

PAI 776
The Economics of Science and Technology
Spring 2014

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Office Hours:
Tuesday 10:00-noon
Wednesday 10:00-noon
or by appointment

Course Description: In an ever-changing world, technological change both influences policy decisions and is influenced by policy. This course looks at the interaction of policy and technological change from both directions. Throughout the course, we will use examples from current policy debates to highlight important issues. The course begins with an introduction to the economic analysis of knowledge. We begin by discussing the role that knowledge plays in the economic growth of nations. Next, we look at why economists consider the creation of knowledge to be a public good, and discuss how the public goods nature of knowledge affects the creation of new knowledge. We then ask how government policy, such as patent protection and government funded R&D, influences the development of new technologies. Next, we look at the diffusion of knowledge. We begin by looking at how new knowledge is transferred, both across institutions in the industrialized world and to developing countries. Finally, we conclude by considering how technological change affects policy. For example, 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?

Goals of the course: The main objective of this course is for you to learn how to think critically about issues relating to science and R&D. Upon completion of this course, you should be able to explain the economic rationale for government involvement in science policy, and be able to discuss what the impact of such involvement will be. In particular, it is hoped that the class will provide you with a better understanding of current issues relating to science and innovation.

Accomplishing these goals requires not only a mastery of some basic economic tools, but also an ability to apply these tools to real world issues. As such, much of the content of the course will apply the basic tools that we discuss in class to current event issues.

Learning to apply economics to the real world takes practice. The assignments for this class are designed to get you thinking and writing using economic analysis. In addition, classroom discussion plays an important role in developing the skills to apply economic theory to the real world. Active participation in discussions, both in class and via e-mail (discussed below) is vital to success in this course. For this reason, class participation will count towards ten percent of your course grade. Don't be afraid to participate because you feel what you have to say isn't important or may not be correct. Many of the things we will discuss in this class have no right answers. Your opinions matter! The class participation grade will consist of two components: participation in general class discussions and participation in discussions on the class e-mail discussion list. I will occasionally use the list to post follow-up questions to topics discussed in class.

Prerequisites: The prerequisite for this course is PAI 723, Economics for Public Decisions, or an equivalent course in microeconomics. If you have any questions about whether or not you have taken an appropriate course, please see me as soon as possible.

Class Home Page: The home page for this class is:

[http:// classes.maxwell.syr.edu/pai776](http://classes.maxwell.syr.edu/pai776)

You can also connect to the home page through my personal home page, which can be found at:

<http://faculty.maxwell.syr.edu/dcpopp/index.html>

The web site includes information about assignments, summaries of lectures, and links to other useful economic sites. These links may be particularly useful as you work on your research paper.

E-mail: All students in the class are required to have an e-mail account and to check e-mail regularly. An e-mail discussion list will be set up for the class, to which you should subscribe. Information on how to subscribe is included below. Participation in a class e-mail discussion list makes up part of your class participation grade. In addition, I will occasionally make announcements about assignments and class material via the discussion list. Not subscribing is not an appropriate excuse for missing these announcements.

E-mail discussion group: I have set up an e-mail discussion group for the class. All students are expected to subscribe to the mailing list. You may use this list for any class related activities, such as asking questions, continuing discussions from class, and instigating new discussions. I will use the list to keep you informed about assignments, answer questions, and instigate discussion. When messages are sent to the list, all students subscribed to the list will get the message.

To subscribe to the list, send an e-mail to listserv@listserv.syr.edu with the following message:

SUB EconSci Jan Smith

Note that this is all that need be in the body of the message, and that it must be typed in exactly as written, except, of course, that you should replace your name for Jan Smith. When you sign up, you will receive a message with detailed instructions for participating in the mailing list. ***This message will ask that you reply, so as to confirm that you intended to join the list. It is important that you remember to reply, or else you will not be added to the list!***

A couple of technical notes: E-mails sent to the list are sent to EVERYONE who subscribes to the list. If you want to send a personal e-mail to a specific class member (or to me), use their e-mail address, not the list's address. The list is a good place to ask questions about class materials, because everyone can see the answer. It is not the way to let me know that you are going to miss class on Wednesday. For that you should send an e-mail to me personally. Also, I am considered the owner of this list. If you experience any problems, please e-mail me directly. My e-mail address is dcpopp@maxwell.syr.edu.

