CCE Course Sep-Nov 04

Lecture 2: Paradigms and the Theory of Science

Nature of Scientific Propositions & 'falsifiability'

Kuhn-Popper debate of 1960s & later adaptations

Copernican revolution

'Paradigm change' in the Physical and Social Sciences'

Can one identify paradigm changes in Economics

In this lecture we look at a number of key topics, notably, the nature of a scientific proposition; the concept of 'paradigm change' in the physical sciences and its relevance for the notion of a 'value free' social science. In the second part of the lecture, a brief taxonomy of 'schools' of economic thought is attempted. How we group such 'schools' and where we locate paradigm changes depends in part on our own ideological location.

Part A: Recent Debates in the Progress of Science

The philosophy of science deals with progress and methodology in the work of trying to make sense of nature using compact, organised theories. The chief elements which must make their way into any philosophy of science are easy to identify but problems arise in mapping the relations between them; eg; elements such as:

- empirical data
- conceptual elements (abstraction, terminology, techniques of interpretation, rules of evidence)
- formal and mathematical elements (deduction)

One can identify at least two 'schools' here:

Empiricism: emphasis on empirical foundations of science and **inductive reasoning**; raw facts are primary, and theory proceeds by empirical generalisation; associated with Sir Francis Bacon (early 17th century), John Locke (late 17th) and in economics with William Petty (late 17th).

Rationalism: Descartes (17th century) rejects the view that raw facts in themselves display any law-governed relationships; instead, one starts from general principles and reasons deductively; the scientist is highly selective in the observations to which he pays attention. Amongst economists, Ricardo is perhaps first to introduce axiomatic reasoning.

NB: note that **Post-modernist** school tends towards the second view in which empirically 'constructed' theory can be 'deconstructed' because it is rooted in a particular socially-conditioned perception of reality. This leads to the view (roughly) that the 'truth-value' of theory is relative and, ultimately, subjective.

The Popper v Kuhn Debate of the 1960s:

It is useful to start by considering what many think of as the founding debate in the what for the past three decades has been called the Philosophy of Science. Prior to this, there had been much discussion in philosophical circles about the truth value of propositions. The foundation of the discussion goes back to the 18th Century philosopher, David Hume, but its 20th century expression starts with Russell and Whitehead at the turn of the century, and proceeds through the Vienna Circle to Witgenstein (inter-war), and more recently to the most influential modern positivist, A J Ayer (post-war).

The **positivist position** can be very broadly characterised in a single phrase: *scientific argument is argument based on empirically verifiable propositions*; hence, to take a trivial example, the assertion "it is raining outside" is scientific in the sense that we can look out the window to observe whether it is true or false. However, if I say "Chocolate ice cream is better than vanilla, " this is not 'scientific' nor meant to be. Nobody would think of inspecting my brain or taste buds to determine the truth-value of the proposition. The statement is merely a 'value judgement'. This distinction between statements which have 'truth value' and statements expressing mere value judgements is one of the touchstones of scientific discourse. Economists make this distinction when speaking of positive v normative economics, the former being 'scientific'. Richard Lipsey in his famous textbook (Positive Economics) gives a clear account of this distinction in the introduction which follows positivist principles.

The **Popper-Kuhn debate** occurs in the mid-1960s and was popularised in the early 1970s at a time when the positivism---indeed much conventional social theory---was called into question. Karl Popper (now Sir Karl) was then Professor of Social Theory at the London School of Economics. His main publications at the time include The Logic of Scientific Discovery in 1965 and The Open Society and its Enemies (1966). The latter work is better known because of its attack on what Popper calls Marx's 'historicism'. The former sets out the basis of Popper's view of science. Science, says Popper, is founded on the principle of 'falsifiability' and moves forward at a relatively consistent rate. Thomas Kuhn was a physicist by training and was Professor at Harvard when he published The Structure of Scientific Revolution (1962). Like Popper, he thinks that most of the time science makes regular advances; unlike Popper, he believes that science goes through periods of revolutionary upheaval and that these periods---periods of 'paradigm break'---affect the way we think far more profoundly than do periods of normal science.

