

14.452: Introduction to Economic Growth

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This half semester class will present an introduction to macroeconomic modeling, particularly economic growth. It will focus both on models of economic growth and their empirical applications, and try to shed light on the mechanics of economic growth, technological change and sources of income and growth differences across countries.

The course has a number of objectives: the first is to familiarize you with a set of issues and questions that are central to macroeconomics, and that are also (hopefully) exciting and important; the second is to develop some of the most important tools of dynamic economics useful in macroeconomics as well as in a number of other subdisciplines of economics including general equilibrium theory, political economy, industrial organization and contract theory; and the third is to provide a first introduction to some of the key empirical issues in economic growth.

We will have 14 lectures in total. Note the following schedule adjustments: November 14 will be a recitation, November 16 will be a half lecture and a half recitation, and November 17 will be a lecture. There is no lecture on November 23 (Thanksgiving).

The main textbook is *Introduction to Modern Economic Growth*, Princeton University Press, 2009.

There will be four problem sets, and only one or two questions within each problem set will be due for grading. The problem sets will have a 30% weight in the final grade, with the remaining 70% coming from the final exam.

What follows is an approximate breakdown of topics to lectures. Some topics will take a little more than the indicated amount, and some less, but the syllabus should give you a rough idea of the topics that will be covered in different parts of the course.

Course details:

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Lectures: TuTh 1-2:30pm, E51-151

Recitation: F 2:30-4pm, E51-151

Teaching Assistant: Todd Lensman tlensman@mit.edu

Office Hours (Daron): M 1:30-2:30pm, E52-446

Office Hours (Todd): Tu 2:30-4pm, E52-548 or by appointment

Final exam: To be announced

Syllabus

Lecture 1: Stylized Facts and Proximate and Fundamental Causes of Economic Development

This lecture will give a brief overview of the stylized facts of economic growth and show the large disparities in income per capita across countries. It will provide an example of how to investigate the relationship between a country level characteristic (in this instance democracy) and economic growth. It will also discuss briefly how the world distribution of income across countries has come to be so unequal.

1. *Introduction to Modern Economic Growth*, Chapter 1.
2. Helpman, Elhanan (2005) *Mystery of Economic Growth*, Harvard University Press, Cambridge MA
3. Quah, Danny (1997) “Empirics for Growth and Distribution: Stratification, Polarization and Convergence Clubs,” *Journal of Economic Growth* vol. 2, pp. 27-60.
4. Jones, Charles (1997) “On The Evolution of the World Income Distribution,” *Journal of Economic Perspectives* vol. 11, pp. 19-36.
5. Acemoglu, Daron, Suresh Naidu, Pascual Restrepo and James A. Robinson (2014) “Democracy Does Cause Growth,” *Journal of Political Economy*
6. Acemoglu, Daron, Simon Johnson and James Robinson (2002) “Reversal of Fortune: Geography and Institutions in the Making of the Modern World Income Distribution” *Quarterly Journal of Economics*, November 2002, volume 117.

Lectures 2 and 3: Introduction to the Solow Growth Model

The Solow growth model is a workhorse for many macro applications, and it is the starting place for the modern theory of economic growth. Here we begin with the basics of this model, which will already be familiar to many of you.

1. *Introduction to Modern Economic Growth*, Chapter 2.
2. Solow, Robert, (1970) *Growth Theory: An Exposition*, Clarendon Press, Oxford, UK.

Lecture 4: The Solow Model and the Data; Growth Accounting, Levels Accounting and the Facts

This lecture uses the Solow growth model to interpret the stylized facts we encountered in the first lecture. In the process, we will also discuss a number of popular empirical strategies used in cross-country work and also the methodology of growth accounting.

