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**Keywords**

Economic history; simulation; networks; non-equilibrium

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1. Introduction

John Sutton is a mainstream economist, but one who is very thoughtful and reflective about the subject. In his excellent little book *Marshall’s Tendencies: What Can Economists Know?*, he describes the process of socialisation which takes place with students of economics. The core model of the discipline remains the so-called rational agent, operating autonomously, with fixed tastes and preferences, gathering information about alternatives, and making the optimal choice. Gradually, students who doubt the validity of these assumptions fall by the wayside and abandon economics. By the post-graduate stage, only the true believers remain.

This by itself would not necessarily be a problem. Like any scientific theory, the model of economic rationality makes assumptions which are approximations to reality. It is ultimately an empirical question as to whether, in any given situation, the assumptions offer a reasonable approximation.

But, somewhere along the line, a transmutation occurs, and the believers come to imagine that the model is reality. If the real world appears different, it is the world which must be changed and not the theory. Preposterous though this may sound, it is reflected in practice in, for example, the advice given by the teams of economists who proliferate in regulatory bodies.

Mainstream economics is not a completely empty box, and it does contain some powerful insights. However, it cannot be stressed too strongly that it is a way of thinking about the world rather than a series of scientifically validated propositions. Much of the material in, say, engineering textbooks has been shown to be a very close approximation to reality. In general, for example, bridges tend to stay up. But the same cannot be said for many of the ‘theorems’ in economics textbooks, especially in the case of macroeconomics.

Mastering the intricacies of economic theory and the demanding statistical techniques of econometrics is hard, and so it is perhaps not surprising that students who succeed in these tasks begin to confuse the models with reality. But we need to teach them that we are providing them with a set of tools to apply to real world problems, and the tools need to be selected according to the particular set of circumstances.

This means that the curriculum needs to become much broader. For example, it should draw on behavioural models developed in other social sciences. The economic definition of rational behaviour is by no means the only one. In many contexts, the assumptions lying behind other theories of agent behaviour may be more realistic.
Above all, we should be inspired by the phrase from Hayek which was cited in the presentation speech at the ceremony when he received the Nobel Prize: ‘Nobody can be a great economist who is only an economist - and I am even tempted to add that the economist who is only an economist is likely to become a nuisance if not a positive danger’.

2. Teaching macro through economic history

It is the area of macroeconomics which is in most need of thorough change. The mainstream models, despite their mathematical sophistication, have been shown by the crisis to be sadly lacking.

We need to remember the claims which were made for them. For example Robert Lucas in his Presidential Address to the American Economic Association in 2003 said: ‘the central problem of depression prevention [has] been solved for all practical purposes’. In August 2008, just three week before the collapse of Lehman Brothers, Olivier Blanchard, Chief Economist at the IMF, concluded in an MIT Discussion paper entitled ‘The State of Macro’ that ‘the state of macro is good’.

One of the problems with macro, indeed with almost all mainstream theory, is that it is essentially timeless. I use the word ‘timeless’ here to mean that the theory is taught without reference to historical events. In this sense, it operates out of time. It is this which needs to be changed.

All students of economics would benefit from studying certain key episodes in economic history. The idea is to make history a key part of the macro theory which students are taught. It is not economic history per se, but using events in economic history to illustrate theory. This has the added advantage of emphasising to students that theory needs to be able to explain empirical reality, it is not an abstract intellectual exercise.

The Great Depression of the 1930s, for example, is one of only two truly global financial crises since the late 19th century (the other of course is the most recent one). A wide range of topics can be discussed in the context not just of the Great Depression, but of the inter-war period as a whole. For example:

- Unemployment. Was this a supply-side phenomenon caused by the level of benefits relative to wages? To what extent was demand deficiency a reason? And heterodox macro ideas such as the role of the profit share (Goodwin’s work, for example) can also be introduced
• The impact of fiscal policy. Under what conditions is this expansionary? What role did it actually play in the recovery of the 1930s? How might wealth effects affect behaviour?
• Monetary policy. Does this only affect the price level or does it also affect real output?

These are not meant to be an exhaustive list of topics which can be dealt with under each heading, nor is the list of headings necessarily complete. For example, under the topic ‘unemployment’, students can be introduced to mainstream models such as real business cycle and dynamic stochastic general equilibrium.

In terms of topics, a novel one for almost all economists is ‘networks’, though it is one which is beginning to get much more traction in the context of the transmission of shocks across the banking system. There is a massive literature on the mathematics of networks and their property of being ‘robust yet fragile’. In other words, whilst most shocks to a system do not spread very far across a network, occasionally one of identical size generates a cascade across the entire network.

The empirical evaluation of evidence can also be introduced with respect to themes such as the above in the context of the inter-war period. Econometrics would form the core of this teaching, but the wider evaluation of evidence and understanding the reliability of data used in statistical analysis would be part of these modules. For example, different authors arrive at quite different estimates of the replacement ratio. How can this be?

In addition to the inter-war period as a whole and the Great Depression specifically, the oil shock crisis of the 1970s and the contrasting transitions to peacetime after the two world wars are examples that spring readily to mind. The period after the First World War was characterized by deep recessions in some countries. Serious problems with both international trade and the world monetary system persisted throughout the interwar period. In contrast, output after the Second World War recovered very rapidly, even in the defeated countries, and a long period of unparalleled growth followed.

