National Systems of Innovation - on the importance of experienced based learning

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National systems of innovation

1. Concept appears first time in 1982 (Freeman working paper for OECD). Referred to in booklet 1985 (Lundvall)
3. Today it is all over the place (Google gives more than 1 million hits).
4. US, Japan, China, OECD, UNCTAD etc use it to frame innovation policy. But also many hits for Libanon and Colombia!

WHY??
Why has the NSI-concept become so popular?

- Dialectic concept – linking individual’s creativity to a national system.
- Helps to correct a widely spread misinterpretation of innovation as a linear process.
- Timing – comes forward in a period where it becomes clear that rich countries cannot compete through low costs.
- A useful framework for national mobilisation for economic growth both in rich and poor countries.
Why we need a broad definition of the innovation system

- Low and high technology sectors
- DUI- and STI-modes of innovation.
- Pioneer firms and early and late followers/users.

Bias among policy makers and analysts in favour of HT, STI and Pioneer firms

BUT in most countries economic performance primarily reflects innovation related activities in Low-tech, DUI-mode and among followers.
Structure of the lecture

1. A brief history of innovation system research:
2. Why we need a broad definition of the innovation system.
3. What are the policy implications of a systemic perspective?
4. Is innovation system an analytical concept?
5. What are the major challenges ahead for innovation system research?
The message

- The drift away from the original concept of NSI made it **narrow**.
- Strong science with weak innovation within a nation is not a paradox!
- Public policy in an evolutionary context should emphasize institutional design.
- A call for research linking institutions, organisations and people to interactive learning and evolution of knowledge.
The Original NSI-concept

- Friedrich List (1840) as the Grandfather and Freeman (1982) as the Father.
- List, Freeman, Nelson and Aalborg versions were broad and linked innovation to the production system and to the organisation of firms.
- The aim was to understand either catching-up or international competitiveness as being more than wage costs.
- Critical to standard economics and to standard economic policy.
NSI and standard economics – NSI as alternative ‘focusing device’

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<th>Allocation</th>
<th>Rational choice</th>
<th>Learning</th>
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<td>Standard</td>
<td>Austrian</td>
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<td>Innovation</td>
<td>New growth theory</td>
<td>Evolutionary economics</td>
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Context for original NSI

- List as catch-up analyst and as involved in policy advice - Freeman as modern List
- The Ad Hoc OECD-group on Science technology and international competitiveness 1981-83.
- Common for early contributions on NSI was criticism of competitiveness strategy based on low wages. (Cf. The EU competitiveness pact!)
- The OECD TEP-program 1989-92 and the diffusion of the NSI-idea.
Context matters

When SI goes to OECD/ministries of science/business schools/technical universities it loses some of its critical dimension.

- OECD combines it with neo-classical production function approach.
- Ministries of science on the interaction between industry and university. With tendency toward regress toward linear approach.
- Business schools focus on NSI as context for firms or sectors.
- Technical universities tend to foster functionalist and mechanical approaches.
Brief history of innovation research – antecedents to the NSI-concept

- Adam Smith on the role of both experience-based and science-based learning as the basis for innovation.

- Friedrich List (born 1789) on the need for governmental infrastructural investment to build national innovation systems.
**Schumpeter on innovation**

- Schumpeter was mainly interested in the implications for economic theory and to explain historical phenomena such as long waves – less on management and policy.
- When explaining innovation he put most of the emphasis on the *supply side* – first the individual entrepreneur and later the R&D-lab of the big company.
- This view was challenged by Schmookler who demonstrated that the growth of *demand* was a prerequisite for innovation.
Christopher Freeman: The father of modern innovation theory

- Economist from London School of Economics – went to Keynes’ lectures, read Marx and Schumpeter.
- Experience from empirical industrial economics before starting SPRU in the sixties.
- Introduced NSI-concept 1982 and related it to catch-up in Brasil and to Structural competitiveness.
- Joined with me and Dick Nelson who, with a similar background, developed parallel efforts in the US (see Dosi et al 1988).
STI-mode and DUI-mode of learning – getting the NSI-concept back on track

- **STI** = Science-Technology-Innovation mode is characterised by science-approach – formalisation, explicitation and *codification*

- **DUI** = Learning by Doing, Using and Interacting mode refers to *experience-based*, implicit, embedded and embodied knowledge.

- Jensen, Johnson, Lorenz and Lundvall, ’Forms of Knowledge and Modes of Innovation’, Research Policy, 2007
The paradox and the built in STI-bias

The Paradox: ’Systems with a lot of good domestic science but less successful in innovation’

- Reflects the limited perspective with too much focus on Science based learning (STI) to the neglect of Experience based learning (DUI).

