Economics of Innovation
Fall 2016
Duke University Fuqua School of Business

Wesley M. Cohen  
Office # A105E  
wcohen@duke.edu

Kevin Bryan  
Office # A105C  
kevin.bryan@rotman.utoronto.ca

Tuesdays 1:25 to 4:00 pm, Room: Conference Room 4
First class Aug 30, Final class Nov 29 | No class on Oct 11

Course Description: This course focuses on technical change, its determinants and consequences, and its links to firm strategy and market structure. Our objective is to understand the economic determinants and consequences of technical change. However, technical change needs to be understood in a historical context, and consequently, the readings cover both historical description and economic analysis.

Course requirements: The course is intended as a PhD course. Intermediate microeconomics and econometrics are pre-requisites. Advanced undergraduates or masters students with appropriate preparation and interest are welcome.

The class will be run as a seminar class. You are expected to have done the readings and come prepared to discuss them in class. To this end, we will hand out discussion questions prior to many of the classes, and you will be expected to answer the questions in a 2-3 page paper based on the readings for each week. You are to turn in the paper at the beginning of class. The primary grading criterion is whether your paper demonstrates that you have read and digested the readings assigned.

We will also have students present key papers during the semester—that is convey the main points from a reading, and succinctly summarize the contribution to the literature.

We shall guide the discussions. Readings should be easily accessible using Google Scholar (particularly via JSTOR for published articles). Chapters from books and older readings will be made available the week before as pdf files through the course website. Readings marked with a (*) are mandatory.

Grading:
Most weeks, short 2-3 page papers, as discussed above, will be assigned. You may miss a maximum of one assignment per mini term without hurting your grade (i.e., the worst paper in each mini-term will be dropped.)

You will also be required to write a research paper. A one page proposal for your paper topic should be submitted to the instructors by September 30th. The paper should be related to the broad themes of the nature and determinants of technological change. Ideally, it should help you develop dissertation research or support your research papers.

The weights for the course grade follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Research paper</td>
<td>50%</td>
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<tr>
<td>Class participation</td>
<td>25%</td>
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<tr>
<td>Short papers</td>
<td>20%</td>
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</tbody>
</table>
*1942, J. Schumpeter, Capitalism Socialism and Democracy  
Read Ch 7, the Late Schumpeter on his “creative destruction”, and Ch 12  
1962, R. Nelson, The Link Between Science and Invention: The Case of the Transistor, in NBER Volume The Rate and Direction of Inventive Activity  
Classic case study of the mutual feedback between science and invention  
1994, H. Brooks, The Relationship Between Science and Technology, RP  
Science affects technology in six ways, and technology feeds back into science  
1966, R. Nelson and E. Phelps, Investment in Humans...., AER P&P  
Formalization of catch-up with explicit role for human capital in diffusion  
1986, P. Romer, Increasing Returns and Long-Run Growth, JPE  
Origin of endogenous growth lit where current knowledge begets future growth  
1990, P. Romer, Endogenous Technological Change, JPE  
Knowledge affects growth like Romer 86 but created as an equilibrium choice  
1991, G. Grossman and E. Helpman, Quality Ladders...., RESTUD  
Expands differentiated products models to allow quality-improving innovation  
1999, C. Jones, Growth: With or Without Scale Effects, AER  
Endogenous growth involves tricky modeling choices to get realistic growth paths  
1997, S. Kortum, Research, Patenting and Technological Change, Ecta  
Why is research output not growing even as we have many more scientists?  
2011, R. Goettler and B. Gordon, Did AMD Spur Intel to Innovate More?, JPE  
Structural examination of how competition moves quality ladder  
WP, B. Jones, The Knowledge Trap: Human Capital and Development Reconsidered  
Diversity in occupations matters so effect of human capital on growth is large  
The classic model of Schumpeterian Growth  
(http://scholar.harvard.edu/files/aghion/files/what_do_we_learn_0.pdf)  
What have we learned from creative destruction models a la Aghion-Howitt?  

