Policy Implications
of Economic Complexity and Complexity Economics

Towards a *Systemic*, *Process-Based*, *Long-Run*,
Frame-Setting, and *Interactive* (*Learning*, *Adaptive*)
Policy Conception for a Complex Economy

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Structure

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W. Elsner, T. Heinrich, H. Schwardt,
The Microeconomics of Complex Economies,
Amsterdam, Boston, London, New York,
San Diego: Elsevier/Academic Press, 2015,

Ch. 17: "Policy Implications: New Policy
Perspectives for Private Agents, Networks,
Network Consultants, and Public Policy
Agencies", pp. 499-527.
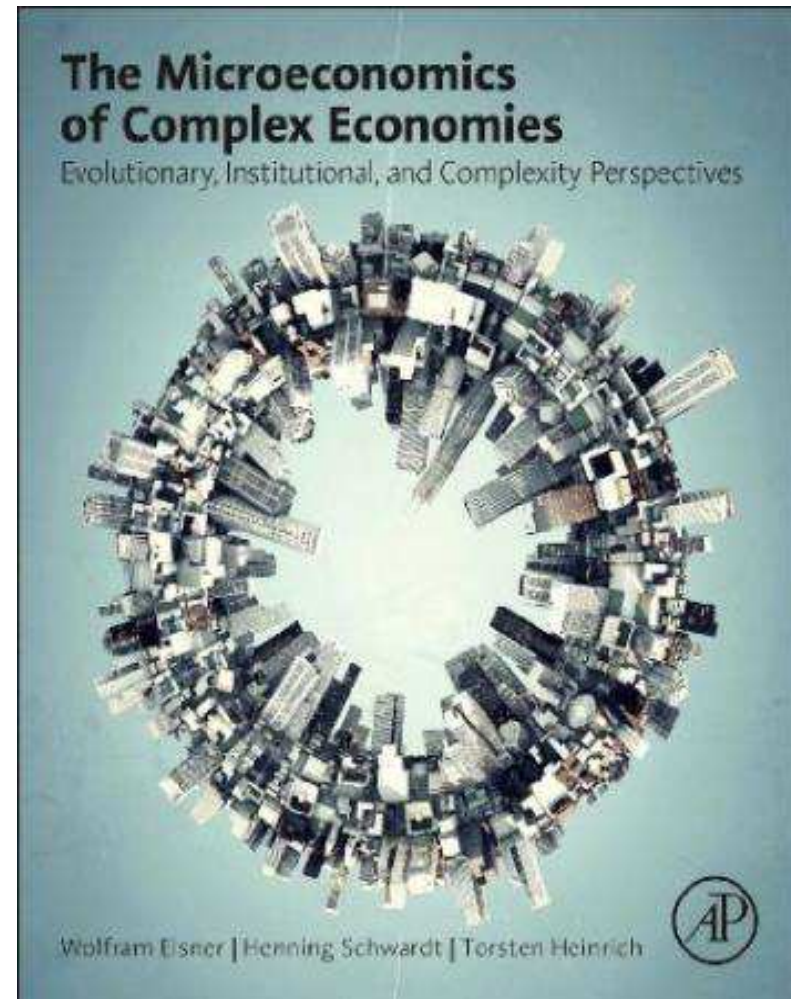
1. The message: Simplistic vs complex economics and policies

- **Economic mainstream policy**

  – Neoclassically based <u>mainstream</u> policy recommendations usually are <u>normative prescriptions</u>, mostly in favor of a <u>neoliberal "market" economy</u>, in a perspective of "<u>T-i-n-a</u>" to "<u>more market</u>".

  – They are simplistic, based on a <u>simplistic, deterministic model</u> with a <u>unique</u>, allegedly <u>"optimal" benchmark equilibrium</u>, thus in a <u>teleological</u> vein, <u>coercive</u>, <u>crypto-normative</u>, <u>methodologically naïve</u>.

  – Thus, it is based on an untenable methodology and epistemology.

