Knowledge, Technology and Innovations for a Bio-based Economy:

Lessons from the Past, Challenges for the Future

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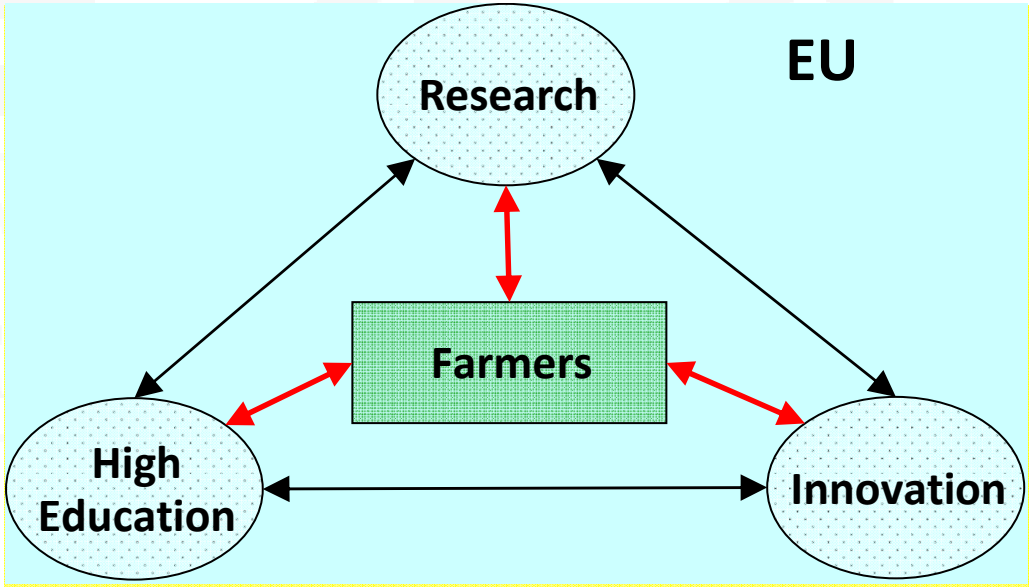
Basic Definition

BIOECONOMY

Object: The ~~Agricultural~~ Knowledge and Innovation System (AKIS)

"The System"

THE KNOWLEDGE TRIANGLE:



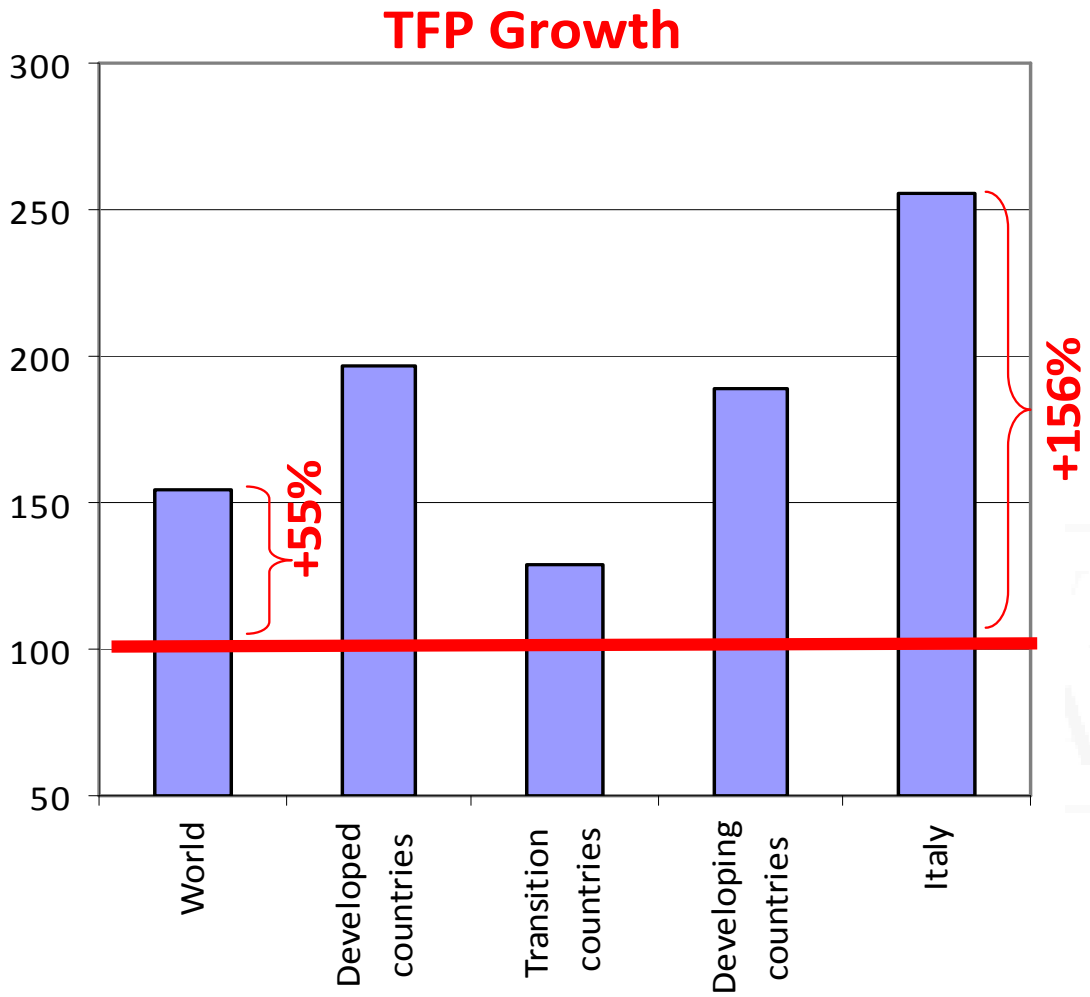
Outline

1. A story of institutional success
2. The emergence of (institutional) failures
3. New challenges, technolog. paradigm/trajectories
4. A new model for the system

BIOECONOMY

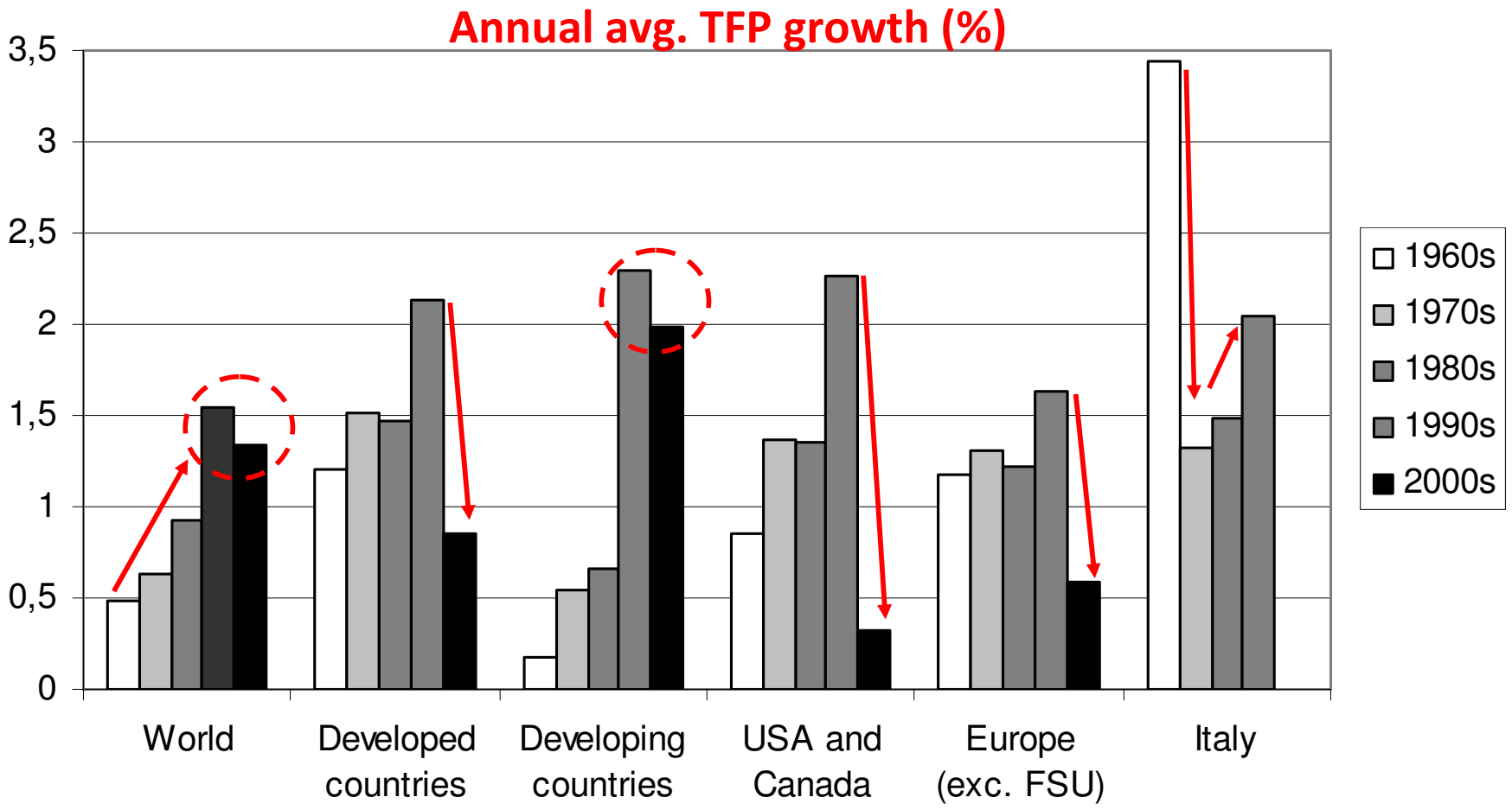
1. It was a success: "slow magic"