1. *Introduction to Modern Economic Growth*, Chapters 3 and 4.
2. Mankiw, N. Gregory, David Romer, and David N. Weil (1992) "A Contribution to the Empirics of Economic Growth," *Quarterly Journal of Economics* 107, #2, 407-37.
3. Barro Robert and Xavier Sala-i-Martin (1995) *Economic Growth*, Chapter 10.
4. Alwyn Young (1995) "The Tyranny of Numbers" *Quarterly Journal of Economics*, volume 110, #3, 641-680.
5. Hall, Robert and Charles I. Jones (1999) "Why Do Some Countries Produce So Much More Output per Worker Than Others?," *Quarterly Journal of Economics*, 114, 1999, 83-116.
6. Klenow, Peter J. and Andres Rodriguez-Clare (1997) "The Neoclassical revival in Growth Economics: Has It Gone Too Far?," *NBER Macroeconomics Annual*, 73-103.
7. Treffer, Daniel (1993) "International Factor Price Differences: Leontieff Was Right!," *Journal of Political Economy* 101, #6 961-987.
8. Diamond, Jared M. (1997) *Guns, Germs and Steel: The Fate of Human Societies*, W.W. Norton & Co., New York NY.
9. Acemoglu, Daron, Simon Johnson and James A. Robinson (2001) "The Colonial Origins of Comparative Development: An Empirical Investigation," *American Economic Review*, 91, pp. 1369-1401.

Lectures 5 and 6: Neoclassical Growth

The neoclassical growth model differs from the Solow growth model in incorporating consumer optimization. These collectors will first introduced the foundations of consumer optimization in dynamic economies and discuss the assumption of representative households. They will then study the equilibria and the Pareto optimal allocations in the workhorse neoclassical growth model. We will characterize both the steady state equilibrium and the dynamic equilibrium path of the economy starting from an arbitrary level of capital stock.

1. *Introduction to Modern Economic Growth*, Chapters 5 and 8.
2. Mas-Colell, Andreu, Michael D. Whinston and Jerry R. Green (1995) *Microeconomic Theory*, Oxford University Press, New York, Oxford, Chapters 4 and 16.

Lecture 7: Overlapping Generations and Dynamic Efficiency

The other workhorse model of dynamic macro is the overlapping generations model developed by Paul Samuelson and Peter Diamond. This lecture focus is on this model. As a preliminary step, called discuss the first than the second welfare theorems in dynamic economies, and then turned to the overlapping generations model. This will enable us to understand sources of and conditions for dynamic inefficiency in overlapping generations model. We will also discuss various applications of overlapping generations models.

1. *Introduction to Modern Economic Growth*, Chapters 5 and 9.
2. Bewley, Truman F. (2007) *General Equilibrium, Overlapping Generations Models, and Optimal Growth Theory*, Harvard University Press, Cambridge, Massachusetts.
3. Shell, Karl (1971) "Notes on the Economics of Infinity" *Journal of Political Economy*, 79, 1002-1011.
4. Diamond, Peter (1965) "National Debt in a Neoclassical Growth Model" *American Economic Review*, 55, 1126-1150.
5. Jones, Larry (1986) "Special Problems Arising in the Study of Economies with Infinitely Many Commodities" in *Models of Economic Dynamics* edited by Hugo Sonnenschein, Berlin, Springer-Verlag, 184-205.

Lecture 8: Neoclassical Endogenous Growth: Capital Accumulation, Externalities and Human Capital

This lecture will first present a model of sustained growth using a variant of the neoclassical growth model, then present the first example of a model with endogenous growth due to the knowledge-base or the technology stock of the society expanding over time, and finally discuss the reasons why modeling sustained economic growth the with externalities is unsatisfactory and what special set of issues emerge in modeling technological change. The lecture will also briefly discuss the role of human capital in economic growth and introduce some basic models that are useful for thinking about human capital investments.

1. *Introduction to Modern Economic Growth*, Chapters 10, 11, and 12.
2. Rebelo, Sergio (1991) "Long-Run Policy Analysis and Long-Run Growth" *Journal of Political Economy*, 99, 500-521.
3. Jones, Larry and Rodolfo Manuelli (1990) "A Convex Model of Equilibrium Growth: Theory and Policy Indications" *Journal of Political Economy*, 98, 1008-1038.
4. Romer, Paul (1986) "Increasing Returns and Long-Run Growth" *Journal of Political Economy*, 94, 1002-1037.