Week 2, Sept 6 | Innovation in 2 Industrial Revolutions and Today | Bryan

* 1997, P. Temin, Two Views of the British Industrial Revolution, JEH  
Was the IR broad or simply driven by a few small industries?  
* 1999, J. Mokyr, Editor's Introduction: The New Economic History and the Industrial Revolution
A lengthy summary of how science and technology drove the IR in Mokyr's View 2002, J. Mokyr, The Gifts of Athena (in particular pp 1-77)  
**Diffusion of useful knowledge, not its creation, was essential in modern growth**  
2009, R. Allen, The Industrial Revolution in Miniature: The Spinning Jenny in Britain, France, and India, JEH  
*The IR did not happen in Britain simply because Britain had better inventions*  
1993, M. Kremer, Population Growth and Technological Change...., QJE  
*Can Romer-style endogenous growth explain the long long long run of history?*  
* 2000, O. Galor and D. Weil, Population, Technology and Growth..., AER  
**Famous Unified Growth Model of Malthusian and Post-Malthusian eras**  
1960, A. E. Musson and E. Robinson, Science and Industry in the Late 18th Century, EHR  
*What did the technological world look like at the dawn of the IR?*  
1994, J. De Vries, The Industrial Revolution and the Industrious Revolution, JEH  
*Increase in labor supply and market production preceded Industrial Revolution*  
*Changes in fertility and economy-wide income preceded the Industrial Revolution*  
2004, N. Crafts, Steam as a General Purpose Technology...., EJ  
*Empirics show steam can only explain tiny portion of TFP growth during IR*  
* 1990, P. David, The Dynamo and the Computer, AER P&P  
**Electricity took long time from invention to impact; similar for the computer?**  
1987, G. Clark, Why Isn't the Whole World Developed? Lessons from the Cotton...., JEH  
*Is culture important for the early modern income differences?*  
*Exploitation of natural resources helps explain the rise of America*  
*Great inventors in early modern era actively pursued market opportunities*  
2006, N. Lamoreaux, M. Levenstein and K. Sokoloff, Mobilizing Venture Capital During the Second Industrial Revolution...., Capitalism and Society  
*Something looking very much like venture capital existed in the late 1800s*  
* 2013, N. Lamoreaux, K. Sokoloff and D. Sutthiphisal, Patent Alchemy..., BHR  
**Active sales markets for patents are not a new phenomenon**  
2011, R. Richter and J. Streb, Catching Up and Falling Behind: Knowledge Spillover from American to German Toolmakers, JEH  
*How does “stealing machines” in a country today affect innovation tomorrow?*  
* WP, B. Z. Khan, Knowledge, Human Capital and Economic Development...  
**Great inventors in early modern era were generally not trained scientists**  
* 2013, A. Nuvolari and J. Sumner, Inventors, Patents and Inventive Activities...., BHR  
**Invention of Porter beer is a great example of collective invention**  
1983, R. Allen, Collective Invention, JEBO  
*In new industries collective sharing of knowledge has long been common,*

**Week 3, Sept 13 | Innovation Geography, Spillovers, Diffusion | Bryan**

1996, D. Audretsch and Feldman, M, R&D Spillovers and the Geography of Innovation and Production, AER  
**Innovation is much more concentrated geographically than production**  
WP, A. Matray, The Local Spillovers of Listed Firms  
*Is agglomeration causally linked to the clustering of innovative activity?*
  Input-output analysis can help identify why industries agglomerate

  Identifying R&D Spillovers has traditionally been incredibly difficult

1993, A. Jaffe, M. Trajtenberg, and R. Henderson, Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations, QJE
  Backward patent citations provide evidence for spillovers

* 2013, N. Bloom, M. Schankerman, and J. Van Reenen, Identifying Technology Spillovers and Product Market Rivalry, Ecta
  Technology spillovers dominate socially-inefficient market stealing

