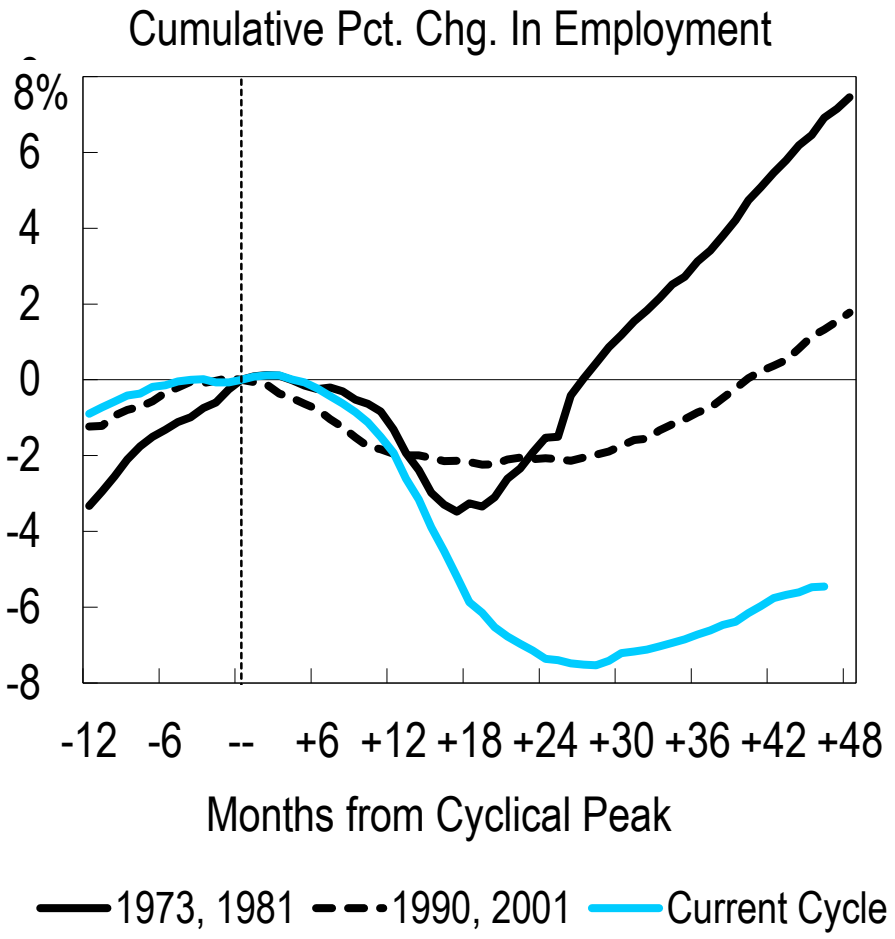
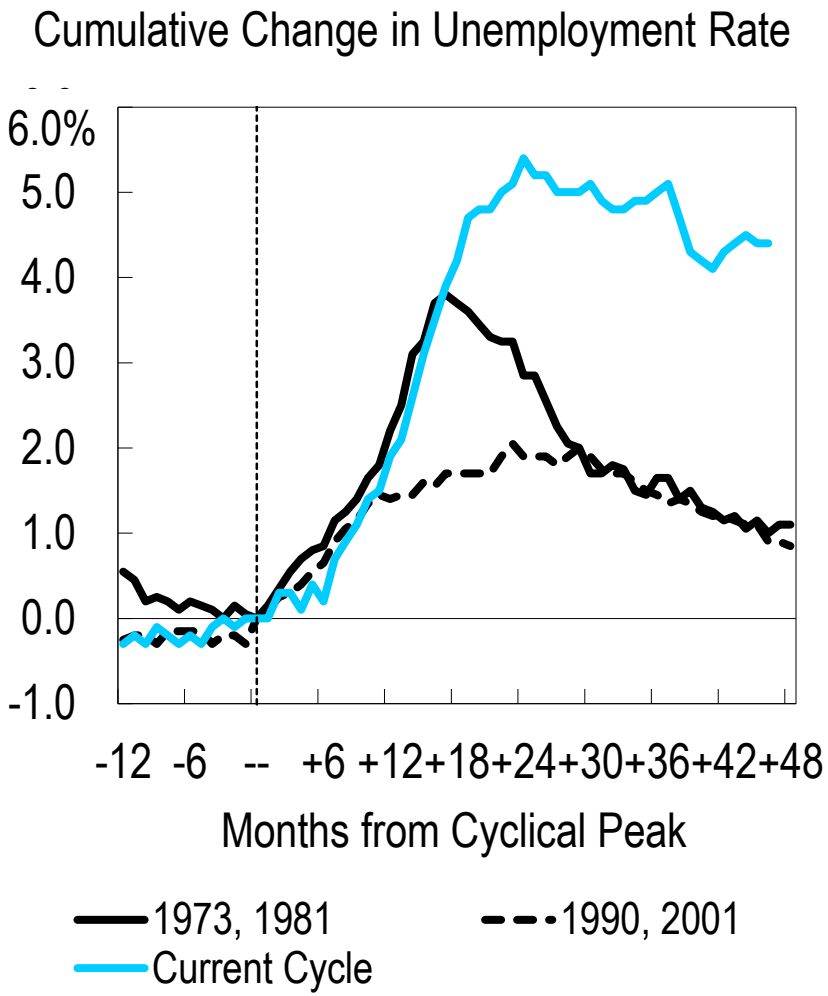
The Global Economy

Growth

NYU STERN

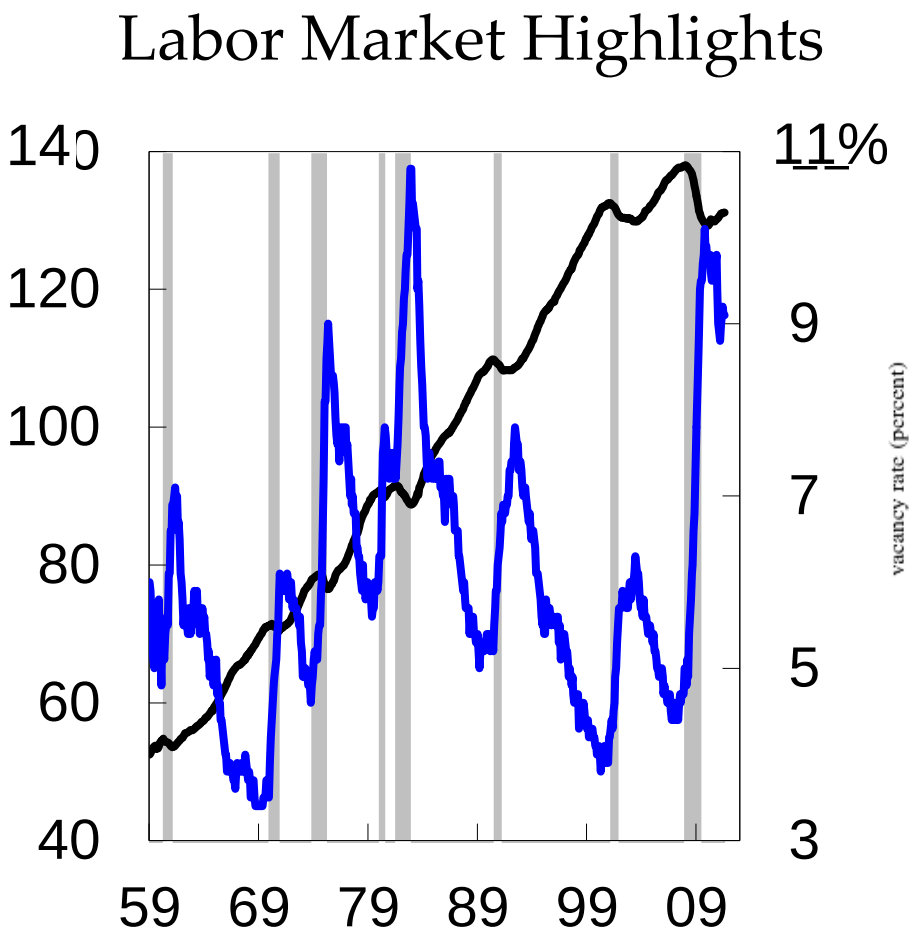
In the News

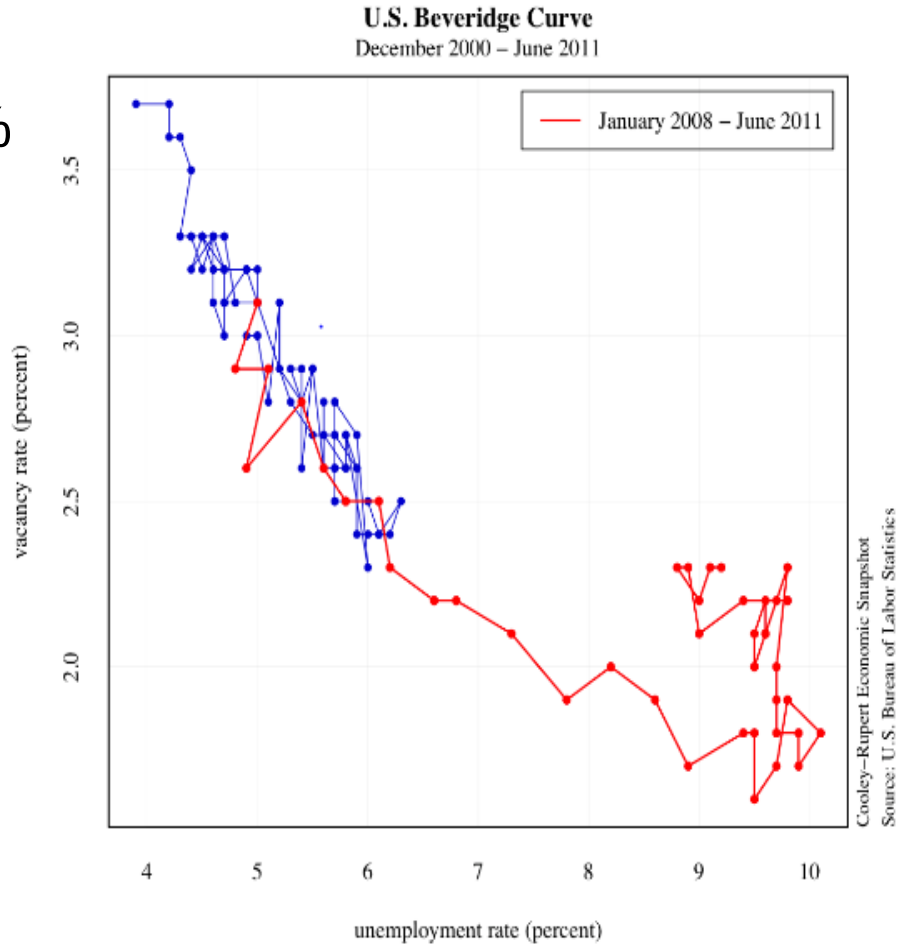




Sources: BEA and Citi.

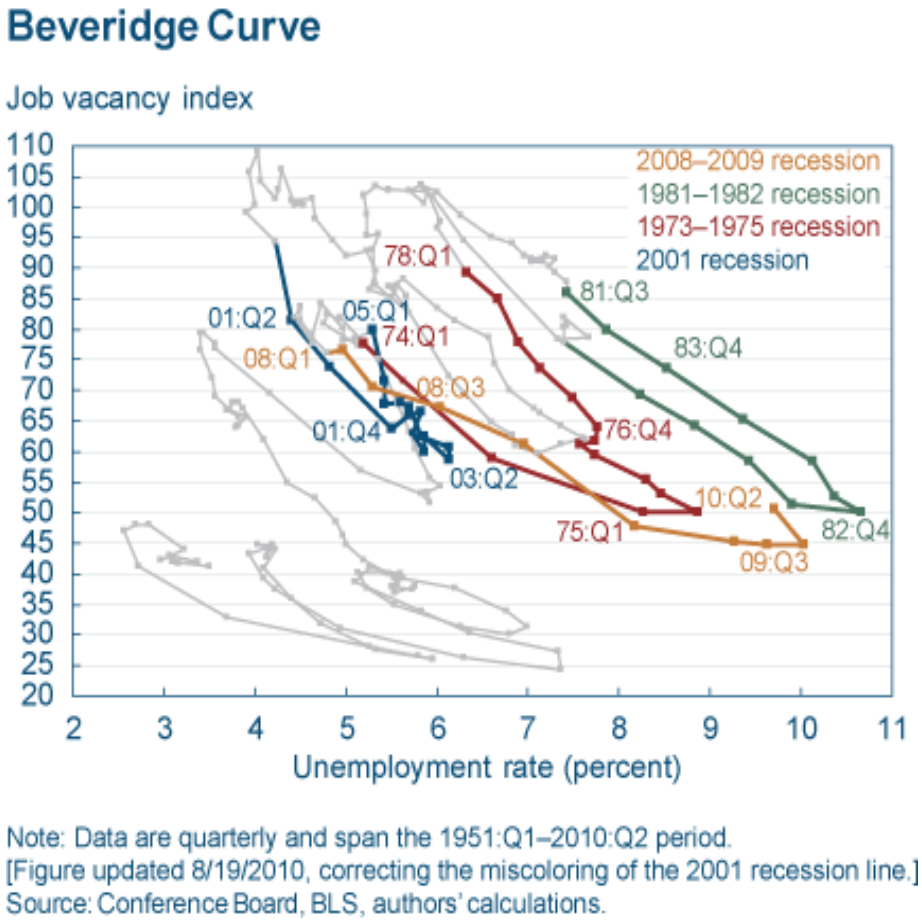
In the news





Note: Shaded areas denote recessions. Sources: BEA and FRB Cleveland.

In the News



Note: Data are quarterly and span the 1951:Q1–2010:Q2 period.
[Figure updated 8/19/2010, correcting the miscoloring of the 2001 recession line.]
Source: Conference Board, BLS, authors' calculations.

"How much of the current unemployment rate is really due to mismatch? The answer seems to be a lot. I mentioned that the relationship between unemployment and job openings was stable from December 2000 through June 2008. Were that stable relationship still in place today, and given the current job opening rate of 2.2 percent, we would have an unemployment rate closer to 6.5 percent, not 9.6 percent."

Narayana Kocherlakota,
President,
FRB Minneapolis, September 8, 2010

Sources: FRB Cleveland and FRB Minneapolis.

Roadmap

- News
- Review from last week
- Solow model with technology growth
- Growth accounting
- Data
- What drives technology growth?

