THE GERMAN INNOVATION SYSTEM AT A GLANCE: GOVERNANCE AND STRATEGIES

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Content

- General remarks on Innovation Systems
- Key features of the German Innovation System
  - Where do we stand in the international knowledge competition?
  - How much is spent on what?
- Governance of the German IS
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  - Relevant actors and Institutions in the German IS
- Innovation Policy in Germany
  - The High-Tech-Strategy
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Introduction on Innovation Systems

- **Definition of Innovation Systems**: “…all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations.“ (Edquist 2006: 183)

- Innovation refers to a new combination of production factors that has a commercial value on the market (→ not limited to the technological frontier!)

- The Innovation process (Dosi 1988) is marked by:
  - **uncertainty**: An ex ante analysis of this process seems difficult because it is impossible to assess the outcome.
  - a steady increase of **scientific knowledge**, especially in life sciences and engineering, thus becoming more and more science intensive.
  - Importance of **research networks**
  - **Learning processes** (learning-by-doing or learning-by-using) reflect the informality of many innovations (→ tacit knowledge)
  - **Path dependency** (The direction of technological progress depends on efforts in the past and the technological standard of today)
“[i]t is important to note that technological progress and innovation processes are evolutionary in nature and, therefore, can not be planned in any detail. Even if we knew all the determinants of innovation processes in detail (which we certainly do not know, and perhaps never will), we would not be able to control them and design or “build” SIs on the basis of this knowledge. Centralized control over SIs is impossible and innovation policy can only influence the spontaneous development of SIs to a limited extend.” (Edquist 2006: 191).

→ This notion must not be mistaken as an argument for any kind of laissez-faire free market policy where the state is stripped of all its powers. Quite the contrary: All levels of any given political system may at least try to positively influence the innovative behaviour of its constituents.

→ It rather points out to the fact that political steering of innovation process in the sense of a predefined outcome is extremely difficult as the process is influenced by a myriad of factors which for the steering entity (be it a ministry or an agency) are simply too complex to deal with.
Introduction on Innovation Systems
Functions of IS

- Provision of R&D, creating new knowledge, primarily in engineering, medicine and natural sciences
- Competence building in the labor force (provision of education, creation of human capital)
- Creating and changing organizations needed for the development of new fields of innovation (supporting incubators and diversifying existing firms, creating new research organizations, policy agencies etc.
- Networking through markets which implies integrating new knowledge elements developed in different spheres of the IS and those coming from outside with existing elements
- Creating and changing institutions such as intellectual property rights laws, taxation laws or R&D investment regulation thus providing incentives or obstacles to innovation
- Provide financing of innovation processes and other activities that can facilitate commercialization of knowledge
The Heuristic Model of (National) Innovation Systems

Co-evolution

Demand
Consumers (final demand)
Producers (intermediate demand)

Industrial System
Large companies
Mature SMEs
New, technology-based firms

The potential reach of public policies...

Co-evolution

Education and Research System
Professional education and training
Higher education and research
Public sector research

Framework Conditions
Financial environment; taxation and incentives; propensity to innovation and entrepreneurship; mobility ...

Political System
Government
R&D policies
Governance

Infrastructure
Banking, venture capital
IPR and information
Innovation and business support
Standards and norms

Source: Fraunhofer ISI
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Key features of the German Innovation System

- Where does Germany stand in the international knowledge competition?
- Common measures: GERD (Gross Expenditures on R&D)
  - BERD (Business Expenditures on R&D)
  - HERD (Higher Education Expenditures on R&D)
- Research Intensity (GERD/DGP)
R&D Intensity versus Absolute GERD in PPP$
Business R&D versus R&D Intensity

Source: Fraunhofer ISI
Higher Education R&D versus R&D Intensity

Source: Fraunhofer ISI
GERD according to financing and Spending Sectors in Germany, 2007

Source: Bundesbericht F&I 2010: 40
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Governance of the German IS

- Central Characteristic: System of Multi-Level Governance
  - Governance structure in horizontal and vertical terms
  - Shared responsibilities between different ministries and authorities on different levels of the political system
- Constitutional rule: funding for the public support of science and research activities is a joint task of the federal government and the 16 states (Länder)
- The education system is entirely managed by the state-Level
- The funding for science and research activities is aligned along two basic concepts: Institutional funding and project funding
  - Institutional funding is the largest share, project funding is allocated for more specific programs
- Indirect funding such as tax credits are being discussed but not yet implemented
Governance of the German IS

- At federal level, the main responsibility for S&T policy lies at the Federal Ministry of Education and Research (BMBF)
- BMBF is implementing a set of instruments, like:
  - Project funding: Grant based thematic R&D programs
  - Institutional funding for large research associations
- Federal Ministry of Economics and Technology (BMWi) conducts more innovation-oriented programs as well as industry related research, situated at the interface of R&D and innovation
- Different fields of research are divided among ministries, e.g. Federal Ministry for Environment, Nature, Conservation and Nuclear Safety and the Federal Ministry of Defense
Governance of the German IS

- Large number of intermediaries with various functions (Joint Conference on Science of the federal and local governments; German Science Council; Office of Technology Assessment at the German Bundestag (parliament); The German Research Foundation (double function as financing and consulting institution)

- Diversified Research Organizations:
  - Max Planck Society (MPG) → Basic Research
  - Fraunhofer Society (FHG) → Applied/contract research
  - Helmholtz Association (HGF) → Basic Research (Big Science)
  - Leibniz-Association (WGL) → different tasks, ranging from long-term research to services for other institutes

