ECON 310 - MACROECONOMIC THEORY

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http://www.aw-bc.com/williamson

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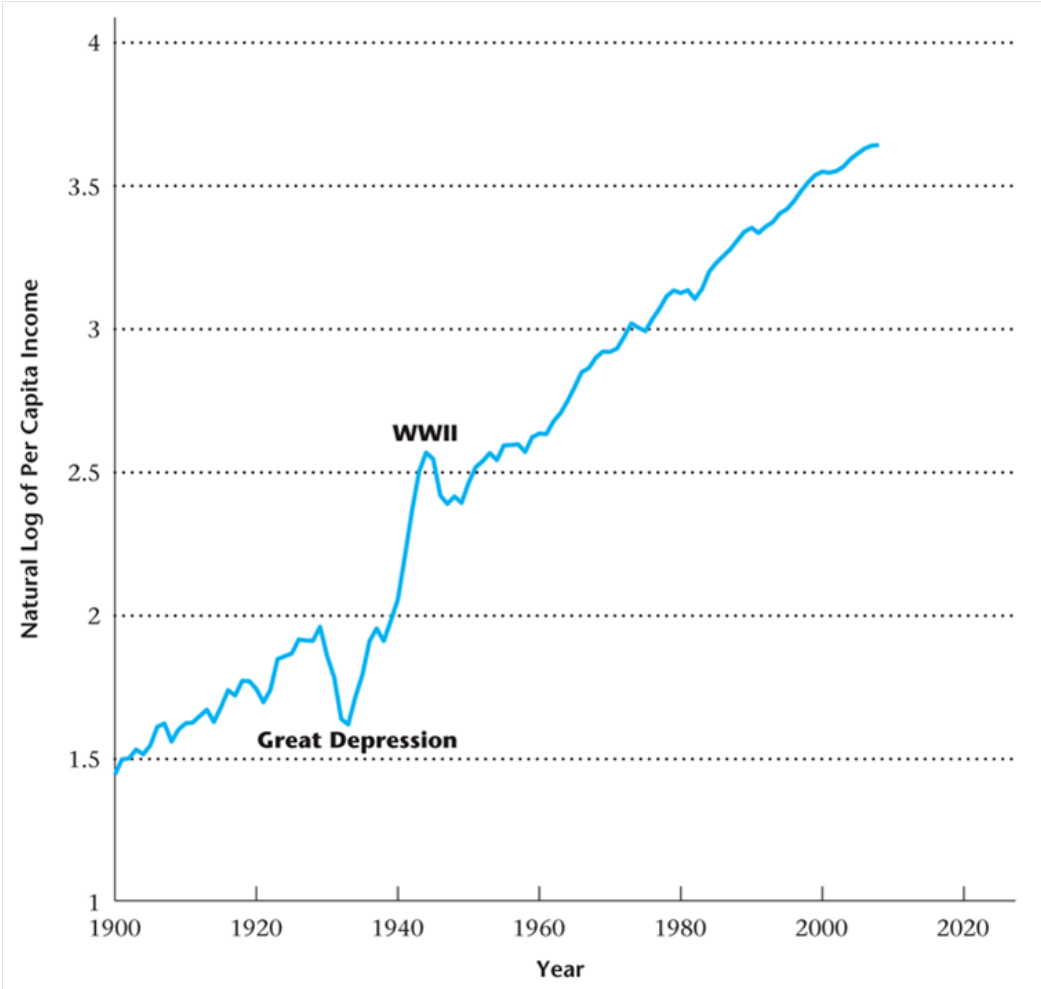
This version compiled March 24, 2014.

Figure 7.1: Natural Logarithm of Per Capita Real GDP



- Note: Except for the Great Depression and World War II, growth in U.S. per capita real income has not strayed far from 2% per year since 1900.

Growth Facts across Countries

1. Before Industrial Revolution (1800) standards of living differed little over time and across countries
2. Since IR per capita income growth has been sustained by the richest countries (US 2% since 1869)
3. ρ(investment, output/worker) > 0
4. ρ(population growth rate, output/worker) < 0
5. $\rho(Y/N_{1960}, E[\Delta Y/N]_{1960-1995}) \approx 0$
6. $\rho(Y/N_{1960}, E[\Delta Y/N]_{1960-1995}|poor) \approx 0$
7. Differences in per capita income increased between 1800-1950 (Industrialized vs non-industrialized)