Reading: There is no textbook for the class. Instead, the readings include a combination of journal and media articles. The class web site includes links to these articles. When possible, direct links to the articles are provided. The remainder are available on Blackboard.

These readings have two purposes: to expose you to influential work in the economics of innovation and to highlight the relevance of these theories to current events. The first goal is accomplished through journal articles written by professional economists. At times, these articles may get quite technical. When that occurs, you are encouraged to focus on the main arguments and conclusions of the paper, and to simply browse through the technical parts. Reading these articles, and discussing them in class, will also help you to become an educated consumer of economic research. The second goal is met by several shorter articles taken from current events publications. Articles in the *Journal of Economic Perspectives* are particularly useful, as they fall under both categories. These articles usually provide summaries of work done by professional economists on current events issues. You may also find it helpful to consult other articles in this journal for paper ideas.

In addition to required readings, the syllabus also includes optional articles. These are marked with an asterisk (*). They are not included on the on-line reading list, but should be available at the library, usually in electronic form. Optional articles provide more detail on selected topics, and may be helpful for your research papers. In particular, Ph.D. students should find the optional articles a useful way to increase their exposure to the economic literature in the field.

Grading: Masters' Students: Your grade in this course will be based on participation in class and e-mail discussions (10%), two take home exams (15% each), participation in a group policy discussions (10%), a take home final exam (20%), and a research paper (30%). The take home exams will be handed out in class, and due the following class meeting. They will focus on applications of the material discussed in class, and will be in the form of short problem or essay questions. The take home final will be given during the final exam period.

Ph.D. Students: In order to get you thinking about the research process, the assignments for Ph.D. students vary slightly. Ph.D. students will participate in the group policy discussions, and will do a research paper. However, rather than take the exams, Ph.D. students will be expected to do a referee report of a working paper in the field. In addition, the requirement for the research paper will be different. Ph.D. students should consider the paper to be a research proposal. That is, in addition to identifying an interesting question, you should think about *how* you would go about answering the question. Note that, given the time constraints of a one-semester course, it is not necessary that you carry out the research. The grading for Ph.D. students will be: participation in class and e-mail discussions (10%), participation in one of the group policy discussions (10%), the referee report (30%), and a research paper (50%).

Finally, note that if you miss a class, it is your responsibility to find out if you missed any assignments or handouts. Not being present when an assignment was given out is **not** an acceptable excuse for missed or late work!

Religious holidays: SU's religious observances policy, found at http://supolicies.syr.edu/emp_ben/religious_observance.htm, recognizes the diversity of faiths represented among the campus community and protects the rights of students, faculty, and staff to observe religious holy days according to their tradition. Under the policy, students are provided an opportunity to make up any examination, study, or work requirements that may be missed due to a religious observance provided they notify their instructors before the end of the second week of classes. For fall and spring semesters, an online notification process is available through MySlice/Student Services/Enrollment/My Religious Observances from the first day of class until the end of the second week of class. In the case of take-home exams, deadlines may be extended if necessary, but exams will still be taken during the assigned exam periods.

Research Paper: The major assignment for this class is a semester-long research paper on a topic of your choosing. It should be between 10 and 15 pages, double-spaced. I will hand out more details on the paper, including suggestions for topics, further into the course. The paper should apply the materials of the course to a public policy question. It should include a summary of the relevant theory that applies to your topic, and apply the theory to the problem to reach a conclusion. To make sure that you are on the right track, a one-page statement of your proposed research topic is due **Wednesday, March 5**. In it, you should state the question that you wish to address, briefly describe why it is important, and propose the means by which you will analyze your proposed topic. The final paper will be due at the beginning of our last class meeting on **Monday, April 28**.

