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ECONOMIC GROWTH 2007

- Course plan and tentative syllabus

Theme 1: Neoclassical growth models

Following an introduction to the key issues we are concerned with in this course, we start by revisiting the neoclassical growth model (Solow, 1956; Mankiw, Romer and Weil, 1992). From a purely technical perspective this model is familiar territory. The main purpose of discussing this framework is to fully develop the so-called "neoclassical view", according to which income per capita differences can be explained, by and large, by differences in investment rates (physical and human). Growth differences are motivated by transitional dynamics.
This part of the course will mainly be empirical. We will review both the strengths and, ultimately, the weaknesses of the neoclassical view thus enabling a clear motivation for the study of alternative frameworks, notably models featuring endogenous growth.

Readings. The neoclassical view: Barro and Sala-i-Martin (2004) (B&S) Ch. 1 (until Section 1.3); Mankiw, Romer and Weil (1992); Young (1995). Critique: Lecture notes, Cho and Graham (1996), Hsieh (1999), Easterly and Levine, 2001; Caselli (2004).

As alluded to above certain problems arise in motivating income and growth differences using the standard framework. These problems may be taken to imply that an alternative approach is called for. This approach does not necessarily require us to abandon the basic set of "neoclassical assumptions" – strictly concave production function and fully transferable knowledge – but nevertheless allows for non-convergence. This literature motivates the existence of "club convergence". We will discuss theory and empirics on this before moving on to endogenous growth models.

Readings: Galor (1996), Lecture notes. Supplementary readings: B&S Chapter 1.4.2; Azariadiz and Drazen (1990); Dalgaard and Hansen (2004); Durlauf and Johnson (1995)

Theme 2: Endogenous Growth Models

In this part we use optimal control theory to solve the households' optimization problem. Hence you may find it useful to review B&S p. 85-94. I'll go over this the first time we need to solve the households' problem, but essentially I expect you to be familiar with this methodology.

As a point of reference, I'll talk about necessary and sufficient conditions for perpetual growth in a one-sector setting. We'll start by focusing on requirements related to the production function (i.e. maintaining exogenous savings, as in the Solow model). Then we add more structure and allow households to choose consumption optimally. This will introduce certain additional requirements, related to preferences. This discussion will provide us with information on the *structure* needed to generate perpetual growth. In the end, however, we would like to motivate this structure theoretically.

To this end we begin by noting that in the standard neoclassical model, featuring constant returns to scale in rival inputs and competitive markets, firms will not pay to advance "A" (see B&S p. 61-62). Hence, we need to be a little creative. Conceptually there are five approaches to motivate endogenous growth. The list of approaches structures the rest of the course.

1. **Forget "A" altogether. Assume capital is sufficiently productive**. The main attraction here is simplicity. We can maintain the assumption of a strictly concave production function (at least when considering the model in B&S § 1.3.3.), common levels of "technology" and fully competitive markets.

Readings: B&S Ch. 1.3.3-1.3.4 and Section 4.1.2-4.1.6

2. **Nobody is paying *directly***. Expansion of "A" is by-product of production. Thus growth arises due to externalities. The key "story" here is Learning-by-doing. We will talk about empirics on this phenomenon, and then build it into a formal growth model.

Readings: B&S: 4.3; Lecture notes (Implicitly therefore Rapping (1965), Irwin and Klenow (1994) and Thompson (2001)).

3. **The government is paying (hence households, indirectly).** Expansion of "A" is a result of government activity. One way to think about this empirically is to examine the effects of government investments in infrastructure.[1] We incorporate this into a growth model and examine its implications.

Readings: B&S: 4.4, Aschauer (1989). Secondary: Hulten (1996).

Before we move on to option 4, we interject a general discussion of "AK" models:

Critique: Investment rates do not matter for *growth rates*: Jones (1995a, p. 495-514). Rebuttal**:** McGratten (1998). Another issue: "If policies are so important, why are they so different?" Alesina and Rodrik (1994).

4. **Households are paying. Human capital and growth**

We begin by thinking more carefully about the role of human capital. In particular we introduce an alternative approach to the one followed in MRW, where production technology is symmetrical for physical and human capital. Time is likely to be critically important in building up human capital; perhaps more so than when investing in physical capital. This recognition introduces asymmetries in the production functions for human and physical capital. From a technical perspective this forces us into the world of multi-sector growth models. As a result, we also discuss whether this tend to modify the requirements for endogenous growth to arise. It does.
After the theoretical discussion we will examine how important human capital is likely to be, in practise. Various empirical articles will be discussed in this context.

[1] Another would be publicly funded R&D.