Figure 7.2: Growth rate of output per worker vs. US

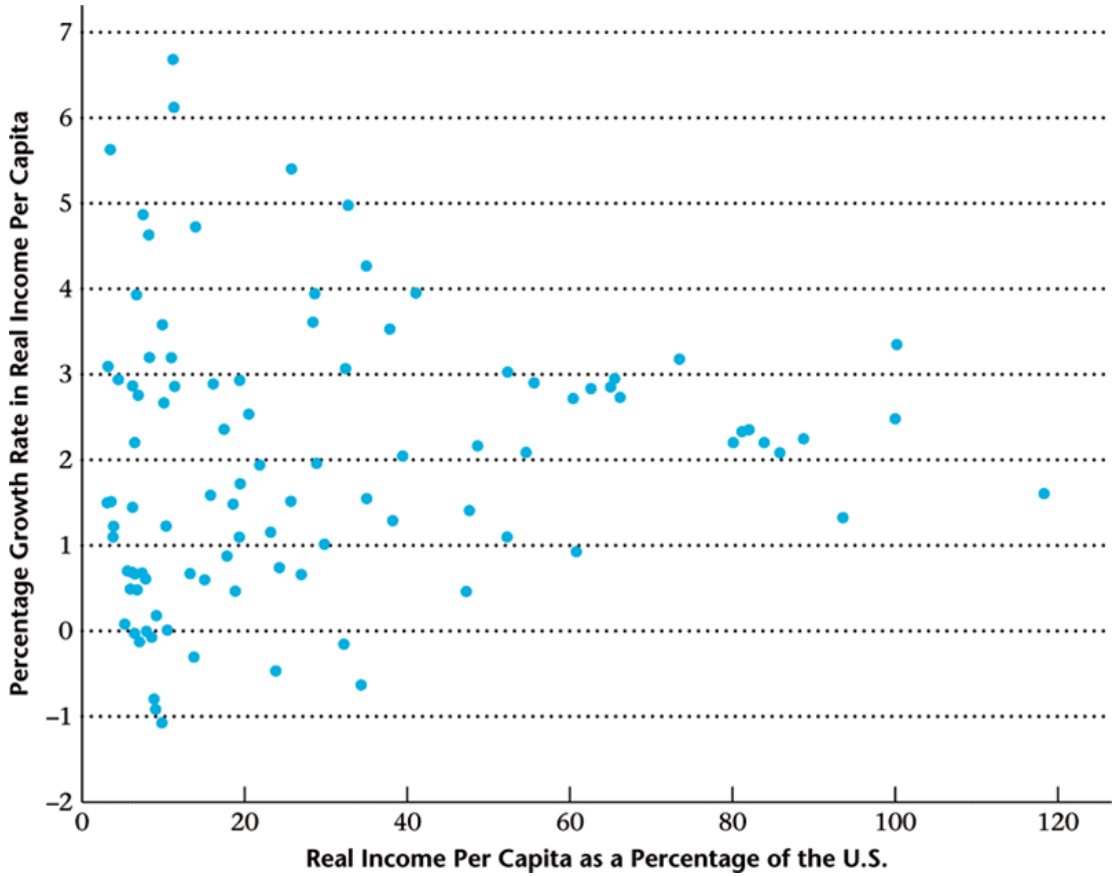


Figure 3.2 World Distribution of Real GDP per Person in 1960

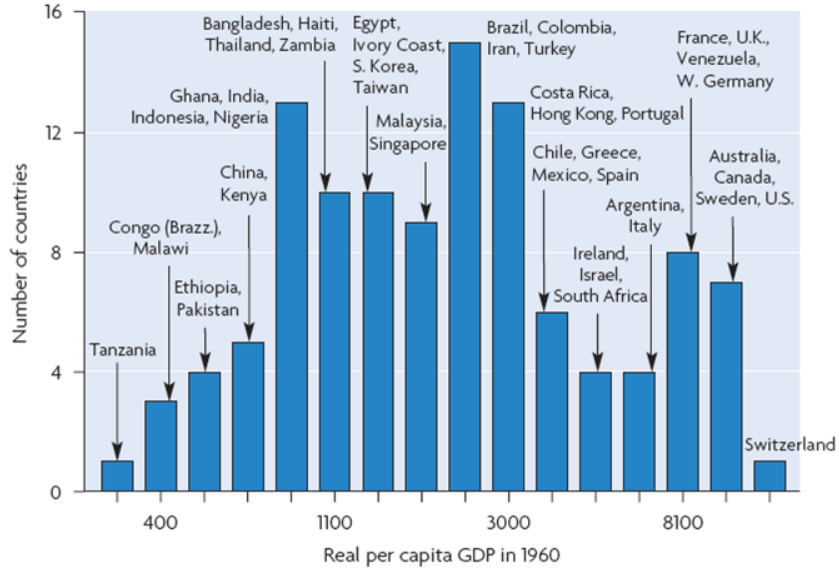