Policy Discussions: Throughout the semester, we will look at applications of the theories discussed in class to current policy issues. To enhance the discussion of these topics, the class will be divided into groups of two or three students to lead discussions on several of these topics. Each student will participate in one such group during the semester. Potential topics and dates for discussion are:

- February 17:** Patent policy reform
- March 17:** The role of universities in research
- April 2:** The TRIPS agreement and patents in developing countries
- April 14:** File sharing and copyright laws
- April 16:** Who pays for broadband?
- April 21:** Technology and globalization

These policy discussions are intended to give you experience using the theories that we discuss in class in an applied setting. Each group will give a short 15-20 minute presentation on their topic. The presentation should begin by introducing the topic and key issues. Each presentation should conclude with suggestions for how policy should be changed (if at all). The class will then continue with a general discussion of the proposals presented. Members of each of the groups assigned to the topic will be expected to take a lead role in the discussion. I will announce the group assignments shortly. Students who have a preference for any of the above topics should send me an e-mail as soon as possible.

Academic Honesty: Students are expected to abide by the academic rules and regulations established by Syracuse University. These require students to “exhibit honesty in all academic endeavors. Cheating in any form is not tolerated, nor is assisting another person to cheat. The submission of any work by a student is taken as a guarantee that the thoughts and expressions in it are the student's own except when properly credited to another. Violations of this principle include giving or receiving aid in an exam or where otherwise prohibited, fraud, plagiarism, or any other deceptive act in connection with academic work. Plagiarism is the representation of another's words, ideas, programs, formulae, opinions, or other products of work as one's own, either overtly or by failing to attribute them to their true source” (*Syracuse University Bulletin* 2003-2004: p. 2). Of particular importance, while you are free to cite the views of others in your work, the final product must be *in your own words*, and any references to the works of others, whether directly quoted or merely paraphrased, must be cited. A good reference on the proper attribution of sources can be found at <http://www.dartmouth.edu/~sources/>. For more information on Syracuse University's academic integrity policies, see <http://academicintegrity.syr.edu>.

If you believe that you need accommodations for a disability, please contact the Office of Disability Services(ODS), <http://disabilityservices.syr.edu>, located in Room 309 of 804 University Avenue, or call (315) 443-4498 for an appointment to discuss your needs and the process for requesting accommodations. ODS is responsible for coordinating disability-related accommodations and will issue students with documented disabilities Accommodation Authorization Letters, as appropriate. Since accommodations may require early planning and generally are not provided retroactively, please contact ODS as soon as possible.

Reading List

I. Introduction

January 13 – Introduction

January 15 –Technology and Economic Growth

Reading: Ruttan, Vernon W. (2001), “Catching Up and Falling Behind,” chapter 2 in *Technology, Growth, and Development: An Induced Innovation Perspective*, Oxford Press, New York, 15-60.

Baily, Martin Neal, James Manyka, and Shalabh Gupta (2013), “U.S. Productivity Growth: An Optimistic Perspective,” *International Productivity Monitor*, 25, 3-12.

Gordon, Robert J (2012), “Is U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds,” *National Bureau of Economic Research Working Paper #18315*.

Grossman, Gene M. and Elhanan Helpman (1994), “Endogenous Innovation in the Theory of Growth,” *Journal of Economic Perspectives*, 8(1), pp. 23-44.

“Has the idea machine broken down?” *The Economist*, January 12, 2013, 21-24.

“Service break,” *The Economist*, March 27, 2010.

*Romer, Paul M. (1990), “Endogenous Technological Change,” *Journal of Political Economy*, 98, pp. S71-S102.

II. The Economics of Knowledge

January 22 – Knowledge as a Public Good

Reading: Cappelli, Riccardo, Dirk Czarnitzki, and Kornelius Kraft (2014), “Sources of spillovers for imitation and innovation,” *Research Policy*, 43, 115-120.