  – It displays no appropriate understanding of <u>collectivity</u>, <u>commonality</u>, proactive <u>policy</u>, participation or <u>democracy</u>.

  – With the slightest <u>alteration of assumptions</u> of a GE model, however, the available next "<u>Second Best</u>" would require <u>more violations</u> of "optimality conditions" (Lipsey and Lancaster 1956). If the benchmark "optimum" dis-appears, there is <u>no piecemeal policy</u> definable to re-approach the "optimum".

  – Public Choice: <u>Arrow Paradox</u> used <u>against any collective rationality and policy</u>. But no process or endogenous preference change considered (Sen 1970).

1. The message: Simplistic vs complex economics and policies

- **Economic complexity/Complexity economics – A sketch**

  – **Structures**: Complexity economics is based on complex models of (an even more) complex economic reality, with <u>multiple and heterogeneous agents</u>, <u>directly interacting</u>, in different, more or less <u>intricate</u> structures of <u>decision problems</u> (different coordination, anti-coordination, non-coordination/zero-sum, and <u>social-dilemma</u> incentive structures, or: game types), with <u>(initial) strong strategic uncertainty</u>, on different <u>network topologies</u> (neighborhoods, different social/geographical distance; hierarchies, stars, circles, complete networks, meshes, "small-worlds", scale-free networks …).

1. The message: Simplistic vs complex economics and policies

- **Economic complexity/Complexity economics – A sketch**

  – **Processes:** Complexity economics deals with continuing <u>tensions</u> among agents and between <u>individualistic and collective solutions</u>, <u>unintended consequences</u> and <u>fallacies of aggregation</u>, <u>non-optimality</u> and <u>lock-in</u>; with <u>non-linear</u> and <u>recursive</u> relations; recurrence, open-ended, <u>path-dependent</u>, <u>cumulative</u> and often <u>idiosyncratic</u> (unpredictable) process (<u>non-ergodicity</u>); with learning and <u>adaptation</u>; with <u>multiple equilibria</u>, often instable and only transitory; differential <u>replication</u> in populations, and, thus, <u>evolutionary</u> process, with potential <u>structural (institutional) emergence</u> (dissipative structures), but also collapse; further with <u>problem-solving</u> (instrumental) vs. <u>ceremonial</u> dominance and encapsulation (institutional lock-in – Veblen, Ayres; see Bush 1987; Hayden 2006; also: David 1985); in dynamic populations usually the <u>survival of the first, the fattest, or of all</u> (i.e., non-"optimal"; Nowak 2006).

1.   The message: Simplistic vs complex economics and policies

- **Policies towards complex economies: Complex policies**

  - **Information theory/cybernetics**: Generally, the <u>complexity</u> (e.g., the number of possible states, degrees of freedom) of a political <u>control system</u> needs to be <u>at least as high</u> as the complexity of the system to be controlled ("<u>Ashby's Law</u>"; Ashby 1956) (in order to shift the controlled system into an aimed-at area of outcome values) – as "only variety can absorb variety": A complex control system to <u>reduce the complexity</u> and deal with <u>avoidance and evasions</u> (of the agents) of the controlled system (homeostasis/equifinality properties of complex systems). But this is impossible with a neoliberal minimalist (and run-down) state.

  - Thus, policies towards complex economic systems need to be themselves **complex, system- and process-oriented** (not just neoliberal "order"-policy), with a <u>long-run</u> <u>learning</u> and <u>adaptation</u> perspective (e.g., Pelikan 2003; Hayden 2006).

1. The message: Simplistic vs complex economics and policies

- **The Hayekian fallacy:**

  – **Not just *any interventionism*/No "road to serfdom"**: Systemic, complex, learning and adaptive steering <u>avoids cumulatively increasing, isolated single interventions</u> – Hayek's alleged "road to serfdom", "stagflation", and other specters, the alleged results of <u>"Keynesian" welfare-state</u> interventions (1960s/70s), in fact, an <u>over-complexity for the political/parliamentary/party system</u> and for a <u>non-qualified public administration</u> (for a recent Hayekian policy argument, s. Lewin 2014).