Figure 3.1 World Distribution of Real GDP per Person in 2000

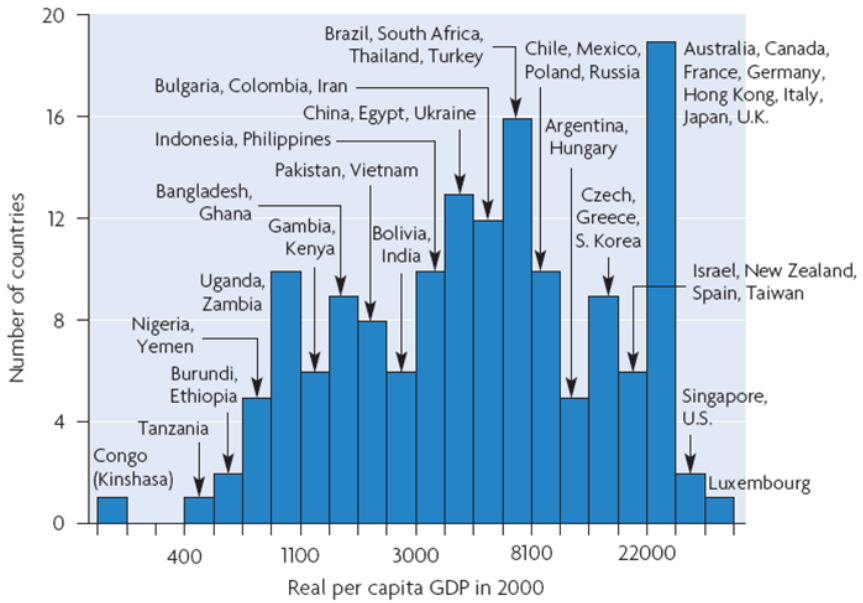


Figure 3.3 World Distribution of Growth Rates of Real GDP per Person, 1960–2000