Geroski, Paul (1995), “Markets for Technology: Knowledge, Innovation, and Appropriability,” ch. 4. in Paul Stoneman, ed. *Handbook of the Economics of Innovation and Technological Change*, pp. 90-131.

Mansfield, Edwin, John Rapoport, Anthony Romeo, Samuel Wagner, and George Beardsley (1977), “Social and Private Rates of Return from Industrial Innovations,” *The Quarterly Journal of Economics*, 91(2), pp. 221-240.

*Arrow, Kenneth, (1962), “Economic Welfare and the Allocation of Resources for Invention,” *The Rate and Direction of Inventive Activity: Economic and Social Factors*, National Bureau of Economic Research, pp. 609-625.

*Nelson, Richard, (1959), “The simple economics of basic research,” *Journal of Political Economy*, 67, pp. 297-306.

*Jones, Charles I. and John C. Williams (1998), “Measuring the Social Return to R&D,” *Quarterly Journal of Economics*, 119-135.

January 27 – Measuring Knowledge

- Reading:* Basberg, Bjorn L. (1987), “Patents and the measurement of technological change: A survey of the literature,” *Research Policy*, 16, pp. 131-141.
- King, David A. (2004), “The scientific impact of nations,” *Nature*, 430, 311-316.
- “R&D and Productivity Growth,” Congressional Budget Office Background Paper, June 2005.
- “Climbing Mount Publishable,” *The Economist*, November 13, 2010, 95-96.
- “Net Benefits,” *The Economist*, March 9, 2013, 76.
- *Griliches, Zvi (1990), “Patent Statistics as Economic Indicators: A Survey,” *Journal of Economic Literature*, 28(4), pp 1661-1707.
- *Griliches, Zvi (1995), “R&D and Productivity: Econometric Results and Measurement Issues,” ch. 3. in Paul Stoneman, ed. *Handbook of the Economics of Innovation and Technological Change*, pp. 52-89.
- *Griliches, Zvi (1979), “Issues in assessing the contribution of research and development to productivity growth,” *Bell Journal of Economics*, 10, 92-116.
- *Hall, Bronwyn H., Jacques Mairesse, and Pierre Mohnen (2010), “Measuring the Returns to R&D,” in *Handbook of the Economics of Innovation*, vol. 2, Bronwyn H. Hall and Nathan Rosenberg (eds.), 1033-1082.

III. Sources of Technological Change

January 29 & February 3 – Sources of Technological Change

- Reading:* Arthur, W. Brian (2007), “The structure of invention,” *Research Policy*, 36, 274-287.
- Link, Albert N. and Donald S. Siegel (2003), “Sources of technological knowledge,” ch. 8 in Link and Siegel (eds.) *Technological Change and Economic Performance*, pp. 60-69.
- Nemet, Gregory F. (2008), “Does Learning By Doing Improve Energy Technology?” *LaFollette Policy Report*, 17(2), pp. 17-20.
- Ruttan, Vernon W. (2002), “Sources of Technical Change: Induced Innovation, Evolutionary Theory, and Path Dependence,” chapter 2 in *Technological Change and the Environment*, Arnulf Grübler, Nebojsa Nakicenovic, and William D. Nordhaus, eds., Resources for the Future, Washington, DC.
- Thompson, Peter (2012), “The Relationship between Unit Cost and Cumulative Quantity and the Evidence for Organizational Learning-by-Doing,” *Journal of Economic Perspectives*, 26(3), 203-224.
- “Big and Clever,” *The Economist*, December 11, 2011, 116.
- “Catch the wave,” *The Economist*, February 20, 1999, pp. S7-S8.
- “Don’t laugh at gilded butterflies,” *The Economist*, April 24, 2004, pp. 71-73.
- “Out of the dusty labs,” *The Economist*, March 3, 2007, pp. 74-76.
- “Rising in the East,” *The Economist*, January 3, 2009, 47.
- *Kortum, Samuel. and Joshua Lerner (1998), “Stronger protection or technological revolution: what is behind the recent surge in patenting?” *Carnegie-Mellon Conference Series on Public Policy*, 48, pp. 247-304.

