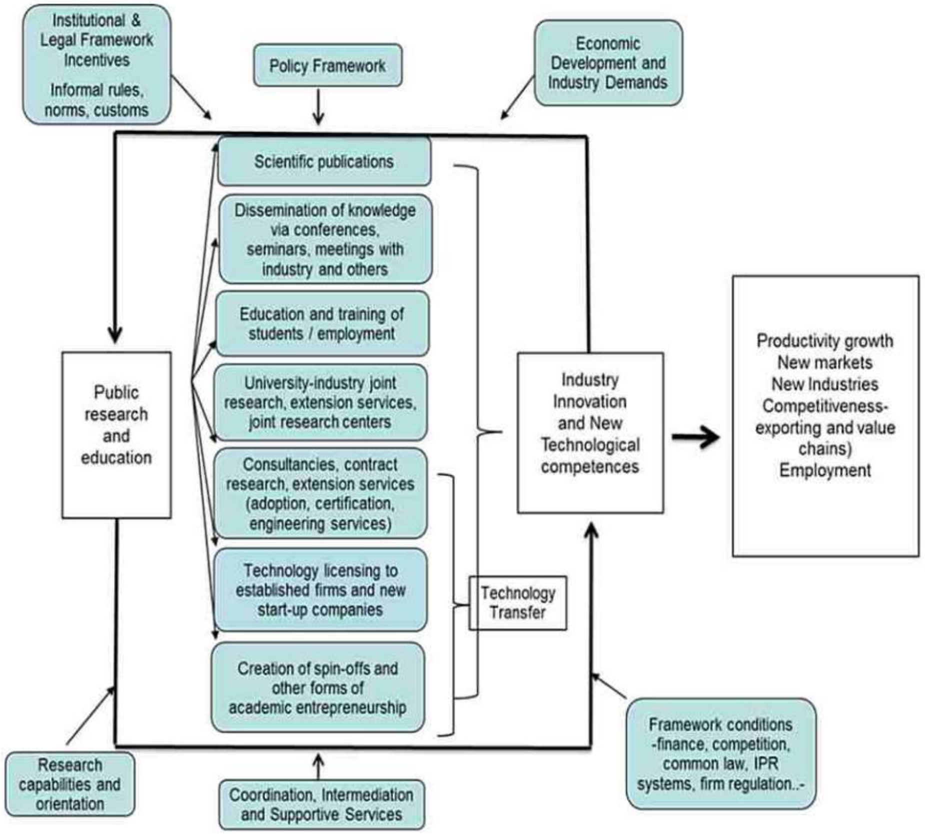
- Research funding
- Enriched education
- Access to industry R&D facilities
- Complementary expertise from application-oriented side
- Network access
- Gains from licensing and IP-sales

Intermediary and bridging organizations
Typology and examples

- Technology Transfer Offices (TTO)
- Incubator
- Business innovation centre
- Science park and technology hub
- ….

→ Cluster Organisation

Conceptualising Knowledge and Technology Transfer between Academia and Industry



Source: Zuniga & Correa (2013): p. 4

Outlook
Science-Industry Interaction II in workshop week 2

- Barriers to science-industry interaction
- Focus on specific transfer channels
- Transfer and its regional impact

→Preferences? Wishes?

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