  – **Self-organization capacities of complex systems do not redudantize policy**: The capability of complex economic systems of some self-organization (structural emergence, dissipation) – based on <u>openness</u> and an increasing <u>metabolism</u> with, and <u>exploitation</u> of, the <u>social and natural systems</u> (Georgescu-Roegen 1966; Kapp 1950) –, indeed requires such systemic policy intervention because of emergence's often <u>long duration</u>, <u>fragility</u>, and <u>non-optimality</u>, given under real-world intricate conditions for individualistic decision -making.

1. The message: Simplistic vs complex economics and policies

- **"Meritorics" and "Interactive/Institutional Policy"**

  - **Meritorization/Modern Meritorics**: A <u>social evaluation</u> process of such multifariously <u>deficient spontaneous process</u> outcomes of a decentralized system ("market failure"), combines with a "<u>pragmatist</u>" <u>policy conception</u> ("instrumental value principle"—Tool 1994; negoti-ated economy: Commons 1934; Ramstad 1991; Nielsen 1992; Hayden 2006).

  - **Interactive/Institutional Policy**: A <u>new kind of private-public</u> <u>interrelation</u> then is to be established: Interactive or Institutional Policy relates to the <u>interaction system of the private agents</u>, sets its <u>frame for</u> <u>easier, faster and more stable coordination/cooperation</u>, but leaves it <u>free to adapt to the conditions politically set</u> (Elsner 2001; Section 4 below).

  - **Intervention areas**: Political target areas then include the (1) <u>incentive</u> <u>structures</u>, (2) <u>network sizes and structures</u> (topologies), (3) <u>awareness</u> <u>of interdependence</u>, and (4) <u>futurity</u>. Policy then may (i) <u>initiate</u>, (ii) <u>accelerate</u>, and/or (iii) <u>stabilize</u> coordination and cooperation among the private agents for their different "commons", and, thus, for economic improvement.

2. "Complexity Hints for Economic Policy": Colander, Velupillai, Gallegati, Kirman et al. (2007)

- Policy recommendations of complexity economics are <u>less certain</u> and <u>less apodictic</u>, more "<u>inductive</u>", prepared for <u>evasive reactions</u>, and acting on the <u>temporal dimension</u>; <u>degrees of freedom</u> and some <u>undecidability</u> require a basic "<u>change in the</u> (mechanistic, deterministic – W.E.) <u>worldview</u> that is currently dominant in policy circles" (Velupillai 2007).

- Although complexity economics is <u>more calculating</u>, policy measures cannot be determined on the basis of calculating the system (Velupillai); "<u>nonalgorithmic</u>" measures need to <u>move the system into a basin of attraction</u> (aimed-at outcome values) (see also on the theory of the <u>Second Best</u> above).

- System <u>stabilization</u> includes <u>complexity reduction</u> through <u>institutions building</u> (not so much complete "design", but guided process), collective self-commitment/<u>self-binding</u> towards earlier decisions; further, <u>control</u> of "idiosyncratic volatility" through <u>reduction of firm size, centrality, and concentration</u> (power-law distrib.; Gallegati, Kirman, Palestrini 2007).

3. Social evaluation: Modern *Meritorics*, and the *negotiated economy*

- Self-organization, under realistic complexity, may easily be <u>uncertain to realize/blocked at all</u>, highly <u>time-consuming</u>, and <u>fragile/prone to backslides</u>.

- The <u>outcomes of a spontaneous, decentralized process</u>, thus , need to be <u>evaluated</u>, according to some "higher" <u>collective rationality</u>, with the <u>criteria</u>: degree of <u>uncertainty</u> of emergence, <u>time requirement</u> for emergence, and **degree of <u>fragility</u>** of emergence.

