

FuturICT: Complexity and Social Sciences

Forth Meeting, December 2011

prepared by

Robert Chambers (*Univ. of Maryland*), **Spiro Stefanou** (*Penn State Univ.*) and **Vangelis Tzouvelekas** (*Univ. of Crete*)

Problem setting:

Propose to investigate the intersection of the financial markets and the markets governing:

- i) natural resources exploitation and,
- ii) the management of environmental assets.

What economics does:

Macro: This involves addressing the causes and consequences of short-run fluctuations in national income and attempt to understand the determinants of long-run economic growth

Micro: This involves producers and consumers looking to efficiently allocate scarce resources among competing ends. Consumers and producers interact via the mechanism of the market.

Fundamental paradigms in the framing of the economic perspective:

- a. In decision making, individuals first identify *what is possible* which serves as a constraint as the individual moves on to determine *what is optimal*.

- b. The notion of equilibrium is a fundamental building block of what economists do as it relates to the process of exchange. Exchange is strategic and motivated by incentives and this process is the market. The notion of equilibrium is why economics analysis has evolved into an applied mathematical science.

This Project: Proposes to integrate the micro behavior as foundation to modeling its impact on the macro economic mechanisms.

How economics address complexity:

Complexity:

The set of all possible states in the world involve risky states (those to which we can assign a probability) and uncertain states (those to which we cannot assign a probability). As agents proceed with decisions, they are aware of only a subset of all possible states. As time goes on and decisions are made, agents learn about some of the uncertain states. The evolution of the subset of states we know takes on the setting of an open loop control problem where there is revision without anticipating the revisions.

An essential element of framing this system is to describe where the complexity is embedded in the system structure as opposed to characterizing complexity as a consequence of the system. To what extent is the degree of complexity internal vs. external to the system?

Nature Resources & Financial Markets:

Financial markets create avenues for exchange, but we need to distinguish between products and services exchanged in a market and the market itself. Some products may not be transacted in a market because they are redundant; that is, firms may be producing their own service to meet their needs. The complexity can arise from the sheer number of states that can emerge that a decision making must be ready to address.

The appearance of financial firms focusing on maximizing short-term returns is a signal that financial markets are undervaluing sustainability. With the market valuation embedding a discount factor (which includes the risk mark-up as well), the characterization of a market reaction emphasizing short-term financial returns can be a consequence of long-term strategy; e.g., create wealth in the early periods to have financial resources to address future states that are

- a) predictable (up to a point) and
- b) zero probability (don't know them but you know that shit happens when you are not expecting it).

In addition, there is the ability to innovate our way in the future to influence the economic correspondence of states in the future.

Background:

In the last decade, financial markets have responded to the depletion of fossil energy, materials, fish and water, climate change, loss of biodiversity and degradation of ecosystem services with the introduction of innovative financial products and instruments dealing with the management of natural resources.

Conventional commodity markets dealing with nonrenewable commodities such as energy (e.g., crude oil, natural gas), raw materials, (gold, copper, phosphates) and renewable commodities from agriculture, forestry and fisheries (wheat, coffee, meat, timber, fish) are mature. Historically, these markets smooth out regional imbalances but what role can they play in managing future global scarcities?

The financial markets of environmental assets vary in their maturity and completeness. The market for carbon emission and project-based carbon credits is the most developed, having progressed significantly the last decade. Standardized futures and option contracts on emission allowances are traded and a future market mechanism has been constructed with the introduction of carbon credits transactions under the Kyoto Protocol and EU Allowance Units Swaps.

What economics can offer to this project:

While we are not good at predicting complexity, we can develop tools for analyzing and modeling reactions to complexity-driven events. These tools can be used downstream to integrate the different forces/phenomena impacted by complexity.

These economic tools will be used to evaluate whether financial products explain adequately complex systems like natural resources including agricultural and non-agricultural commodities.

This can be accomplished (in part) with a simulation tool using the existing range of financial products and the economic model developed.