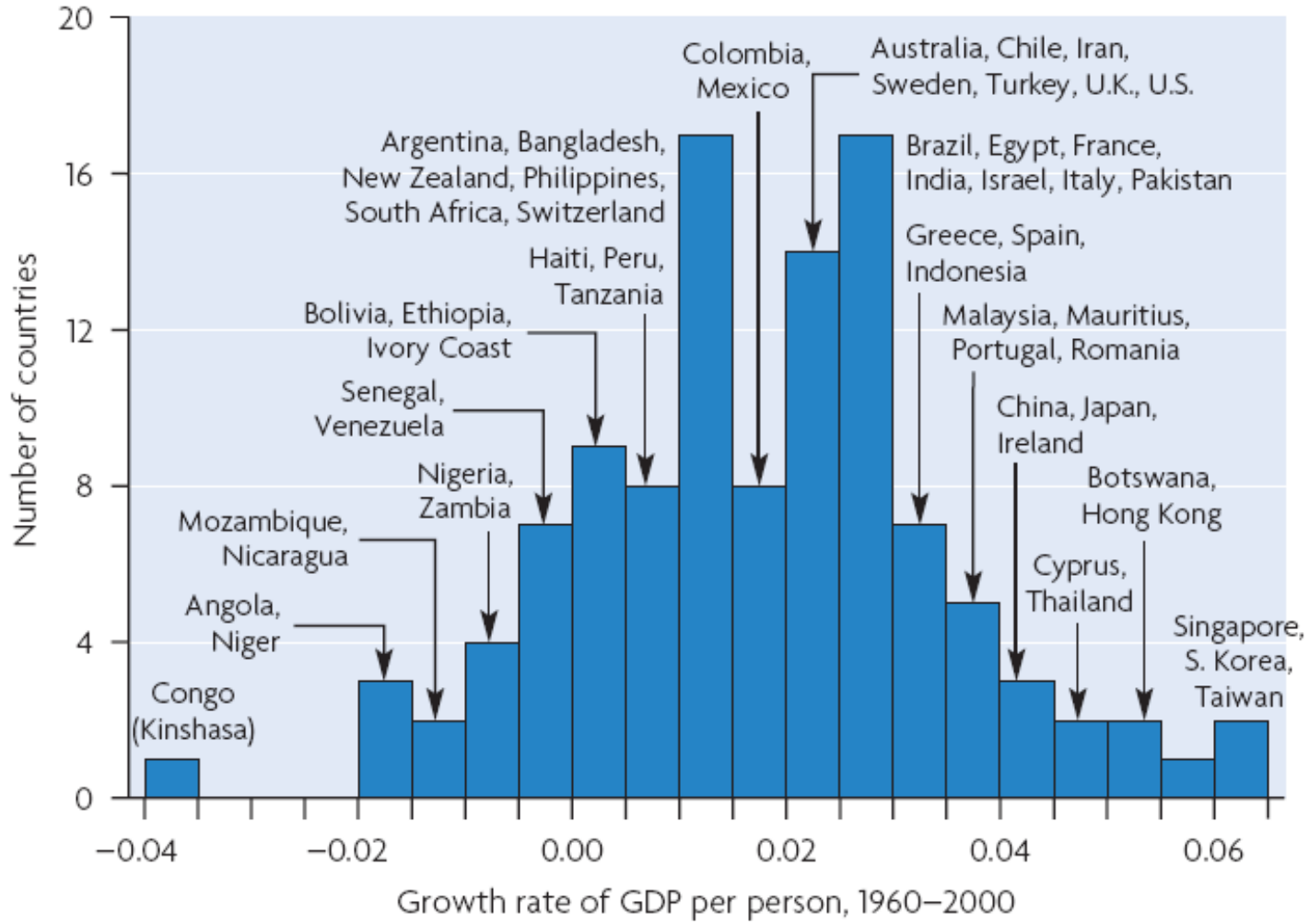


Figure 7.3: Output per worker vs. Investment rate

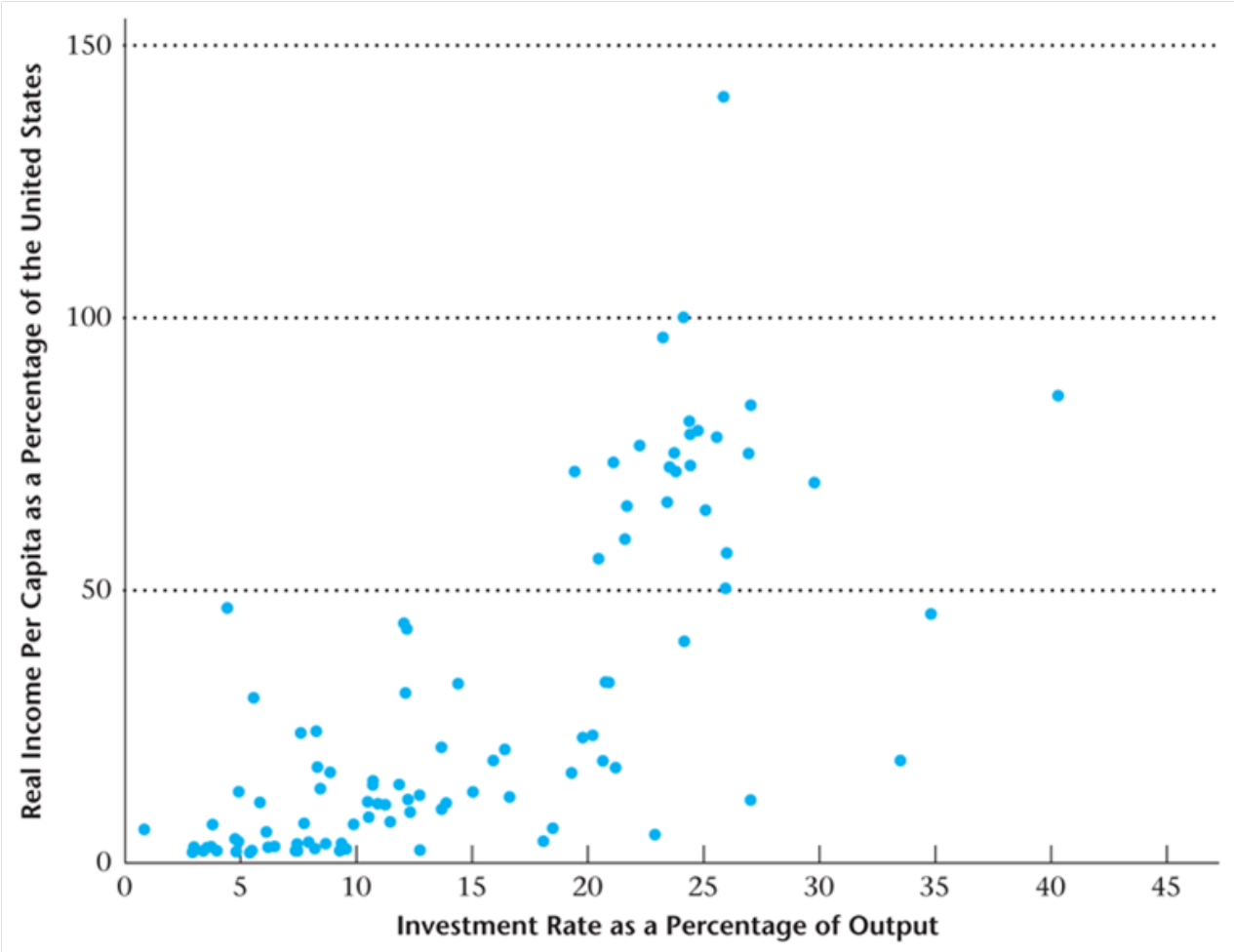
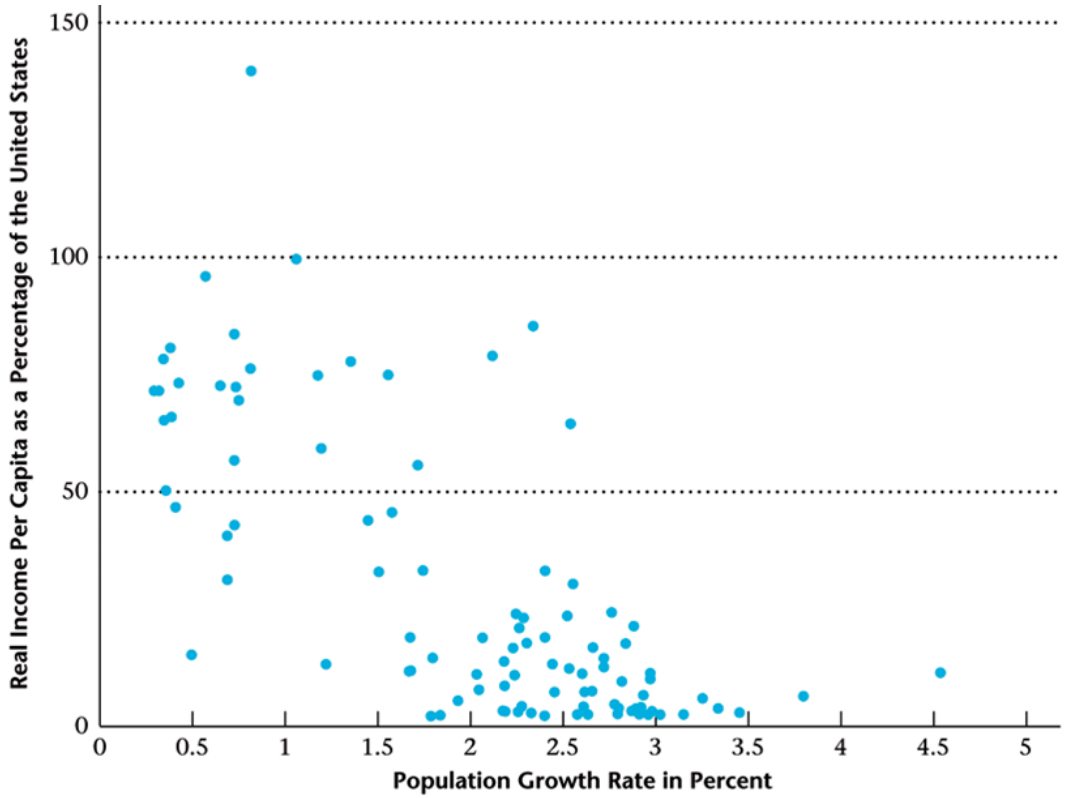