5. Ben Porath, Yoram (1967) "The Production of Human Capital Over the Life Cycle," *Journal of Political Economy*, Vol. 75, No. 4-1, pp. 352-365.
6. Nelson, Richard and Edmund Phelps (1966) "Investment in Humans, Technological Diffusion and Economic Growth." *American Economic Association Papers and Proceedings*. 56, pp. 69-75.
7. Acemoglu, Daron (1996) "A Microfoundation For Social Increasing Returns in Human Capital Accumulation." *Quarterly Journal of Economics*, 111 (3), pp 779-804.
8. Lucas, Robert (1988) "On the Mechanics of Economic Development," *Journal of Monetary Economics* 22, 3-42.
9. Acemoglu, Daron and Josh Angrist (2000) "How Large are Human Capital Externalities? Evidence from Compulsory Schooling Laws." NBER Macroeconomics Annual 2000. MIT Press, Cambridge, pp. 9-59.

Lecture 9: Endogenous Technical Change

This lecture will introduce the first models of endogenous technological change, where sustained economic growth takes place as a result of purposeful R&D-type activities. We will also briefly discuss some of the evidence on knowledge spillovers and externalities and the innovation process.

1. *Introduction to Modern Economic Growth*, Chapters 13 and 14.
2. Romer, Paul M. (1990) "Endogenous Technological Change," *Journal of Political Economy* 98, S71-S102.
3. Jones, Charles I (1995) "R&D-based Models of Economic Growth" *Journal of Political Economy*, 103, 759-784.
4. Bloom, Nicholas, Mark Schankerman and John Van Reenen, J. (2013) "Identifying Technology Spillovers and Product Market Rivalry" *Econometrica*, 83, pp. 1347-1394.
5. Jaffe, Adam, Manuel Trajtenberg and Rebecca Henderson (1993) "Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations" *Quarterly Journal of Economics* 108, pp. 577-598.
6. Kerr, William (2008) "Ethnic Scientific Communities and International Technology Diffusion" *The Review of Economics and Statistics* 90, pp. 518-537.
7. Griliches, Zvi (1957) "Hybrid Corn: An Exploration in the Economics of Technological Change" *Econometrica*, 25, pp. 501-522.

8. Griliches, Zvi (1992) "The Search for R&D Spillovers" *Scandinavian Journal of Economics*, 94, pp. 29-47.
9. Irwin, Douglas and Peter Klenow (1994) "Learning by Doing Spillovers in the Semiconductor Industry" *Journal of Political Economy*, 102, pp. 1200-1227.
10. Aghion, Philippe and Peter Howitt (1992) "A Model of Growth Through Creative Destruction" *Econometrica*, 60, pp. 323-351.
11. Grossman, Gene and Elhanan Helpman (1991) "Quality Ladders in the Theory of Growth" *Review of Economic Studies*, 58, pp. 43-61.
12. Aghion, Philippe, Nick Bloom, Richard Blundell, Rachel Griffith and Peter Howitt (2005) "Competition and Innovation: An Inverted-U Relationship." *Quarterly Journal of Economics*, 120, pp. 701-728.

Lecture 10: Beyond Factor-Augmenting Technology

This lecture will revisit the question of whether the standard aggregate production function used in macro and growth models, assuming factor-augmenting technological change, is plausible, and what the alternatives are, and how these alternatives help us think about the stylized facts of growth and the implications of technological change.