- Reasons for bias:
  - STI-learning can be measured and manipulated more easily than DUI-learning – cf. the Meadow-project in Europe.
  - The policies involved are less controversial – cf. The LOK-program in Denmark.
The double change in context

- ICT and access to elements from the science base becomes increasingly important for firms in all sectors – calls for a strengthening of STI-mode of learning
- But these changes and globalisation contribute to accelerating change and requires learning organisations – calls for a strengthening of DUI-mode of learning
Illustrating empirically how DUI and STI-learning promote innovation

- Year 2001, DISKO survey on technical and organisational change addressed to Danish firms in the private sector.
- Survey and register data from 692 firms included in the following analysis.
DUI-learning - seven indicators reflecting ’learning organisation’ and ’user focus’

- The firm makes use of some of the following practises:
  - Interdisciplinary workgroups
  - Quality circles/groups
  - Systems for collecting employee proposals from employees
  - Autonomous groups
  - Integration of functions
- Demarcations between groups of employees have become less sharp 1998-2000.
- The firm has established closer relationships with customers 1998-2000.
STI-learning – three indicators reflecting R&D-effort and networking with science infrastructure

- The firm has positive expenditure on R&D.
- The firm has personnel with academic degree in natural science or engineering.
- The firm interacts with researchers attached to universities or other science institutes.
Odds ratio estimates (with control variables for sector, size & ownership)

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<tr>
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<th>Odds ratio</th>
<th>Coefficient estimate</th>
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<tr>
<td>DUI/STI</td>
<td>5.064</td>
<td>1.6222**</td>
</tr>
<tr>
<td>STI</td>
<td>2.355</td>
<td>0.8564**</td>
</tr>
<tr>
<td>DUI</td>
<td>2.218</td>
<td>0.7967**</td>
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On the need to combine science- with experience-based learning

- Firms combining science-based (STI-mode) with experience-based (DUI-mode) learning are more innovative than firms biased toward one mode.

- Calls for analytical efforts that establish the connection between knowledge creation through research and knowledge creation through organisational learning and interaction with users.

- Implies broad definitions of innovation systems, innovation policy and knowledge management.
Two kinds of bias in industrial policy

1) Promoting the science base of high-tech firms assuming DUI takes care of itself

2) SME policies sometimes neglects the importance of linkages to sources of codified knowledge

The big challenge lies in stimulating firms to combine the DUI- and the STI-mode.
Implications for how to define innovation systems

- In order to explain how new ideas are brought to the market and transformed into economic performance it is necessary to take into account both science-based learning and experience-based learning.
- Human resources and organisation within and across firms are important dimensions of the innovation system.
Moving a step back from innovation to knowledge and learning

- Linking innovation to learning by doing, using and interacting (DUI).
- David and Foray on innovation systems as knowledge distribution systems (STI).
- The knowledge based economy versus the learning economy (Lissabon process 2000).
- Tacit knowledge, local knowledge and the codification issue (Regional systems of innovation).
- The Learning Economy (Lundvall & Johnson 1994).
Future challenges: People, learning and systemic context

- More systematic research on how learning by doing, using and interacting takes place. Development of indicators and taxonomies.
- Deepening our understanding of how people learn differently in different national systems and how it affects patterns of innovation.
- Linking learning to labour mobility, networking and social context.
- Arundel et al in next ICC as a step ahead.
Forms of knowledge and localised learning

- Tacit knowledge can be transferred only through face-to-face interaction or through people moving.
- Important elements of know-how remain tacit and imply local interaction and direct interpersonal interaction.
- Therefore relationships among agents involved in innovation remain localised.
- DUI-learning more localised than STI-learning — science systems more globalised than education and labour market systems.
Different conceptualisations of the innovation system

- Functionalist approach – defining basic functions within the system and studying how these are organised differently in different national systems (Edquist)
- Analytical approach starting from the analysis of the role of knowledge and learning in connection with the innovation process (Lundvall).
The functionalist approach (Edquist)

1. Entrepreneurial activities
2. Knowledge development
3. Knowledge diffusion
4. Guidance of search
5. Market formation
6. Resources mobilization
7. Creation of legitimacy
Analytical approach

- Innovation process uses knowledge as input and output.
- Not meaningful to distinguish knowledge development from knowledge diffusion.
- Knowledge emanates both from learning and from searching.
- Intensity of learning and searching will reflect:
  - Technological opportunities
  - Demand
  - Competition
The Fundamentals of the Innovation Process

- Most innovations are outcomes of *combinations* of diverse elements of knowledge.
- Such outcomes reflect *interaction* among agents with different insights and skills.
- Interaction is *social as well as localized* and reflects formal and informal institutions.
- Innovation policy as *institutional design*
Adam Smith on Innovation and Specialisation in Science

- Many improvements have been made by .... those who are called philosophers or men of speculation ... who ... are often capable of combining together the powers of the most distant and dissimilar objects.

- In the progress of society, philosophy or speculation becomes, like every other employment.... subdivided into a great number of different branches, each of which affords occupation to a peculiar tribe or class of philosophers; (Adam Smith 1776: p. 9) ;
Innovation are new combinations: they combine diverse (distant!) elements of knowledge and innovation thrives when people with different background meet and interact.

Innovation drives and shapes the division of labour. The evolution of the division of labour contributes to diversity and opens up new interfaces for interaction. **But Smith forgot to tell that the formation of ’tribes’ establish communication problems.**

Short social distance and low cultural barriers facilitate interactive learning and promote innovation.
Innovation as Interactive Process within the firm

- Innovation needs to draw upon new knowledge (from R&D department)
- Innovation needs to match the needs of production (involves the production department).
- Innovation should match the needs of users and customers (involves the marketing department)
- Horizontal interaction across the borders of departments is crucial for the success of innovation.
- This is why learning organisations are not only more adaptive but also more innovative!
The core and the wider setting of NSI

- The CORE is about firms and their interaction with each other and with knowledge institutions, consumers and finance.
- Opening the black boxes at the core shows that human interaction is fundamental.
- Therefore: WIDER SETTING shapes people and their mutual relationships – education system, labour market and welfare regimes.
• Thanks for your attention