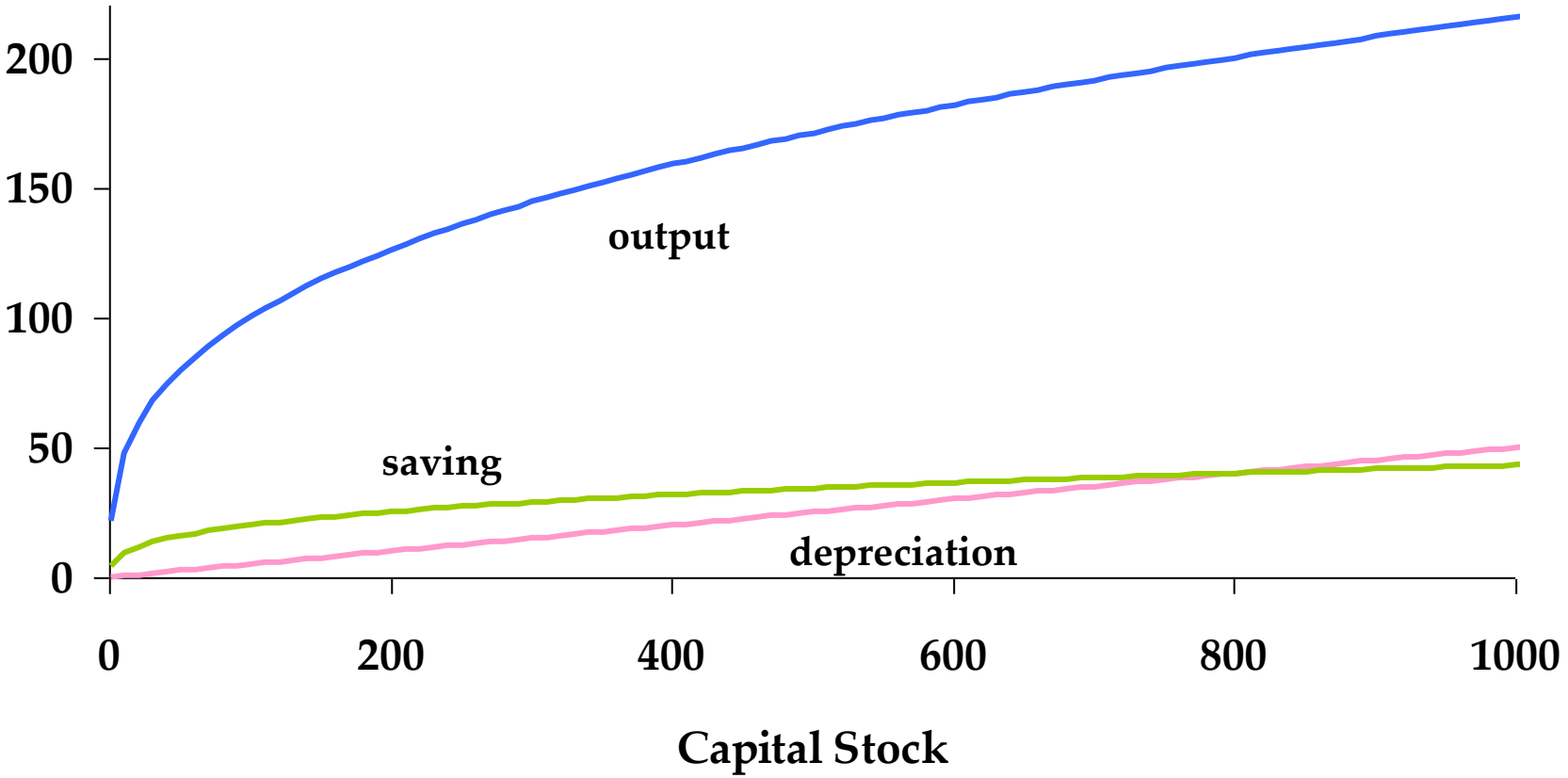
Review

- Production function

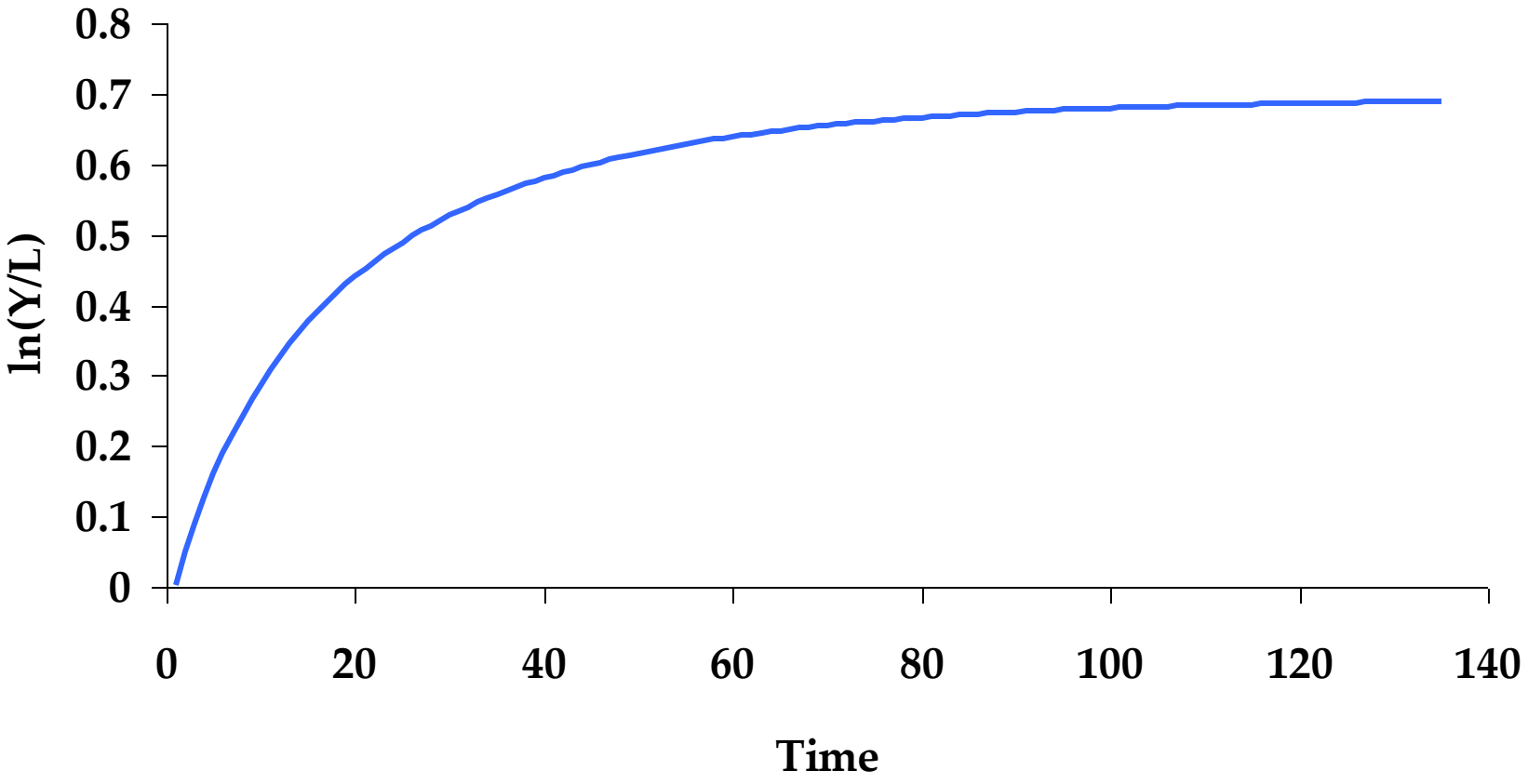
$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$$

- Solow Growth Model
  - Savings funded investment drives growth
  - No long-run growth. Why?

