

A Macro Dynamic Evaluation Model for the Formation of National Science & Technology Policy

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Outline of Talk

- Brief review of a new systems evaluation framework
- An argument for dynamic evaluations
- The model and indicators
- Example from an E.U. study
- Summary and future directions

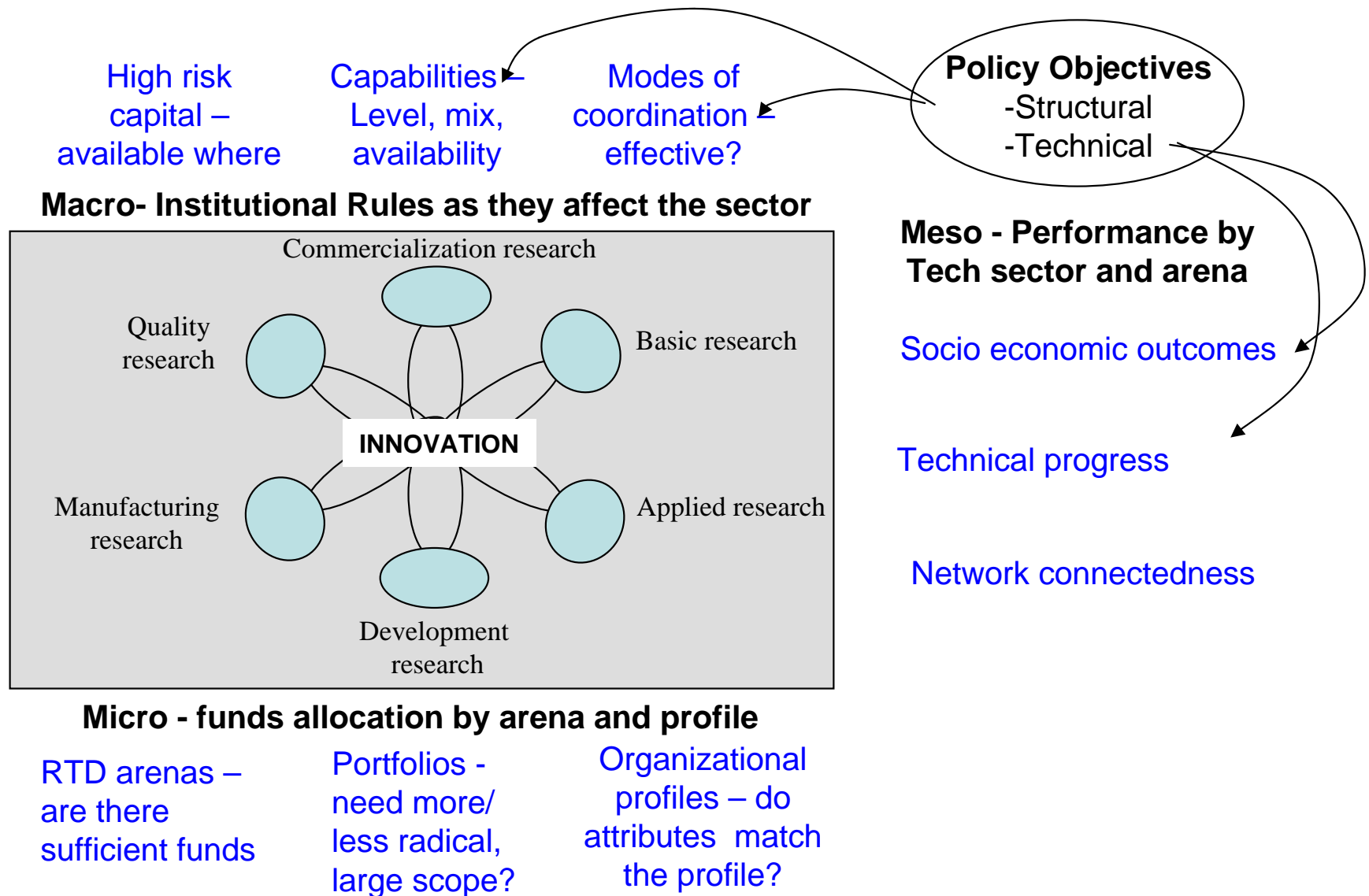
Strengths of a New Systems Evaluation Framework

- Grounded by several theories (e.g. idea innovation network, new product development, institutional change)
- Captures the complexity of innovation processes
- Able to identify bottlenecks and provide quick feedback for policy reformulations

