Lecture V: Economic Growth

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1. Lessons from classical growth models

- In Harrod-Domar and Solow technology is a major determinant of aggregate economic growth
- Where the technology come from?
- New research have pointed out the role of factors that explain the role of technology in economic growth:
  - Endogenize technological change
  - Explain conditional economic convergence
  - Explain why the availability and use of technology differ across countries
  - Explain the role of state in promoting technological innovations

2. Conditional convergence and the role of policy

- There have been multiple attempts at testing empirically the prediction of the Solow model on convergence in per-capita income levels
- Prediction: if there is convergence, then the initial level of income should negatively affect the rate of growth of the economy towards the steady state
- Empirically:

$$\gamma_{i,(t,t+T)} = \alpha + \beta\gamma_{it} + \epsilon_{it} \tag{1}$$

- If convergence is conditional on a set of initial (presumed exogenous) country characteristics, then:

$$\gamma_{i,(t,t+T)} = \alpha + \beta\gamma_{it} + \theta X_{it} + \epsilon_{it} \tag{2}$$

Conditional convergence

- Mankiw et al (1992) used cross-country growth regressions to test the convergence hypothesis that derives from the Solow model
  - Sample of 22 OECD countries: convergence in income per-capita over the period 1960-1985
  - Sample of 75 countries including developing countries: β is not significantly different from zero
- Based on Solow model, Mankiw et al (1992) add the savings rate and the population growth to the regression specification and find that β becomes negative and significant
- Mankiw et al (1992) extended the basic Solow model to incorporate human capital (rate of secondary education)
- Mankiw et al (1992) found conditional convergence on these variables

Role of policy

- Sachs and Warner (1995) showed that the strength of convergence itself depend on the policy context:
  - 111 countries for 1970-1989 period
  - Explore the role of trade, rate of secondary education, rate of investment and inflation rate
- Main finding 1: income grew faster in open economies

Average annual growth rate in per capita income (percent)	**Open countries**	**Closed countries**
Rich countries	2.29	0.74
Poor countries	4.49	0.69

- Main finding 2: There was not convergence among economies that were closed in the base period, but there was strong convergence among economies that were open

- This paper provides evidence that good policies matter for growth but its empirical approach suffers of severe endogeneity problems

3. The coordination problem in growth

- Economic growth requires solving a complex coordination problem
- Example: Coal, steel and railroads during the industrial revolution

		Railroad Invest **Steel**	
		Invest	Withhold
Coal	Invest	50, 50, 50	-100, 0, -100
	Withhold	0, -100, -100	0, 0, -100

		Railroad Withhold Investment **Steel**	
		Invest	Withhold
	Invest	-100, -100,0	-100, 0, 0
	Withhold	0, -100, 0	0, 0, 0

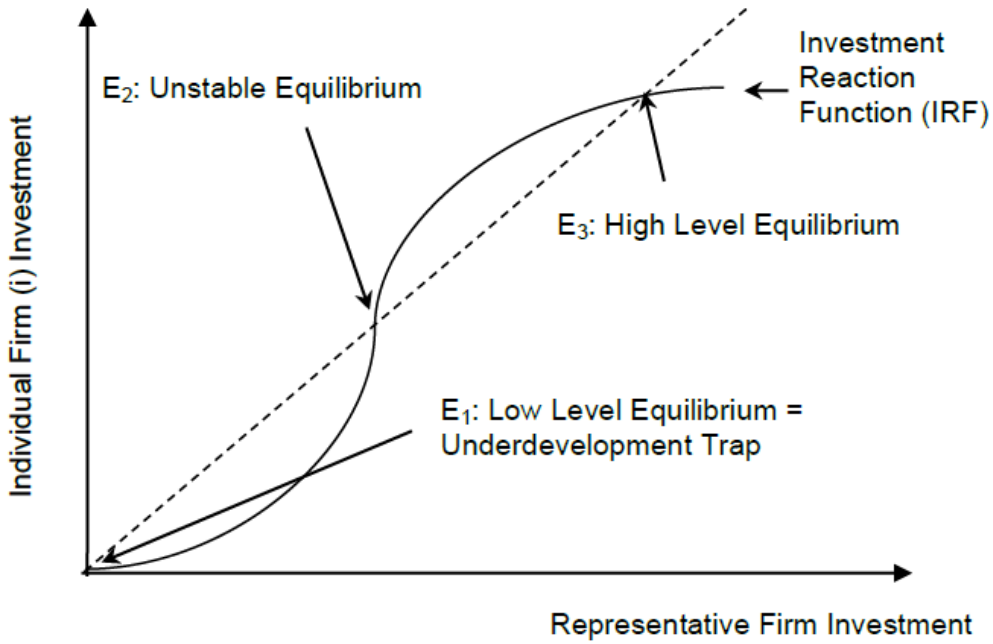
- Consider a simpler version:

