Reviewing Telecom Policy from a Complexity Theory Perspective

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Presented at CITI Conference
November 3, 2006

Introduction and Overview

- **Goal**: Successful policies are those that are sustainable.

- **Challenge**: Digital technology, rapid technological change, and competitive markets complicate the design of sustainable policies.

- **Reality and insight**: Policymaking and the economy are coevolving complex adaptive systems.

- **Consequences**: Sustainability requires adaptability and robustness of policies (rules) and policymaking processes (governance).

- **Example**: Federalism is a policy decision-making algorithm with important adaptive properties.
Sustainable Policies Are Adoptable and Achievable

- Sustainable policies consist of rules that are politically *adoptable* and for which the underlying policy goals are reasonably likely to be *achievable*. (Cherry, 2003)

- Adoptability and achievability require
  - Both at the initial time of adoption and over time,
  - Compatibility among multiple rules and goals, and
  - Simultaneous satisfaction of political, economic, legal, social and technological constraints.

Sustainable Policies Under Traditional Monopoly Regimes

- Traditional monopoly policy was sustainable while pursuing other social policy goals. Why? Because circumstances enabled satisfaction of adoptability and achievability.
  - Entry barriers simplified market structure and conduct for government monitoring and response.
  - Rate of technological change was (relatively) slow.
  - Communications technologies created economically distinct markets.
  - U.S. policymaking process was able to timely adapt policies and governance to accommodate change.
Sustainable Policies More Difficult Under Current Regimes

- Sustainable policies are now more difficult to design and implement. Why? Because digital technology, rapid technological change, and competitive markets make it more difficult to satisfy conditions of adoptability and achievability.
  - Current market structure and conduct are more complex for government monitoring and response.
  - Rapid rate of technological change accelerates pace and complexity of change.
  - Communications technologies no longer created economically distinct markets.
  - U.S. policymaking process less able to timely adapt policies and governance to accommodate change.

- We need to reappraise conditions for sustainable policies.

Understanding Complexity Theory

- Complexity theory is refers to the study of nonlinear, dynamic - that is, complex - systems. Although originating in the physical sciences, complexity theory is also applied in the social sciences.

- A complex adaptive system has distinctive properties.
  - Nonlinear, dynamic
  - Sensitivity to initial conditions
  - Path dependence
  - Unpredictability of performance
  - Irreducibility and uncomputability
  - Phase states: chaos, edge-of-chaos
  - Transitions between states
    - Self-organization
    - Catastrophes
Policymaking and the Economy Are Coevolving Complex Adaptive Systems

- **Insight from complexity theory:** Policymaking process and the economy are complex adaptive systems that coevolve.

- Thus, we need to understand that policies are:
  - Outputs of a complex adaptive system (policymaking process).
  - Inputs to a complex adaptive system (economy).
  - Affected by feedback from coevolving complex adaptive systems (policymaking process & economy).

[Cherry, 2004; Cherry & Bauer, 2004]

Sources of Policy Unsustainability

- Policies are unsustainable when the conditions of adoptability and achievability are not simultaneously satisfied.

- Policy unsustainability may arise for different reasons and at different points in time.
  - (1) Improper initial policy design.
  - (2) Changes internal or external to the policymaking system.
  - (3) Failure of the policymaking system to adapt.
Implications of Complexity Theory: Adaptability and Robustness

- Sustainability requires *adaptability and robustness* of policies and policymaking processes.

- Complexity theory points toward a new policy paradigm.
  - Change expectations of policies and policymaking processes.
  - Invest in policy R&D and new research tools.
  - Understand adaptive properties of types of policymaking processes (*e.g.*, federalism).

Toward a New Policy Paradigm

- Change expectations
  - Expect policies to affect but not determine outcomes.
  - Expect churn in technological, economic, & socio-legal environments.
  - Expect pressures for continuous policy change.
  - Expect pressures to alter the policymaking process.

