ECON0055: Economics of Science

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Textbook & Lecture notes

There is no specific textbook. The module is largely taught based on academic papers and lecture notes. However, the following books may provide some interesting and useful background to some of the topics:

- **On 'traditional' Economics of Science**
    - **Paula Stephan**, *How economics shapes science*, Harvard University Press (2012);
- **On Technology & diffusion of technology**
    - **W. Brian Arthur**, *The Nature of Technology*, Penguin Books (2009);
    - **Everett M. Rogers**, *Diffusion of Innovations*, Free Press (2003);
- **On 'Scientometrics'**
    - **James Wilson**, *The Metric Tide*, Sage (2015);
- **On networks:**
    - **Estrada, E. & Knight P.A**, *A first course in Network theory*, Oxford University Press (2015);

General structure of the Course

Economics of Science (ECON0055) deals with the interactions between Science, Technology and the Economy. The main themes of the module are:

- How do Science and Technology affect human productivity and how does Economic activity fund Science and Technology?
- What is the nature of the "goods" and services involved in Science and Technology and how does that affect its Economics?
- How does the reward-structure of Science & Technology relate to the specifics of these disciplines?
- How do discipline-relevant choices get made by the agents (scientists / engineers) in these disciplines?

Some of these themes. Particularly the first two, fit very neatly with what I will call "traditional Economics of Science". This is for example the case when we consider the role of scientific and technological progress in the emergence of economic growth.

Some of these themes, particularly the last two, tread on ground more commonly covered in "Philosophy of Science" modules. This is the case, for example, when we consider the notion of paradigmatic change in a Science and look for models to describe such changes.

Some themes, like the middle one, will be viewed and discussed from both a "traditional" perspective as well as from viewpoints embedded more firmly in the actual working and requirements of the discipline. Traditionally there has been a lot of research and debate on the degree to which scientists and engineers respond to financial incentives. But we will also cover in depth the role of non-financial incentives such as reputational and priority-rewards.

Quantitative vs Essay-based

You can take ECON0055 as a very quantitative module but also as a very essay-based module. This may sound surprising, but the way the module is taught, and the format of the assessments, mean you can make your own choice, create your own mix, in this. It means that during the classes you will encounter both quantitative as well as non-quantitative aspects and cannot avoid either. But in your own assessed work you can put the balance where you prefer to have it.

How to study for ECON0055

Although ECON0055 is *very accessible* for year-2 as well as year-3 students, it will require a *mature attitude* to learning and studying. You should be willing and eager to explore the material on your own initiative and not rely on "*being told what to do and how to do it*".

Independent vs Group work

Working together with one or more peers on the formative assignments is *strongly recommended* and sometimes even necessary! But you will be expected to complete the *summative* assessment individually. The format of the formative assignments will be such to train and practice the skills you will need in the individual summative assessments.

Key skills

Three of the key skills you will train in *Economics of Science* are the following:

- The ability to analyse and think creatively about Science, Technology and Innovation and their role in the Economy;
- The ability to analyse and discuss the interactions between financial, 'economic' and 'scientific' or 'technological' incentives influencing the choices made by agents working in these fields;
- the ability to *analyse* and *debate* the characteristics of scientific and technological knowledge and the impact these have on the nature of science, engineering, and their economies;

You will be able to emphasize for yourself whether you want to develop these skills mostly in a modelling & simulation fashion, or in a discursive and argumentative fashion.

An immediate consequence of the fact that ECON0055 will teach, train, and assess you in these key skills, while allowing you a lot of freedom to choose the quantitative/qualitative flavour that best suits you, is that the marking-schemes will reward creativity, precision, attention to detail and originality. The problems in exams and problem sets will typically ask you to *define* the problem, *interpret* a question/instruction, *explain* your approach (or code), and *analyse* the results.

Marks

Reproducing (and somewhat understanding) stuff from the lectures, the internet or your friends is probably going to allow you to pass or achieve a II.2, but will not be enough for a II.1 or higher.