Figure 7.4: Output per worker vs. Population growth



Source: A. Heston, R. Summers, and B. Aten, *Penn World Table Version 6.1*, Center for International Comparisons at the University of Pennsylvania (CICUP), October 18, 2002, available at pwt.econ.upenn.edu.

Figure 7.5: Growth rate in per capital income vs. level of per capita income

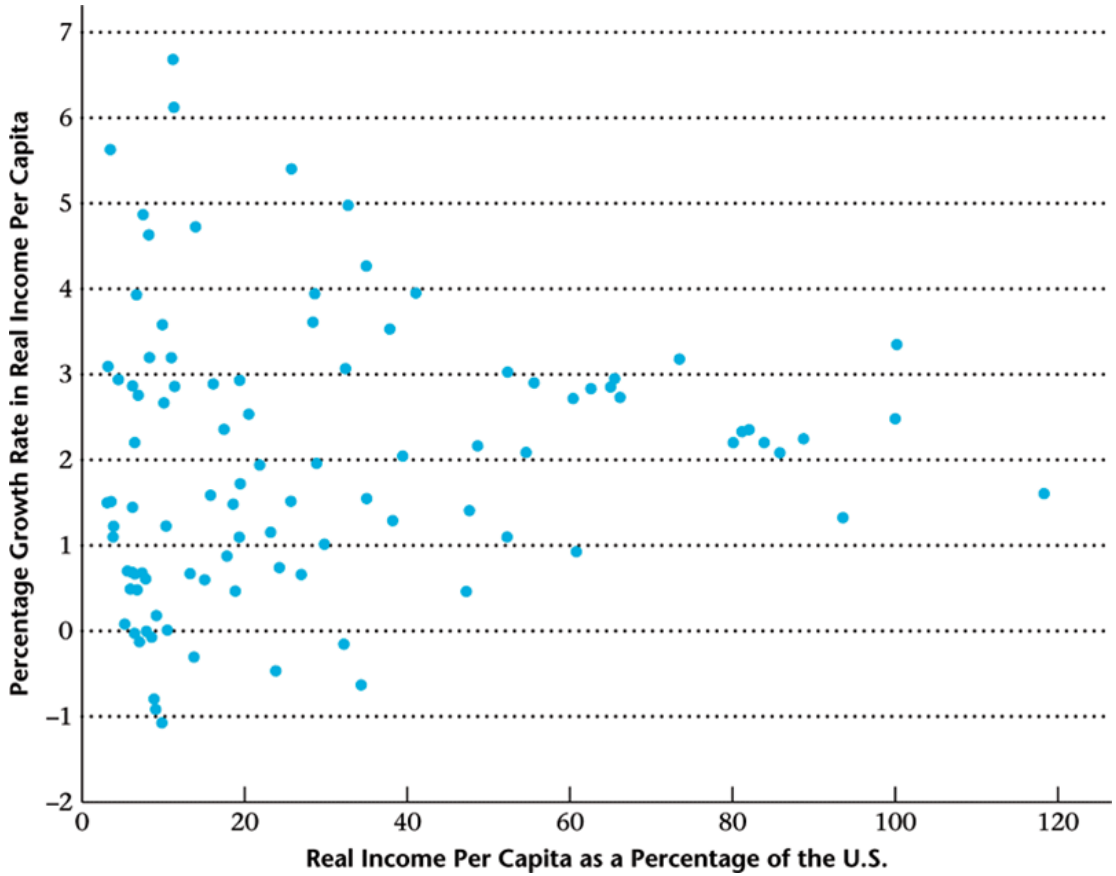
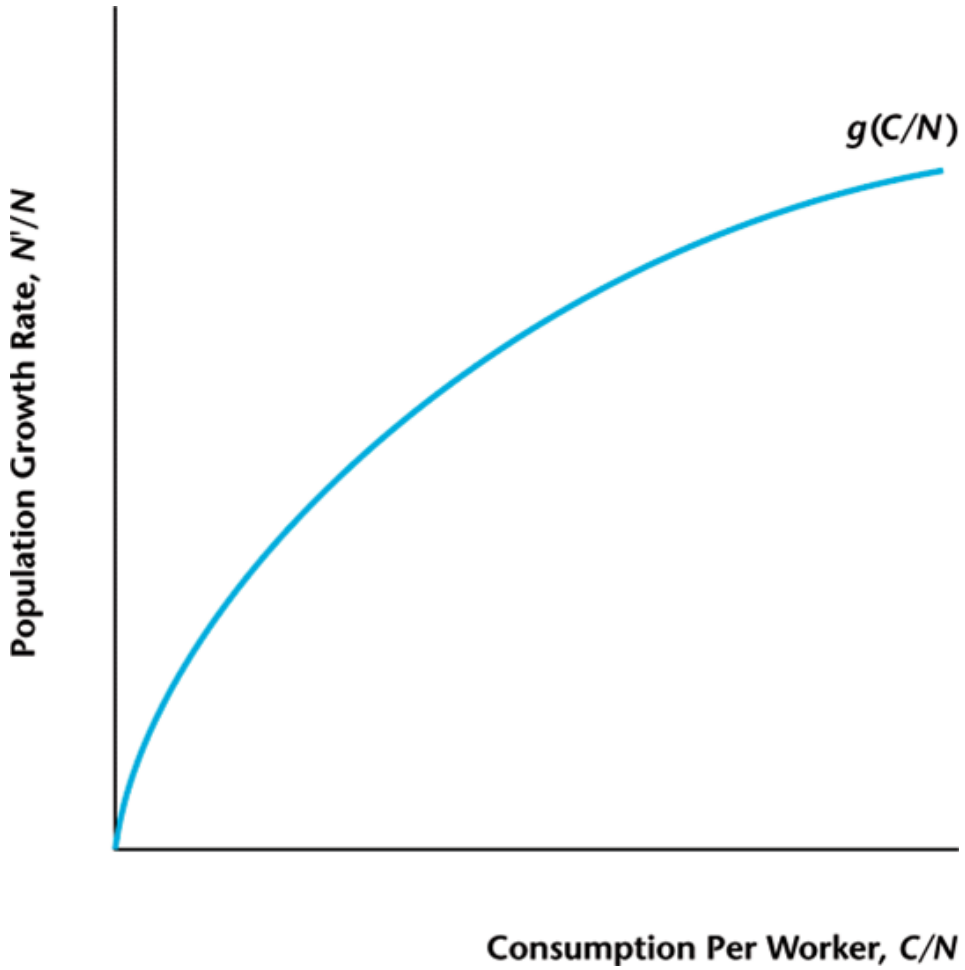


Figure 7.6: Population Growth function of C/N



Matching Solow with Data

- Use Heston-Summers Penn-World Tables dataset
- Solow model predicts 2 things:
  1. Increase in s causes increase y
  2. Increase in n causes decrease y
- Data says
  1. Fig 7.2 $\rho(s, y) > 0$
  2. Fig 7.3 $\rho(n, y) < 0$

