

Global Systems Science

- A perspective from the scientific community –

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Future and Emerging Technologies (FET)

DG-CNECT, FET Information Day

Brussels, 20 January 2014



What is Global Systems Science?

- GSS: not only a FET call, also an emerging **scientific community**
 - several conferences/meeting since 2010, about 150 contributors
- Roots of GSS:
 - Discussions by **Ralph Dum** and **Ulf Dahlsten** and FP7 coordination action **GSDP**
 - Inspirations from: Lawrence Hall of Science of UCLA, Berkeley; World System Theory by Wallerstein and others; Complexity Theory by Gell-Mann and others; Theory of the Internet by Papadimitriou and others
- Societal and scientific **demand**:
 - can **complex systems** science and **interdisciplinary** science concretely **help policy makers and society** to address **global issues** ?
 - E.g. climate change, systemic risk, energy, sustainability, cities, etc.
 - There are some success stories, but fundamental **gaps** remain
- **Vision**: today's progress in network science, computer science, big data, ICT makes it possible to try and fill such gaps.

Global challenges

- **financial systems:** risk, real economy, inequality
- **cities:** infrastructures inter-dependencies
- **health:** pandemics vs mobility
- **climate:** human impact
- **Energy:** resource limits, rights, pollution, geopolitics
- ...
- **Interdependencies:** e.g. financial, climate, energy, cities systems

Methods/Themes

- network science, economics, computer science
- algorithmic game theory
- big data, visualization techniques
- **Empower citizens**
 - Participation to policy making
 - Collective data gathering
- **Engage citizens:** gamification, art, narratives
- **Policy makers:** dialogue, decision making support tools
- **Conflicting evidence**
- **Unintended consequences**

Global Systems Science

Scientific Community

FET PROJECTS

GSDP, EUNOIA
INSITE, NESS
FOC,
MULTIPLEX

ICT-Policy
Modelling
SIMPOL,
SINPHONY
GROWTHCOM

GSS 2014
Call Projects

Broader Public

Civic
Society

Policy
Makers

Objectives of Global Systems Science

1. Better understanding of **global systems** and global issues in **holistic**

Examples:

- (International) **financial** system: systemic risk, real economy, inequality
- **Urban** development: smart cities, sustainability
- **Infrastructures**: multi-level interdependencies among services
- Global **health**: individual vs population, pandemics vs mobility
- Earth **climate**: human driven climate changes
- **Energy** resources: limits to growth, rights to use, pollution
- **Interdependencies**: e.g. among financial, climate, energy, city systems

2. Develop evidence, concepts and **doubts**

3. Develop a general approach/**theory across domains**

- E.g. Common good games, on networks, with social influence and presence of positive feedbacks → leading to instabilities, tragedy of commons etc.

4. Bridge science with **policy makers** and **civic society**

- Reach and help dealing with possible consequences of their actions
- Handle **conflicting** data/evidence