Huge agricultural productivity growth. 1960-2005:



- Capital intensification matters (26% of output growth worldwide)
- Technology matters more (44% of output growth worldwide) & more homogeneous
- Mendel vs. Malthus: Mendel won

1. Is there a productivity slowdown?



- **Slowdown only in the last decade in developed world**
- **Generalized (is Italy a little different?)**
- **Is the slowdown real and permanent? How can we explain it?**

1. The role of agricultural R&D

Estimated annual MIRR (%) to agricultural R&D and extension

	R&D only	*Extension only*	*R&D +Extension*
Alston et al. (2001) – various countries	99	85	48
Evenson (2000) - various countries	49	41	45
Alston et al. (2011) – 48 USA states, various methodologies			10-23
Italy (various studies)	~25	~15	~40

- **R&D growth accompanied (caused?) productivity growth**
- **High social returns to ag. R&D invest.; e.g. about 40€ from 1€**
- **Generalized slowdown but more in developed countries**

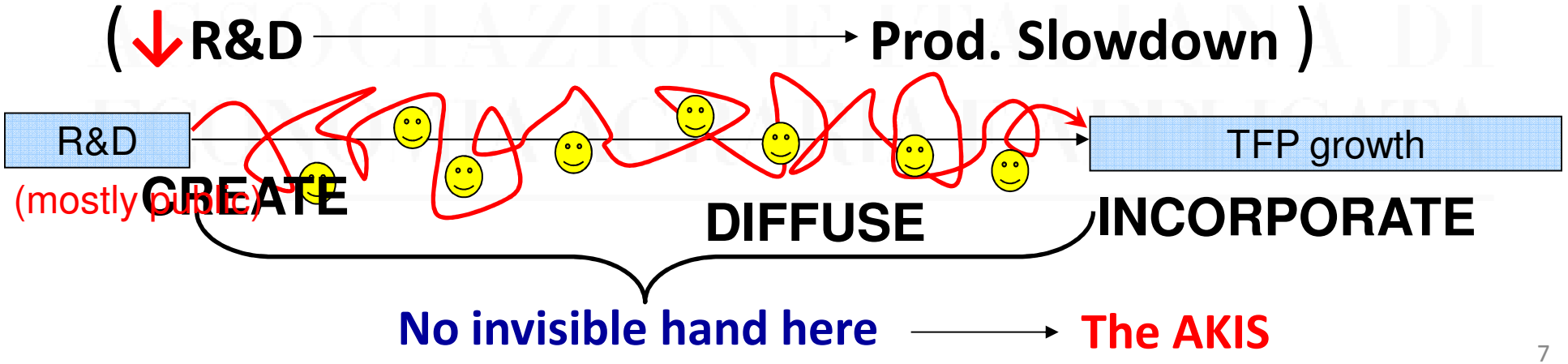
1. A certain idea of "the system"

THERE IS A DIRECT CAUSE-EFFECT RELATIONSHIP:
productivity growth rate increases (or slowdown) depending on the ag. R&D effort (+extension+education)

The "system" is Science-based and driven by the Supply-side:

a SS AKIS

Why an institutional success?