2014, S. Kantor and A. Whalley, Knowledge Spillovers from Research Universities: Evidence from Endowment Value Shocks, RESTAT
  University research instrumented using endowment shocks spills over to industry

  Social network data to examine how a new pineapple spreads in Ghana

* 1957, Z. Griliches, Hybrid Corn: An Exploration in the Economics of Technical Change, Econometrica
  Examines the rationality of the lagged diffusion of hybrid corn in a classic study

  The classic diffusion paper, among doctors in Chicagoland

* 2003, B. Hall, Innovation and Diffusion, in Handbook of Innovation
  Handbook chapter summarizing economics of diffusion

2010, D. Comin and B. Hobijn, An Exploration of Technology Diffusion, AER
  Why does technology take so long to diffuse across countries?

WP, D. Gross, Scale versus Scope in the Diffusion of New Technology
  Products diffuse partially via changes in the scope of tasks they perform

1995, E. Rogers, Diffusion of Innovations
  Legendary psuedotextbook covering diffusion literature from many different fields

1995, G. Saloner and A. Shephard, Adoption of Technologies with Network Effects, RAND Journal
  Empirical investigation of the diffusion of a network good

WP, K. Bryan and Y. Ozcan, The Impact of Open Access Mandates on Innovation
  Inventors use academic knowledge more if it is easier to access

* 2010, J. Evans, Industry Induces Academic Science to Know Less about More, AJS
  Industry collaboration causes academics to work less deeply and more broadly,

Week 4, Sept 20 | Path Dependence and Industry Evolution | Bryan

1985, P. David, Clio and the Economics of QWERTY, AER P&P
  Path dependence can explain QWERTY, though see Liebowitz and Margolis

1990, R. Cowan, Nuclear Power Reactors: A Study in Technological Lock-in, JEH
  Path dependence based on a minor factor led to dominance of light water

1994, S. Liebowitz and S. Margolis, Network Externality: An Uncommon Tragedy JEP
  Socially inefficient path dependence is not what happened to the QWERTY
Great typology of ways that “path dependence” can be thought of formally

Strategic interdependence and not just “minor factors” induce path dependence

Some industries follow very clear “product life cycle” for predictable reasons

Why don’t incumbents with complementary assets just buy promising startups?

Relational contracts means shifting technology can be difficult for incumbents

Rust belt declines because of labor-management relations limit tech adoption

General Purpose Technology and Recombination | Bryan

Recombinant knowledge across fields is valuable

Limit to growth is finding new combinations from huge set of existing knowledge

Optimally your work should be weird but not too weird

Patents limit subsequent use in complex fields where many users are small

Uses topic modeling to show recombinant inventions are not breakthroughs

Innovators can be socially useful or rent-seekers, and have been both historically

Introduces idea of key “general purpose technologies” in history of innovation

Empirical case of how a GPT leads to growth-inducing reallocation

How did the economy react to the introduction of electricity and IT?
Why is it so hard to find evidence that certain technologies matter for growth?

* 2014, D. Acemoglu, U. Akcigit, D. Hanley and W. Kerr, Transition to Clean Technology
* How can directed technical change guide policies to limit climate change?

**Week 6, Oct 4 | Firm Characteristics and Innovation | Cohen**

  Read pages 159-168
1987, S. Winter, Knowledge and competence as strategic assets, in D. Teece, ed., *The Competitive Challenge*
* 1990, W. Cohen & D. Levinthal, Absorptive Capacity: A New Perspective on Learning and Innovation, ASQ
  Read one of the two above articles on absorptive capacity
* 2000, F.M. Scherer & Harhoff, Technology policy for a world of skew-distributed outcomes, *RP*
* 2010, Hall & Lerner, The Financing of R&D and Innovation, in Hall and Rosenberg, eds., *Economics of Innovation*
2007, J. Lerner & J. Wulf, Innovation and Incentives: Evidence from corporate R&D, *RESTAT*
* 1942, J. Schumpeter, *Capitalism, Socialism and Democracy*, Chapter 12
* 2010, H. Sauermann & W.M. Cohen, What makes them tick? Employee motives and Firm Innovation, *MS*
2004, S. Stern, Do Scientists Pay to Be Scientists?, *MS*
* 1959, Jewkes, Sawers, and Stillerman, *The Sources of Invention*,
Read Chapter 7 and Epilogue, pp. 117-151, 194-228.