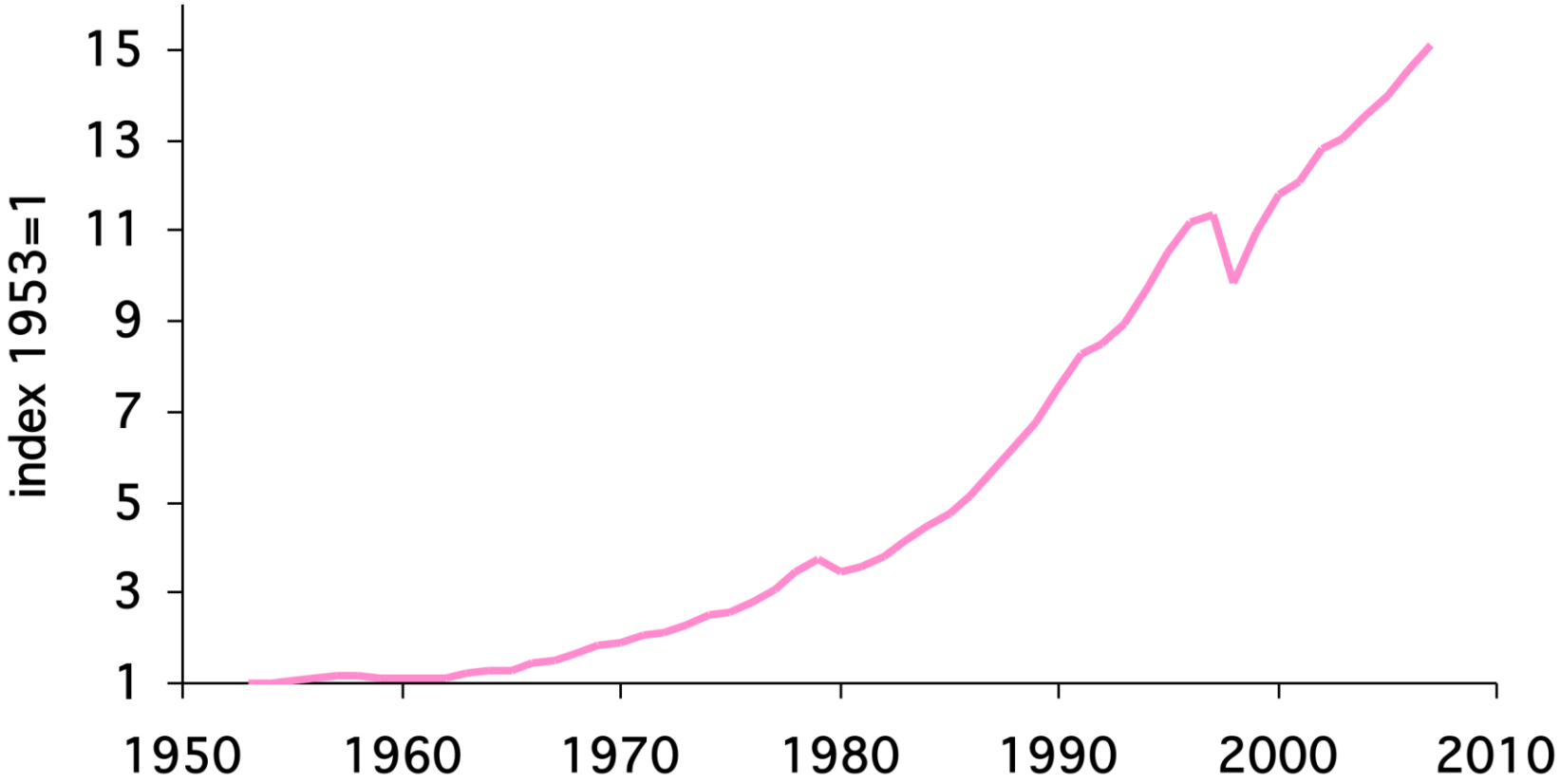
Solow model: dynamics



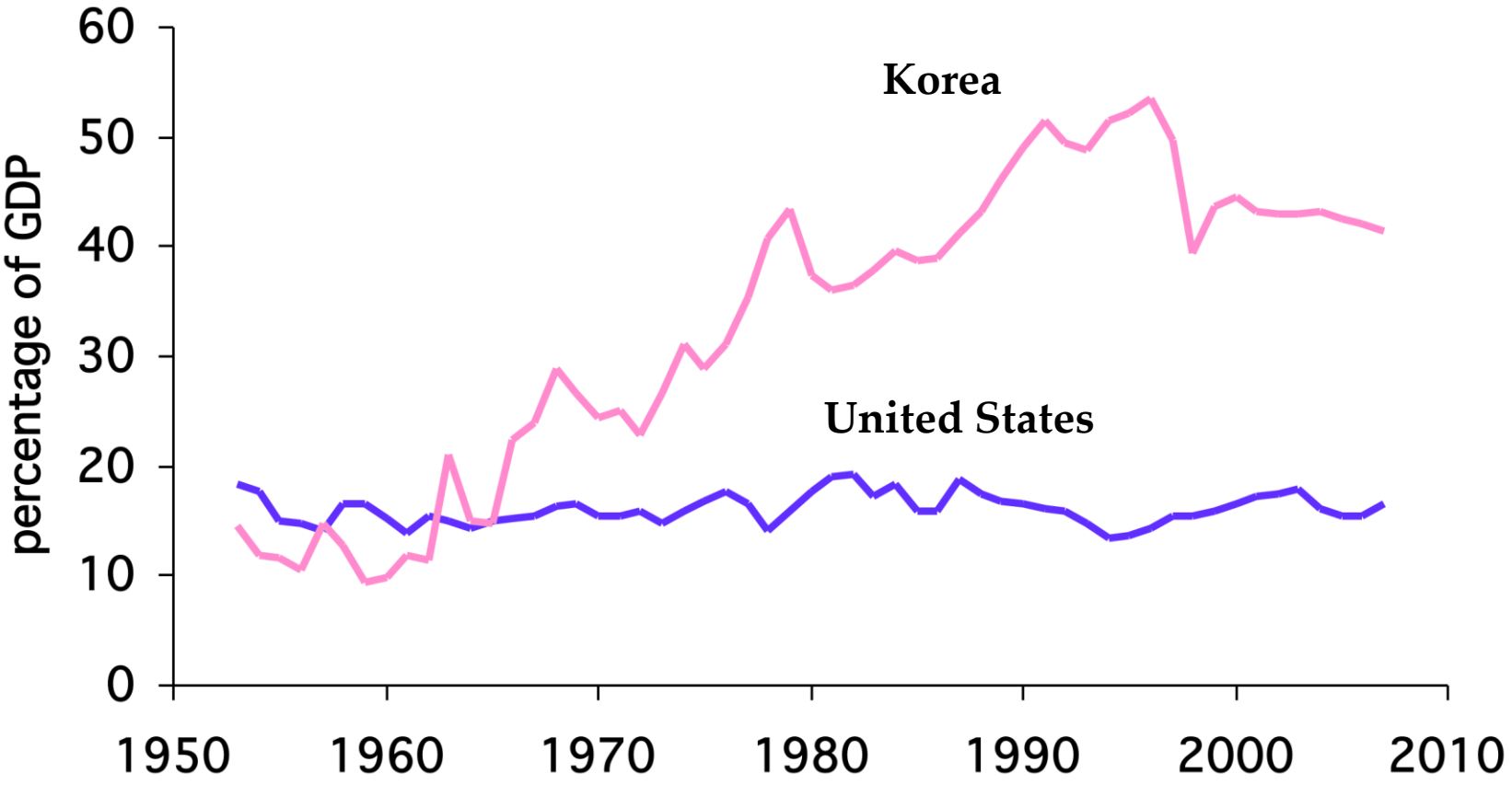
Steady state



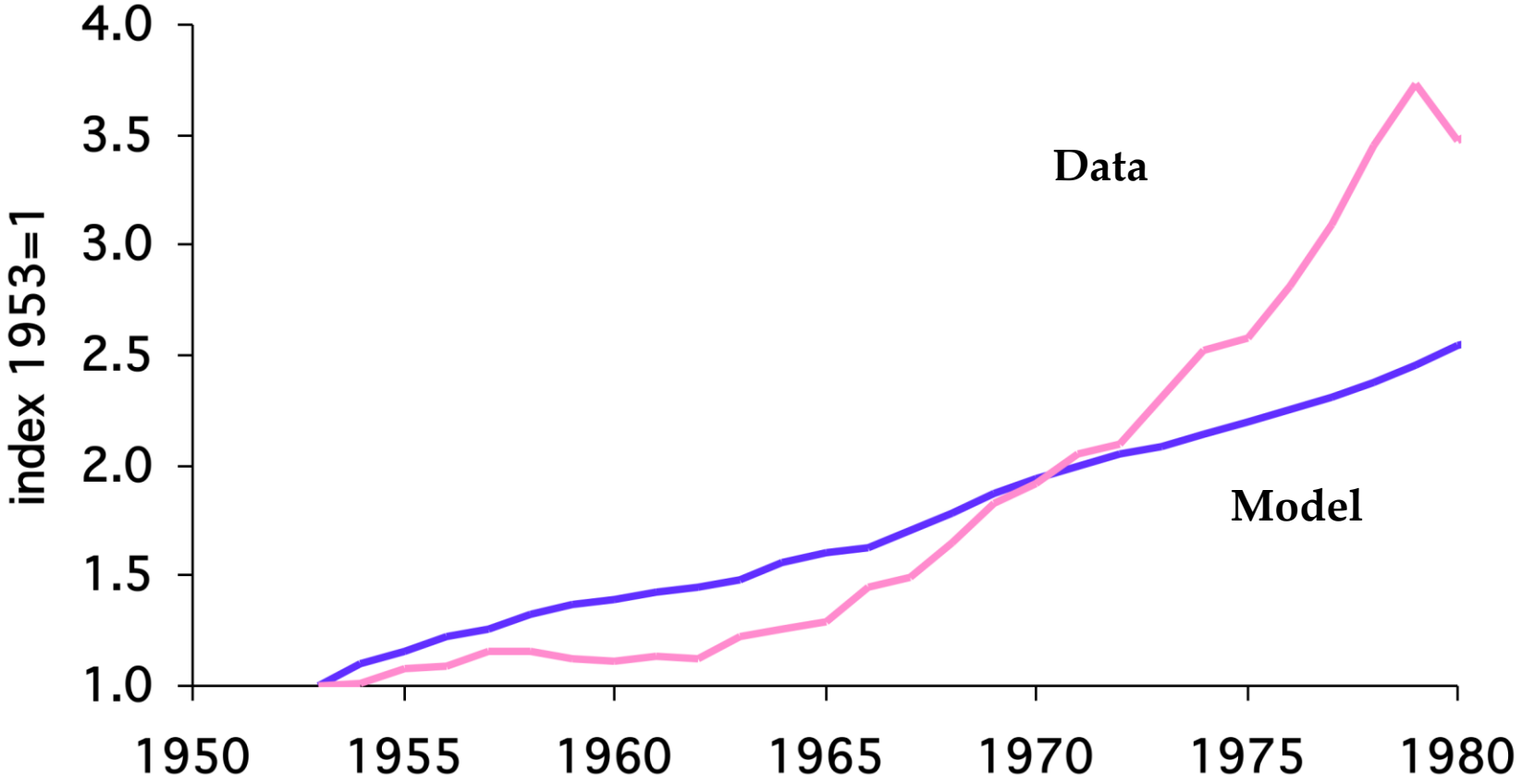
Korean GDP per capita



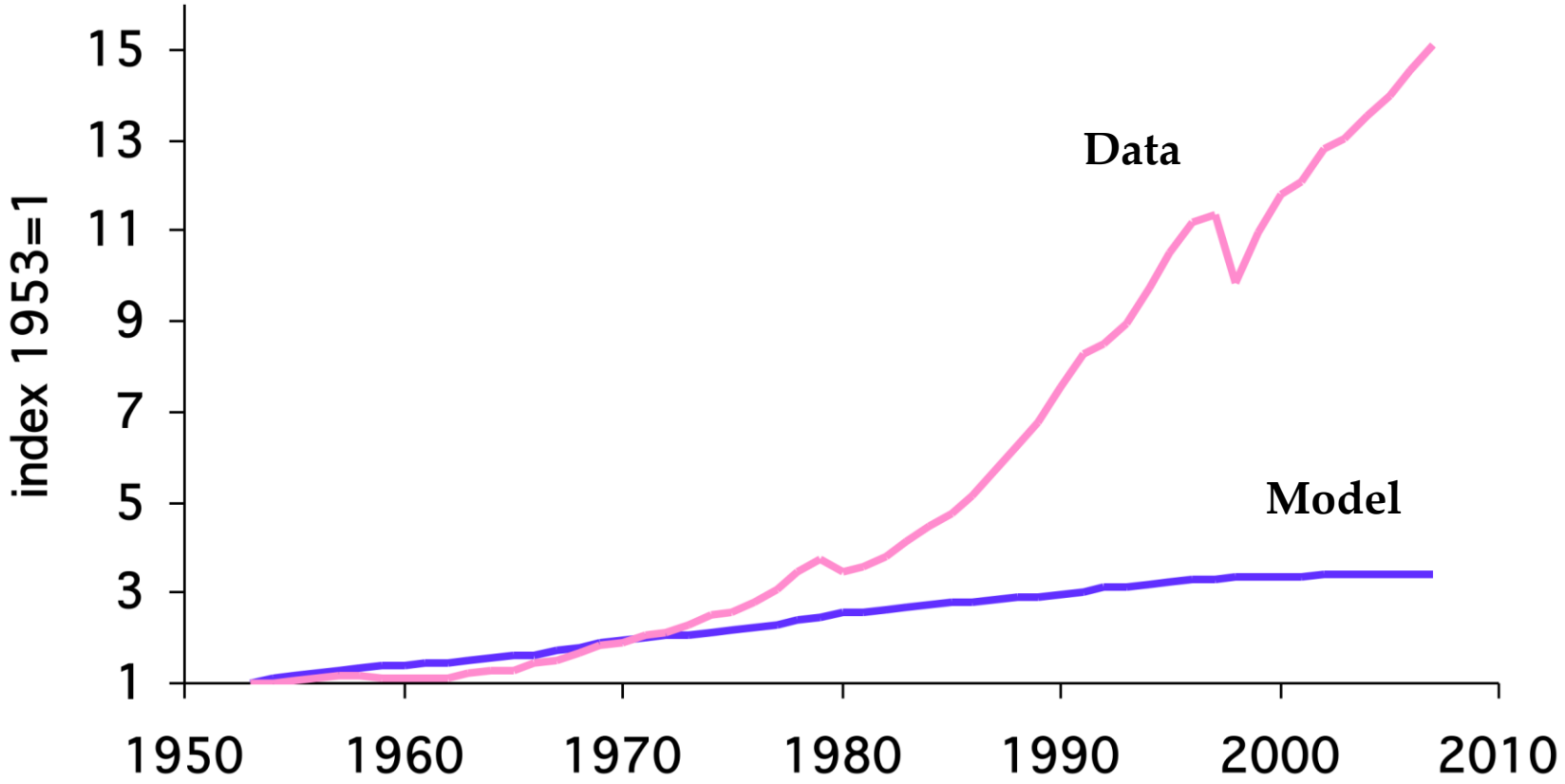
Investment Rates



Korean GDP per capita



Korean GDP per capita



What are we missing?

- Total Factor Productivity Growth

Model with TFP and population growth

- Production function

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$$

- Capital accumulation

$$K_{t+1} = K_t + I_t - \delta K_t$$

- Savings flow

$$S_t = I_t$$

- Savings rate

$$S_t = sY_t$$

Model with TFP and population growth

- Assume TFP and labor grow at constant rates

$$A_t = A_{t-1}\ 1+g_a$$

$$L_t = L_{t-1}\ 1+g_l$$

- Growth is *exogenous* to the model

Model with TFP and population growth

- Guess capital and output grow at the same rate

- After some algebra we can show

$$1+g_y = 1+g_k = 1+g_a^{\frac{1}{1-\alpha}} 1+g_l$$

$$\frac{1+g_y}{1+g_l} = 1+g_a^{\frac{1}{1-\alpha}}$$

Balanced growth path

- Output grows in the steady state
  - Sometimes called a “balanced growth path”
- Saving rates
  - Do not affect growth rates in steady state
  - Do affect levels of Y/L

Example: United States

- Ballpark numbers:

$$g_l = 0.005$$

$$g_a = 0.01$$

$$\alpha = 1/3$$

- What is $1 + g_y$?

Example: United States

- Ballpark numbers:

$$g_l = 0.005$$

$$g_a = 0.01$$

$$\alpha = 1/3$$

- What is $1+g_y$?

$$1+g_y = (1+g_a)^{\frac{1}{1-\alpha}}(1+g_l)$$

$$1.0201 = 1.015 \times 1.005$$

Example: China

- Ballpark numbers:

$$g_l = 0.005$$

$$g_a = 0.06$$

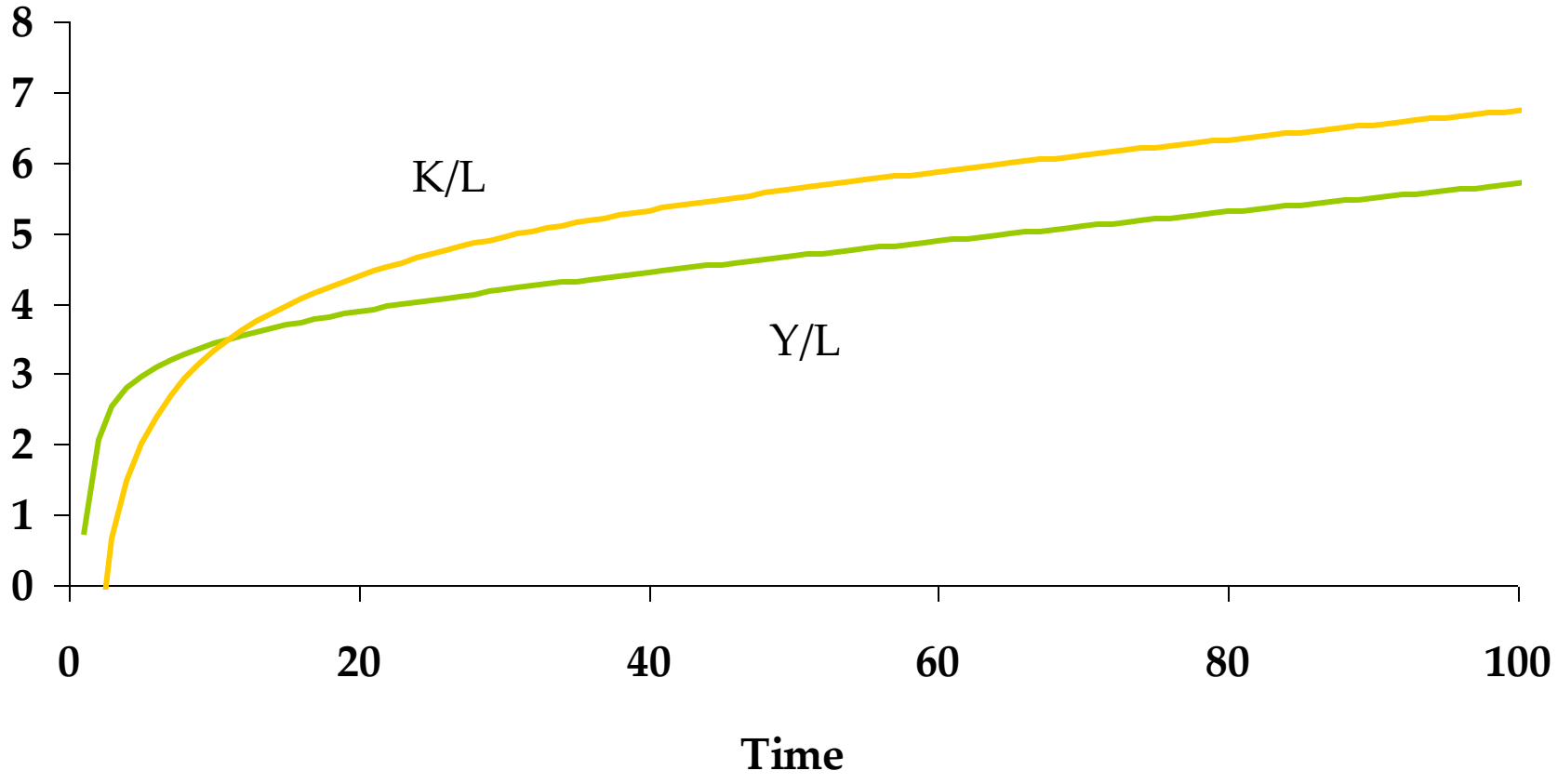
$$\alpha = 1/3$$

- What is $1+g_y$?