⇒ Strength of the German IS: Relatively strong and clear division of labor between research organizations and societies and between public and private actors
Governance of the German IS

Governance of the German IS

Characteristics of Research

- **Applied Research**
  - Federal/German Länder Institutes 0.9
  - MPG* 1.45²
  - HGF* 2.3
  - Fraunhofer* 1.3
  - Mainly government

- **Fundamental Research**

Market for Applied Research

- **Mainly industry** 55.4¹
  - Industry (internal and external expenditures)
  - AiF ≈ 0.25
  - Universities ≈ 9.2
  - Fraunhofer*
  - HGF*
  - MPG*

Characteristics of Funding

¹ estimated by Stifterverband Wissenschaftsstatistik for 2008
² 2006

Source: Stifterverband für die Deutsche Wissenschaft, Destatis, BMBF

Source: STN: SCISEARCH; EPO: PATSTAT, Calculation and illustration by Fraunhofer ISI
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Innovation Policy in Germany

- Research and Technology Policy have a long tradition in Germany, going back basically until the 60s
- „Modern“ Innovation Policy only from the late 80s onward
- Given the economic importance of medium-sized enterprises („Mittelstand“) this sector is increasingly targeted by federal and state policy initiatives
- Complex distribution of responsibilities between EU, federal and state level
- Before the mid 90s policy instruments were mainly orientated towards broad programs and countless additional smaller programs („jungle“ of public support mechanism)
- A recent attempt to better coordinate policy instruments among the involved ministries was the High-Tech-Strategy of 2005
Innovation Policy in Germany

- The **High-Tech-Strategy (HTS)** was an attempt to design a systemic and cross-departmental framework for the federal level.
- The greater goal was to create an economic structure conducive to innovation, also in order to sustain in the international knowledge competition.
- New lines of research were implemented and were added to the already existing support mechanisms (medical technologies, transportations technologies, nano technologies, Biotech, material science and environmental technologies).
- Apart from more resources for research activities the HTS aimed at:
  - increasing the focus on the commercialization of research results,
  - Innovation friendly regulations
  - Support for start-ups
  - Allocation of promotional funds explicitly for SMEs (e.g. ZIM, central SME innovation programme)
- The inclusion of old and new schemes into this policy proved to be advantageous (innovation policy is rather sensitive to rapid policy change)
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New developments of the German IS
The High-Tech-Strategy 2020

- Focusing on **Global Challenges**:
  - Drivers of innovation: new technologies, services, changes in society and global challenges creating the need to find answers and solutions
  - Challenges are mainly found in five areas of demand (=Bedarfsfelder), namely: climate/energy; health/alimentation; mobility; security; communication

- **Mission Oriented Approach**:
  - Core concern of the High-tech-Strategy: orient research and innovation politics towards central missions
  - Definition of “future projects” which pursue concrete goals of scientific, technological and societal developments and may last for 10-15 years

- Definition of **Key Technologies**: sustainability of the German economy depends on a leading role in developments in Bio- and Nanotechnology, Micro- and Nanoelectronics, Optical Technology, Micro-system- raw material and production Technology, service research, Aerospace Technology and Information- and Communication Technology
The High Tech Strategy 2020

Global Challenges → 5 Areas of Demand

- Climate Energy
- Health and alimentation
- Mobility
- Security
- Communication

Key Technologies

Cross-cutting Issues / Framework Conditions

Source: Bundesbericht F&I 2010
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Concluding remarks and rough comparison with the Brazilian IS

- Germany has a comparatively strong innovation system. Even though it is not the top-performer compared to other countries, Germany has managed to build up a very competitive economic structure (former export leader, 12% of worldwide high-tech exports, 47% export quota, etc).

- Certain challenges remain: knowledge and technology transfer (faced by all R&D performing nations), social innovations are hardly ever treated, skilled workforce (link to educational system), internationalization, demographic change, etc.

- Though very different in scale and scope in terms of innovation policy and performance, there are certain features, that can be found in Brazil as well:
  - Federalism: A large set of responsibilities is in the hands of the state level
  - Various ministries are involved which makes horizontal coordination necessary
  - „jungle“ of support mechanisms for R&D
  - The relative importance of SMEs

- Long and stable and good relations between the two countries make future cooperation more easy.
Thank you very much for your attention!

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The Fraunhofer Institute for Systems and Innovation Research (ISI)

- studies how innovations originate, which actors are to be integrated, who benefits from them and how they can be promoted
- evaluates economic, social and political potentials and the limits of technical innovations
- helps decision-makers in industry, science and politics in setting a strategic course
- utilizes the newest theories, models, social-science measurement instruments and databases and constantly develops them further
- handles circa 290 research projects per year
- has influenced the German innovation landscape for more than 35 years as no other research institution has
Range of Services and Methods of Fraunhofer ISI

Comparative analysis of innovation systems at national, sectoral and technological levels

Technology foresight and preparation of scenarios and roadmaps of future technological developments

Examination of the institutional and regulatory contexts of innovations

Analysis of the diffusion processes of innovations

Evaluation of innovations and their potentials in an economic, societal and ecological perspective

Assessment of the innovation-related policy options as well as the chances for success and acceptance in the market and by society

Advisory services to industrial players and policy-makers on the introduction and implementation of innovative solutions