Readings on Human Capital: B&S 5.2.2; Lucas (1993) § 1&2; Lucas (1998) § 4. Bills and Klenow (2000; Hendriks (2002). Secondary readings: Hanushek and Kimko (2000).

5. Deviation from Perfect Competition: R&D and Growth

The final category of endogenous growth models involves the idea that technology is brought forward by purposely investing in R&D. This forces us to introduce imperfect competition into the model. We'll distinguish between technological innovations that emphasize new products, and growth through quality improvements. Ultimately we'll focus on the testable predictions of the model. Much like what is the case for AK models, some implications of the standard models seem to be at variance with the data. In particular: the prediction that more scientists lead to faster TFP (and income per worker) growth. We'll discuss various ways of remedying this problem. We'll also discuss other empirical issues. In particular we'll address questions such as: How productive are R&D likely to be? Are we investing too much, or too little, in R&D as it is?

Readings: B&S Ch 6. Aghion and Howitt (but read ch 7). Nonneman and Vanhaut, 1996; Jones, 1995a,b; 1999, Dalgaard and Kreiner, 2001; Jones and Williams, 1998.

Time permitting we'll also talk about models where knowledge gradually diffuses across countries. *Readings* (tentative) : B&S Chapter 8 (technology transfer).

Preliminary syllabus

All articles will be downloadable via the course web page.

Main text:

Barro and Sala-i-Martin, 2004. Economic Growth. MIT Press. Chapters: 1,4, 5, 6, 7 and time permitting Ch. 8

Articles: ("§" denotes "section". This list only contains "core readings". "Secondary readings will be available as well, via the web page)

- Aghion and Howitt, 1992. A model of Growth Through Creative Destruction. *Econometrica*, 60, 323-51
- Alesina and Rodrik, 1994. Distributive Politics and Economic Growth. *Quarterly Journal of Economics*, 109, 465-490
- Aschauer, D., 1989: "Is Public Expenditure Productive?" *Journal of Monetary Economics*, 23, 177-200. (Until beginning of § 3.1).
- Bills M. and P. Klenow, 2000. Does Schooling Cause Growth? *American Economic Review*, 90. 1160-82.
- Caselli F., 2004. Accounting for Cross-Country Income Differences. Forthcoming chapter in the *Handbook of Economic Growth*. Download: http://personal.lse.ac.uk/casellif/papers/handbook.pdf. (§ 1 & 2).
- Cho and Graham, 1996. The other side of Conditional Convergence. *Economics Letters*, 50, 285-90
- Dalgaard, C-J and C.T. Kreiner, 2001. Is Declining Productivity Inevitable? *Journal of Economic Growth* , 6, p. 187-203. (§ 1-3)
- Easterly and Levine, 2001. It's not factor accumulation. *World Bank Economic Review*, 15. (Only pages 181-187 - until § 2.B).
- Galor, 1996. Convergence? Inferences from Theoretical models. *Economic Journal*, 106, 1056-1069. (except § II and III).
- Hendricks, L., 2002. How Important Is Human Capital for Development? Evidence from Immigrant Earnings, *American Economic Review*, *92, p. 198-219.*
- Hsieh C.T., 1999. Productivity Growth and Factor Prices in Asia. *American Economic Review Papers and Proceedings*, 89, p. 133-38. (except § 2).
- Jones, C.I, 1995a. Time series test of endogenous growth models. *Quarterly Journal of Economics.*
- Jones, C.I., 1995b. R&D Based Models of Growth. *Journal of Political Economy*, 103, 759-84.
- Jones, C.I and J.C. Williams. Measuring the Social Return to R&D. *Quarterly Journal of Economic*s, 113, 1119-35.
- Jones, C.I., 1999. Growth: With or without scale effects? *American Economic Review Papers and Proceedings*, May 1999, Vol. 89, pp. 139-144.
- Lucas, R., 1988. On the mechanics of development. *Journal of Monetary Economic,* 22, 3-42 (only § 4)
- Lucas, R., 1993. Making a Miracle. *Econometrica*. 61, 251-72. (Only § 1 & 2)
- Mankiw, N. G.; D. Romer and D. Weil, 1992. A Contribution to the Empirics of Economic Growth. *Quarterly Journal of Economics*, 107, 407-37

- McGratten E., 1998. A Defense of AK Growth Models. *Federal Reserve Bank of Minneapolis Quarterly Review* Vol. 22, No. 4, Fall 1998, pp. 13–27
- Nonneman W and P. Vanhout, 1996. A Further Augmentation of the Solow Model and the Empirics of Economic Growth for the OECD. *Quarterly Journal of Economics*, 111, p. 943-53.

In addition various lecture notes.