Key GSS Activities so far

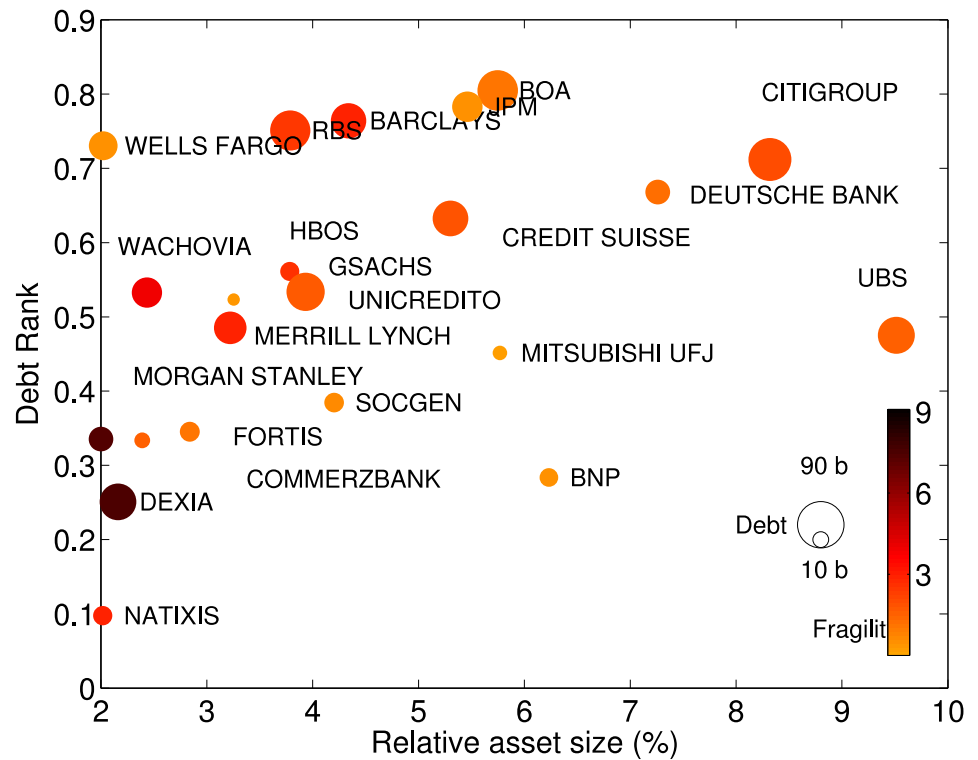
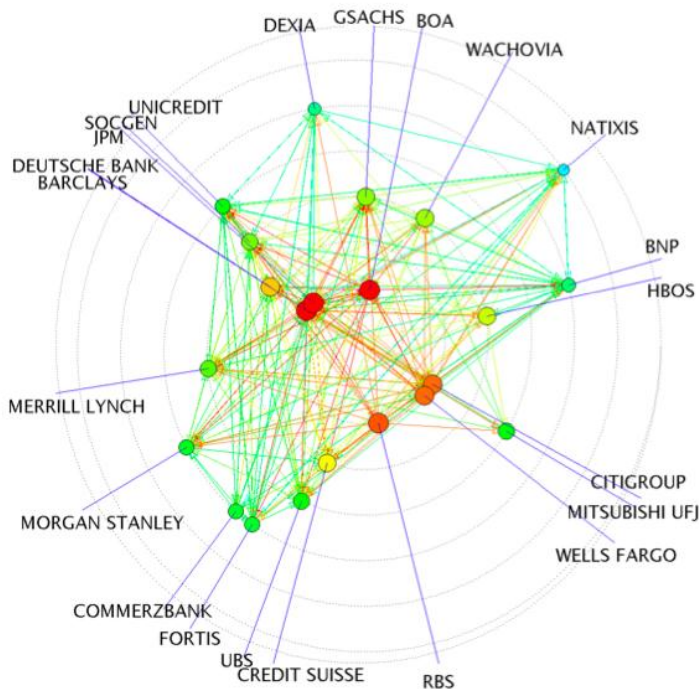
- Coordination action **GSDP** (FET-OPEN) :
 - 2010-2013 workshops and dialogue with other FET and FP7 projects
 - e.g. INSITE, NESS, FOC, CRISIS
- 1st and 2nd **Open Global Systems Science Conferences**:
 - organized by the Global Climate Forum (**GCF**) on behalf of:
 - **GSDP, EUNOIA, FOC, INSITE, MULTIPLEX, NESS**
 - **Brussels**, November 2012 and June 2013
 - Researchers meet **policy makers**, e.g. panel on financial markets
- **Online consultation** (spring 2013) contributing to shape:
 - the present GSS call, <http://ec.europa.eu/digital-agenda/futurium>
- Prep. meeting for 3rd Open Global Systems Science Conference organized by GCF and Beijing Normal University, **Beijing**, October 2013
 - Creation of Global Systems Science **Society**

Key GSS Activities so far

- Reflection on relation between ICT and global systems (2010-2013)
- White papers, key GSS documents
 - Bishop, S. et al. (2013) Best Practice Guidelines for a Science of Global Systems, downloadable at www.gsdp.eu.
 - Jaeger, C. et al. (2013) Towards a Research Program for GSS (see www.global-systems-science.eu, forthcom. Ecol. and Soc.).
 - Tabara, D. et al. (2013) GSS – Orientation Paper, downloadable at blog.global-systems-science.eu/?author=79.
- On-going research activities by scholars, scientific publications inspired by/relevant to GSS, e.g.
 - Teaming-up of network scientists, economists, policy makers
 - DebtRank, Sci Rep 2 (2012)
 - Complex derivatives, Nature Physics 9, 123–125 (2013)