$$1+g_y = (1+g_a)^{\frac{1}{1-\alpha}}(1+g_l)$$

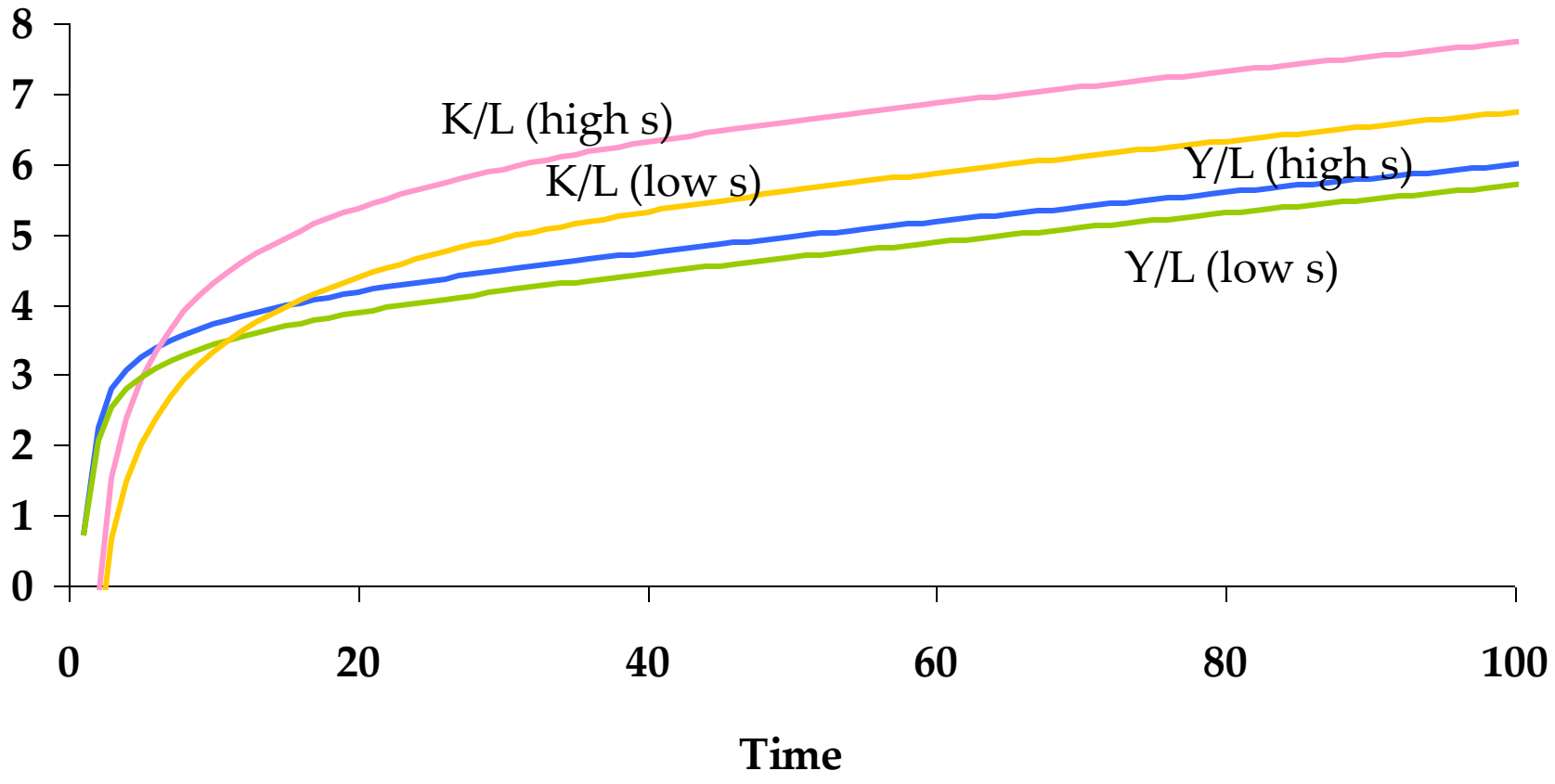
$$1.096 = 1.091 \times 1.005$$

Savings rates



Note: K/L, not K/Y!

Saving rates



Note: K/L, not K/Y!

Summary

Q: Why does technological progress sustain growth?

A: Because technology does not have diminishing returns.

Understanding Solow

Succeeding-period Ratios in the Steady State

Variable	Fixed Labor	Population Growth	Population Growth + TFP Growth
Y	1		
L	1		
Y/L	1		
K/L	1		
K/Y	1	1	1

Understanding Solow

Succeeding-period Ratios in the Steady State

Variable	Fixed Labor	Population Growth	Population Growth + TFP Growth
Y	1	$(1+g_L)$	$(1+g_A)^{\frac{1}{1-\alpha}}(1+g_L)$
L	1	$(1+g_L)$	$(1+g_L)$
Y/L	1	1	$(1+g_A)^{\frac{1}{1-\alpha}}$
K/L	1	1	$(1+g_A)^{\frac{1}{1-\alpha}}$
K/Y	1	1	1

Growth accounting

Using theory to decompose data on growth

Level comparisons

- Why is Y/L larger in the U.S. compared to Mexico?

	Employment (mils)	Capital (bil. $)	GDP (bil. $)
Mexico	46.94	4,278	1,293
U.S.	155.45	42,238	12,619

Source: Penn World Tables 7.0 and own calculations.

Level comparisons

	Employment (mils)	Capital (bil. $)	GDP (bil. $)
Mexico	46.94	4,278	1,293
U.S.	155.45	42,238	12,619

Compute TFP:

$$A_M = 1293 / (4278^{1/3} * 46.94^{2/3}) = 6.12$$

$$A_{US} = 12619 / (42238^{1/3} * 155.45^{2/3}) = 12.53$$

Level comparisons

- Use the production function to make comparisons

$$\frac{(Y/L)_{US}}{(Y/L)_{MX}} = \frac{A_{US}}{A_{MX}}\left(\frac{(K/L)_{US}}{(K/L)_{MX}}\right)^{\alpha}$$

Growth rate review

- Traditional growth rate

$$(1+g)^m = \frac{x_{t+m}}{x_t}$$

- Continuously-compounded growth rate

$$e^{m\gamma} = \frac{x_{t+m}}{x_t}$$

- Computing the growth rate

$$\gamma = \frac{\ln(x_{t+m}/x_t)}{m} = \frac{\ln(x_{t+m}) - \ln(x_t)}{m}$$

- See
  - "Math review"
  - "Sources of growth"

Growth accounting

$$\frac{Y_t}{L_t} = \frac{A_t K_t^{\alpha} L_t^{1-\alpha}}{L_t}$$

$$\frac{Y_t}{L_t} = A_t \left(\frac{K_t}{L_t} \right)^{\alpha}$$

$$\ln\left(\frac{Y_t}{L_t} \right) = \ln\ A_t\ + \alpha \ln\left(\frac{K_t}{L_t} \right)$$

Growth rates

- In period t

$$\ln\left(\frac{Y_t}{L_t}\right) = \ln\ A_t\ + \alpha \ln\left(\frac{K_t}{L_t}\right)$$

- In period $t+m$

$$\ln\left(\frac{Y_{t+m}}{L_{t+m}}\right) = \ln\ A_{t+m}\ + \alpha \ln\left(\frac{K_{t+m}}{L_{t+m}}\right)$$

- Subtract t from $t+m$ and divide all by m

Growth rates

$$\frac{\left[\ln\ Y_{t+m}/L_{t+m}\ -\ln\ Y_t/L_t\ \right]}{m} =$$

$$\frac{\left[\ln\ A_{t+m}\ -\ln\ A_t\ \right]}{m}$$

$$+\ \frac{\alpha\left[\ln\ K_{t+m}/L_{t+m}\ -\ln\ K_t/L_t\ \right]}{m}$$

$$\gamma_{Y/L} = \gamma_A + \alpha\gamma_{K/L}$$

Growth accounting

- Each term is an annual growth rate

$$\gamma_{Y/L} = \gamma_A + \alpha\gamma_{K/L}$$

- How much growth can be attributed to
  - Changes in the capital stock?
  - Changes in technology?

With population growth (notes, pg 7)

- Population, N_t

$$\frac{Y_t}{L_t} = A_t \left(\frac{K_t}{L_t} \right)^{\alpha}$$

$$\frac{L_t}{N_t} \frac{Y_t}{L_t} = A_t \left(\frac{K_t}{L_t} \right)^{\alpha} \frac{L_t}{N_t}$$

$$\gamma_{Y/N} = \gamma_A + \alpha \gamma_{K/L} + \gamma_{L/N}$$

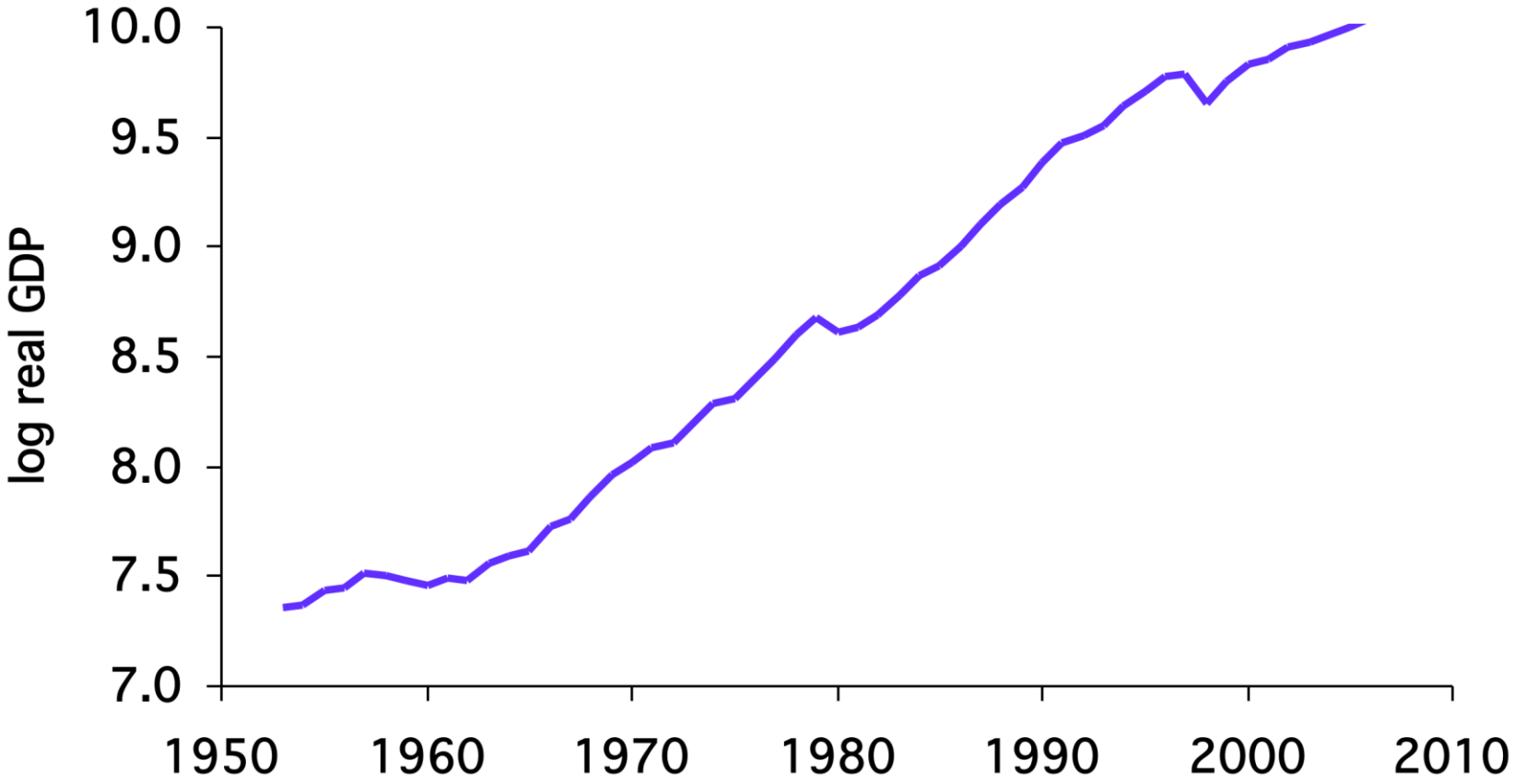
Growth accounting

- Each term is an annual growth rate

$$\gamma_{Y/N} = \gamma_A + \alpha\gamma_{K/L} + \gamma_{L/N}$$

- How much growth can be attributed to
  - Changes in the capital stock?
  - Changes in technology?
  - Changes in labor supplied?

Example: Korean GDP per capita



Example: Korea

	Y (bil 2005 US$)	K (bil 2005 US$)	L (ths)	N (ths)	A
1970	97.32	131	10062	32241	0.041
2009	1214	4551	24275	48509	0.087

