Lecture # 1 -- Introduction

I. Why Study the Economics of Science and Technology?

- Why study the economics of science and technology?
  - Innovations in science and technology play an important role in economic growth.
  - Thus, it is useful to understand what factors influence the development of technology.
- In general, economists study of the allocation of scarce resources.
  - In this course, the scarce resource is the effort utilized in the scientific process.
  - This could be money invested in R&D, labor efforts of scientists and engineers, etc.
- We want to ask:
  1. What determines how much effort is invested into the scientific process?
     - How do firms (or governments) decide how much to invest in R&D?
     - How do they decide which projects to invest in?
       - E.g. how much money for AIDS research vs. cancer research?
     - How do they decide which technologies to use?
  2. How does government policy affect this process?
     - Why is intervention necessary?
       - What are the market failures?
     - How much money should the government spend on R&D?
       - How do we evaluate the effectiveness of government R&D investments?
     - Should it subsidize private R&D?
     - How strong should intellectual property rights be?
       - E.g.: Do software patents help or hinder innovation?Should developing countries recognize patents on life-saving drugs?
  3. What affect does this research have on economic well-being?
     - As we discussed later in class, increases in productivity greatly affect long-run economic growth. How do scientific gains translate into productivity gains?
  4. How does technology affect government policies?
     - What policies are needed to govern information technology?
     - How does globalization affect the outcomes of technological progress?
     - How can policy promote the development of clean energy technologies?

II. The Importance of Technology

- Usually, when economists look at the effects of science and technology, we look at productivity.
- Productivity is the amount of output per unit of input.
- Examples:
    - Labor productivity – output per worker.
        - Note that this is simply average product from managerial economics.
        - Labor productivity has tended to be strongly correlated with wages, and is thus a reasonable measure of changes in economic welfare.
    - Total factor productivity – a measure of output per unit of combined inputs.
        - Unlike labor productivity, this looks at the productivity of all inputs in the economy.
        - Traditionally, economists focus on capital and labor:
            - change in Y = change in K + change in L + change in technology.
            - We can measure changes in output, capital, and labor. Changes in technology are the residual.
            - See today's slides for examples
            - Those interested in more information can find detailed data at the U.S. Bureau of Labor Statistics page on multifactor productivity.
- Increases in productivity are important because small differences in growth rates lead to large long-term results. Today's slides include an example and sample growth rates from around the world.

III. Policy Relevance

- Three “parts” to technological change.
    - Invention: the initial development of an idea. Could be represented, for example, by a patent.
    - Innovation: adopting the invention for commercial use.
    - Diffusion: the spread of the new innovation throughout the economy.
- Different policies affect different parts of the process.
- Government intervention in science and technology can be justified by market failures.
    - As we will see, knowledge is a public good.
    - There are positive spillovers from the creation of knowledge for which firms are not rewarded.
    - Thus, underinvestment in R&D is likely.
- One role of government policy is to encourage invention and innovation.
    - Patent protection allows firms to capture spillovers.
    - Tax subsidies lower the cost of R&D.
    - Because some knowledge is not rewarded in the marketplace, or because widespread dissemination of some knowledge is sired, the government may perform R&D directly.
        - Today's slides provide examples of R&D spending by country.
- Government policy can also encourage diffusion
    - Patents make knowledge public
    - Government labs transfer knowledge to industry
    - Universities license technology to industry