1. Karabarbounis, Loukas and Brent Neiman (2014) "The Global Decline of the Labor Share," *The Quarterly Journal of Economics*, 129(1): 61-103.
2. Allen, Robert C. (2009) "Engels' Pause: Technical Change, Capital Accumulation, and Inequality in the British Industrial Revolution," *Explorations in Economic History*, 46(4): 418-435.
3. Acemoglu, Daron and Pascual Restrepo (2019) "Automation and New Tasks: How Technology Changes Labor Demand", *Journal of Economic Perspectives*, 33(2): 3-30.
4. Acemoglu, Daron and Pascual Restrepo (2018) "The Race Between Man and Machine: Implications of Technology for Growth, Factor Shares and Employment", *American Economic Review*, 108(6): 1488-1542.
5. Zeira, Joseph (1998) "Workers, Machines, and Economic Growth," *Quarterly Journal of Economics*, 113(4): 1091-1117.
6. Jones, Charles I. (2005) "The Shape of Production Functions and the Direction of Technical Change," *The Quarterly Journal of Economics*, 120(2): 517-549.
7. Oberfield, Ezra and Devesh Raval (2014) "Micro Data and Macro Technology," NBER Working Paper No. 20452.

Lecture 11: Inequality

This lecture will discuss how the various approaches developed so far shed light on the recent rise in various dimensions of inequality in industrialized economies.

1. Autor, David, Lawrence F. Katz and Alan B. Krueger (1998) “Computing Inequality: Have Computers Change the Labor Market?” *Quarterly Journal of Economics*, 113(4): 1169-1213.
2. Acemoglu, Daron (2002) “Technical Change, Inequality, and The Labor Market,” *Journal of Economic Literature*, 40(1): 7-72.
3. Goldin, Claudia and Lawrence F. Katz (2008) *The Race Between Education and Technology*, Harvard University Press, Cambridge.
4. Autor, David, Frank Levy and Richard Murnane (2003) “The Skill Content of Recent Technological Change: An Empirical Exploration,” *Quarterly Journal of Economics*, 118(4): 1279-1333.
5. Acemoglu, Daron and David Autor (2011) “Skills, tasks and technologies: Implications for employment and earnings,” *Handbook of Labor Economics*, 4: 1043-1171.
6. Brynjolfsson, Erik and Andrew McAfee (2014) *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, W. W. Norton & Company.
7. Acemoglu, Daron and Pascual Restrepo (2022) “Tasks, Automation and the Rise in US Wage Inequality” forthcoming *Econometrica*.

Lecture 12: Directed Technical Change: Endogenous Skill-Bias and Endogenous Labor-Augmenting Technological Change

This lecture will introduce models of directed technological change, where not only aggregate technological change, but the direction of technological change is endogenous. These models will enable us to discuss why and when technological change may be skill biased (favoring more educated workers), and why we may expect technological change to be labor augmenting.

1. *Introduction to Modern Economic Growth*, Chapter 15.
2. Acemoglu, Daron (2002) “Directed Technical Change” *Review of Economic Studies*, 69, 781-810.
3. Acemoglu, Daron (2003) “Labor- and Capital-Augmenting Technical Change” *Journal of European Economic Association*, 1, 1-37.
4. Acemoglu, Daron (2007) “Equilibrium Bias of Technology.” *Econometrica*, 75(5), pp. 1371-1410.

Lecture 13: Interdependencies: Technology Diffusion and Trade

The models discussed up to this point in the class are closed economy models. These are not good approximations to the world we live in, where international trade and exchange of ideas are important. This lecture will provide an overview of major interdependences across countries that arise both because of technology diffusion and international trade. The emphasis will be on how these interdependences fundamentally affect the process of economic growth and the world distribution of income.

1. *Introduction to Modern Economic Growth*, Chapters 18 and 19.
2. Acemoglu, Daron and Jaume Ventura (2002) “The World Income Distribution” *Quarterly Journal of Economics*, 117, 659-694.
3. Ventura, Jaume (1997) “Growth and Interdependence” *Quarterly Journal of Economics*, 112, 57-84.
4. Grossman, Gene and Elhanan Helpman (1991) *Innovation and Growth in the Global Economy*, Cambridge, MA, MIT Press.