$$\gamma_{Y/N} = \gamma_A + \alpha\gamma_{K/L} + \gamma_{L/N}$$

	Y/N	L/N	αK/L	A
1970-2009	5.42	1.21	2.28	1.93

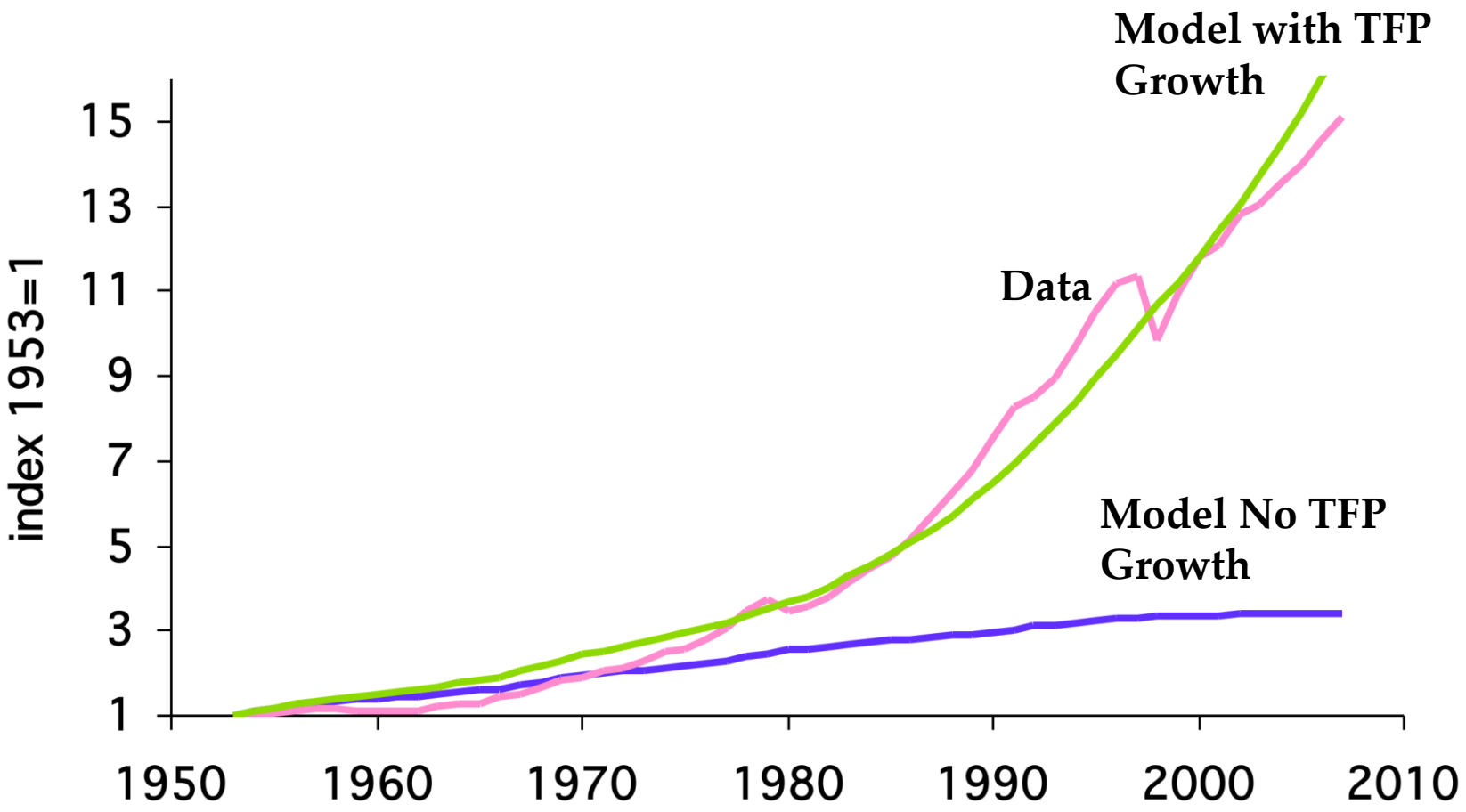
Example: Korea

$$A_{1970} = 97.32 / (131^{1/3} * 10062^{2/3}) = 0.041$$

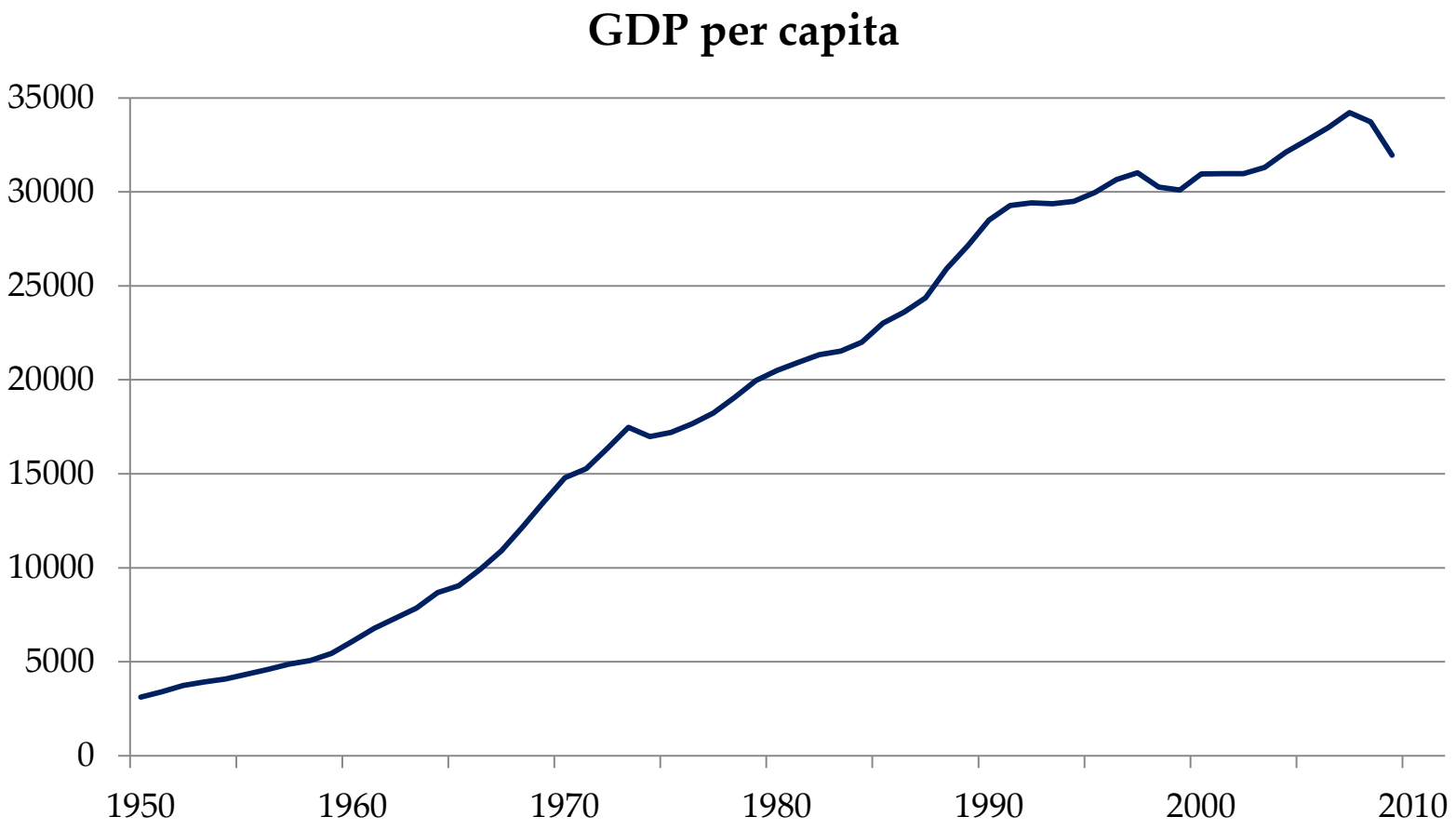
$$A_{2009} = 1214 / (4551^{1/3} * 24275^{2/3}) = 0.087$$

$$\gamma_{Y/N} = \frac{\ln(\frac{1214}{48509}) - \ln(\frac{97.32}{32241})}{39} * 100$$

Korean GDP per capita



Japan


GDP per capita
35000
30000
25000
20000
15000
10000
5000
0
1950
1960
1970
1980
1990
2000
2010

What happened in Japan?

$$\gamma_{Y/N} = \gamma_A + \alpha\gamma_{K/L} + \gamma_{L/N}$$

	Y/N	**L/N**	**αK/L**	**A**
1960-1970				
1970-1991				
1991-2009				

What happened in Japan?

$$\gamma_{Y/N} = \gamma_A + \alpha\gamma_{K/L} + \gamma_{L/N}$$

	Y/N	L/N	αK/L	A
1960-1970	8.87	0.28	3.27	5.32
1970-1991	3.25	0.26	1.73	1.26
1991-2009	0.49	-0.06	0.61	-0.07

Productivity in Japan

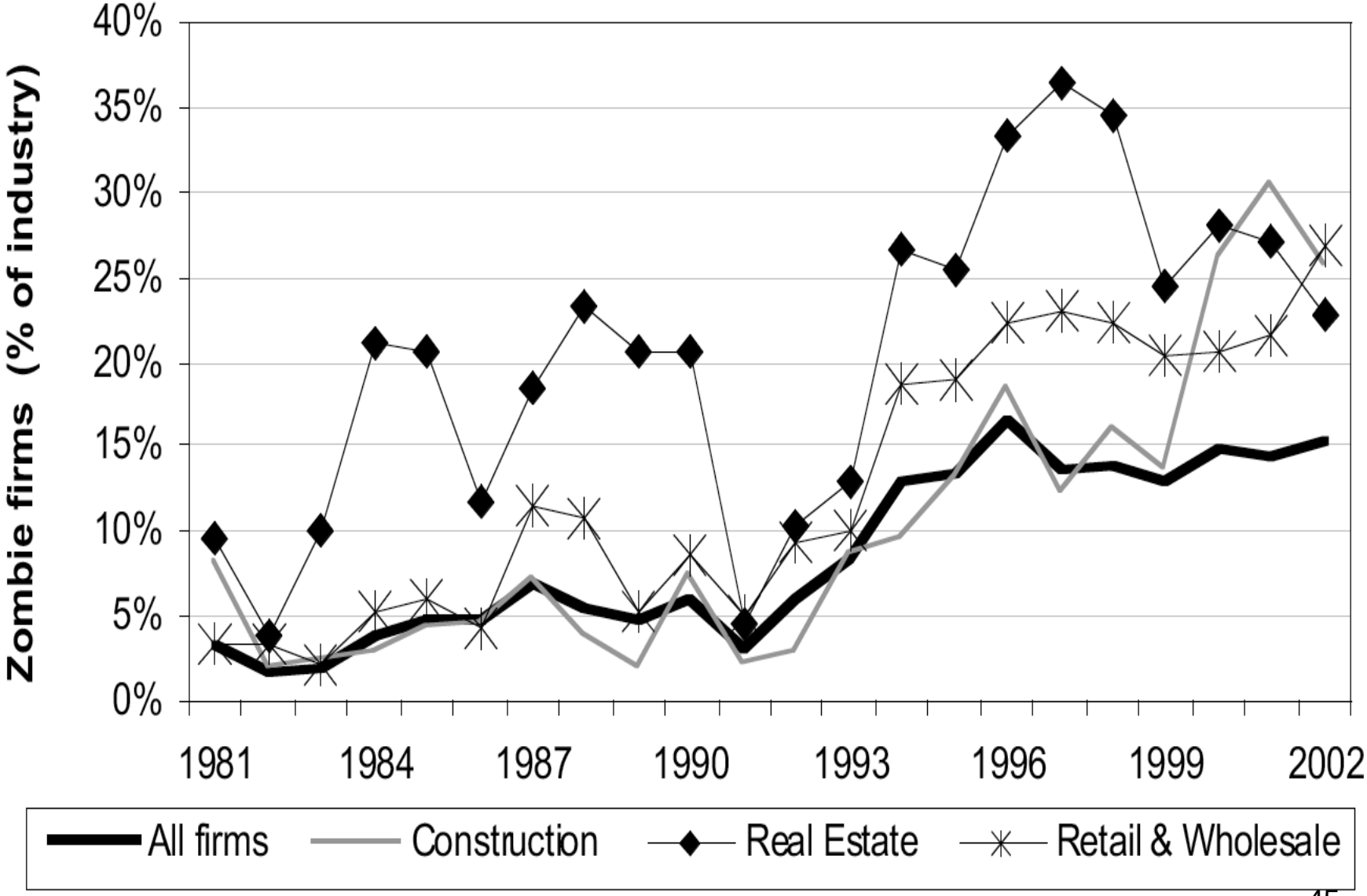
"The 1990s in Japan: A Lost Decade"

Fumio Hayashi and Edward Prescott

"the problem is low productivity growth… perhaps the low productivity growth is the result of a policy that subsidizes inefficient firms and declining industries.

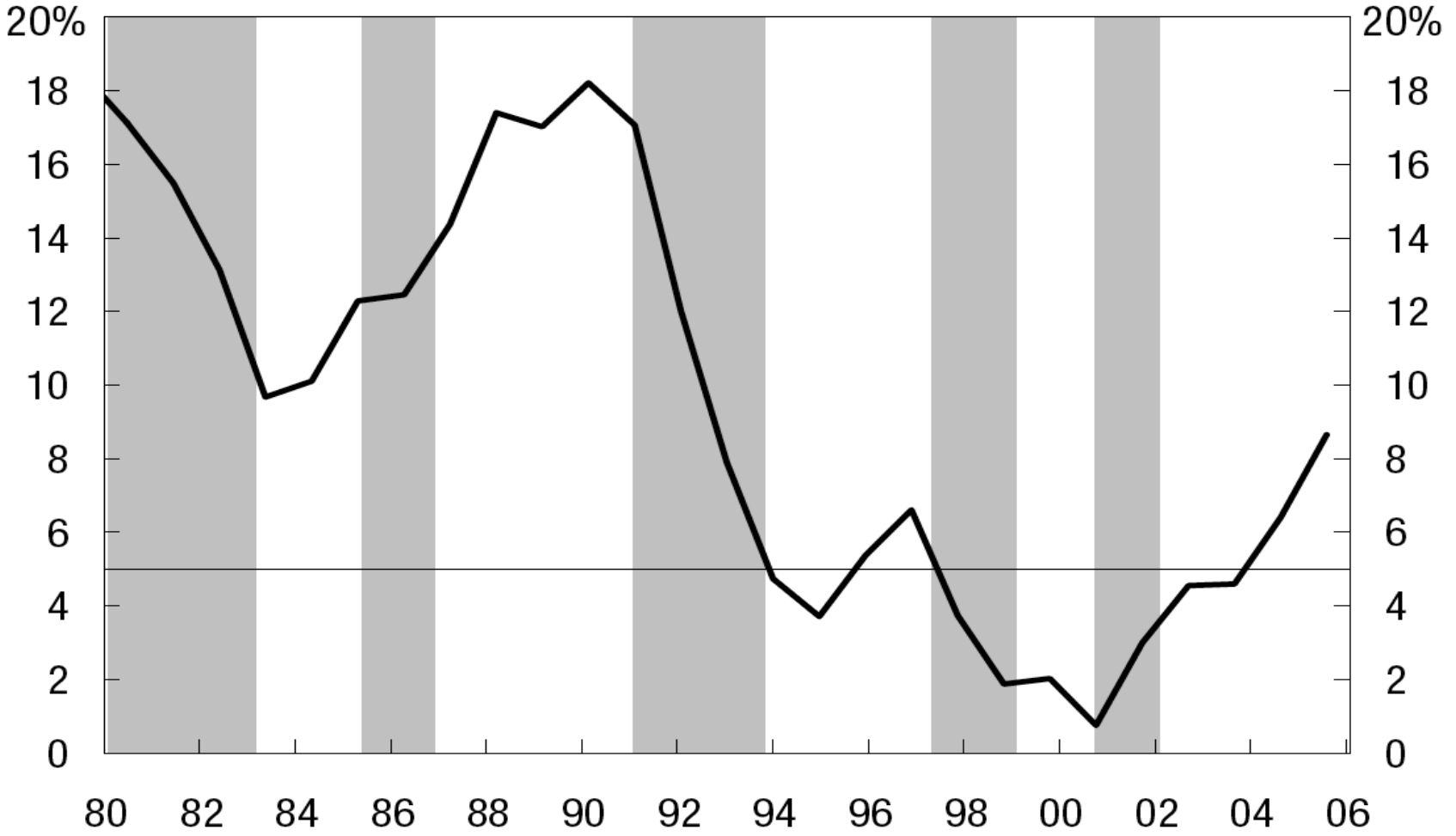
This policy results in lower productivity because the inefficient producers produce a greater share of output." More on this later.

