Empirical Applications of the Solow Model

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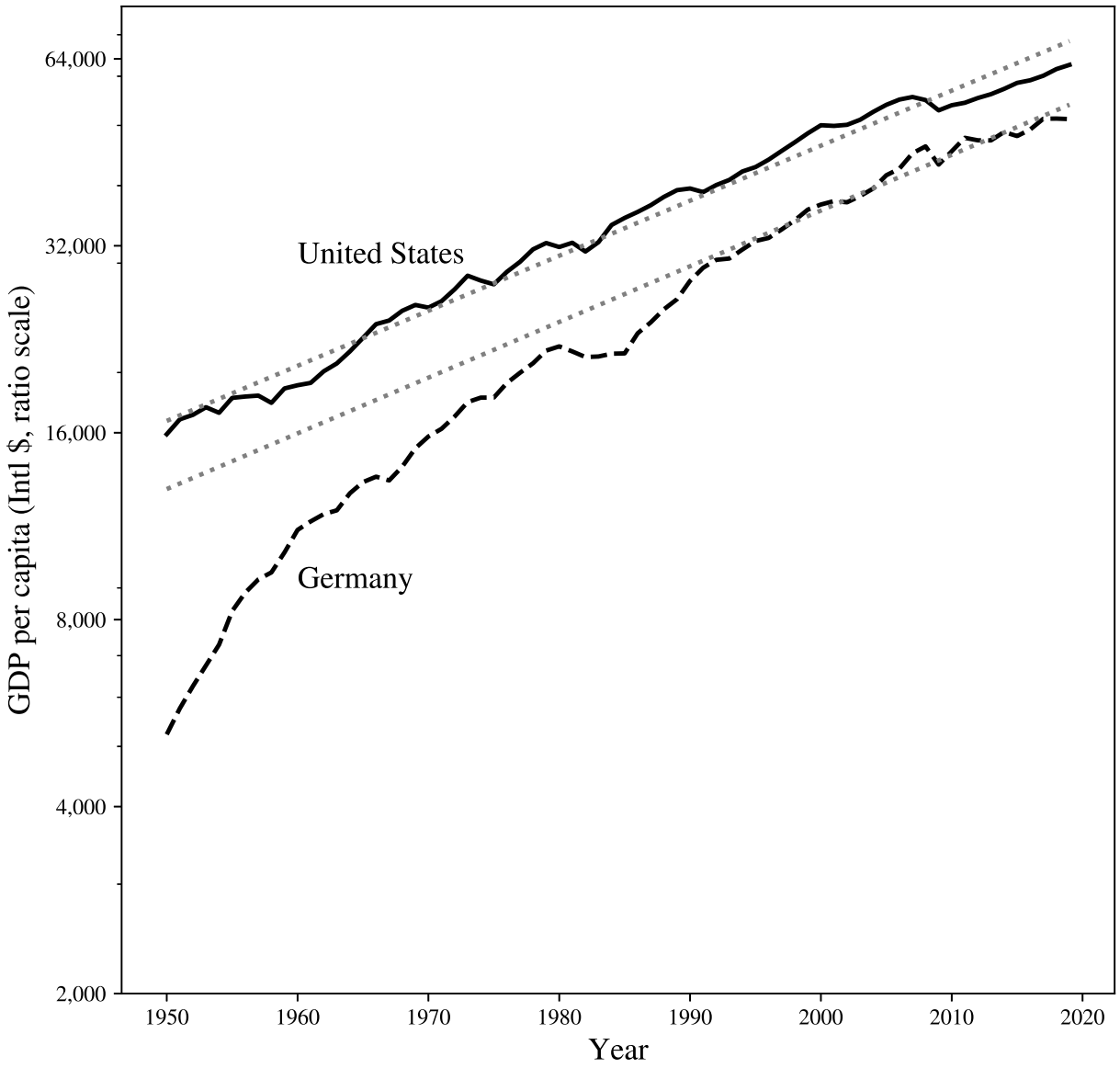
Introduction to Economic Growth