Example: Financial risk indicators for policy makers

– DebtRank --

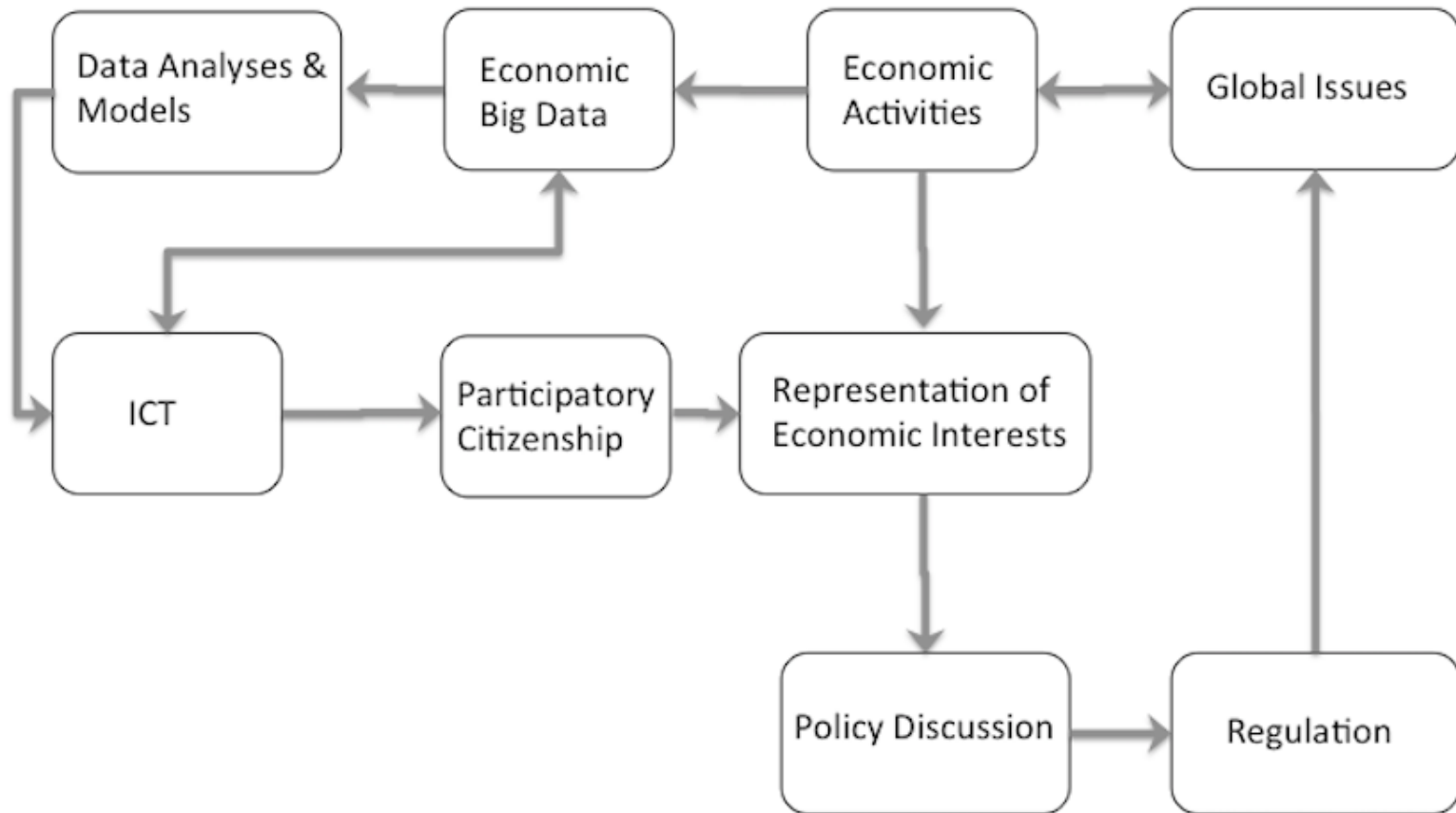


- Designed an indicator overcoming limitations in previous state of art
 - Measure systemic importance, accounting for network and no-default only
- Discussions with ECB, Bank of Italy, Deutsche Bundesbank, Bank of England
- Add on to the policy maker toolkit