IV. Policies to Promote Innovation

February 5 – What is Intellectual Property Protection (IPP)?

- Reading* Rockett, Katharine (2010), “Property Rights and Invention” in *Handbook of the Economics of Innovation*, vol. 1, Bronwyn H. Hall and Nathan Rosenberg (eds.), **read secs 1-4 only**, 315-332.
- Varian, Hal R (2005), “Copying and Copyright,” *Journal of Economic Perspectives*, 19(2), pp. 121-138.
- Porter, Eduardo, “In a Ruling, The Legacy of Betamax,” *The New York Times*, March 27, 2013, B1, B4.
- *Jaffe, Adam B. (2000), “The US Patent System in Transition: Policy Innovation and the Innovation Process,” *Research Policy*, 29, 531-557.

February 10 – How Firms Use Intellectual Property Protection

- Reading:* Greenhalgh, Christine and Mark Rogers (2007), “The value of intellectual property rights to firms and society,” *Oxford Review of Economic Policy*, 23(4), pp. 541-567.
- Hall, Bronwyn H., Christian Helmers, Mark Rogers, and Vania Sena, “The Choice Between Formal and Informal Intellectual Property: A Literature Review,” *NBER Working Paper #17983*.
- Duhigg, Charles and Steve Lohr, “The Patent, Mighty as a Sword,” *The New York Times*, October 8, 2012, A1, A14-A15.
- Rusli, Evelyn M., “Quest for Patents Brings a New Focus in Technology Deals,” *The New York Times*, August 19, 2011, B6.
- “Can you keep a secret?,” *The Economist*, March 16, 2013, 67.
- “Patently Absurd,” *The Economist*, June 23, 2001, pp. S40-S42.
- “Standard procedure,” *The Economist*, May 11, 2013, 83.
- *Hall, Bronwyn H. and Rosemarie Ham Zedonis (2001), “The patent paradox revisited: an empirical study of patenting in the U.S. semiconductor industry, 1979-1995,” *RAND Journal of Economics*, 32(1), 101-128.
- *Levin, Richard C., Alvin K. Klevorick, Richard R. Nelson, and Sidney G. Winter (1987), “Appropriating the Returns from Industrial Research and Development,” *Brookings Papers on Economic Activity*, 3, pp. 783-831.

February 12 – Case: Medical Biotechnology

- Reading:* Cockburn, Iain M., Scott Stern, and Jack Zausner (2011), “Finding the Endless Frontier: Lessons from the Life Sciences Innovation System for Energy R&D,” chapter 4 in *Accelerating Energy Innovation: Insights from Multiple Sectors*, Rebecca M. Henderson and Richard G. Newell eds., University of Chicago Press, Chicago, IL, 113-157.
- Liptak, Adam, “Justices, 9-0, Bar Patenting Human Genes,” *The New York Times*, June 14, 2013, A1, A16.
- Wilson, Duff, “Patent Woes Threatening Drug Firms,” *The New York Times*, March 7, 2011, A1, A3.
- “An open-source shot in the arm?” *The Economist*, June 12, 2004, pp. S17-S19.
- “Cliffhanger,” *The Economist*, December 3, 2011, 76.
- “Friends for life,” *The Economist*, August 8, 2009, 55-56.
- “More harm than good?” *The Economist*, April 17, 2010, 90-91.
- “Prometheus unsound,” *The Economist*, March 24, 2012, 66.
- “Regenerative medicine,” *The Economist*, February 23, 2013, 63.