		Steel	
		Invest	Withhold
Coal	Invest	50, 50	-100, 0
	Withhold	0, -100	0, 0

- These games reveal essential complexities of economic growth process:
  - Strategic interaction or interdependence of investment decisions
  - The importance of information and expectations formation
  - Dichotomy of outcomes
  - Existence of spillover effects or externalities

The role of coordination: multiple equilibria in development

- Achieving coordination is key for growth. How can help to obtain coordination?
- States can play that role but tends to be weak in developing countries where its coordination role is fundamental
- Consider the coordination problem for a representative firm:



4. Endogenous growth

- In the Solow model, technological change is the only source of long-term per-capita income growth but technical change is not explained
- Romer (1990) extends the Solow model to incorporate a mechanism that explains the origin of technical change: firms investment in research and development (innovation)
- A fraction of labor force L_y is employed in the production sector whereas the other part L_A is employed in the research sector, where A is generated
- The new production fuction:

$$Y = f(K, A(L_A), L_Y) = K^{\alpha}(A(L_A), L_Y)^{1-\alpha} \qquad (3)$$

- Somme comments:
  - Technical change is Hicks labor saving (e.g. it increases the marginal productivity of L_Y relative to that of capital at a given K/L ratio)
  - A grows because more L_A is applied to the generation of A, then $f()$ displays increasing returns to scale
  - Gain in productivity is assumed to be proportional to the level of productivity already achieved:

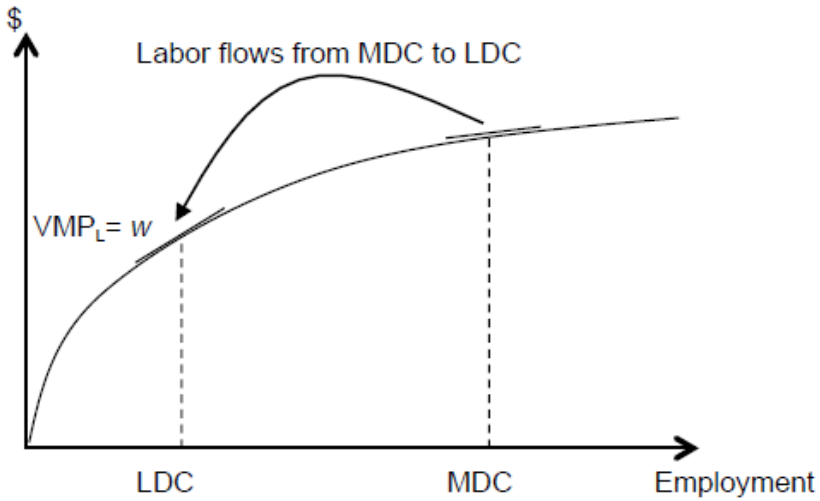
$$\Delta A = A\delta L_A \tag{4}$$

Comparing Solow versus Romer

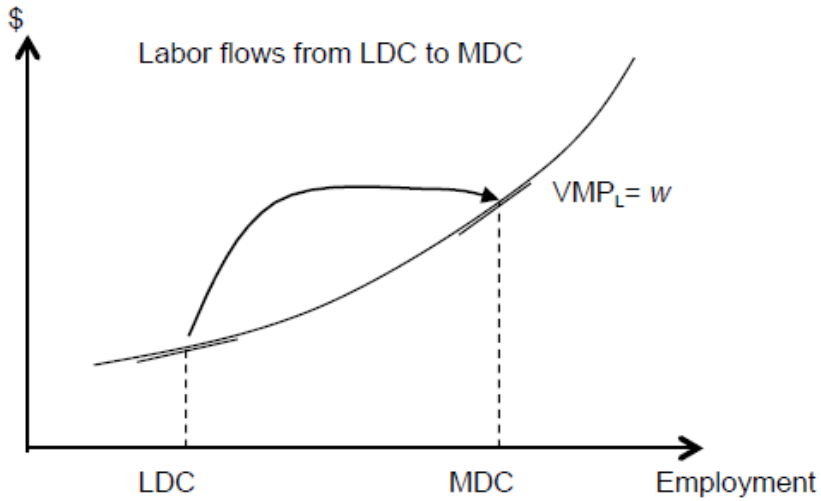
Model structure	**Solow model**	**Endogenous growth model**
Production function	$Y = A\,f(K, L)$	$Y = f(K, A(L_A)L_Y)$
Technological change ΔA	Hicks neutral, exogenous	Labor-saving, endogenous
Origin of technological change	International public good	Firm investment of L_Y in R&D
Market structure	Perfect competition	Monopoly power (patents)
Returns to scale	Constant	Increasing due to $\Delta A = A\delta L_A$
Model predictions		
Income growth across countries	Convergence	Divergence
Predicted international labor flows	From MDC to LDC	From LDC to MDC

- There are increasing returns to scale, this rules out convergence
  - Knowledge creates more knowledge
  - Labor and capital should flow from LDC to MDC due to labor-augmenting technology that creates increasing return to scale
- Knowledge is a private good due to rents needed to create incentives to foster innovation
  - Jones and Romer (2010) provide evidence of the importance of TFP as a source of growth
  - Model may be too pessimistic about reality and it does not tell us about why rich countries are rich