Zombie Firms in Japan



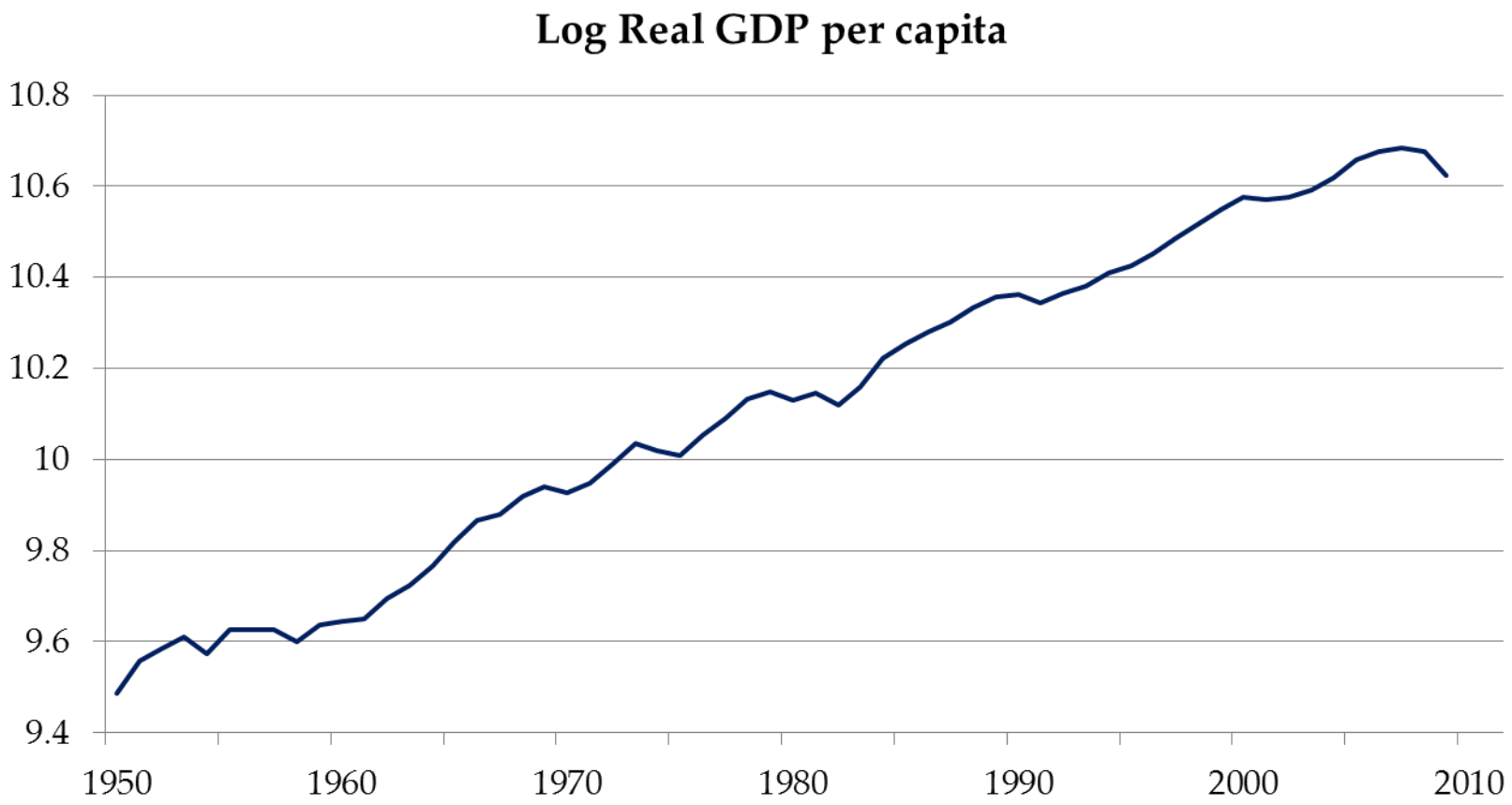
Source: Caballero, Hoshi and Kashyap, *American Economic Review*, 2008.

Japan: Marginal Product of Capital



Note: The figure shows 100 times the ratio of the five-year change of GDP to the five-year change of business fixed capital formation. Shaded areas denote recessions.
Sources: OECD and Japan Cabinet Office.

United States



What happened in the U.S.?

$$\gamma_{Y/N} = \gamma_A + \alpha\gamma_{K/L} + \gamma_{L/N}$$

	Y/N	A	αK/L	L/N
1960-2009	2.00	0.62	0.51	0.87
1960-1973	3.91	1.91	0.29	1.71
1973-1995	1.86	0.41	0.46	0.99
1995-2007	2.17	0.68	0.94	0.55
2007-2009	-3.06	-2.63	0.57	-0.99

Solow (1987): *"You can see the computer age everywhere but in the productivity statistics."*

Source: PWT 7.0

Summary

- Growth accounting: quantifies sources of GDP growth

$$\gamma_{Y/N} = \gamma_A + \alpha\gamma_{K/L} + \gamma_{L/N}$$

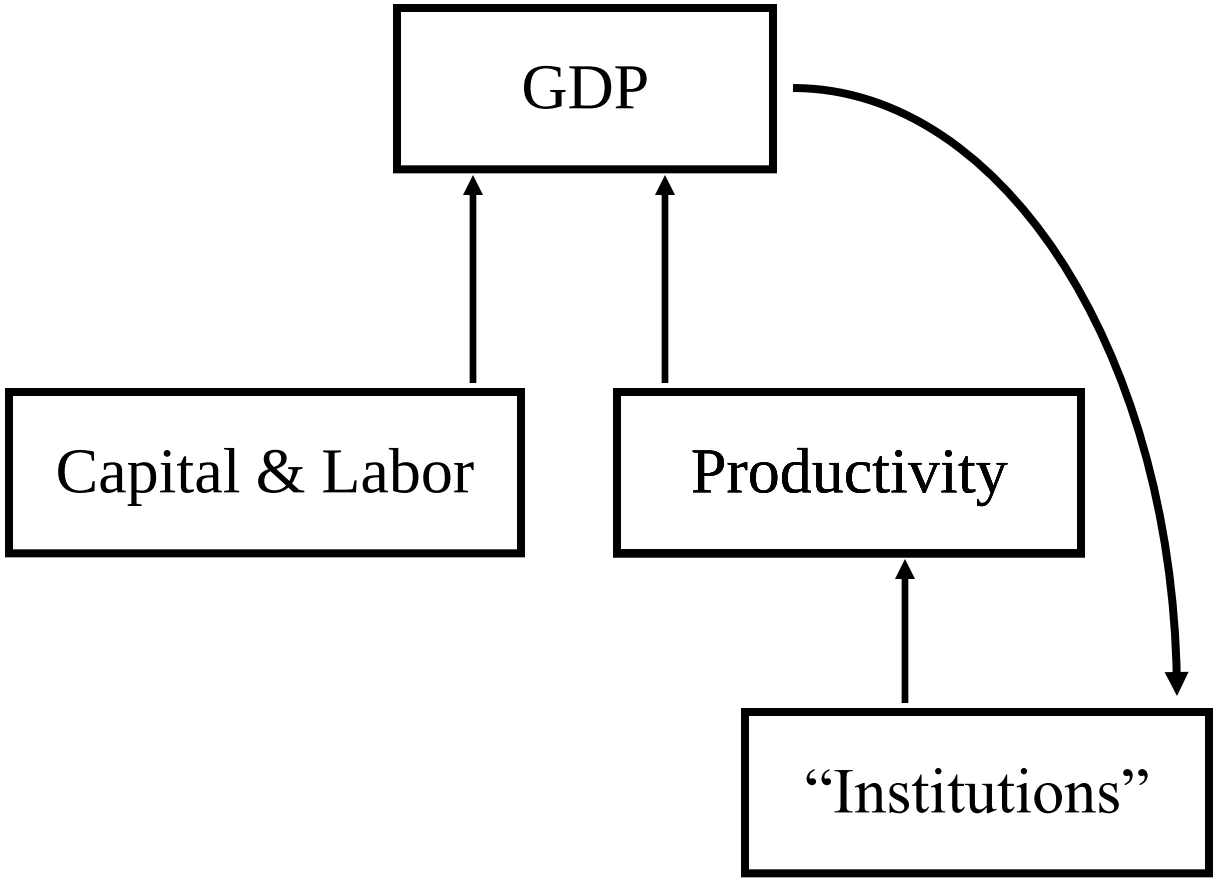
- Data: TFP is important
  - Important for fast growth (Korea 1980s)
  - Important for slow (or negative) growth (Japan 1990s)
- Solow model with TFP growth
  - Balanced growth path
  - Technology growth: no diminishing returns

The Global Economy

Productivity and Institutions

NYU STERN

Productivity and institutions



What are institutions?

- "Social mechanisms" that facilitate economic activity
- … through higher productivity ("TFP")
- Like what?
- What institutions are important in your industry?

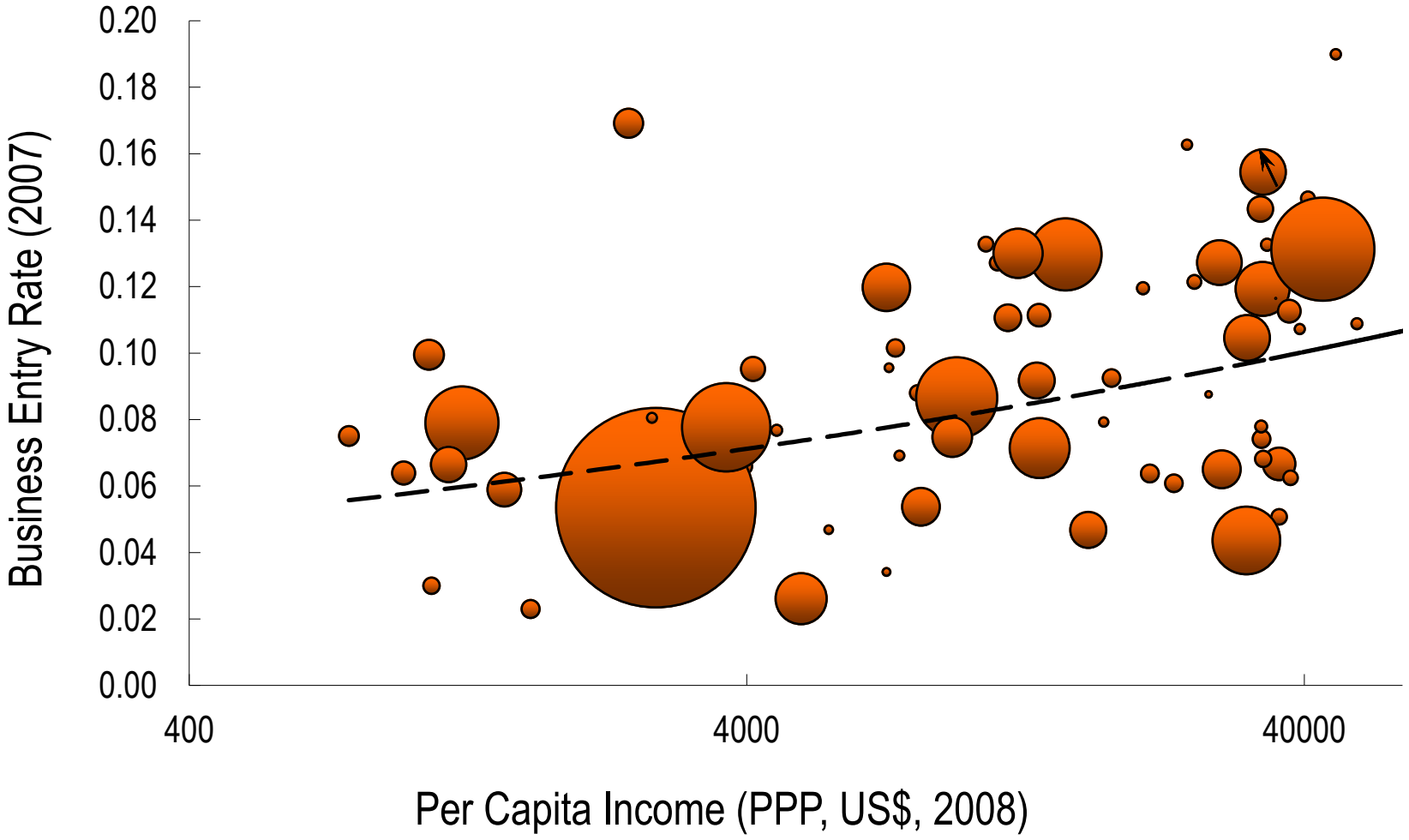
Institutions

- **Rule of law**
- Clearly defined **property rights**
- Open **competitive markets** (not "free")

Vibrant entrepreneurship

- Social capacity for innovation
  - creation of new businesses
  - new products
  - new processes
  - higher quality
  - new markets
  - new organizational forms
- …requires property rights, open access to opportunity, downside risk protections and cultural support

Entrepreneurship and Income



Source: World Bank Entrepreneurship Database 2008 and World Development Indicators 2009.

Effective financial systems
Historical Perspective

- Efficiently channel funds for optimal deployment
  - provide liquidity and leverage
  - provide capital for public and private projects

- Components in mature economies
  - credible money
  - banks (CB, public and private institutions)
  - efficient tax system (and stable public finances)
  - efficient capital markets
  - insurance programs
  - liberal corporation laws

Source: Professor George Smith.