Germany after WWII

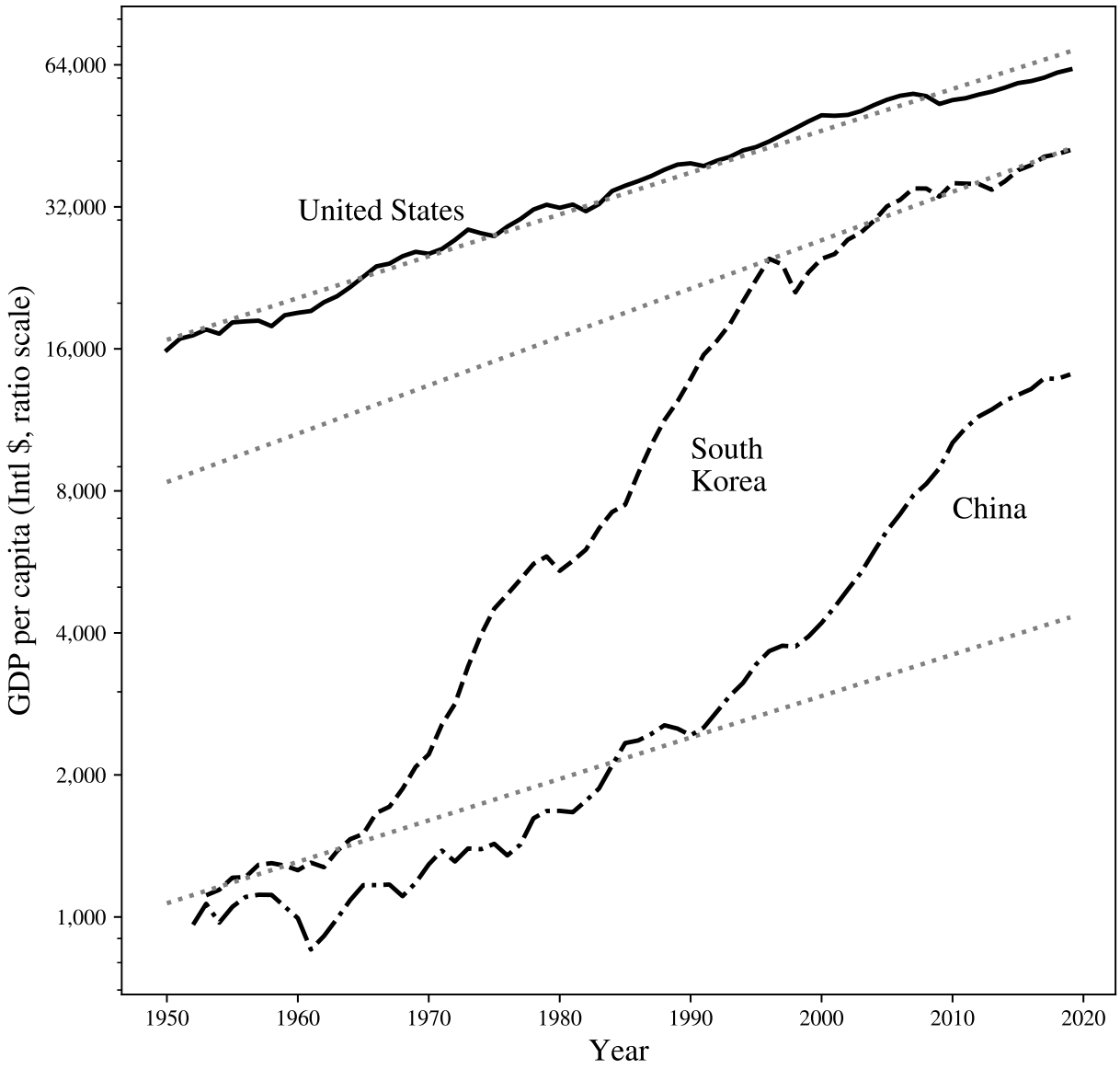


Germany after WWII

The data from Germany is consistent with:

- A substantial loss of K in the war relative to L
- The "initial" K/AL ratio in 1946 is very low and below steady state
- The dynamics of capital imply a high g_K
- Transitional growth $\alpha(g_K - g_A - g_L)$ is very high for a time
- Transitional growth dissipates as Germany reaches the BGP
- Germany's BGP is lower than the US, so there remains some difference in parameters (s_I, A_0, g_L) creating a level difference

