

# ITRN 701.004 TECHNOLOGICAL CHANGE AND ECONOMIC GROWTH

## George Mason University: School of Public Policy

Spring 2003

004	32597	R	7:20 – 10:00	ARL238	G. Chris Rodrigo
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### Content, objective and prerequisites

This course is designed as a broad survey of contemporary approaches to long-term economic growth and technological change. It is not a course on formal models of economic growth, but growth theories will be very briefly reviewed at the beginning of the course. The study focuses on understanding how processes of innovation have worked in the major industrial sectors in the advanced industrial countries. The evolution of information technology, hardware, software and the Internet, will be discussed as well. The course will also cover catch-up technological change in selected East Asian new industrial economies. The recent research perspective of *national innovation systems* will be discussed and insights deriving from evolutionary models of growth and technical change will be compared and contrasted with perspectives of neoclassical growth theory. Contemporary debates on the roles of the state and market in the initial industrialization of Europe, the USA and East Asia will also be introduced in the latter part of the course.

The objective of the course is to introduce graduate students in Public Policy and Economics to current thinking in economic growth and technological change. Instruction and learning will take place through lectures, class discussion and exercises, a mid-term exam, a presentation and paper on a selected topic. To adequately follow the ideas introduced, students should have some initial training in economics (ITRN 504 at a minimum) and familiarity with high school algebra. Other students should discuss their special situation with the instructor before enrollment.

### Learning goals and evaluation

The main objective of the course is to develop a working knowledge of what drives technological change and long-term economic growth, why growth performance varies across countries and in time. Instruction will be based on firm, industry and country studies taken from two textbooks. Acquisition of these insights will be tested through a single (mid-term) exam, class participation, an individual or group presentation and a final paper. There will be no final exam. The final grade will be made up as follows.

Mid-term exam	30 %
Exercises and class participation	20 %
Class presentation on selected topic	20 %
Final paper on selected topic	30 %

### Required texts and other readings

Technology, growth and development, Vernon Ruttan, 2001, Oxford University Press.  
Technology, economic growth and crises in East Asia, G. Chris Rodrigo, 2001, Edward Elgar.

Some supplementary readings will be held on reserve in the Arlington Library.

**List of topics to be covered** (readings related to topic in parentheses)

1. Technological change and productivity growth (Ruttan: ch. 1 & 2; Rodrigo: ch. 1 & 2)  
Role of technology in economic growth. Accounting for productivity growth. Growth empirics: patterns of growth in the USA, Europe, Japan and Asia; catch-up and convergence. Relationship of technological innovation to science and invention. Why growth is not 'automatic,' why most developing countries are slow to develop, why Russia did not industrialize along with Western Europe and why Italy's South has not caught-up with the North. Introduction to the neoclassical approach and evolutionary perspectives.
2. Introduction to neoclassical growth theory (Rodrigo: ch. 2 & 3; supplementary readings)  
Kaldor's stylized facts of growth. The Harrod-Domar model, the Solow-Swan models and the derivation of the steady-state condition. New, endogenous theories of growth. The problem of assessing the role of total factor productivity growth in assessing technological change.
3. The process of invention and innovation (Ruttan: ch. 3)  
Invention and innovation; Schumpeterian innovation. Cumulative synthesis: steam engine; rice varieties and the microprocessor. Linkage between science and technology. The research institution. Learning by doing and using.
4. Technical and institutional innovation (the evolutionary perspective) (Ruttan: ch. 4)  
The sources of technical change and institutional innovation that influence the rate and direction of technical change and their roles within the Ruttan-Hayami model of induced innovation. The Nelson-Winter model of evolutionary change.
5. Technology adoption, diffusion and transfer (Ruttan: ch. 5 & Rodrigo: ch. 4, 5 & 6)  
The diffusion of technology, product cycle models and industrial learning in advanced and newly industrializing nations. The role of exports, imports and the evolution of development theory.
6. Technical change and agricultural development (Ruttan: ch. 6)  
Models of agricultural development. Induced technical change in agriculture. Scientific and technical constraints. Resource and environmental constraints. Agricultural research systems in the USA and abroad.
7. Lighting, power and energy (Ruttan; ch. 7)  
The battle of rival power supply systems. Electricity and the transformation of industrial energy use. Petroleum, growth and productivity; economic and political issues. Electricity generation. Clean air, renewable energy, energy conservation and deregulation.
8. Technical change in the chemical industry (Ruttan: ch. 8)  
The university-industry linkage in Germany. Synthetic dyestuffs, the Haber-Bosch process and the invention of nylon. Chemical engineering and the petrochemical revolution. The international diffusion of chemical technologies.
9. Computer and semiconductor industries (Ruttan: ch. 9)  
The commercial development of calculators and computers. IBM and the setting of mainframe

standards. Transistors and microprocessors. Minicomputers and microcomputers. The software industry. Software as capital: a perspective on the evolution of technology. The software industry in India. Computers and productivity growth in the USA.

10. The Biotechnology industries (Ruttan: ch. 10)

Biological technology, biotechnology and molecular biology. The university-industry nexus. The patenting issue with regard to natural products and related information. the pharmaceutical industry and agricultural biotechnology. Industrial policy and international competition. The food industry and genetically modified organisms.

11. National innovation systems; a historical perspective (Ruttan: ch. 11 & Rodrigo: ch. 7)

The American system, the Japanese system and the German system. Innovation in the East Asian “tiger” economies. New research on national innovation systems.

12. Technology, resources and the environment (Ruttan: ch. 12)

Resources and economic growth. The economics of renewable and non-renewable resources. Externalities and environmental concerns. Industrial production and ecological sustainability. Emissions trading and global climate change.

13. Science and technology policy (Ruttan: ch. 13 & Rodrigo: ch. 9)

Principles of science and technology policy. The patent system. Military procurement. The politics of science and technology policy. Other issues in science and technology policy. The debate over industrial policy and technological progress in the USA. The debate over technology and development in developing countries.

14. The future of technological change (Ruttan: ch. 14)

General purpose technologies. The role of the government. Induced innovation. Establishing social control over the evolution of technology. Ecological sustainability and food security. The challenges ahead.