Again, whilst by no means being an exhaustive list, the sorts of themes raised by these periods of economic history include:

• The role of institutions. Is theory independent of institutions, or can these play a key role in outcomes?
• Trade theory. What are the benefits of trade? What exceptions might there be?
• Growth theory. Just why did the West have a prolonged period of sustained growth after World War Two?

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During the 1950s and 1960s, inflation rates in the West were close to each other. However, in the mid 1970s there was a rapid and dramatic widening of the differences between them. In 1975, for example, the inflation rate in Germany was only 4%, but it was above 20% in both Italy and the United Kingdom. The analysis of such formative periods raises many important questions in economic theory. In this context, an obvious topic is the cause(s) of inflation.

Again, with both the transitions to peace-time after the two world wars, and the inflationary experience of the 1970s, empirical evidence and its evaluation would be a key part of the curriculum.

3. Agent behaviour and simulation techniques

Economics at the moment is in a rather schizophrenic frame of mind. On the one hand, behavioural economics is very fashionable. On the other, the ‘rational’ agent continues to be the bedrock of the curriculum.

One of the great intellectual attractions of the mainstream theory of agent behaviour is its ability to obtain analytical results. It is undoubtedly satisfying to be able to wade through thickets of calculus and establish a ‘theorem’. This can then be used to compare the outcomes in two equilibria when, for example, a tax rate if changed.

For some reason, simulation approaches to modelling have not found favour amongst economists. We can think of these as being numerical rather than analytical approaches to obtaining solutions. However, in the harder sciences, numerical techniques are frequently used to, for example, obtain solutions of systems of partial differential equations. Analytical results may be desirable, but they may not always be possible to obtain. And even when they are, they may require large amounts of intellectual effort. It makes sense to use instead the well-established numerical solution techniques.

The use of simulation has two advantages: First,

• it enables us to explore a wider range of agent rules of behaviour. We are no longer constrained to choose rules which facilitate the use of calculus in order to obtain analytical results
it enables us to examine the paths along which a system moves between two equilibria (assuming for the moment that equilibria exist). In other words, we can examine the behaviour of the system when it is out of equilibrium.

So we can readily model agent behaviour using empirical insights from behavioural economics, or draw on models from other social sciences.

Such models are straightforward to program in packages such as Matlab or Mathematica. Even better from a teaching perspective, programs such as Netlogo are easier to use and contain excellent graphics. A wide range of models developed by the Netlogo community can be downloaded. These are, admittedly, of varying scientific quality, but an important model such as the Schelling segregation model can be downloaded and explored (http://ccl.northwestern.edu/netlogo/models/Segregation) as an introduction to the methodology.

Analytical results are always desirable when they can be readily obtained. But it is a great mistake to remain fixated by them. We should embrace technological developments and introduce students to simulation models at the earliest possible opportunity.

4. Networks

Two key assumptions of the core paradigm of agent behaviour are that agents make decisions independently and that their tastes and preferences are fixed. All scientific theories of necessity make assumptions. A great deal therefore depends upon how close an approximation to reality such assumptions are. The social and economic world is becoming one in which the assumptions of independence and time invariant tastes are less and less a reasonable description of reality.

This does not mean that incentives, say, no longer operate. This is a very powerful insight from economics. But, increasingly, agent behaviour is influenced directly by the behaviour of others. In the standard model, the decision of any given agent can influence the decisions of others. But this influence operates only indirectly via the price mechanism. In many real world situations, the tastes and preferences of an agent are affected directly by the behaviour of others. We see this most clearly in web-based activities such as YouTube or Flickr. Even the most casual knowledge of these sites is enough to reveal that, in general, the attributes of the most viewed/downloaded are indistinguishable from very large numbers of alternatives which receive very few viewings or downloadings. Copying is the decisive motivations in these ‘markets’.

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Mainstream economics does acknowledge such phenomena, but essentially regards them as a special case. The general model of agent behaviour remains the one with independent agents and fixed preferences. But reality has inverted this relationship. It is the standard model which has become the special case.

Influence spreads across networks. This has been acknowledged clearly for several years in the work on financial institutions carried out by Andy Haldane and his team at the Bank of England. Recently, the European Central Bank has recognised the importance of the propagation of shocks and cascades across networks for banking stability. Incredibly, prior to the financial crisis, regulators did not envisage the possibility of such systemic risks. The criteria for bank solvency related to banks as individual agents, not to the network of connections between them and the possibility of a cascade of failures.

There is a massive literature outside economics on networks in general, and how the inclusion of networks into the rules describing agent behaviour produce outcomes which are in general decisively different from those of the rational agent model of standard theory.

The maths which underlies network models – graph theory to mathematicians – is just as hard as calculus, so economists who relish the abstract intellectual challenge of maths will find more than enough to keep them occupied.

But we should teach students the basics of network theory as well as calculus. This is essential. And, again, models in which networks feature can readily be programmed in the environments discussed at the end of section 3.

5. What is left?

The above is a fairly root and branch reform of the curriculum. But it is not meant to be a detailed manifesto.

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2 Mark Newman’s book, Networks: An Introduction, OUP, 2010 is a very good guide
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