Week 8, Oct 25 | Division of Labor and Tech Markets | Bryan and Cohen

* 1776, A. Smith, The Wealth of Nations
  Read Chapter 1 from the foundational text on the division of labor
* 1951, G. Stigler, The Division of Labor is Limited by the Extent of the Market, JPE
  Smithian (following Young 1928) rather than Coasean theory of firm scope
1998, T. Bresnahan and A. Gambardella, The Division of Inventive Labor and the Extent of the Market, in General Purpose Technologies and Economic Growth
* 2010, A. Arora and A. Gambardella, The Market for Technology, in the Handbook of the Economics of Innovation
  Handbook chapter on modern literature of sale and purchase of technology,
1994, E. von Hippel, Sticky Information and the Locus of Problem Solving..., MS
  Users innovate because their knowledge of what is needed is hard to transfer
  Empirical test confirming Bresnahan and Gambardella
2009, M. Marx, D. Strumsky, and L. Fleming, Mobility, Skills, and the Michigan Non-Compete Experiment, MS
  Noncompete agreements limit mobility of technically skilled employees
* 2011, O. Sorenson and S. Samila, Non-compete Covenants?: Incentives to Innovate or Impediments to Growth, MS
  Noncompete agreements are bad for entrepreneurship
2011, J. Singh, and A. Agrawal, Recruiting for Ideas: How Firms Exploit the Prior Inventions of New Hires, MS
  Not much evidence that you get firm’s knowledge when you buy a researcher
  How do you organize a firm to get the right information to the right people?
  Optimal labor schemes for scientists are lenient about failure
1994, J. Lerner and U. Malmendier, Contractibility and the Design of Research..., QJE
  How to get the firm you contract with to actually do the research you want?
  Incomplete contracts as an explanation for why R&D is sometimes internal
1989, B. Holmstrom, Agency Costs and Innovation, JEBO
  Exploration of how mech. design can explain strange-looking R&D contracts
  Give academics autonomy in basic research because it's cheaper
1990, N. Rosenberg, Why Do Firms Do Basic Research (with their own money?), RP
  By accident, because of agency problems, because they are big or like risk
1994, B. Holmstrom and P. Milgrom, The Firm as an Incentive System, AER
  Performance incentives need bundle with additional organizational features
   Read Chapter 17, pp 630-651
* 2010, W.M. Cohen, FYES  
   Read pp 140-159
* 1962, K. Arrow, Economic Welfare and the Allocation of Resources for Invention, in NBER Volume, The Rate and Direction of Inventive Activity  
   Read pp 619-626
1984, F.M. Scherer, *Innovation and Growth*  
   Read Chapter 12, pp 239-248
*2009, R.R. Nelson and S. Winter, An Evolutionary Theory of Economic Change  
   Read Chapter 13, pp 308-328
   Read Chapter 1, pp 3-31
1994, P. Geroski, Market Structure, Corporate Performance and Innovative Activity  
   Read Chapter 3-4, pp 26-60
* 1996, S. J. Nickell, Competition and Corporate Performance, JPE
2006, R. Gilbert, Looking for Mr. Schumpeter: Where are we in the competition innovation debate, Innovation Policy and the Economy