Reduce Transaction Costs
Allocate Resources to Most Productive Use

- Mobilizing and pooling savings
- Boost investment, innovation, productivity
  - Liquidity and payments system access
    - Safekeeping and accounting
  - Collecting and processing information
    - Screening
    - Monitoring
    - Influence corporate governance
  - Diversifying, transforming and managing risk
    - Helps risk-taking
- Question: Ebay and Prosper.com

What We Observe

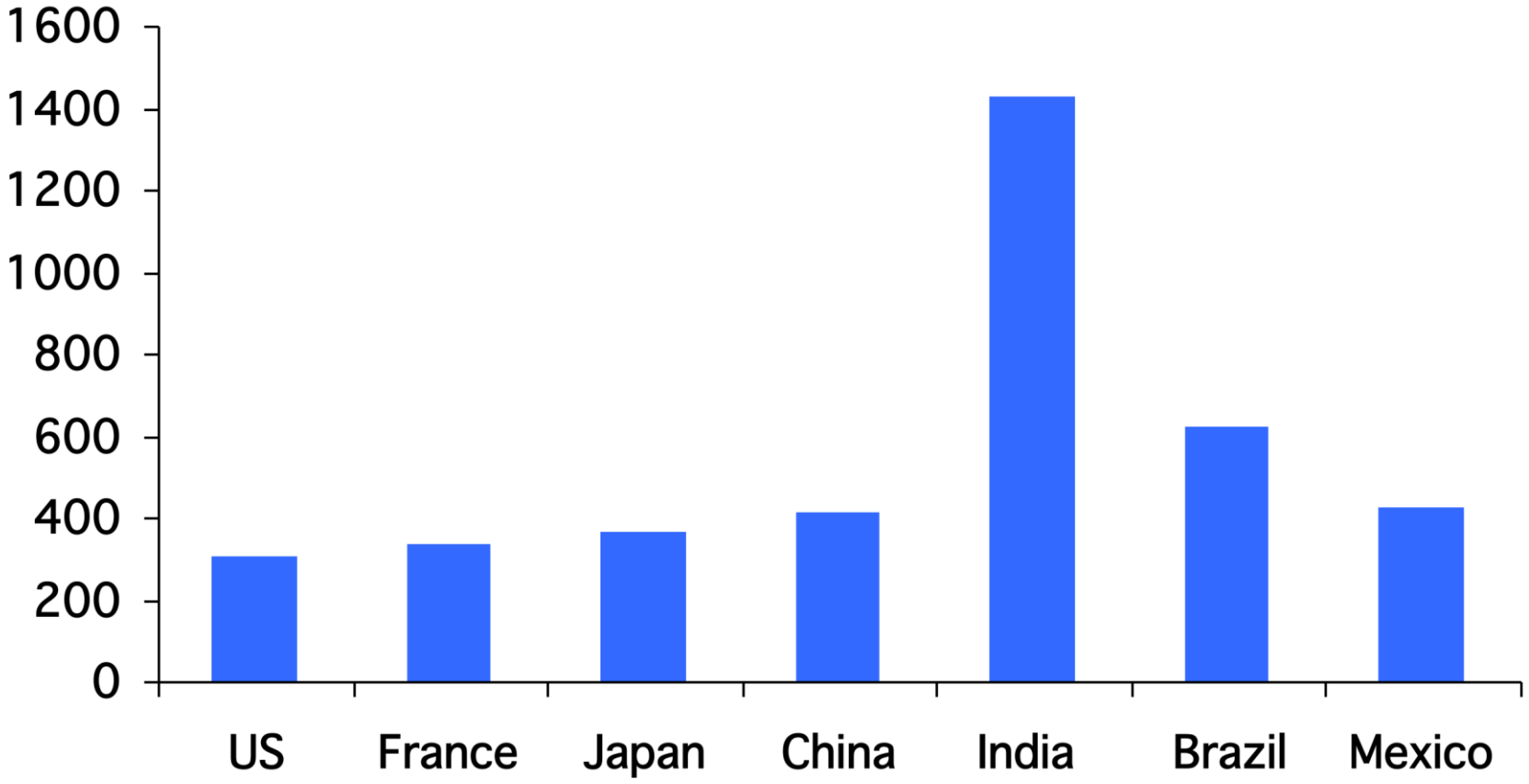
- Countries with better-developed private financial systems grow faster. Both intermediaries and markets matter for growth.
- Better financial systems add to productivity growth and facilitate external financing.
- Well-functioning financial systems need macro stability and strong legal/information systems.
- Effective regulation empowers markets.

Source: Demirguc-Kunt and Levine, “Finance, Financial Sector Policies and Long-Run Growth,” World Bank Policy Research Working Paper 4469, January 2008.

Capital markets

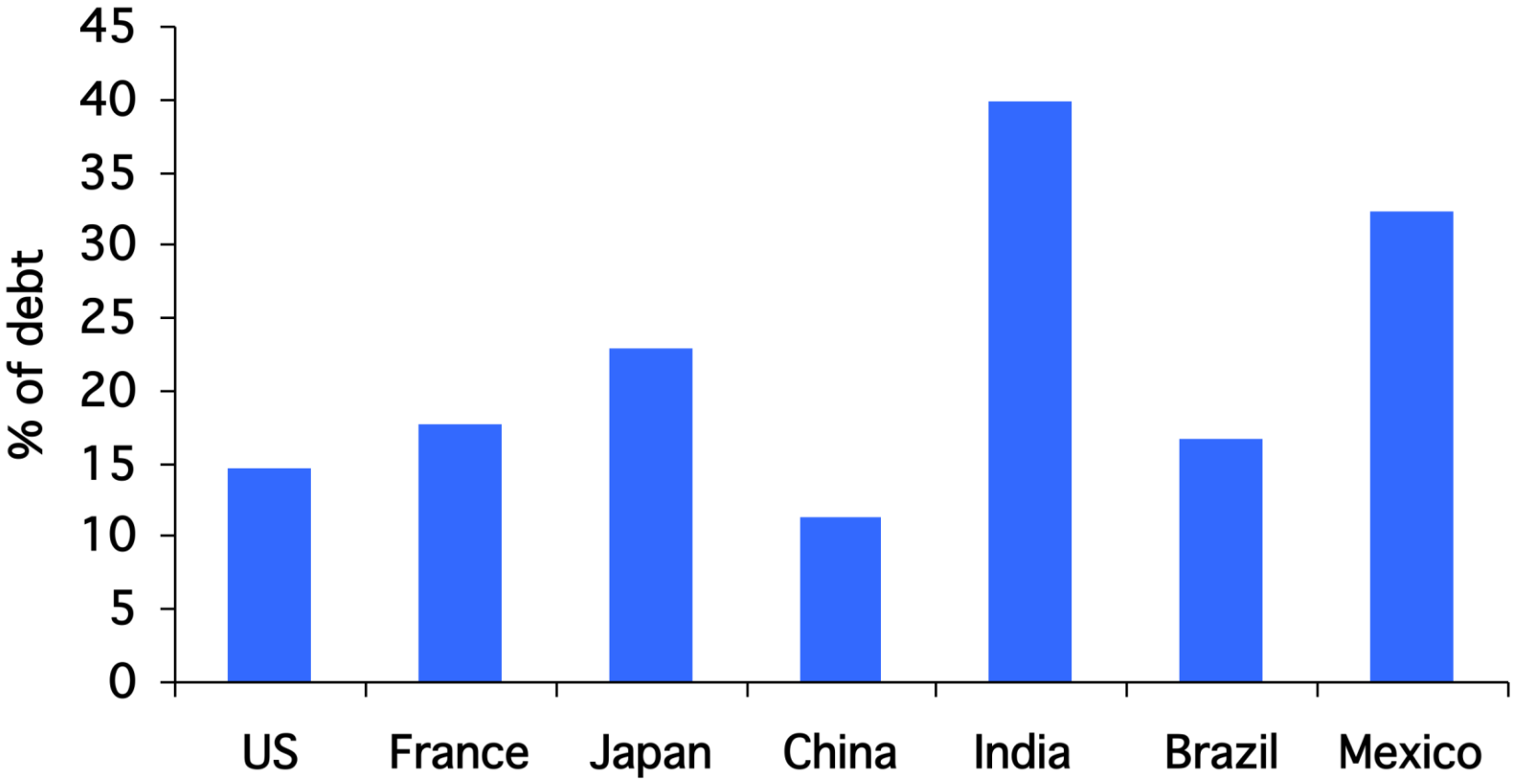
- Note: creditor rights help borrowers!
  - Making it easy to default simply kills off loan market, which hurts borrowers as well as lenders
  - Result: positive NPV projects not funded, TFP lower than it could be
- Evidence:
  - States/countries with stronger creditor rights have more lending, lower rates
  - Countries with strong creditor rights have more advanced financial systems and higher GDP per capita

Days to enforce contracts



Source: World Bank Group, *Doing Business*

Cost of enforcing contracts



Source: World Bank Group, *Doing Business*

Measuring institutions

- Measures of institutional quality are attempts to quantify important features of the economic and business environment but are inherently subjective
- Sources
  - Corruption Indices (Transparency International)
  - Doing Business (World Bank Group)
- Lord Kelvin: "If you can't measure it, you can't improve it"

Competitive markets

- Entry and exit of firms
  - Inefficient firms exit
  - efficient firms enter, grow
- Frictions to entry/exit from
  - Property rights
  - Corporate governance, rule of law
  - Corruption, lobbying
  - Subsidies, competition policy

Barriers to entry

The Other Path by Hernando de Soto

- Researchers tried to set up a small garment factory in Lima while complying with all regulations.
  - Steps required: 11
  - Time needed: 289 days
  - Bribes requested: 10 (2 paid)
  - Cost: $1,231 (32 times monthly min. wage)

Efficiency across firms

- Example: two firms
  - High productivity (g)
  - Low productivity (b)
- $A_g > A_b$

$$Y_g = A_g K_g^{\alpha} L_g^{1-\alpha}$$

$$Y_b = A_b K_b^{\alpha} L_b^{1-\alpha}$$

Efficiency across firms

- Aggregate TFP

$$A = \frac{Y_g + Y_b}{K_g + K_b^{\alpha} \; L_g + L_b^{1-\alpha}}$$

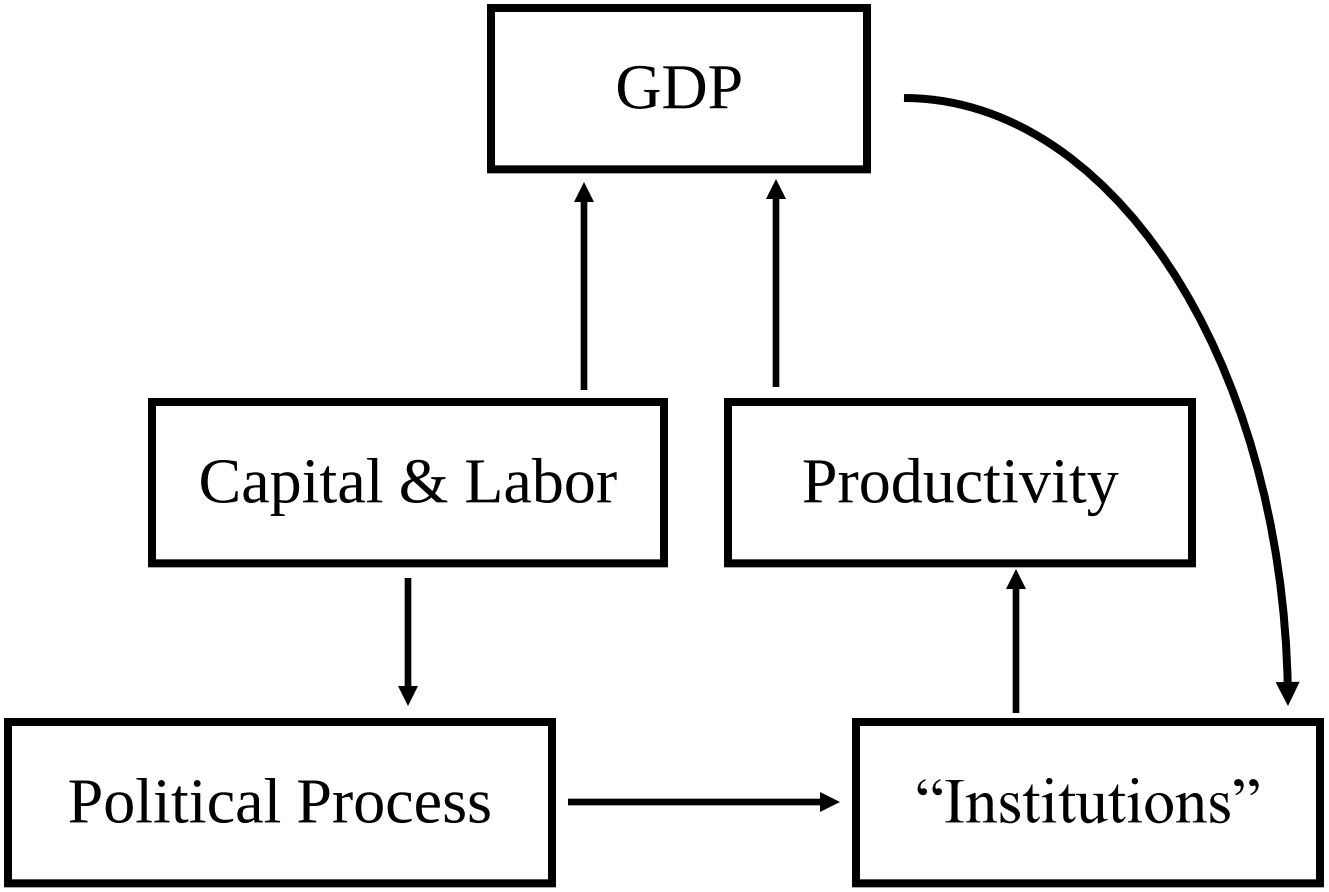
Efficiency across firms

- We can show (but don't worry about being able to do it)

$$A = A_g \left(\frac{K_g}{K_T}\right)^{\alpha} \left(\frac{L_g}{L_T}\right)^{1-\alpha} + A_b \left(\frac{K_b}{K_T}\right)^{\alpha} \left(\frac{L_b}{L_T}\right)^{1-\alpha}$$

- Aggregate TFP is a weighted sum of firms' TFP
- More K, L to good firms: higher aggregate TFP and output

Governments and institutions



Enabling political systems

- Organize geographic and economic unity
- Provide stability and related public goods
- Establish legitimate "monopoly of force"
- Establish "rule of law"
  - legitimize economic activity
  - protect property rights and reduce risks
  - judicial processes for dispute resolution
  - address market failures and dysfunctional inequalities
- Public goods: Security of life, liberty and property
- Promote "open access" to opportunity
  - baseline access to education and employment
- Legitimize innovation

Source: Professor George Smith.