Figure 7.2: Output per worker vs. Investment rate

$$\rho(\text{investment, output/worker}) > 0$$

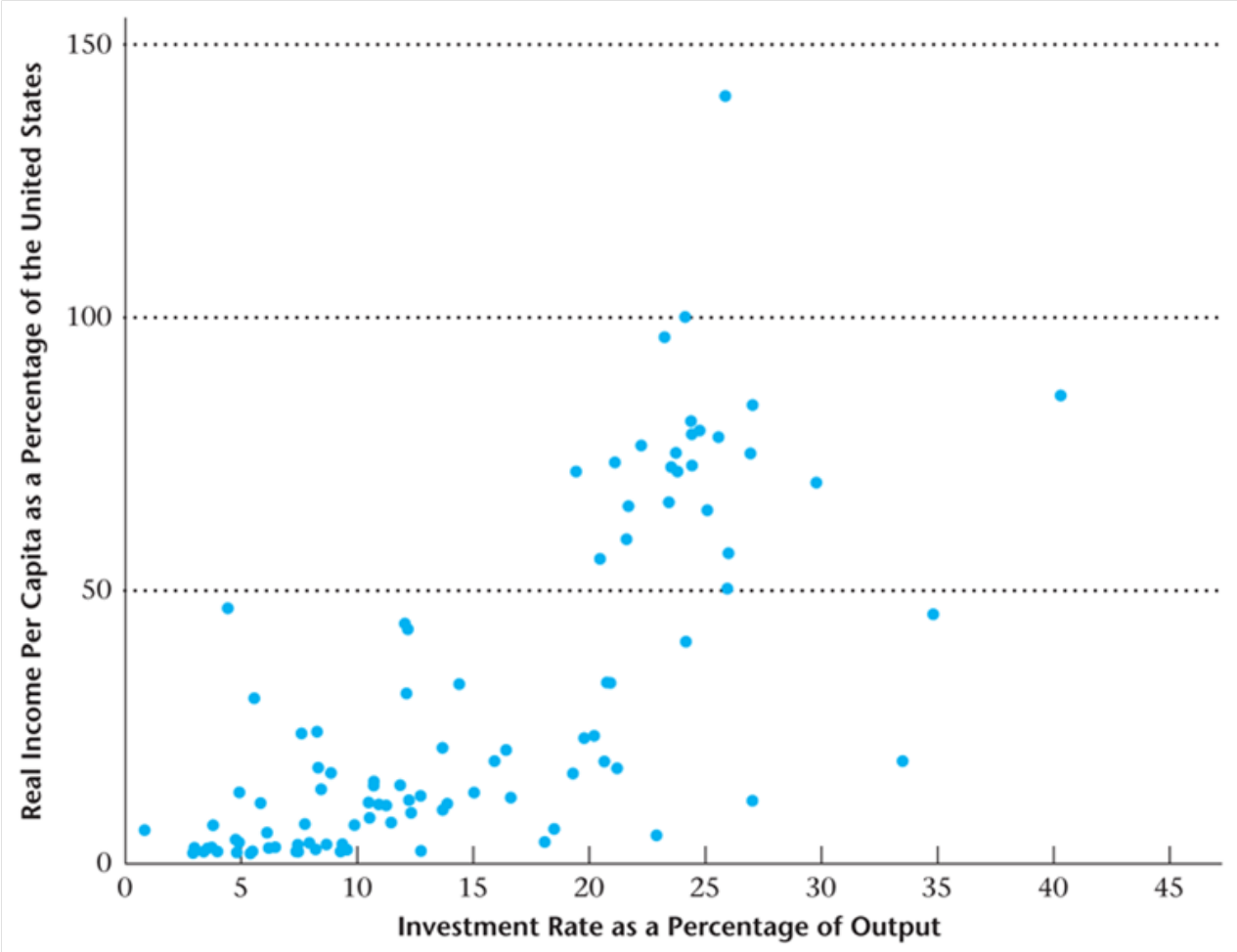
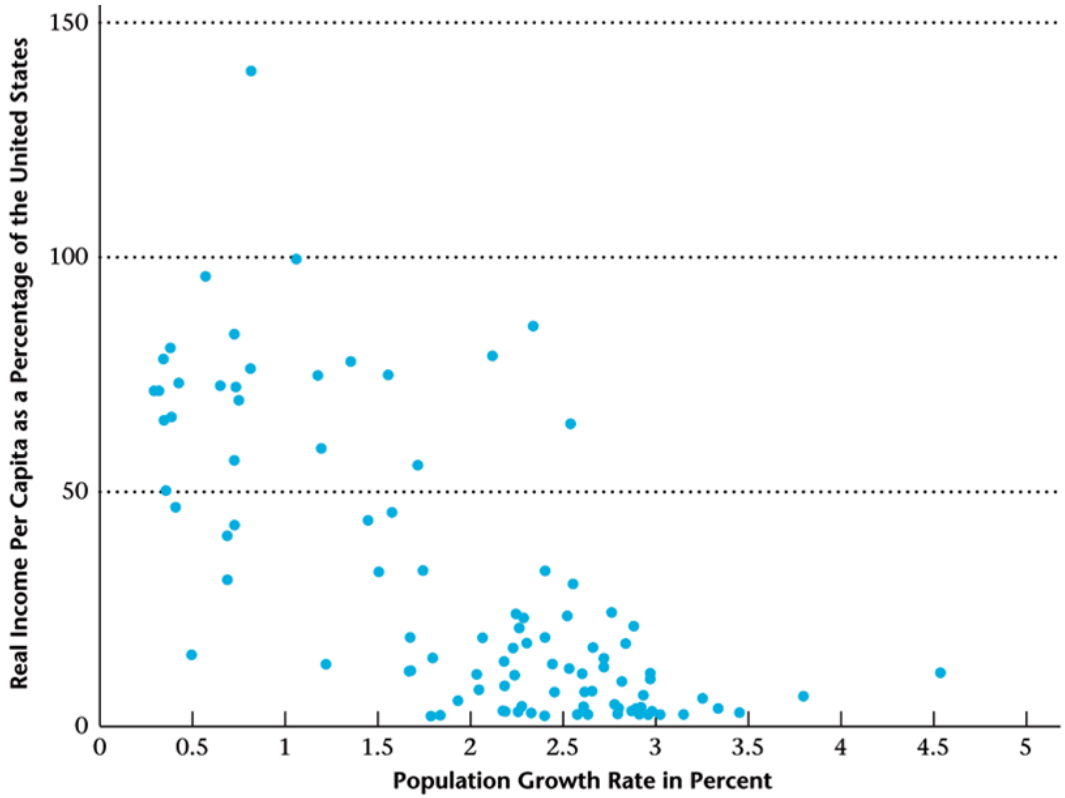