Central to Popper's argument is the notion of falsifiability. What makes a proposition 'scientific' is not whether it can be proved to be 'true', but rather *whether it can be proved untrue* ('falsified') . Nothing is 'true' for all time unless, of course, it is true by definition; eg, "two plus two equals four" is true merely because axiomatically or by convention we call it true. The statement "the sun will rise tomorrow morning" is not true---it is merely highly probable. What gives the statement scientific value is not merely than we can observe the sun rising in the morning but---and this is fundamental---the fact that the sun might fail to rise one day. In other words, the statement is 'falsifiable'.

No statement (or set of statements) is scientific, Popper argues, unless it can in principle be falsified. If it cannot be falsified---if no imaginable evidence can show it to be wrong---it must be tautologically and thus trivially true. Axiomatic statements and deduction are the stuff of mathematics; science is inductive and non-axiomatic. But there is a second argument, too which in simplified form is as follows. The business of science is to test propositions until sooner or latter an experiment reveals some cherished theory to be flawed. The theory is then reformulated and improved such that it is made consistent with the latest experimental evidence. Science is forever testing theories and adjusting and improving them in the light of new evidence. In a word, science is forever ascending the gradient we call progress.

The above example, "it is raining outside", is merely trivial; a high level hypothesis is Newton's 'inverse square law'

> "all bodies attracted to each other with a force proportional to the product of their masses but inversely proportional to the square of their distance"

such a statement not amenable to 'testing' since we do not 'observe' gravity;
---> rather, it provides hypothesis **consistent with experimental evidence** about the behaviour of apples, planets, etc. It becomes an accepted theory when it proves consistent with evidence for a substantial number of experiments and relevant phenomena

Principle of Falsifiability

- Undoubtedly Popper's main contribution---breaks with earlier version of Russell true/false dichotomy and provides new basis for thinking of the meaning of a scientific statement. It says that **the mark of a scientific statement is that in principle it can be falsified**; ie, all sorts of statements are 'unscientific'; eg:
    - I dislike ice cream (value judgement)
    - socialism will triumph over capitalism (historicism)
    - Freud's notion of *unconscious drives* (cannot be disproved)
    - certain religious statements are statements of 'faith', not scientific statements.

Popper's view of Scientific Progress

Basically, scientific discovery can be characterised as a cumulative and relatively **smooth process of discovery** of increasingly powerful theories;

Figure 1: Popper v Kuhn

Characterisation of Popperian View of Scientific Advance

1. experimental & background facts ===> hypothesis

2. if hypothesis accords with body of experimental evidence ===> theory (T1)

3. T1 exposed to further experiments A, B, C … F

4. when F (falsifier) found, T1 dropped and replaced by T2

5. since T2 is 'scientific', eventually a falsifier (F2) will be found ===> T3

6. process continues smoothly forever

Kuhn's Critique

1. Popper's characterisation of T1 ==> T2 move acceptable if theories do not include rules of evidence on how facts are interpreted (background knowledge is 'stable')

2. 'grand theory' typically *does* include 'own rules of evidence'

3. Example:

If T2 'true', F will refute T1

but: if T1 thought 'true', F will refute T2

3. Thus, choice of 'paradigm' T1 or T2 becomes (for a time) value-judgement!

Kuhn's attack on Popper

1. the history of scientific development does not support the "orderly replacement" view of science (T1, T2 …. etc)
2. it is important to distinguish periods of **normal science** (for which Popper is relevant) from periods of **revolutionary science**
   - ⇒ period of scientific revolution: a period during which a new body of theory (paradigm) emerges which forces reconsideration of all previous theory and experimental evidence in the field;
   - ⇒ normal science long periods which come in between 'revolutionary' periods. Here, the job of most scientists is to 'articulate' the ruling paradigm, filling it out and applying it to further relevant phenomena; here they follow T1, F ==> T2 sequence

     "the object of normal science is to solve a puzzle for whose very existence the validity of the ruling paradigm must be assumed" (Kuhn)