2. Did this *visible* hand ever failed?

Most literature concentrated on the public/private nature of knowledge/innovation:

- Public nature: favours diffusion but may discourage creation
- Private nature: favours incorporation but may prevent diffusion

Failures (↓creation, incorp., diffusion) arise when too public or too private

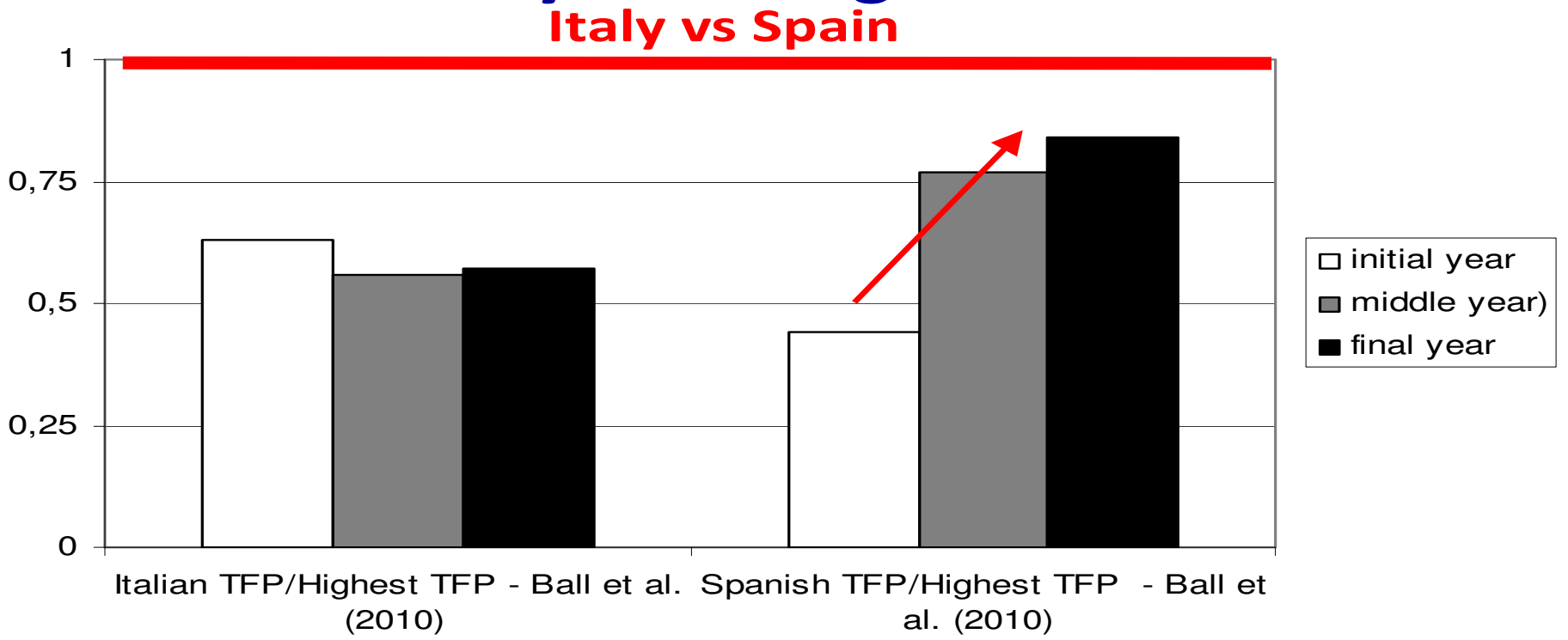
The spillover/convergence debate: public vs. non-public parts

- If the former prevails: high spillovers, productivity convergence (a common knowledge/innovation stock)
- If the latter prevails: low spillovers, no productivity convergence (a country-area-commodity specific knowledge/innovation stock)