Figure 7.3: Output per worker vs. Population growth

$$\rho(\text{population growth rate, output/worker}) < 0$$

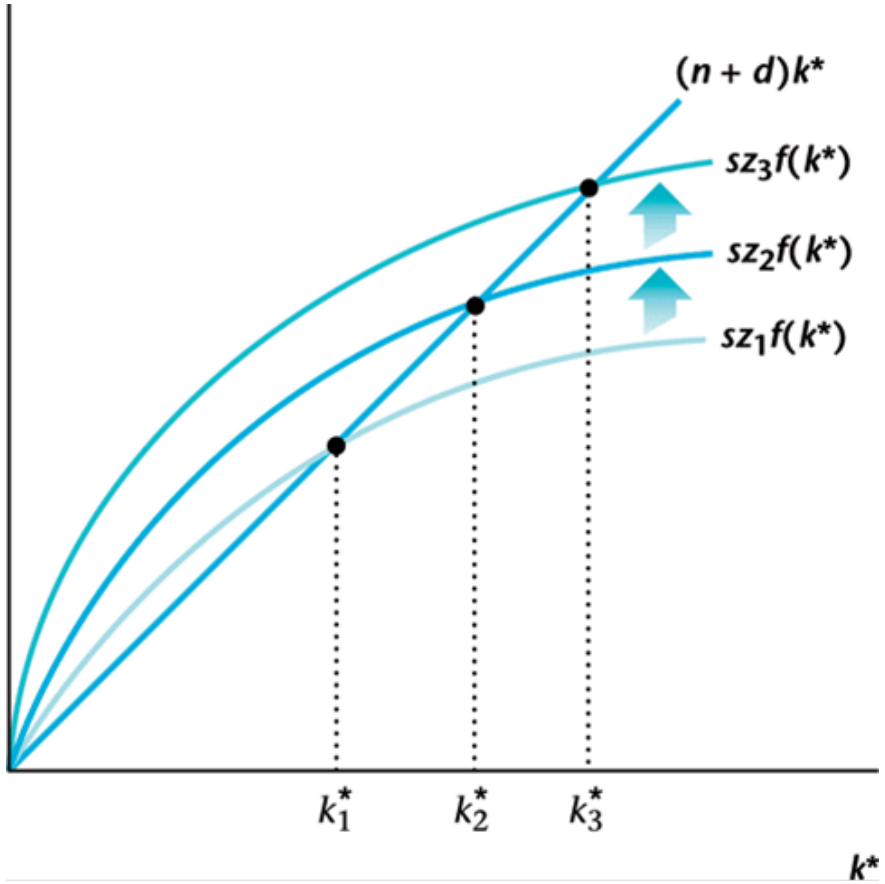


Source: A. Heston, R. Summers, and B. Aten, *Penn World Table Version 6.1*, Center for International Comparisons at the University of Pennsylvania (CICUP), October 18, 2002, available at pwt.econ.upenn.edu.

Increase in TFP

- savings is bounded from $0 < s < 1$
- Increase in z from z_1 to z_2
- Causes increase in k from k_1^* to k_2^* (Fig. 7.22)
- savings is one-time shot but TFP can lead to unbounded growth
- Malthus told TFP no long run effects
- Hopefully as long as TFP increases

Figure 7.20: $\Uparrow$ in z in Solow Model



Solow Residual

- Production function specification - Cobb-Douglas

$$Y = zK^{\alpha}N^{1-\alpha}, 0 < \alpha < 1$$

- CRS - homogeneity properties
- capital receives α share of Y and labor $1-\alpha$ [US post-WWII $\alpha = 0.34$]

$$\begin{aligned} z &= \frac{Y}{K^{\alpha}N^{1-\alpha}} \\ \textit{or} & \\ \log z &= \log Y - \alpha \log K - (1-\alpha)\log N. \end{aligned}$$

- f(inventions, weather, mgmt techniques, G regulations, price of energy, etc)