Solow versus Romer's predictions about labor flows

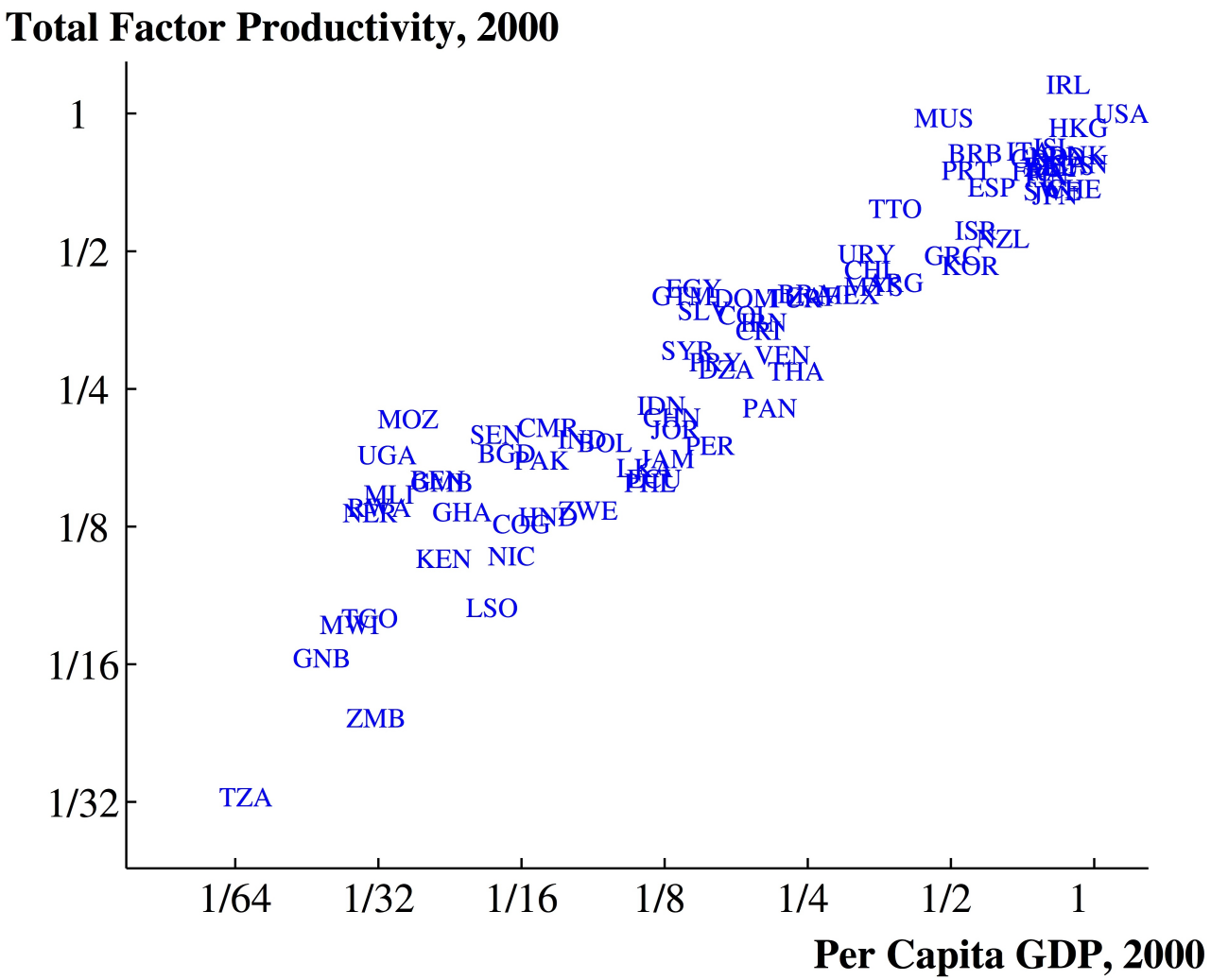


Solow growth model
Decreasing returns to scale
Predicts convergence



Endogenous growth model
Increasing returns to scale
Predicts divergence

Cross-country relation between TFP and GDP per-capita



- Productivity growth has large spillover effects across firms
  - Markets failures due to monopolistic rights for innovations and positive externalities in research
  - State intervention due to existence of market failures

5. Behavioral determinants of growth

- Human behavior determines innovation, adoption, and diffusion fo technologies
- Factors that explain innovation, adoption and diffusion vary with institutions and the social context
- Three aspects of behavior are critical:
  - Entrepreneurship
  - Expectation formation
  - Learning

Entrepreneurship

- Entrepreneurship has been stressed as an important behavioral trait since Schumpeter (1961)
- It is defined as self-employment, an initiative that will lead to enterprise start-ups, contributing to growth if it is successful
- Entrepreneurship by opportunity needs to be distinguished from entrepreneurship by necessity (U-shaped curve between self-employment and GDP per-capita)
- Who become an entrepreneur?

$$pA\theta f(L) + \phi - wL - K > wL + \mu \tag{5}$$

- Which policies can help to promote entrepreneurship?

- Entrepreneurial ability: θ
  - Education?
  - Wealth inequality?
- Non-pecuniary benefits from entrepreneurship: ϕ
  - Protective policies in case of failure (bankruptcy laws / social safety nets)
  - Role of social networks
- Economic, political, and legal context: p, K, and A
  - Investment climate

Expectations

- Expectation about others' behaviors can strongly influence behavior
- Recent scholarship suggests that behavior is not fully rational:
  - Animal spirits
  - Herd effects
  - Irrational exuberance
  - Collective gloom
  - Other psychological forces
- How expectations are determined and how they influence behavior remains incompletely understood

Learning

- Learning plays an important role in innovation, adoption, and diffusion
- Learning follow different paths:
  - Learning by doing
  - Learning from others: role of social networks

6. Concluding remarks

- Jones and Romer (2010):
  - Extraordinary rise in the extent of the market via globalization
  - There has been a sharp overall acceleration of growth in population and in GDP per-capita
  - There exist large differences in GDP pc growth rates across countries
  - There are large income and TFP differences across countries, with high TFP associated with high GDP pc
  - There has been a rapid increase in human capital per-worker in successfully growing countries
  - There is surprisingly long-run stability in relative wages for skilled and unskilled workers