Evidence is puzzling:

- High spillovers (40-45% TFP growth) but convergence in questionable

2. Productivity convergence?



- If any, convergence is conditional: permanent Δ in TFP levels
- Nothing changes? Maybe, but convergence is "individual"
- There are technological leaders and followers
- There are knowledge/innovation producers and free-riders

2. Why does the system fail?

Two interpretations:

1st interpretation: **the underinvestment hypothesis**

- Agricultural R&D: typical under-provision of a public good
- The problem is its public nature: *tragedy of the commons*
- Solutions
  - Strengthen the global/international agricultural R&D
  - Reinforce property regimes

→The underlying SS perspective remains undisputed

2nd interpretation: **the SS is perspective misleading**

- Look inside the "black box": R&D (science) is not so crucial in many agricultural innovations
  - Contribution of R&D is overestimated

→The problems is too much emphasis (resources) on R&D, too little on other critical processes for innovation

2. Italian (EU) cases

Can the conventional SS perspective explain this?

1. GM crops:

- Many public and private R&D investments (+education+extension)
- Strong patent protection
- No results (no adopted innovations, impact on productivity figures)

2. Last 20 years: what are the major innovations in Italian agriculture?

Agrotourism, organic agriculture, direct selling, agroenergy…

- Few R&D investments (if any); mostly informal knowledge
- Limited property rights issues
- Relevant policies and institutions other than those of ag. R&D
- Strong results: real diffused innovations, performance improvement

CONSIDER THE EU FP INVESTMENTS:

- Biotech= 19% on FP6-Food (127 mill. €); Organic=5%
- FP7 (approx.): Biotech/Organic=6/1

But are these technological innovations?

This is exactly the point: what do we mean with "agricultural innovation" today?

3. New challenges, new agendas

AGRICULTURAL INNOVATION FOR WHAT?

New challenges → New agendas for "the system"

- *New-scarcity agenda* : food security (feed the world)
  - ✓ Old challenge but new landscape
  - ✓ Malthus vs. Mendel, the revenge
  - ✓ Prevalent in developing countries
- *Post-scarcity agenda*: food safety&quality, sustainability, multifunctionality
  - ✓ More needs and a wider idea of agricultural innovation
  - ✓ "Much more than Malthus" vs. "Much more than Mendel"
  - ✓ Prevalent in developed countries

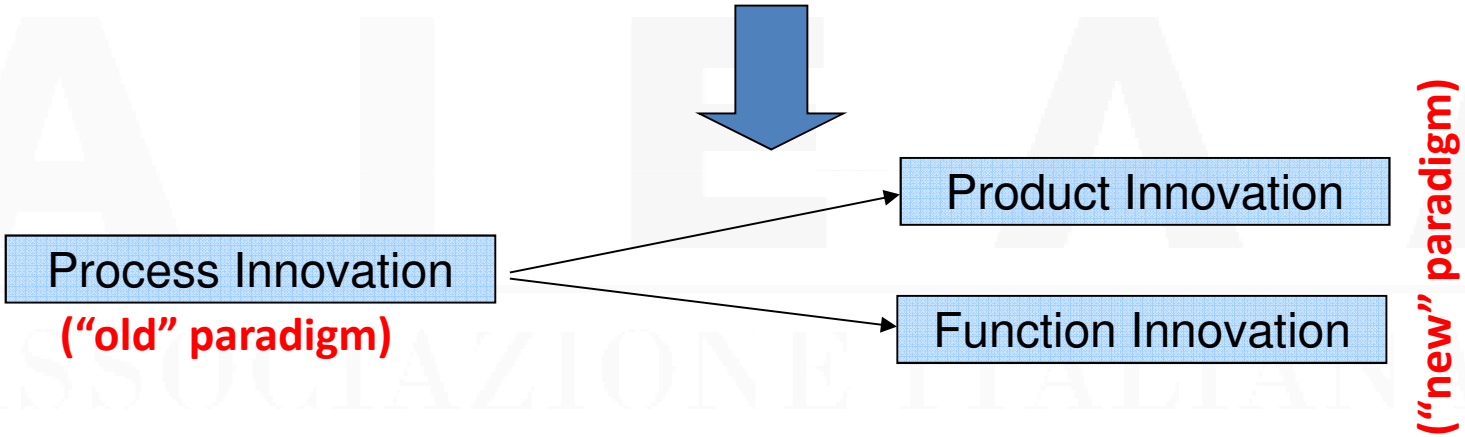
3. Diverging agendas?