February 17 – IPP Policy Issues

- Reading:* Boldrin, Michele and David K. Levine (2013), “The Case Against Patents,” *Journal of Economic Perspectives*, 27(1), 3-22.
- Graham, Stuart and Saurabh Vishnubhakat (2013), “Of Smart Phone Wars and Software Patents,” *Journal of Economic Perspectives*, 27(1), 67-86.
- Hunt, Robert M., “You Can Patent That? Are Patents on Computer Programs and Business Methods Good for the New Economy?” *Business Review*, Quarter 1, 2001, pp. 5-15.
- Barnes, Robert and Alan Sipress, “Rulings Weaken Patents’ Power: High Court Decides on Two Key Cases,” *The Washington Post*, May 1, 2007, p. D1.
- Schwartz, John, “Broad View of Patents on Methods,” *The New York Times*, June 29, 2010, B1, B4.
- Varian, Hal R., “Economic Scene: A patent that protects a better mousetrap spurs innovation. But what about one for a new way to amuse a cat?” *The New York Times*, October 21, 2004, C2.
- National Academies (2004), “Patent System for the 21st Century: Summary of a STEP Board Report.”
- “iPhone, uCopy, iSue,” *The Economist*, September 1, 2012, 12-14.
- “Many patents, still pending,” *The Economist*, September 10, 2012, 72.
- *Moser, Petra (2013), “Patents and Innovation: Evidence from Economic History,” *Journal of Economic Perspectives*, 27(1), 23-44.

February 19 – Science vs. Profit

- Reading:* Stephan, Paula E. (2010) “The Economics of Science,” in *Handbooks in Economics: Economics of Innovation Volume 1*, Bronwyn H. Hall & Nathan Rosenberg eds., North-Holland, Amsterdam, pp. 216-273 (focus on sections 1-7).
- Foray, D. DC. Mowrey, and R.R Nelson (2012), “Public R&D and social challenges: What lessons from mission R&D programs?” *Research Policy*, 41, 1697-1702.
- “Science and Profit,” *The Economist*, February 17, 2001, pp. 21-22.
- “Outrageous Fortune,” *The Economist*, May 19, 2001, pp. 77-78.
- “Pity the messenger,” *The Economist*, March 28, 2009, 90-91.
- *Murray, Fiona and Scott Stern (2007), “When Ideas Are Not Free: The Impact of Patents on Scientific Research,” in *Innovation Policy and the Economy vol. 7*, Adam B. Jaffe, Josh Lerner, and Scott Stern (eds.), MIT Press, Cambridge, MA, pp. 33-69.
- *Stephan, Paula (2013), “The Endless Frontier: Reaping What Bush Sowed?,” *National Bureau of Economic Research Working Paper #19687*.

Take home exam 1 handed out in class on Wednesday, February 19. Due in Class Monday, February 24.

February 24– Government Subsidies of R&D

- Reading:* Hall, Bronwyn and John Van Reenen (2000). “How Effective are Fiscal Incentives for R&D? A Review of the Evidence,” *Research Policy*, 29, pp. 449-469.
- David, Paul A., Bronwyn H. Hall, and Andrew A. Toole (2000), “Is Public R&D a Complement or Substitute for Private R&D? A Review of the Econometric Evidence,” *Research Policy*, 29, pp. 497-529.
- Williams, Heidi (2012), “Innovation inducement prizes: Connecting research to policy,” *Journal of Policy Analysis and Management*, 31(3), 752-776.
- Lohor, Steve, “A \$1Million Research Bargain for Netflix, and Maybe a Model for Others,” *The New York Times*, September 22, 2009, B1, B4.

February 26 & March 3 – Evaluating Public R&D Programs

- Reading:* Jaffe, Adam B. (2002), “Building Programme Evaluation into the Research Design of Public Research-Support Programmes,” *Oxford Review of Economic Policy*, 18(1), 22-34.
- Lane, Julia (2009), “Assessing the Impact of Science Funding,” *Science*, 324, 1273-1275.
- Ruegg, Rosalie and Irwin Feller (2003), *A Toolkit for Evaluating Public R&D Investment*, US Dept. of Commerce National Institute of Standards and Technology, chapters 1-2, pp. 6-53.
- Committee on Prospective Benefits of DOE’s Energy Efficiency and Fossil Energy R&D Programs (2007), *Prospective Evaluation of Applied Energy Research and Development at DOE (Phase One): A First Look Forward*, National Research Council, National Academies Press, Washington, DC, chapters 1-3, pp. 6-31.
- *Jacob, Brian A. and Lars Jefgren (2011), “The impact of research grant funding on scientific productivity,” *Journal of Public Economics*, 95, 1168-1177.