- Invest in policy R&D and new research tools
  - To reveal likely effects of policy options.
  - To monitor actual effects of policy options.
  - To develop options for adaptable and robust policies and policymaking processes.
References


Example:
Adaptive Properties of Federalism
Decision-making Algorithms to Improve CAS Performance

- A complex adaptive system (CAS) changes its performance by moving along its fitness landscape.

- There are different decision-making algorithms for moving along a CAS fitness landscape.

- The relative effectiveness of these algorithms vary with characteristics of the CAS.

Moving along a fitness landscape

A complex adaptive system changes its performance by moving along its fitness landscape.

X(t) is location on fitness landscape at time t.
Moving along a fitness landscape

The fitness landscape may change due to changes external to the system.

\[ \text{denotes shift in fitness landscape} \]

Adaptive Walk v. Patching Algorithms

- **Adaptive walk**
  - Incremental movements along fitness landscape based on improvements of *aggregate, system fitness.*

- **Patching**
  - Incremental movements along fitness landscape based on improvements of *local, within-patch fitness.*
Relative Effectiveness of Mechanisms

- For a CAS with no spillover effects
  - Adaptive walk is effective to find highest system fitness peak.

- For a CAS with spillover effects,
  - Adaptive walk is likely to become trapped on local fitness peaks.
  - Patching can efficiently search for high aggregate system fitness.

Note: Spillover effect exists when an element's fitness contribution to the system and/or patch is a function of the state of other elements.

Adaptive Walk v. Patching For CAS with Spillover Effects

Where
- $X(i) =$ starting point $i$
- $L(i) =$ local fitness peak for $X(i)$
- $G(i) = G =$ global fitness peak for all $i$

For adaptive walk: $X(i) \rightarrow L(i)$
For patching: $X(i) \rightarrow G$
Advantages of Experimentation Within Patches

- **Coupling**
  - Whenever the spillover effects of a patch are not wholly internalized, that patch is coupled with some other patch(es).

- For coupled, patched systems
  - Movement to points below local fitness peaks - *destabilizing effects* - enables movement to points higher than local fitness peaks.

- It is precisely the destabilizing effects from patches that provide the opportunity to improve overall system fitness.

Federalism is a Distinctive Algorithm for Policymaking

- *Federalism* is a system of governance where a group of equally-sovereign states combine to form a union in which they cede some sovereignty to a central government and retain some sovereignty.

- Within a *given* federalism system, the allocation of sovereign powers among federal and state governments may vary over time.
Federalism is a Patching Algorithm

- **Reality:** Federalism is a patching algorithm with capacities for both innovation and stability that are critical for system adaptability and resilience.
  - States make decisions based on improvements of local, within-State fitness.
  - States are coupled (have spillover effects among each other).
  - Federal government can provide stability by addressing spillover effects among States.

- **Insight:** State experimentation is essential for aggregate system (national) adaptability and resilience.

Implications for Policies of Preemption and Deregulation

- Federal preemption
  - Complete preemption *eliminates* state experimentation
  - Conditional preemption *limits* state experimentation

- Full deregulation
  - Eliminates federal *and* state experimentation
  - Shifts burden of effects to other social problem-solving systems.

- **Implications:** Policies of federal preemption and deregulation - particularly complete preemption and full deregulation - should be pursued with great caution.
Complexity theory supports insights of oft cited Justice Brandeis (1932)

- “There must be power in the states and the nation to remould, through experimentation, our economic practices and institutions to meet changing social and economic needs …

To stay experimentation in things social and economic is a grave responsibility. Denial of the right to experiment may be fraught with serious consequences to the nation. It is one of the happy incidents of the federal system that a single courageous state may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country. [The U.S. Supreme] Court has the power to prevent an experiment... But, in the exercise of this high power, we must be ever on our guard, lest we erect our prejudices into legal principles.”

New State Ice Co. v. Liebmann (1932), (Justice Brandeis, dissenting opinion)