- *EU SCAR 1st Foresight Exercise: 4 scenarios*
  - ✓ *Climate shock*
  - ✓ *Energy crisis*
  - ✓ ***Food crisis***
  - ✓ *Cooperation with nature*
- *FP7 KBBE 3 main topics*
  - ✓ *sustainable production and management of biological resources from land, forest and aquatic environments*
  - ✓ *fork to farm: food (including seafood), health and well-being*
  - ✓ *life sciences, biotechnology and biochemistry for sustainable non-food products and processes*
- *USA SAES expenditure on productivity enhancing projects*
  - ✓ *In 1985: 69%*
  - ✓ *In 2007: 56%*

4. New paradigm, new tech. trajectories

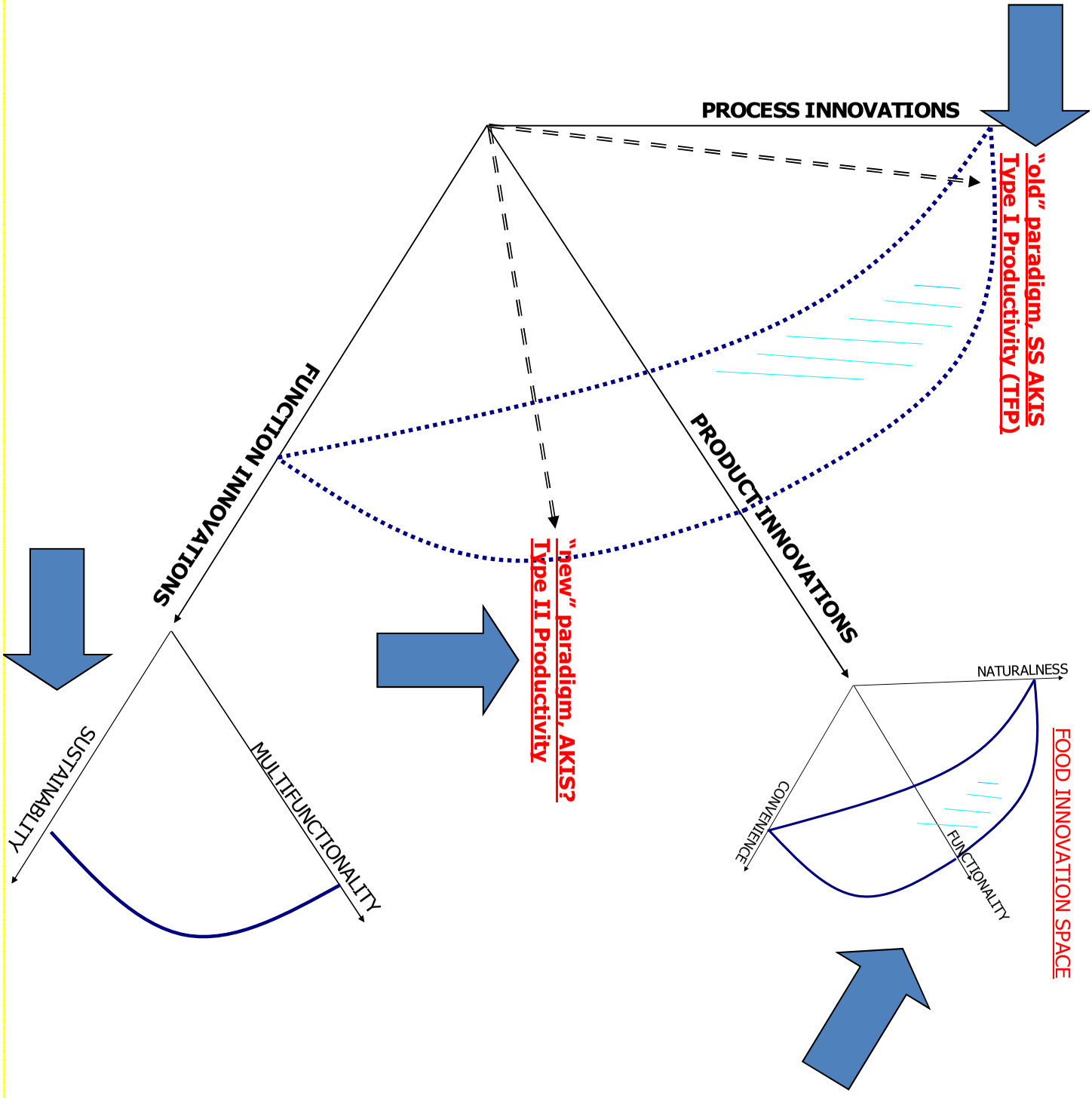
1. What kind of innovation for this agenda?