- The original (neoclassical) <u>**collective good**</u>, infeasible through private production, then assumes the character of a <u>**"private" good**</u> in the sense of its potential emergence in a complex decentralized system, and then becomes a <u>**merit good**</u> (Musgrave 1959, 1987; Ver Eecke 1998, 2008), now socially evaluated not mainly after price and quantity, but uncertainty, time consumption, and fragility (Elsner 2001).

- Public policy then is to be targeted to <u>unlock/de-block</u>, <u>accelerate</u>, and <u>stabilize</u> cooperation and , thus, the emergence (production process) of the common good.

4.   A simple example of an *Interactive/Institutional Policy* approach: Frame-setting for institutional emergence in PD-supergames (Axelrod) Or: "Single-Shot Solution" – A Designer's Perspective

- The <u>PD</u>:

$$a, a \qquad d, b$$
$$b, d \qquad c, c$$

with $b > a > c > d$,   and $a > (d + b)/2$.

- The <u>EGT/ESS approach for a PD-SG</u> $P_{ALL\ C/ALL\ C} = P_{TFT/TFT} = a + \delta a + \delta^2 a + \ldots$
  (Axelrod 1984/2006):

$$= \frac{a}{1 - \delta}$$

$$P_{ALL\ D/TFT} = b + \delta c + \delta^2 c + \ldots$$

$$= \frac{c}{1 - \delta} + b - c.$$

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4. A simple example of an Interactive Policy approach:
Frame-setting for institutional emergence in PD-supergames (Axelrod)
Or: "Single-Shot Solution" – A Designer's Perspective

- The invasion/evolutionary-stability perspective <u>with the Single-Shot Solution</u>: Can a population of TFT-co-operators be invaded by defectors and thus be an evolutionarily stable strategy? (*C* in a SG → *TFT*, not *ALL-C.*) One of the ESS conditions:

$$P_{TFT/TFT} > ! \ P_{ALL \ D/TFT}$$

$$a/(1-\delta) \ > ! \ c/(1-\delta)+b-c$$

$$\rightarrow \ \delta > ! \ (b-a)/(b-c) \ ,$$

the deterministic and static logical condition in terms of δ and the payoffs, for the *institution of* (conditional) cooperation (e.g., *TFT*) to emerge in the population (i.e., to be superior).

- <u>Cooperation</u> feasible only as an **institution**, a social rule plus **endogenous sanction**, non-hyper-rational, but **habituated** and "semi-conscious", rule-following, based on a <u>trigger strategy</u> …

4.   A simple example of an Interactive Policy approach: Frame-setting for institutional emergence in PD-supergames (Axelrod) Or: "Single-Shot Solution" – A Designer's Perspective

- A **general management and policy** perspective of the solution of a social dilemma: Trigger the Pareto-superior behavior by a general political assurance that other agents will also do the "right" thing as well, e.g., through a contrât social or general-trust building ("assurance" game, A. Sen 1967).

- A more **specific designer's or policy perspective** ("institutional design"): Increase future expectations "to meet the same again" ($\delta\uparrow$) and/or weaken the fierceness of the dilemma ($b\downarrow$, $a\uparrow$), so that the single-shot condition (inequality) will hold with greater probability:

$$\rightarrow \ \delta\uparrow \ >! \ [(b\downarrow\text{-}a\uparrow)\downarrow / (b\downarrow\text{-}c\downarrow\downarrow)\uparrow]\downarrow \ .$$

- Interpretable and accessible to policy measures and strategies! (Axelrod; Elsner 2001).

- $\delta\uparrow$ – „enlarging the shadow of the future" (Axelrod).