Jordan, Hage and Mote, 2006

“A Theory-based Framework for Evaluating Diverse Portfolios of Scientific Work”, paper presented New Frontiers in Evaluation Conference in Vienna, Austria

Key Indicators in this Systems Evaluation Framework



A special case - radical S&T advance - requires indicators of institutional change

- *A central insight is that as S&T expenditures increase in real terms, there is growing complexity in the innovation processes and the need for increased integration.*
- If the processes of growing complexity and integration do not occur fast enough, government interventions may be necessary.
- A dynamic evaluation
 - investigates change in evolutionary processes of innovation produced by S&T radical advance, and
 - whether that change is occurring fast enough to remain competitive or solve world crises.

Why Dynamic Evaluations are Important for Policy Makers - 1

Informing government interventions is increasingly important:

In economic sectors:

Rising levels of RTD expenditures are making:

- Radical technical advances important
- Speed of product development critical

In non-economic sectors:

Global crises are making:

- Radical technical advances important
- Speed of service development critical

Why Dynamic Evaluations are Important for Policy Makers - 2

Informing government interventions is increasingly important:

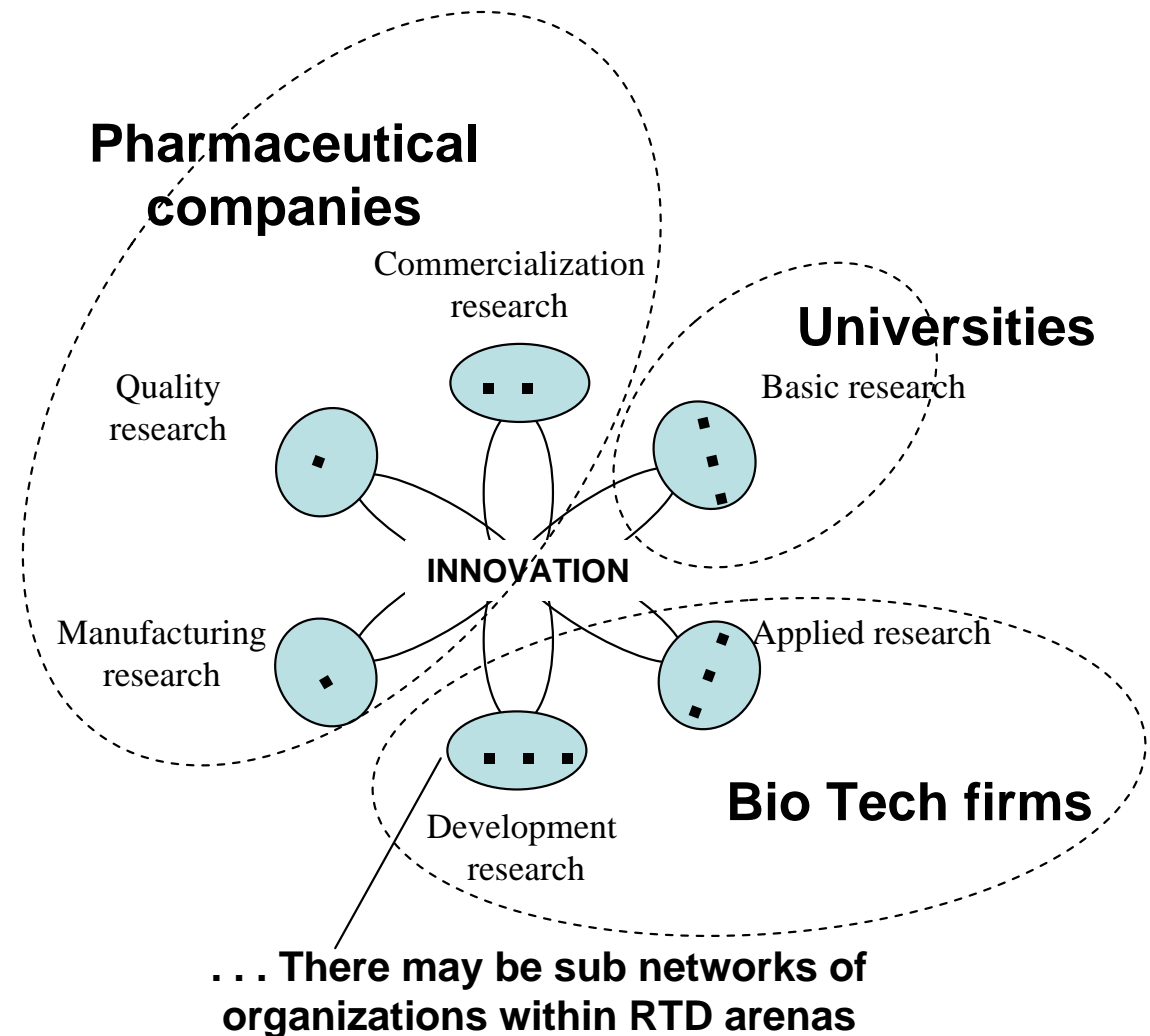
In both economic and non-economic sectors:

Increased importance of radicalness of technical advance and speed of development:

- Triggers evolutionary processes (Hage and Hollingsworth, 2000)
- Makes more apparent organizational, network and institutional failures (Arnold, 2004)

Evolutionary Processes in Innovation

- Increasing differentiation of the idea innovation network arenas
- New and more organizations formed
- Increasing linkages within and between arenas
- Increasing strength of linkages within and between arenas



An example -Bio-Tech/Pharmaceutical Sector

Indicators To Check

Evolutionary Predictions of Our Model

Evaluation indicators of growing complexity:

- products and services have multiple performance attributes
- arenas are differentiated
- emergence of new small research organizations in some arenas
- Networks becoming internationalized

Evaluation indicators of growing integration:

- growing relationships between sectors
- growing connections between arenas within a sector
- growing connections within arenas
- increasing strength of connectedness

A Test of the Evolutionary Predictions

The E.U. study (van Waarden et al., 2001) of:

- Four countries: Austria, Finland, Germany, and the Netherlands.
- Two sectors: Telecommunications and Pharmaceuticals
- Technological breakthroughs in digital transmission, network architecture, and optic fibers in telecommunications
- Paradigmatic breakthroughs in molecular biology and genetics plus new tools called bio-tech in bio-tech/pharmaceuticals

Both sectors illustrate how discontinuous change in one or two arenas of the technological sector made competencies obsolete or required new ones.

Evolutionary Changes in Telecommunications

- The government monopolies were broken and new service providers entered.
- Concentration occurred but it was international rather than national
- Small companies emerged to handle various activities in some of the arenas of the idea innovation network
- Functional differentiation of research occurred
- Sub-networks developed in research, marketing, physical infra-structure of the networks, manufacturing of end-line equipment, and management of call centers.

Evolutionary Changes in Pharmaceuticals

- Much the same story emerged in pharmaceuticals as occurred in telecommunications
- But the pattern is less sharp because it involves three industries: agriculture, drugs and environmental protection
- Concentration remains because of the very large costs of development and marketing of pharmaceuticals
- Networks of research have merged in basic, applied and product development
- Functional differentiation has occurred but it is more upstream (basic and applied research) in pharmaceuticals and down stream in telecommunications (commercialization research)

Identification of Institutional Blockages

The Case of Germany

- Risk adverse culture and therefore a government intervention to create small high tech companies
- Lack of private high risk capital and therefore government funding needed
- Civil servants in universities prevented from forming or working for small high tech companies and therefore companies recruit from elsewhere

But while German interventions have created a cluster of small bio-tech companies in Munich, they haven't changed the risk culture: companies are pursuing low risk innovations and most of the companies are directed by Germans trained in the U.S.

Summary: How To Do Evaluations in Dynamically Growing Sectors

When there is concern about competitiveness or solving crises given institutional changes resulting from a major scientific breakthrough or radical technological advance, launch a dynamic evaluation, which

- Checks on the evolutionary processes of innovation (indicators of growing complexity and growing integration)
- Identifies obstacles because of path dependency in those areas
- If necessary also identifies obstacles by using our new systems evaluation framework

On the basis of the evaluation make recommendations for facilitating the predicted evolutionary processes so they occur more rapidly.

Future Directions in Dynamic Evaluations

- Evaluate government interventions intended to increase complexity, integration and eliminate obstacles in order to develop a theory of what works.
- Do comparative dynamic evaluations to gain some sense of appropriate time lags.
- Contribute to the debate about path dependency vs. institutional change.

Comments and Questions

Please contact us if you have questions, suggestions, or opportunities to collaborate.

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Thank you!