Classes

Every week there will be *one 2-hour lecture class on Friday and one 1-hour practical class on Wednesday* during the times scheduled in the UCL timetable. In addition, there will be some pre-recorded material every week to use in preparation of the class-hours.

The topics per week

Provisional schedule of topics:

- ***Getting started with Economics of Science.***
    - **Week 1**: *Agents, Preferences and Productivity*
    - **Week 2:** *Data, Information & Knowledge*
- ***Engineering and Learning***

- o **Week 3**: *The Engineering problem*
- o **Week 4**: *Individual and Social Learning*
- **The Structure of Science & Technology**
  - o **Week 5**: *Exploration & Competition for priority*
  - o **Week 6**: *The Networks of Knowledge*
- **Paradigms and Schools of Thought**
  - o **Week 7**: *Paradigms*
  - o **Week 8**: *Schools of Thought*
- **Science, Technology & Economic Growth**
  - o **Week 9**: *Economics growth*
  - o **Week 10**: *Endogenous growth*

Summative & Formative Assessment

Formative Assessment

Weekly Problems:

The weekly *assignment* will each involve a single problem/question the answering of which will require

- some reading of (parts of) research papers or book,
- some independent research, and
- some computational work using *Mathematica*.

Summative Assessment workloads

The Take-Home Exam typically has a workload of around **5** hours. The individual research project usually has aworkload of around **55** hours in total.

Format of the Week 5 Presentation & the Project: 50%

In ECON0055 you will spend part of your time of term 1 on a research project on a topic of your own choosing. The topic must have a clear connection with the *Economics of Science* material in the module but can be diverse, ranging from case-studies of innovations, science- and technology-policy to technological progress related issues in environmental or public health or other parts of economics.

At the start of week 5 you will be asked to submit a *5–10-minute, self-recorded presentation*. This will be a work-in-progress presentation on your research project in which you review the literature you have read and present (the latest iteration of) your research question.

At the start of term 2 you will be asked to submit your final project report.

Mark: The mark for the Research project component will be computed as follows

$$Project\ mark = (Presentation\ mark)^{0.2} * (Project\ report\ mark)^{0.8}$$

and is a so-called "**geometric mean**" of the presentation and the project-report mark.

Format of the Take-Home Exam: **50%**

Usually each take-Home Exam will consist of 4 problems, each of the same format as the formative "weeklyassignment" problems.

Module Mark: So, the module mark is computed as

$$Module\ mark = 0.5 * (TakeHome\ Exam\ mark) + 0.5(Presentation\ mark)^{0.2}$$

$$\ast\ (Project\ report\ mark)^{0.8}$$

And is the arithmetic mean of the project mark and the take-home exam mark.

Week-5 Presentation:
Weight: 0.2
Material: Your own, *wider*, readings during weeks 1-5 + reading week.

Project report:
Weight: 0.8
Material: Your own research project executed during term 1.

Take-Home Exam:
You usually have a week for this exam in Term 3.
Weight: 50%
Material: The Final Take-Home Exam will cover the material of weeks **1** through **10**.

Workload

Every 15 credit UCL module is considered to have a total workload of **150** hours. The typical workload for theECON0055 module is as follows:

- The ECON0055 *Project*: **55** hours, distributed as follows:
    - The ECON0055 Presentation will typically require 20 hours of reading and 2 hour of planning and recording, so 22 hours in total;
    - The ECON0055 Project-report will take around (at 25 words per minute) 3 hours of writing and 30 hours of reading or modelling & simulation, so 33 hours in total.
- The ECON0055 *Take-Home exam* has a workload of approximately **5** hours in total;
- *Class hours* are 1 2-hour and 1 1-hour class a week + about 1 hour of preparation & recorded material for each, i.e. **50** hours in total
- The weekly problems have a workload of 2 hours *each*, i.e. **20** hours in total;
- The remaining **20** hours are revision for the final Take-Home Exam during the term break between terms 1 and 2;

Note that this will mean that, *during the 10 weeks of term* (excluding Reading week) you will be spending *on average 12-13 hours each week* on ECON0055. That can **feel** like 2 to 3 days a week when you bunch it too much in inefficient lengthy blocks.