**Week 10, Nov 8 | Industry level Determinants of Innovation: Demand and technological opportunity | Cohen**

* W. M. Cohen, FYES  
  Read pp 168-182
1962, J. Schmookler, Economic Sources of Inventive Activity, JEH
  Read pp 193-195, 225-238
1988, E. von Hippel, The Sources of Innovation  
  Read Ch. 2 and 8, pp 11-27, 102-116
* 2004, D. Acemoglu and J. Linn, Market size in innovation: Theory and evidence from the pharmaceutical industry, QJE
* 1976, N. Rosenberg, The Direction of Technological Change: Inducement Mechanisms and Focusing Devices, in Perspectives on Technology
1986, A. Jaffe, Technological opportunity and spillovers of R&D, AER
1982, R. R. Nelson, The role of knowledge in R&D efficiency, QJE

**Week 11, Nov 15 | Patents, IPRs, and Economic Modeling | Bryan**

* 1979, G. Loury, Market Structure and Innovation, QJE  
  *The classic "patent race" model and why firms might innovate too much*
1980, T. Lee and L. Wilde, Market Structure and Innovation: A Reformulation, QJE
A minor but important caveat to Loury's patent race

1982, J. Reinganum, A Dynamic Game of R and D..., Ecta
How do patent races change when we allow non-static strategies?
1997, J. Lerner, An Empirical Exploration of a Technology Race, RAND
Reinganum-style patent races do seem to occur in the disk drive industry
Benefit of patents versus prizes depends on slope of demand curve
  Governments should buy patents to reduce deadweight loss, use auction to do it
* 2005, M. Lemley and C. Shapiro, Probablistic Patents, JEP
  Patents are not that strong in practice
* 2009, J. Bessen and E. Maskin, Sequential Innovation, Patents, and Imitation, RAND
  Patents can discourage innovation in cumulative industries like software
2011, C. Ponce and E. Henry, Waiting to Imitate: On the Dynamic Pricing..., JPE
  Inventors earn rents by threatening to give away their tech to rivals if no one pays
  Trade Secrets actually are a tool for disclosure if policy is optimal
1994, J. Anton and D. Yao, Expropriation and Inventions: Appropriable Rents..., AER
  Inventors without patents can earn rents by threatening to make invention public
1986, M. Katz and C. Shapiro, How to License Intangible Property, QJE
  What goes wrong when firms try to sell to product market competitors?
2006, H. Hopenhayn, H. Llobet and M. Mitchell, Rewarding Sequential Innovators..., JPE
  Forcing innovators to set a buyout price optimally rewards sequential innovators
1995, J. Green and S. Scotchmer, On the Division of Profit in Sequential Invention, RAND
  Basic model of sequential invention
* 2002, D. Acemoglu, Directed Technical Change, RESTUD
  How do changes in factor prices affect the incentive to innovate?

A brief handout on modeling in economics will be provided in-class.

2012, L. Brunt, J. Lerner and T. Nicholas, Inducement Prizes and Innovation, JIE
  Examines a series of royal society prizes for innovation in the 1800s
WP, B. Sampat and H. Williams, How do patents affect follow-on innovation?...
  Formal IP less harmful if easy to license and IP holders have incentive to do so
* 2014, H. Williams, Intellectual Property Rights and Innovation..., JPE
  Formal IP causes innovations to be used less frequently by downstream users
1990, A. Trajtenberg, A Penny for your Quotes..., RAND
  Citations are a useful proxy for the (otherwise highly skew) value of patents
  Why do firms in some industries say patents don’t matter but then use them a ton?
2012, P. Moser, Innovation Without Patents: Evidence from World's Fairs, JLAWE
  Almost all important innovations in 1800s Britain were not patented,
* 2010, W.M. Cohen, FYES
  Read pp. 182-193.
* 2005, P. Moser, How do patent laws affect innovation: evidence from nineteenth century trade fairs, AER
* 1986, D. Teece, Profiting from technological innovation: implications for integration, collaboration, licensing and public policy, RP
* 2000, S. Winter, Appropriating the Gains from Innovation, in Day and Schoemaker, eds., Wharton on Managing Emerging Technologies

**Week 13, Nov. 29: Readings to be announced.**