Natura non facit saltum

PREFACE TO THE FIRST EDITION

"The Mecca of the economist lies in economic biology rather than in economic dynamics. But biological conceptions are more complex than those of mechanics; a volume on Foundations must therefore give a relatively large place to mechanical analogies; and frequent use is made of the term "equilibrium," which suggests something of statical analogy. This fact, combined with the predominant attention paid in the present volume to the normal conditions of life in the modern age, has suggested the notion that its central idea is "statical," rather than "dynamical." But in fact it is concerned throughout with the forces that cause movement: and its key-note is that of dynamics, rather than statics."

The mathematician and author David Orrell considers the relationship between science and economics  
(downloaded from http://www.worldfinance.com)

Since Marshall wrote those words a century ago, however, there has been surprisingly little integration between economics and other life sciences. Instead economics has continued to model itself after physics. The General Equilibrium Models favoured by policy makers, or the risk models used by banks, are based on a mechanistic framework which makes economics very different from fields such as biology or ecology.

Given the failure of these models to predict the recent crisis, one may ask if it is time for a different approach.

In the next few columns, I will argue that Marshall’s Mecca may yet be reached, but it will require some fundamental shifts in the way we study the economy.

While Marshall noted the relevance of biology, he did not pursue the metaphor very far. One reason was simply that mechanical systems were easier to analyse using the mathematics of the time. As he continued in the preface, “biological conceptions are more complex than those of mechanics ...” (see above).

In order to make progress, and inspired by the “rational mechanics” of Isaac Newton, neoclassical economists therefore made a number of simplifying assumptions. One was that a collection of people behave much like a single “average” person, so the macro picture could be built up from the micro level. Indeed, they argued it should be easier to predict the behaviour of a large number of people, because the individual peculiarities come out in the wash. A related assumption was homogeneity. For example the law of supply and demand assumes that there are a multitude of near-identical firms all in direct competition with one another.

Together with other assumptions, such as rational behaviour, these allowed economists to build up a model of the economy in which people or firms acted like inert atoms, deprived of any
individuality. The law of supply and demand would then drive prices to Marshall’s static equilibrium.

While these assumptions may have seemed reasonable at the time, they have found less use in life sciences such as biology or ecology. For one thing, living systems show emergent behaviour, so the macro-behaviour cannot be predicted from a knowledge of individuals. An ant colony is not simply a larger version of a single ant. The reason is that ants do not behave as atomistic individuals, but are embedded in a complex social organisation, are in constant communication with one another, develop specialised roles, experience group dynamics, and so on.

Also, living systems are not homogeneous. Indeed, as Charles Darwin pointed out in his Origin of Species (1859), diversity, along with competition, is one of the drivers of evolution. If everything were the same, “survival of the fittest” would result in a draw and nothing would change. Similarly, it is diversity in the business world which explains why markets are often dominated by a small number of successful firms, instead of a large number of essentially indistinguishable firms as assumed by neoclassical economics. It also explains how the economy grows and evolves.

The result of this evolutionary process is not equilibrium, but a state of dynamic change and continuous adaptation. And while competition plays an important role, so does cooperation. Diversity means that people and firms can often do more when they function as part of a team, than they can individually. Ecological niches appear as a result.

All of this complexity poses something of a problem to conventional models, because it is no longer possible to make the simplifying assumptions of the physics-based approach. In recent years, however, a number of alternative mathematical techniques have become increasingly popular in the life sciences, and now seem poised to take over economics. These include areas such as nonlinear dynamics (studies systems that are far from equilibrium), complexity (emergent properties), and network theory (systems where elements are in communication).

A key tool is agent-based models, which are computer programs which simulate interactions between individual agents. In systems biology, the agents may represent proteins within a cell, or individual cells within an organ; in ecology, they might represent members of different species; in models of the economy, the agents typically represent people or firms. The behaviour of each agent is determined by a relatively short set of rules.

The program then simulates the interactions between the agents, which often results in emergent behaviour which is easy to recognise but impossible to predict from a knowledge of the individual agents alone. The models can represent the diversity and dynamism which make the system tick.

For example, models have been developed in which hundreds of simulated traders buy and sell stocks in an artificial stock market. Each of the trader “agents” has its own strategy, which can change in response to market conditions or the influence of other agents. Rather than settle on a stable equilibrium, prices are in a constant state of flux, and periodically experience booms or busts as investors flock in or out of the market.

Of course, such models will never be able to perfectly capture the behaviour of human beings. But one thing seems clear: there will be no going back to the mechanistic view which has so long dominated economics.