V. Diffusion of Knowledge**Statement of Research Topic Due Wednesday, March 5**

March 5 – Technology Transfer

- Reading:* Bozeman, Barry (2000), “Technology transfer and public policy: a review of research and theory,” *Research Policy*, 29, pp. 627-655. (skim sec. 6)
- Mowrey, David C. and Timothy Simcoe (2002), “Is the Internet a US invention – an economic and technological history of computer networking,” *Research Policy*, 31, pp. 1369-1387.
- “Research and Development: Funds and Technology Linkages,” chapter 4 in *Science and Engineering Indicators: 2006*. Read pages 4-19 to 4-38.
- *Jaffe, Adam B. and Josh Lerner (2001), “Reinventing public R&D: patent policy and the commercialization of national laboratory technologies,” *RAND Journal of Economics*, 32(1), pp. 167-198.
- *Vonortas, Nicholoas (1997), “Research joint ventures in the US,” *Research Policy*, 26, pp. 577-595.

March 17 – Government Policy For Technology Transfer

- Reading:* Larsen, Maria Theresa (2011), “The implications of academic enterprise for public science: An overview of the empirical evidence,” *Research Policy*, 40, 6-19.
- Link, Albert N. (2006), “Research Joint Ventures,” chapter 9 in *Public/Private Partnerships: Innovation Strategies and Policy Alternatives*, Springer, New York, NY, 83-95.
- Sampat, Bhaven N. (2006), “Patenting and US academic research in the 20th century: The world before and after Bayh-Dole,” *Research Policy*, 35, pp. 772-789.
- Flanigan, James, “The Route From Research to Start-Up,” *The New York Times*, January 18, 2007, p. C16.
- Kunhardt, Erich E., “Necessity as the Mother of Tenure?” *The New York Times*, December 14, 2004, A33.
- Morrissey, Susan R., “Maximizing Returns,” *Chemical & Engineering News*, September 15, 2003, pp. 17-20.
- Pérez-Peña, Richard, “Patenting Their Discoveries Does Not Pay Off for Most Universities, a Study Says,” *The New York Times*, Nov. 21, 2013, A18.
- *Foray, Dominique and Francesco Lissoni (2010) “University Research and Public-Private Interaction,” in *Handbooks in Economics: Economics of Innovation Volume 1*, Bronwyn H. Hall & Nathan Rosenberg eds., North-Holland, Amsterdam, pp.375-314.

March 19 – Technology Policy for Local governments

- Chatterji, Aaron, Edward L. Glaeser, and William R. Kerr (2013), “Clusters of Entrepreneurship and Innovation,” *National Bureau of Economic Research Working Paper #19013*.
- Dewan Shaila, “Cities Race to Bet on Biotech, Despite Long Odds,” *New York Times*, June 11, 2009, A1, A16.
- Goolsbee, Austan, “What Baseball Can Teach Those Who Dream of Creating the Next Silicon Valley,” *The New York Times*, August 17, 2006, C3.

March 24 – Theories of Diffusion

- Reading:* Gillingham, Kenneth and Karen Palmer (2013), “Bridging the Energy Efficiency Gap: Policy Insights from Economic Theory and Empirical Evidence,” *Resources for the Future Discussion Paper 13-02-REV*.
- Hall, Bronwyn (2004), “Innovation and Diffusion,” *NBER Working Paper #10212*.
- “Lock and Key,” *The Economist*, September 18, 1999, p. 88.
- “Getting the message,” *The Economist*, March 4, 2006, p. 61.
- *Griliches, Zvi (1957), “Hybrid Corn: An Exploration of the Economics of Technological Change,” *Econometrica*, 25, pp. 501-522.
- *Karshenas, Massoud and Paul Stoneman (1995), “Technological Diffusion,” ch. 7 in Paul Stoneman, ed. *Handbook of the Economics of Innovation and Technological Change*, pp. 265-297.