4. A simple example of an Interactive Policy approach: Frame-setting for institutional emergence in PD-supergames (Axelrod) Or: "Single-Shot Solution" – A Designer's Perspective

- $\delta\uparrow$ >! $[(b\downarrow\text{-}a\uparrow)\downarrow / (b\downarrow\text{-}c\downarrow\downarrow)\uparrow]\downarrow$ needs to be qualified algebraically, transforming it in to an <u>equation</u>:

$$\delta_{min} = (b - a)/(b - c) = 1 - [(a - c)/(b - c)] = (b - a)^1(b - c)^{-1},$$

with marginal conditions:

$$\frac{\partial \delta_{min}}{\partial (b-a)} = 1/(b - c) > 0,$$

$$\frac{\partial \delta_{min}}{\partial (b-c)} = -(b - a)/(b - c)^2 < 0,$$

$$\frac{\partial \delta_{min}}{\partial b} = (a - c)/(b - c)^2 > 0,$$

$$\frac{\partial \delta_{min}}{\partial a} = 1/(c - b) < 0, \text{ and}$$

$$\frac{\partial \delta_{min}}{\partial c} = (b - a)/(b - c)^2 > 0.$$

4.   A simple example of an Interactive Policy Approach:
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Again: $\dfrac{\partial \delta_{min}}{\partial (b-a)} > 0$, $\dfrac{\partial \delta_{min}}{\partial (b-c)} < 0$, $\dfrac{\partial \delta_{min}}{\partial b} > 0$, $\dfrac{\partial \delta_{min}}{\partial a} < 0$, and $\dfrac{\partial \delta_{min}}{\partial c} > 0$.

- **Specific Policy implications**: (1) reduce the "opportunity costs of common cooperation", (*b-a*), so that the requirement, in terms of futurity (δ_{min}), for the dilemma to be solved through the superiority of cooperation decreases as well, thus, the probability that the dilemma will be solved by the agents (as cooperation will be the more paying) increases.
  The requirement δ (δ_{min}) for a solution then could even be reduced, c.p., and the problem solved anyway.

Similarly: (2) increase the "opportunity cost of common defection", (*b-c*), or: increase the frustration for defecting agents.

Similarly, and more obviously: (3) decrease *b*, (4) increase *a*, and (5) reduce *c*, rewarding cooperation

in order to support the agents in their learning to solve the social dilemma.

4.   A simple example of an Interactive Policy Approach: Frame-setting for institutional emergence in PD-supergames (Axelrod) Or: "Single-Shot Solution" – A Designer's Perspective

- **Further policy implications for the *deep structures of socio-economies*:**

  - Identify the collective good common to the agents involved/Identify the relevant interaction arena (e.g., common location factors of regional firms).

  - Identify the incentive structure at work/the type of game (PD, stag hunt, strong/intricate or soft structure).

  - Identify the public interest in the (merit) good, which the private may generate in their interaction process, in a proper participative process.

  - Identify the payoffs agents get for the solution, their own interest in the solution. Do not generate the collective good in lieu of the private (as in classical collective-good theory), call them in to contribute according to their own interest. Also, do not subsidize cooperative behavior so much as to dissolve the social dilemma (may be too expensive, also static and trivial).

4.   A simple example of an Interactive Policy Approach: Frame-setting for institutional emergence in PD-supergames (Axelrod) Or: "Single-Shot Solution" – A Designer's Perspective

- **Further policy implications for the *deep structures of socio-economies*:**

  - Do <u>not work mainly with pecuniary incentives</u> (subsidies) but with qualitative incentives (e.g. preferential <u>information</u>, jointly used <u>soft infrastructures as club goods</u>, …).

  - <u>Increase the future expectations</u> of agents: Care for higher expectations "<u>to meet</u> the same again (or a knowing agent) <u>next interaction</u>": Commit them in <u>overlapping projects</u> generating merit goods.

  - A <u>leaner policy approach</u>, less expensive. A <u>gradual approach</u>: gradually <u>improving the incentive structure</u> or <u>increasing the discount factor</u> increases the probability of the cooperative/coordinated solution. Clearer definition of the private and public interests and relative responsibilities (no fuzzy PPPs).