- The advent of new GPT
  - ❑ Different from the past ones: **KET**s (Key Enabling Technologies)
- The advent of a "new" consumer
  - ❑ The hyper-modern consumer (or the **hyper-consumer**)



From an one-dimensional to a multidimensional idea of agricultural innovation: many different (and diverging) trajectories may be generated and co-exist

4. The Agricultural Innovation Hyperspace



4. Here comes the bioeconomy

Implications of this new paradigm:

- Agriculture (sectors) becomes more knowledge intensive
- Agricultural (sectoral) boundaries expand and fade

The new paradigm implies convergence of more knowledge-intensive sectors

BIOECONOMY is the new paradigm

"It includes agriculture, forestry, fisheries…. Its sectors have a strong innovation potential due to their use of a wide range of … enabling industrial technologies (biotechnology, nanotechnology, information and communication technologies (ICT), and engineering), as well as local and tacit knowledge" (EU Commission, 2012)

Therefore: from the AKIS to the KISB

4. Towards a new model

2. What kind of KISB for this innovation?

- **3 basic features of this new idea of innovation:**
  - ➢ *no ready-to-use solutions; users continuously adapt/upgrade*
    - ✓ ***permanent beta***
  - ➢ *complex combination of different components (tech., organiz.., social, envir.)*
    - ✓ ***system innovation***
  - ➢ *many stakeholders involved, innovation is a network outcome*
    - ✓ ***agricultural network innovation***
  - ❖ *Many similar concepts:*
    - ✓ *social innovation*
    - ✓ *multi-actor (or participative) innovation*
    - ✓ *collective intelligence…*

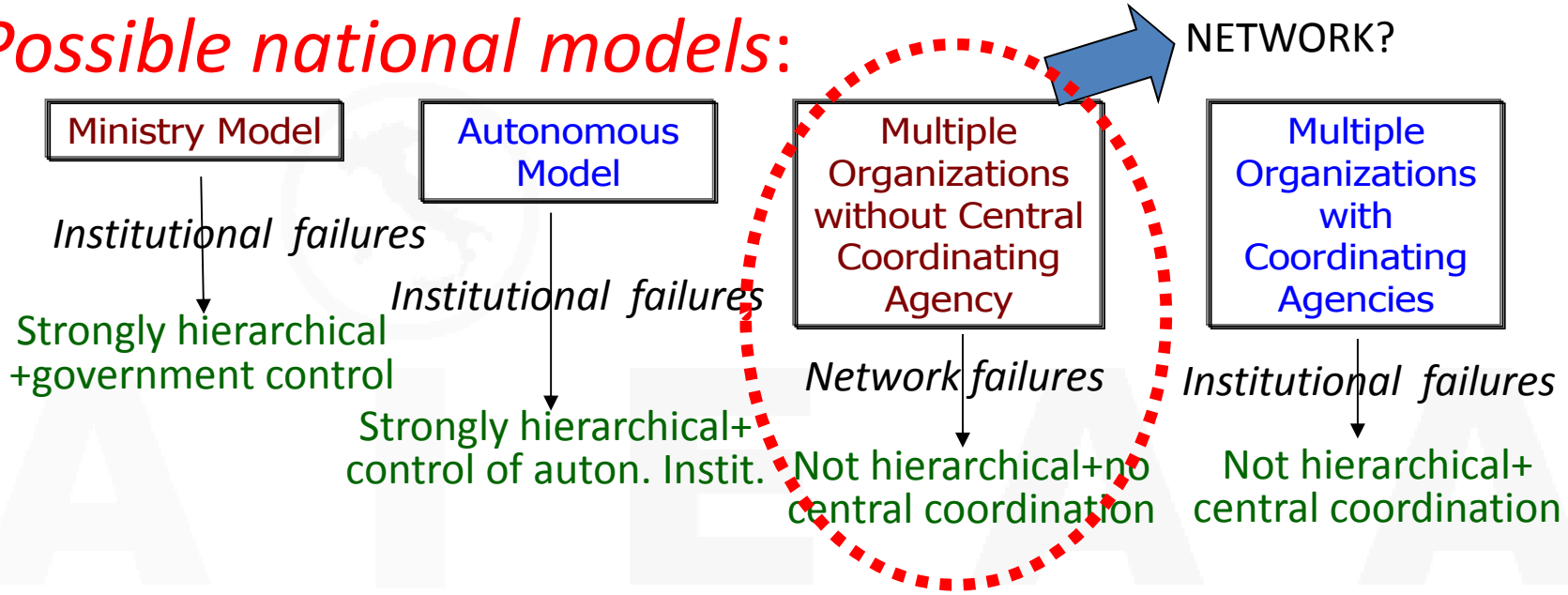
What about the "system"?