VI. International Technology Diffusion

March 26 – International Technology Diffusion

- Reading:* Keller, Wolfgang (2001), “International Technology Diffusion,” *NBER Working Paper #8573*.
- World Investment Report 2005: Transnational Corporations and the Internationalization of R&D*, United Nations Conference on Trade and Development, chapters V & VI.
- *Krugman, Paul (1995), “Technological Change in International Trade,” ch. 9 in Paul Stoneman, ed. *Handbook of the Economics of Innovation and Technological Change*, pp. 342-365.
- *Coe, David T. and Elhanan Helpman, (1995), International R&D spillovers, *European Economic Review*, 39, pp. 859-887.

March 31 & April 2 – International Technology Policy

- Reading:* “Determinants of Technological Progress: Recent Trends and Prospects,” chapter 3 in *Global Economic Prospects 2008: Technology Diffusion in the Developing World*, World Bank, Washington, DC.
- Attaran, Amir and Lee Gillespie-White (2001), “Do Patents for Antiretroviral Drugs Constrain Access to AIDS Treatment in Africa?” *Journal of the American Medical Association*, 286(15), pp. 1886-1892.
- Bollyky, Thomas J. (2013), “Access to Drugs for Treatment of Noncommunicable Diseases,” *PLOS Medicine*, 10(7), 1-3.
- Forero-Pineda, Clemente (2006), “The impact of stronger intellectual property rights on science and technology in developing countries,” *Research Policy*, 35, pp. 808-824.
- Gervais, Daniel J. (2013), “TRIPS & Development” *SAGE Handbook on Intellectual Property*. Ed. Matthew David and Debora Halbert, eds., SAGE, 1-30.
- Dugger, Celia W., “Study Finds Small Developing Lands Hit Hardest by ‘Brain Drain’,” *The New York Times*, October 25, 2005, p. A9.
- Harris, Gardiner, “India’s Efforts to Aid Poor Worry Drug Makers,” *The New York Times*, December 30, 2013, A1, A3.
- “Drain or gain?” *The Economist*, May 28, 2011, 80.
- “Patents and the poor: The rights to good ideas,” *The Economist*, June 23, 2001, pp. 21-23.
- “Plight of the sea turtles,” *The Economist*, July 6, 2013, 41-42.
- “Weaving the world together,” *The Economist*, November 19, 2011, 72-74.
- *Ginarte, Juan C., Park, Walter G. (1997), “Determinants of patent rights: a crossnational study,” *Research Policy* 26, 283–301.
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Take home exam 2 handed out in class on Wednesday, April 2. Due in Class Monday, April 7.

April 7 – Examples of Technology in Developing Countries

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VII. Information Technology and the Economy

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- Reading:* Varian, Hal and Carl Shapiro (1997), “U.S. Government Information Policy”.
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VIII. Policy Issues

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Reading: Freeman, Richard . (2013), “One ring to rule them all: Globalization of Knowledge and Knowledge Creation,” *National Bureau of Economic Research Working Paper #19301*.

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April 23 – Innovation, Energy, and Climate Change

Reading: Newell, Richard G. (2011), “The Energy Innovation System: A Historical Perspective,” chapter 1 in *Accelerating Energy Innovation: Insights from Multiple Sectors*, Rebecca M. Henderson and Richard G. Newell eds., University of Chicago Press, Chicago, IL, 25-47.

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April 28 – Innovation Policy or Industrial Policy?

Reading: “Green Innovation and Industrial Policies,” chapter 3 in *Inclusive Green Growth: The Pathway to Sustainable Development*, The World Bank, Washington, DC, 2012, 65-90.

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RESEARCH PAPERS DUE IN CLASS MONDAY, APRIL 28

TAKE HOME FINAL EXAM WILL BE AVAILABLE TO SIGN OUT DURING EXAM WEEK