Figure 2: Examples of Competing Paradigms

Cosmology	**Ptolemaic 'geocentric' solar system v Copernican 'heliocentric' solar system (16th century) & Galileo (17th)**
Natural History	**'Biblical creation' v Darwinian selection (19th century)**
Physics	**Newtonian mechanics v Quantum mechanics (20th century)**
Social Sciences	**- Neo-classical Economics v Keynesian Economics v Marxist Econmics** **- Keynesianism v Monetarism (20th century)**

Example: the Copernican Revolution in Cosmology

Kuhn dwells at some length on the **Copernican revolution of the 16th Century.**
Aristotle had argued (elaborated by Ptolemy of Alexandria in 2nd Century) that earth was the centre of the universe and solar system (geocentric). One problem, first raised by Pythagoras, was to explain the relative motion of the planets relative to the fixed background of stars, in particular of **Mars**. The problem is that tracking its motion through the night sky, once a year Mars appears to stop and go backwards briefly. In a geocentric view, this could only be explained if Mars was assumed to rotate (very slowly) about its own path of movement. Very complex mechanical models (orreries) were built showing the earth as centre of the solar system and explaining the relative motion of Mars.

Copernicus (1543): advanced the theory of the heliocentric universe. In consequence, he died excommunicated and obscure in Poland. Yet in the course of the next 100 years, telescopic evidence (Galileo) and mathematical proofs (Kepler) led the way to universal acceptance. By Newton's time (1650), the Copernican heliocentric theory was universally accepted.

Kuhn' central point**: it was necessary to articulate the Ptolemaic paradigm to such a point where some astronomers and mathematicians could no longer find an answer within it.**

Kuhn's Characterisation of Scientific Revolution

1. Paradigm must become sufficiently articulated to be challenged;
2. When challenged, old and new paradigms will live together for a time and become the subject of bitter controversy;
3. 'Conversion' to new paradigm involves a whole complex of social phenomena (including 'changing values') which Popper's 'smooth view of progress' cannot accommodate.

Natural Sciences and Social Sciences

A number of others in the 'Philosophy of Science' have qualified the notion of 'paradigm change as **too radical**. Professor Imre Lakatos of the LSE (for a long time a disciple of Popper's) is one of the best known critics.

Lakatos:

1. 'Paradigm breaks' in the social sciences are far less clear than in the physical sciences; perhaps we should speak of "competing research agendas" instead for often, contending social scientists are **asking different questions;** ie, not investigating quite the same field
2. The social sciences after all are about rules governing psycho-social and economic behaviour of groups/societies;
3. 'Societies' themselves are not static---unlike the universe, they evolve on a far more rapid scale---- one might say 'societies are in a state of constant change'
4. It follows that as society changes, so 'social scientists' questions change: some become more relevant, others less so;
5. This can be called **changing the research agenda**; as society changes, X's 'research agenda' will become more relevant to answering new questions than Y's.
6. Example: **Keynes** had a quite different research agenda from that of the **neo-classical economists who preceded him**; the latter created and articulated the new field of marginal analysis in economics---the analysis of optimal markets for products and services. By contrast, Keynes was concerned with the question raised by the Crash of 1929---why do economies go into recession and why is recession so prolonged? Can Governments lift economies out of recession? Today, Keynes has not so much been falsified as integrated into the theoretical mainstream---new questions occupy the research agenda: the globalisation of competition, the rise of major trading blocks, the rapidity of technical innovation, the importance of human capital and so on.
7. 'Verification' often plays a useful role in the development of theory.

Some Questions for Discussion following Lecture 2

1. Discuss the 'paradigm shift' in the Theory of Evolution: Are contending paradigms 'scientific'; ie, can they be verified/falsified?? Explain?

2. How would you categorise contending paradigms in modern physics and cosmology? Can contending paradigms be falsified? Can they even be understood?

3. Can you cite a possible 'paradigm shift' in poltical economy. Characterise the competing paradigms. Explain what you would expect to happen in periods of 'normal science'.