- ➢ A strong SS design is outdated (and ineffective)
- ➢ Must involve the demand-side and all the relevant stakeholders
- ➢ NETification: must favour a network structure

→ **From the SS to the Permanent-Beta Network model**

4. Is there an Italian model?

Possible national models:



The network model is suited for the Italian case:

- Weak hierarchies and formal coordination, many actors, much dispersion
- Two possible outcomes:
  - It is a well-functioning network
  - It is a very fragmented system (network failures)
- Institutional or network failures?
  - **FAILURES: GM crops, nanofood(?)**
  - **Cases of SUCCESS: organic ag., agrotourism, agroenergy…**

Some final considerations on policies (1)

An EU perspective: building a EU-wide KISB

Main issues:

- Strong cross-country(region) heterogeneity: no one-fits-all model
- Top-down coordination: EU policies vs. national/local policies
- Cross-policy coordination. 2 EU policies involved:
  - EU Research policy: ideally, the supply-side of the system
  - the CAP (II Pillar): ideally, the demand-side of the system

Currently – Common horizon: Lisbon's Agenda; no common framework/instrument

- **EU research policy (FP7)**
  - already within a bioeconomy perspective: KBBE
  - FP7-KBBE (2007-13): about 2 billion €, 4% of FP7 budget
- **CAP Pillar II**
  - Strictly sectoral (limited extension to "bioeconomy")
  - 4 Axis I measures (+extra) related to AKIS: in Italy 6% of the budget; in the EU would be a little more than 1 billion €/year

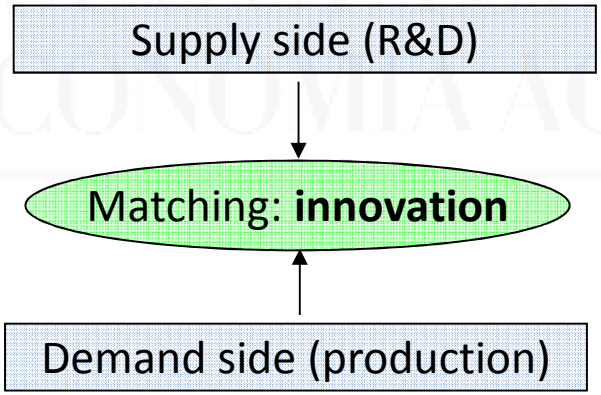
Some final considerations on policies (2)

The future: Europe2020 and a new integrating framework: Innovation Union, the Agricultural EIP

- **EU research policy (Horizon2020)**
  - ↑resources to KBBE: 4,5 billion €; 5% of Horizon2020 budget
    - *From the CAP budget (1%)*
- **CAP Pillar II**
  - Strictly sectoral (limited extension to "bioeconomy")
  - Knowledge transfer is 1 of the 6 key priorities
  - New/reinforced 2 major measures related to the AKIS

The combination of the two through the new framework (EIP) to facilitate the matching of supply and demand sides of the system:

In principle:



In practice (EU policy):