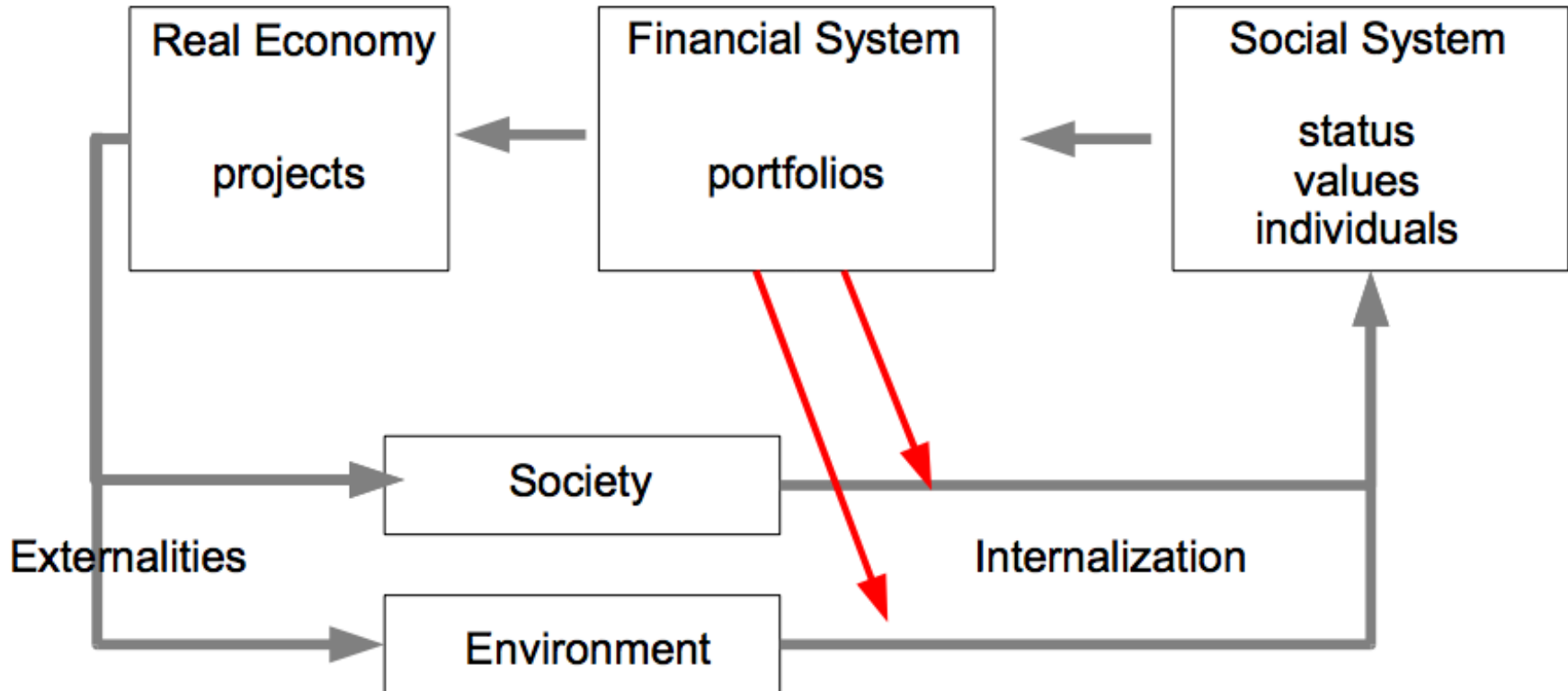
Towards general approach to global issues

- Environmental and financial risk (as other global issues) have in common:
 - nature of Common Good Game at global scale
 - increasing complexity of technologies and interdependencies
 - market concentration
 - unbalance in the representation of interests
 - massive conflicts of interest, moral hazard
 - excessive risk taking and socialization of downside
- Instruments to model this include
 - Economic theory and game theory, but should go beyond
 - Complex system approach: e.g. positive feedbacks, non-linearities, emerging phenomena, social influence
 - Empirical analyses of network of interests
- Challenges
 - Citizens engagement: too-big-for-me, narratives, art
 - Contributions aggregation
 - Policy makers dialogue: complex, conflicting evidence

Example: SIMPOL strategy



Example: Fundamental open problem



- Financial complexity decouples savings from unintended consequences of economic activities. Internalization of externalities fails
- Unbalanced positive feedbacks, moral hazard, concentration
- Threaten to sustainability