4.   A simple example of an Interactive Policy Approach:
Frame-setting for institutional emergence in PD-supergames (Axelrod)
Or: "Single-Shot Solution" – A Designer's Perspective

- **Further policy implications for the *deep structures of socio-economies*:**

    - Develop proper arena/platform sizes: local, regional, national, global merit goods: structural (industrial, regional) policies. Meso-economics: Meso-sizes favorable, higher interaction density/frequency.

    - Care for less turbulence: lower mobility, higher commitment, membership, social capital building, … (Glaeser et al. 2002) …

    - Appropriate network structures: small-world networks with high clustering but small average path lengths; vs power-law distributions.

    - Appropriate for different types of policy agents: (1) the agents involved themselves, establishing those instruments in a common discourse and commitment, (2) neutral "network" consultants, and (3) public policy agents or their intermediaries, making use of those mechanisms.

    - High requirements for public policy: a qualified, "strong", proactive, independent, non-corrupt state with reliably and sustainably clarified public goals, in a participative, bottom-up decision-making structure.

5.   Policy implications of (evolutionary) game theory: Target areas and instruments

- Improving incentive (payoff) structures in favor of coordination and/or cooperation: weakening social dilemmas, making structures less intricate (in anti-coordination or non-coordination structures), creating focuses (e.g., public assurance) for superior coordination (in coordination problems; Sen 1967; Schelling 1960; more recently, e.g., McCain 2009).

- Promoting recognition of interdependence (recognized interdependence – Bush 1999), e.g., through systems of layered and overlapping meso-sized arenas (smaller arenas, networks, platforms, neighborhoods, clusters, groups) (Elsner, Schwardt 2014) … enlightened self-interest.

- Promoting awareness of common future/enlarging the time horizon (futurity; Commons 1934; Hayden 2006; horizonal approach, Jennings 2005): another, long-run calculation rationality … enlightened self-interest.

5.   Policy implications of (evolutionary) game theory:
Target areas and instruments

- Favoring <u>equality</u> (Hargreaves Heap 1989): symmetrical incentives structures/games easier to solve (vs battle-of-the sexes game, chicken game, zero-sum games).

- Caring for <u>complete information</u>, <u>transparency</u> (complete payoff matrices, incentive structures known), through, e.g., memorizing, monitoring, reputation building, public information and assurance.

- <u>Reducing complexity , volatility, and turbulence</u> through improving interactive learning, stabilizing relations, and <u>promoting institutional emergence</u> (through, in turn, incentive structure, futurity, equality, meso-size, recognized interdependence, transparency, smaller arenas, …), <u>reduced mobility</u> (e.g., Glaeser et al. 2002), …

5.   Policy implications of (evolutionary) game theory:
Target areas and instruments

- Supporting search, experimentation, behavioral innovation in favor of problem-solving cooperation or superior coordination, e.g., supporting minimum critical masses of problem-solving cooperators (e.g., Axelrod 1984/2006).

- Caring for long-distance information exchange to avoid behavioral lock-in and institutional degeneration into ceremonial dominance and encapsulation, e.g., (interactions/games on) small-world networks (Watts/Strogatz 1998) as effective systemic structures.

- Promoting break-out in critical time windows, optimizing stability/ coordination (with potential collusion/lock-in) vs change (with potential volatility/turbulence), e.g., optimizing standard and information openness (Heinrich 2013).

6.   Conclusions

- A fundamentally different conception of policies, politics and state …

- Systemic, strong, reliable, long-run, adaptive, multi-dimensional interventions …

- Complexity overshoot of policy, to reduce the over-complexity of de-regulated "markets" …

- More calculative, but also less apodictic and certain.

- Specifically and interactively related to the interaction system of the private: incentive structures, futurity, arena sizes, network structures … thus, an <u>Interactive Policy</u>, focused on <u>building instrumental institutions</u> and <u>preventing ceremonial institutions</u>.

- Layered systems of overlapping and meso-sized arenas/platforms/ networks.

- Further factors to frame: Settlement structures, size-distributions, mobility, turbulence/volatility …

- A leaner/cheaper policy …

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Thank you for your patience!

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