Figure 7.21: Solow Residual 1948-2001

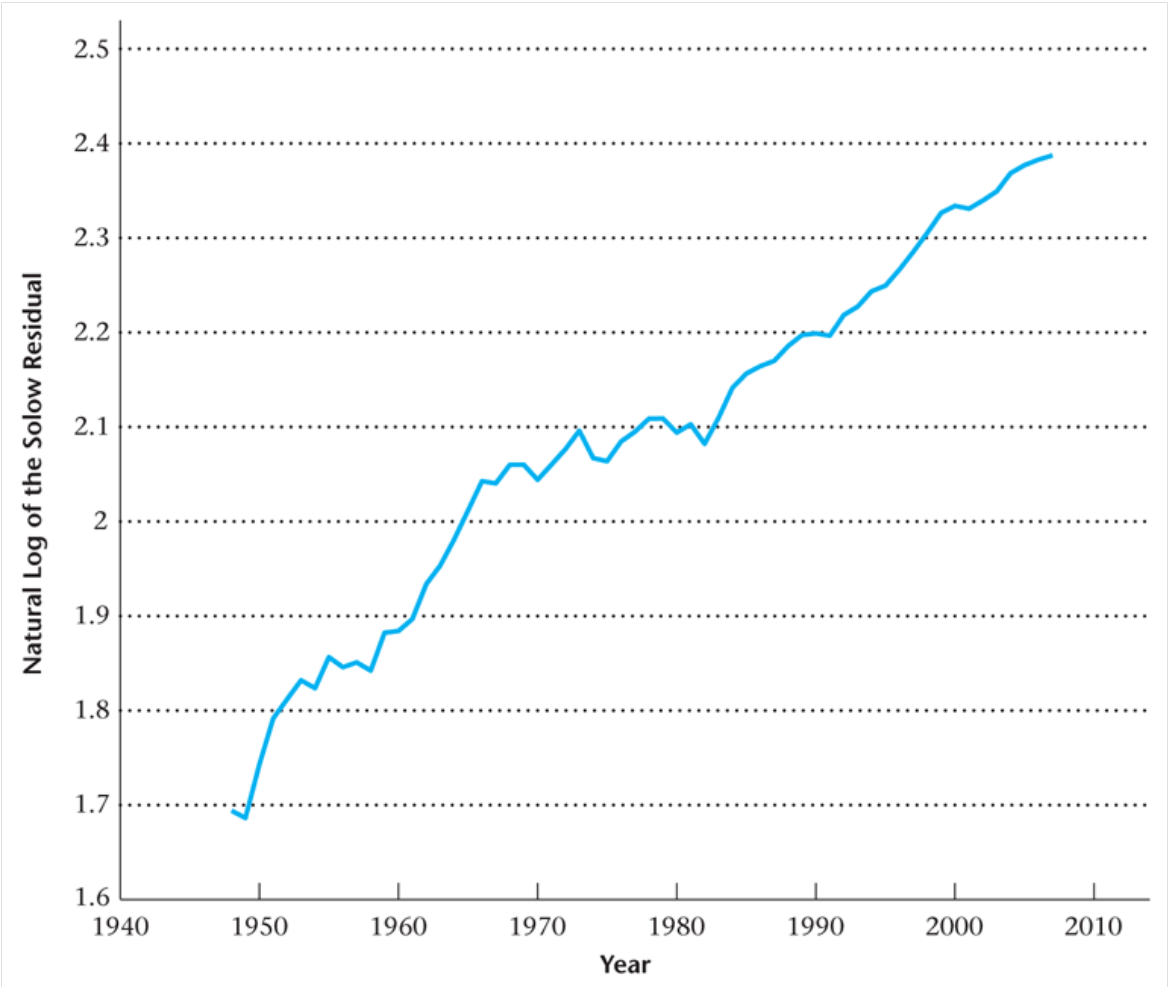
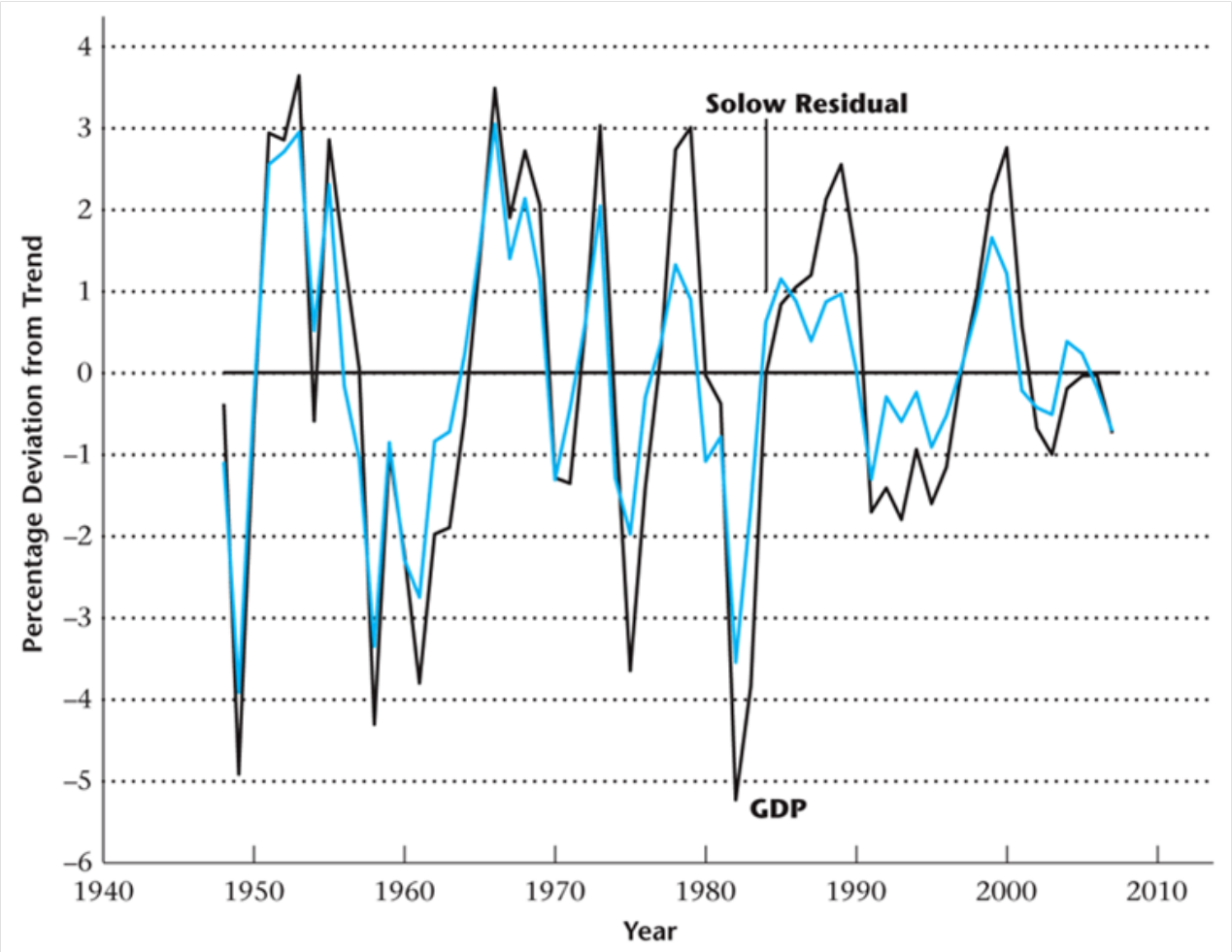


Figure 7.22: GDP deviations and Solow Residual



Growth Accounting East Asian Miracles and TFP

- Look at spreadsheet replicate Table 6.2 and 6.3
- Look at Table 6.4 for Alwyn Young
- East Asian growth miracles?
- HK, Singapore, SK, Taiwan
- TFP growth not that high relative to US
- high s and low n
- not sustainable as s and n are bounded
- determined by technology

Table 7.1 Average Annual Growth Rates in the Solow Residual

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Years	Average Annual Growth Rate
1950–1960	1.42
1960–1970	1.61
1970–1980	0.50
1980–1990	1.05
1990–2000	1.36
2000–2007	0.76

Table 7.2 Measured GDP, Capital Stock, Employment, and Solow Residual

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Year	$\hat{Y}$ (billions of 2000 dollars)	$\hat{K}$ (billions of 2000 dollars)	$\hat{N}$ (millions)	$\hat{z}$
1950	1777.3	5991.8	58.89	5.715
1960	2501.8	8602.1	65.78	6.580
1970	3771.9	12557.1	78.69	7.721
1980	5161.7	17273.8	99.30	8.115
1990	7112.5	22877.9	118.80	9.011
2000	9817.0	29917.1	136.90	10.312
2007	11523.9	35910.4	146.05	10.875

Table 7.3 Average Annual Growth Rates

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Years	$\hat{Y}$	$\hat{K}$	$\hat{N}$	$\hat{z}$
1950–1960	3.48	3.68	1.11	1.42
1960–1970	4.19	3.86	1.80	1.61
1970–1980	3.19	3.24	2.36	0.50
1980–1990	3.26	2.85	1.81	1.05
1990–2000	3.28	2.72	1.43	1.36
2000–2007	2.32	2.64	0.93	0.76

Table 7.4 East Asian Growth Miracles

	Output	Capital	Labor	Total Factor Productivity
Hong Kong (1966–1991)	7.3%	7.7%	2.6%	2.3%
Singapore (1966–1990)	8.7%	10.8%	4.5%	0.2%
South Korea (1966–1990)	10.3%	12.9%	5.4%	1.7%
Taiwan (1966–1990)	9.4%	11.8%	4.6%	2.6%
United States (1966–1990)	3.0%	3.2%	2.0%	0.6%