Non-enabling Political Systems

- Anarchy (rule of the strongest)
- Predatory government (arbitrary seizure)
  - Public vs private interest
- Incompetent government
  - Unable to supply public goods of protecting life, liberty and property
- Note: Democracies can be predatory and incompetent (slavery)

How Government Can Promote Financial Development

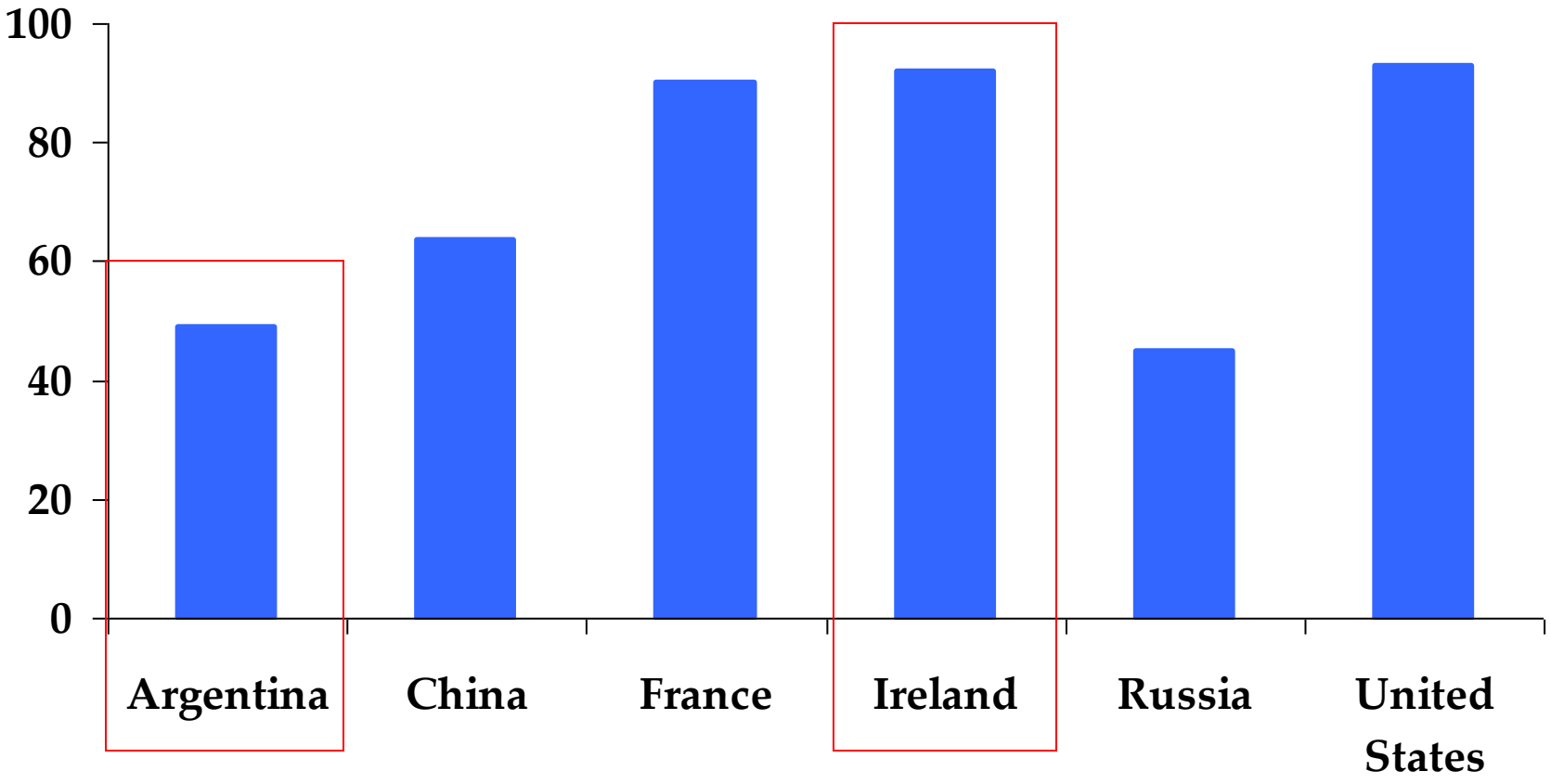
- Macroeconomic stability
- Limit corruption and crime
- Enforce legal rights of investors
  - Strengthens access to external finance
  - Flexible and adaptive conflict resolution
- Regulation through private empowerment
- Contestable markets
- Private allocation of credit
- Sequencing of liberalization (example: Korea)

Equity Liberalization

- Did equity market liberalizations boost economic growth?
- Controversy: consumption boom, hot speculative capital, reduced domestic savings?
- Answer: It raised investment and productivity, especially in countries with high-quality institutions.
- Lower cost of capital due to:
  - Improved risk-sharing
  - Supply of external financing from abroad

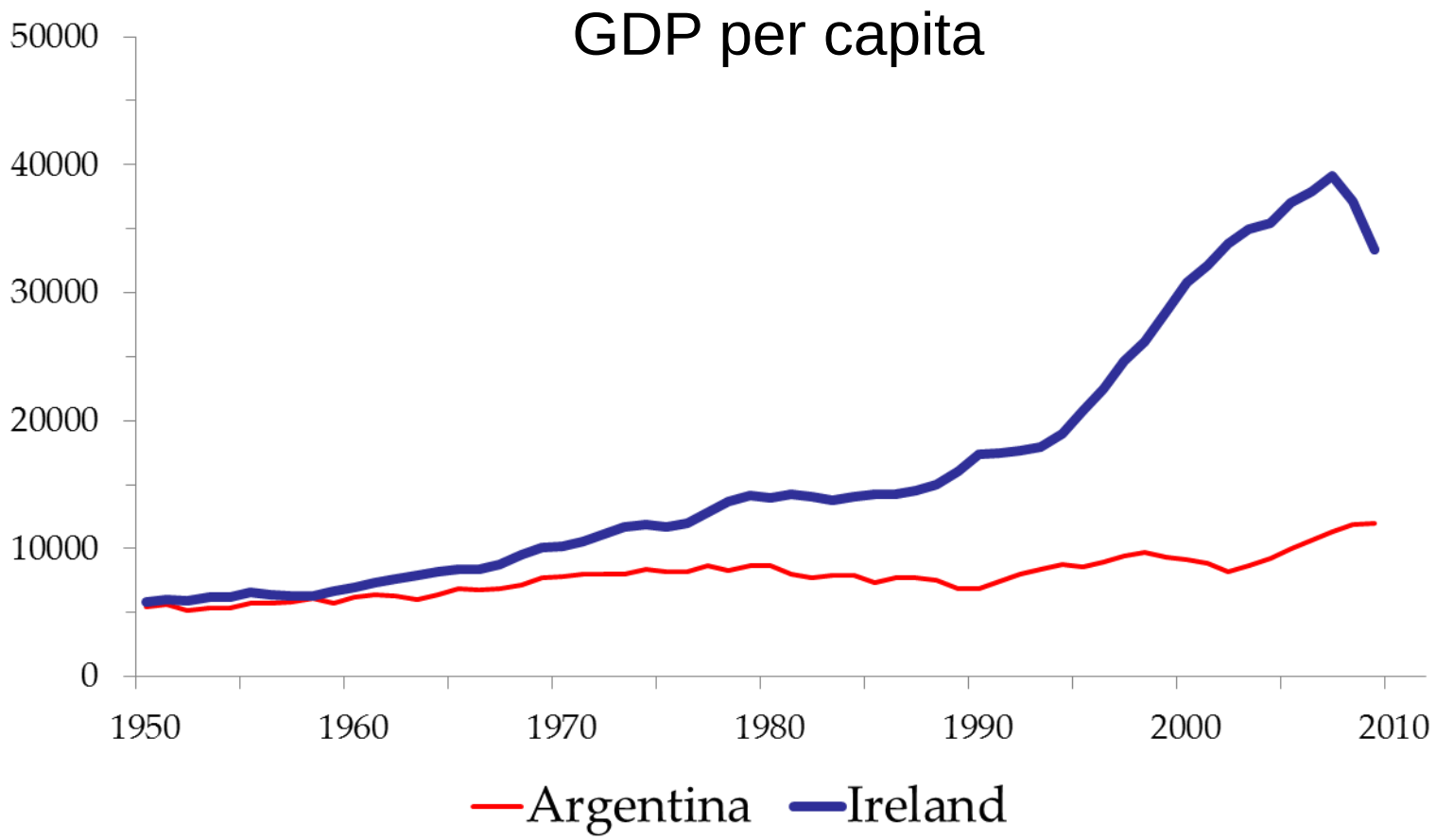
Source: Bekaert et al., "Does Financial Liberalization Spur Growth," *Journal of Financial Economics*, Volume 77, Issue 1, July 2005, pages 3-55.

Government Effectiveness



Source: World Bank, *Governance Indicators*

Governments: Ireland and Argentina



Governments

- Argentina then
  - Facing inflation over 1000%, the government announced in 1991 that citizens could use either dollars or local currency and pegged the peso to the dollar. A decade later, the government converted all dollar assets into pesos ("pesification") and devalued by 75%.

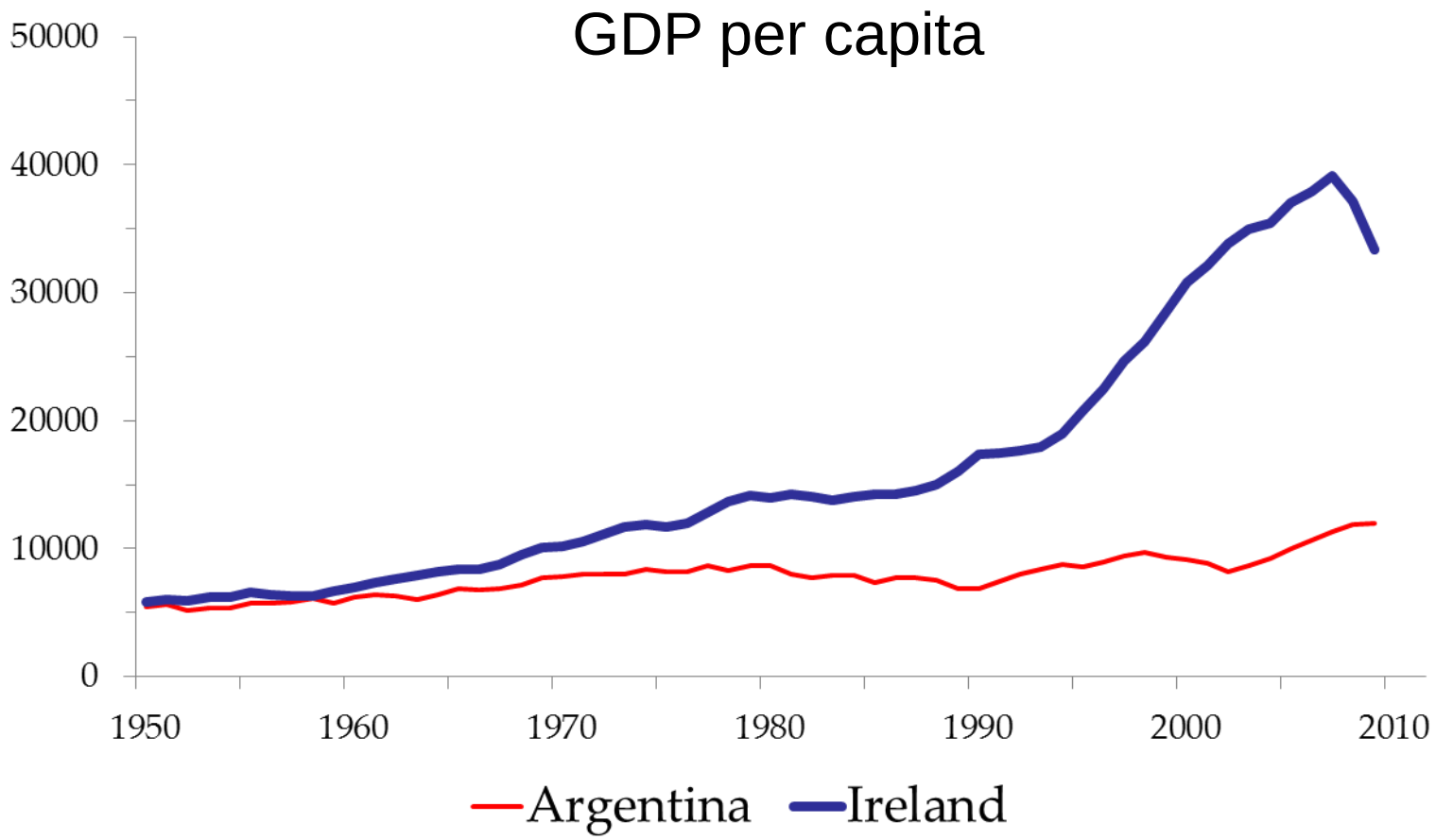
What happened?

- Pegging the Peso meant the government could not finance government debt by printing money
- Requires fiscal discipline
  - Provincial governments
  - Federal governments
- Short answer: it didn't happen

Governments

- Argentina now… (*WSJ*, Oct 28 08):
  - Argentina's government pressed forward with its controversial plan to nationalize private pension funds. … [President] Kirchner said her move to seize the private funds is designed to protect contributors from alleged mismanagement amid the global market crisis.
- … and again (*NYT*, Jan 25 10):
  - Mrs. Kirchner fired the bank president, Martín Redrado, by decree this month for refusing to release $6.59 billion in reserves …. A federal judge … ruled that Mrs. Kirchner could not fire Mr. Redrado or take control of the reserves without congressional approval…. Mr. Redrado said on Sunday that the police in Buenos Aires had prevented him from entering the bank.

Governments: Ireland and Argentina



What happened in Ireland?

- Why did growth accelerate in early 1990s?
- Where do we start?

What happened in Ireland?

	L/N	K/L	A
1960	0.39	39,456	0.052
1993	0.39	111,540	0.095
2007	0.51	162,061	0.141
2009	0.49	167,819	0.122
Contribution 1960-1993	-0.01	1.05	1.83
Contribution 1993-2007	1.85	0.89	2.83
Contribution 2007-2009	-1.61	0.58	-7.01

What happened in Ireland?

- EU membership, aid recipient
- Fiscal discipline (>1987)
  - Tax rates slashed
  - Government budget balanced
- Attractive terms for foreign firms
  - Lowest corporate tax rates in OECD
- Private credit surge before 2007
- 2007: Guarantee for banks!

What have we learned today?

- Good institutions are ones that
  - Put capital and labor to efficient use
  - Ensure proper incentives (finance!)
- Examples
  - Rule of law
  - Property rights
  - Competitive markets

Something for the ride home

- Labor market institutions
  - Unemployment benefits
  - Firing taxes
  - Union coverage
  - Work rules
  - No-compete clauses
- What incentives do these create?
- Why do they exist?