South Korea and China

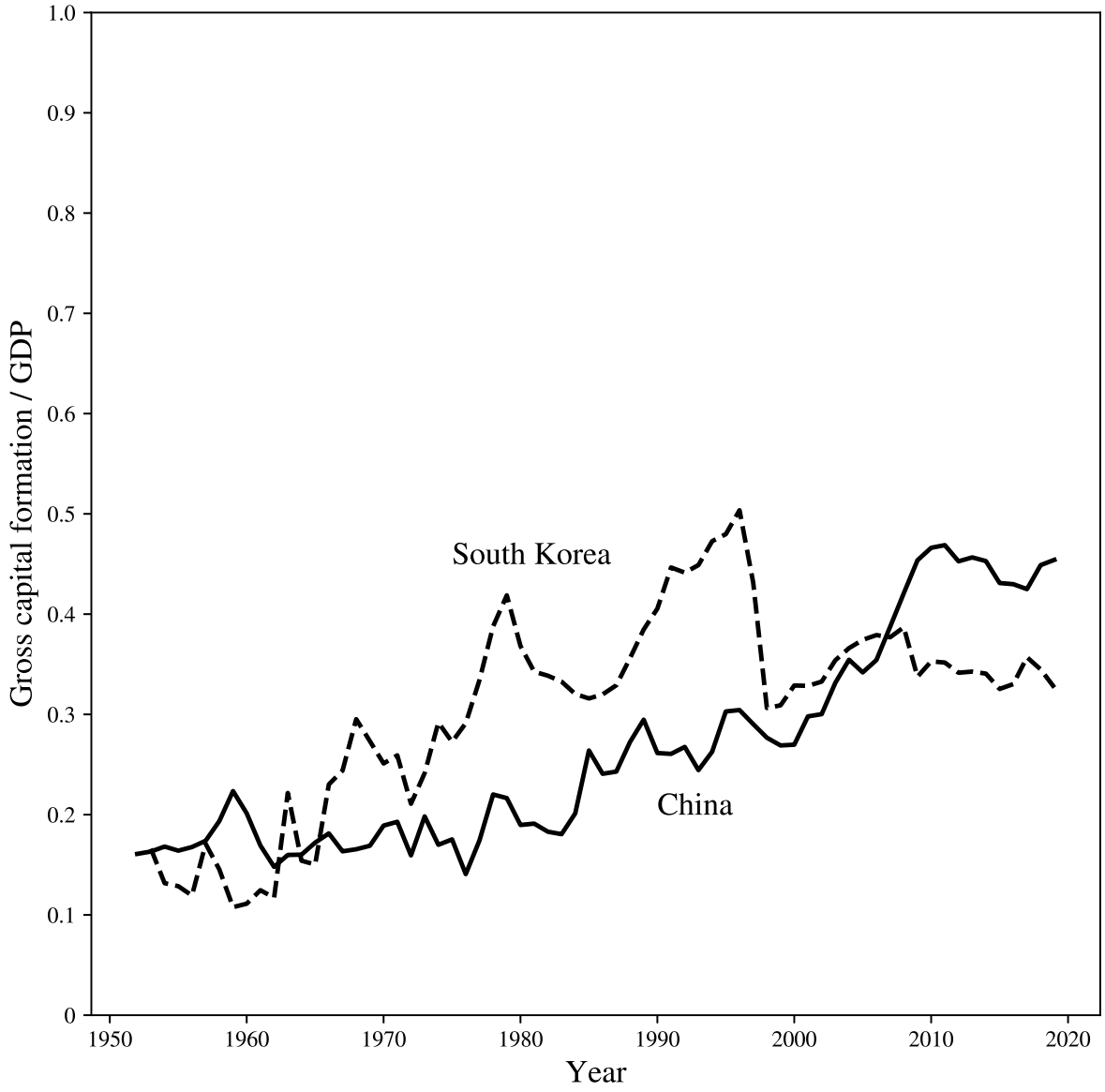


South Korea and China

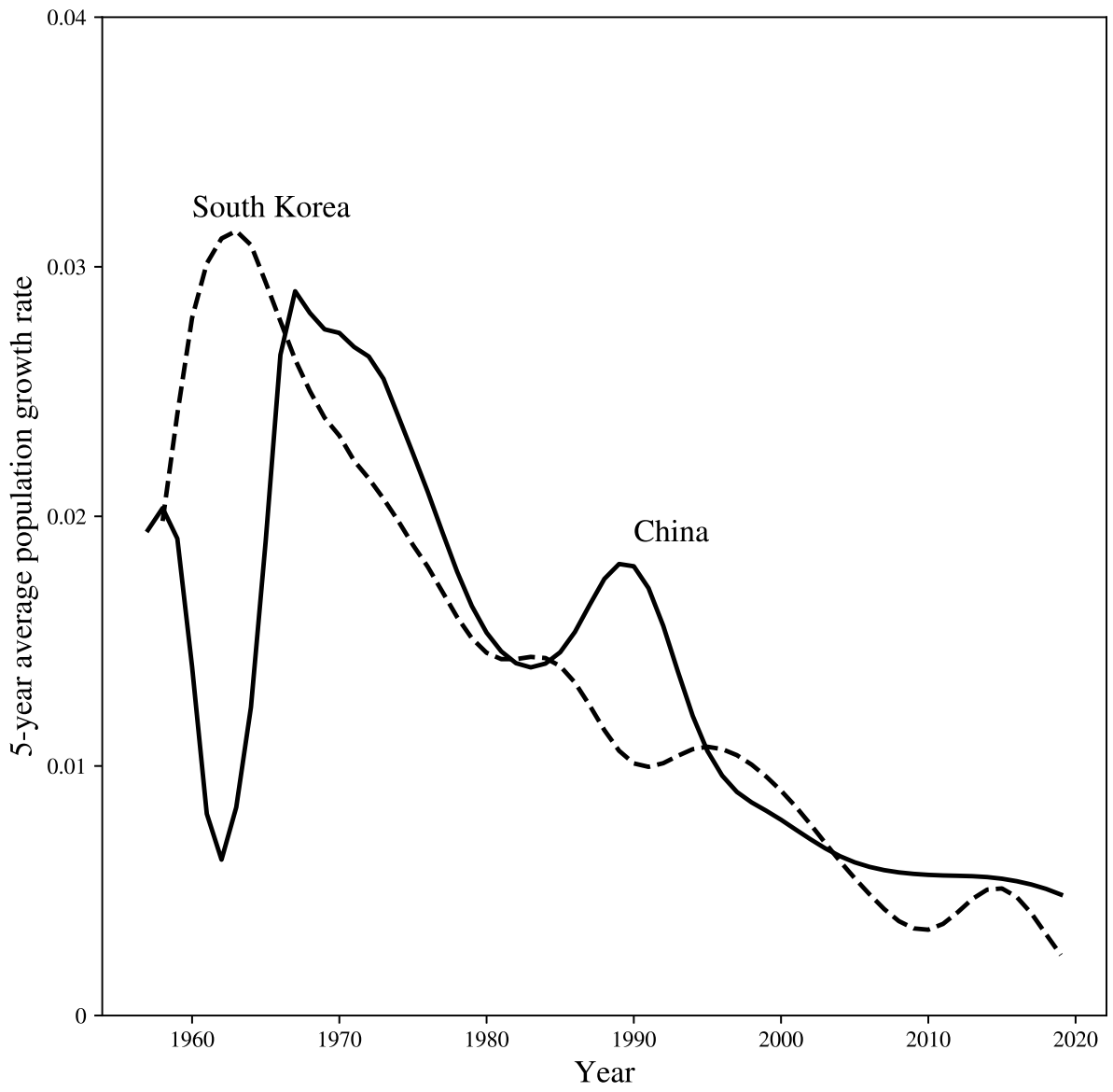
The data from East Asia is consistent with:

- South Korea and China are on a “low” BGP in the 1950s and 1960s
- Around 1970 something shifts the S. Korea BGP up
- South Korea’s K/AL is thus below steady state around 1970
- Transitional growth occurs because $\alpha(g_K - g_A - g_L)$ is positive
- By 2000 South Korea has converged to new BGP and growth rate matches that in the US
- Around 1990 something shifts the Chinese BGP up and K/AL is below steady state
- Transitional growth is occurring in China, but we don’t quite know if it has reached the enw BGP yet.

What changed the East Asian BGP?



What changed the East Asian BGP?



Differences in levels

Remember the level of GDP per capita on the BGP is

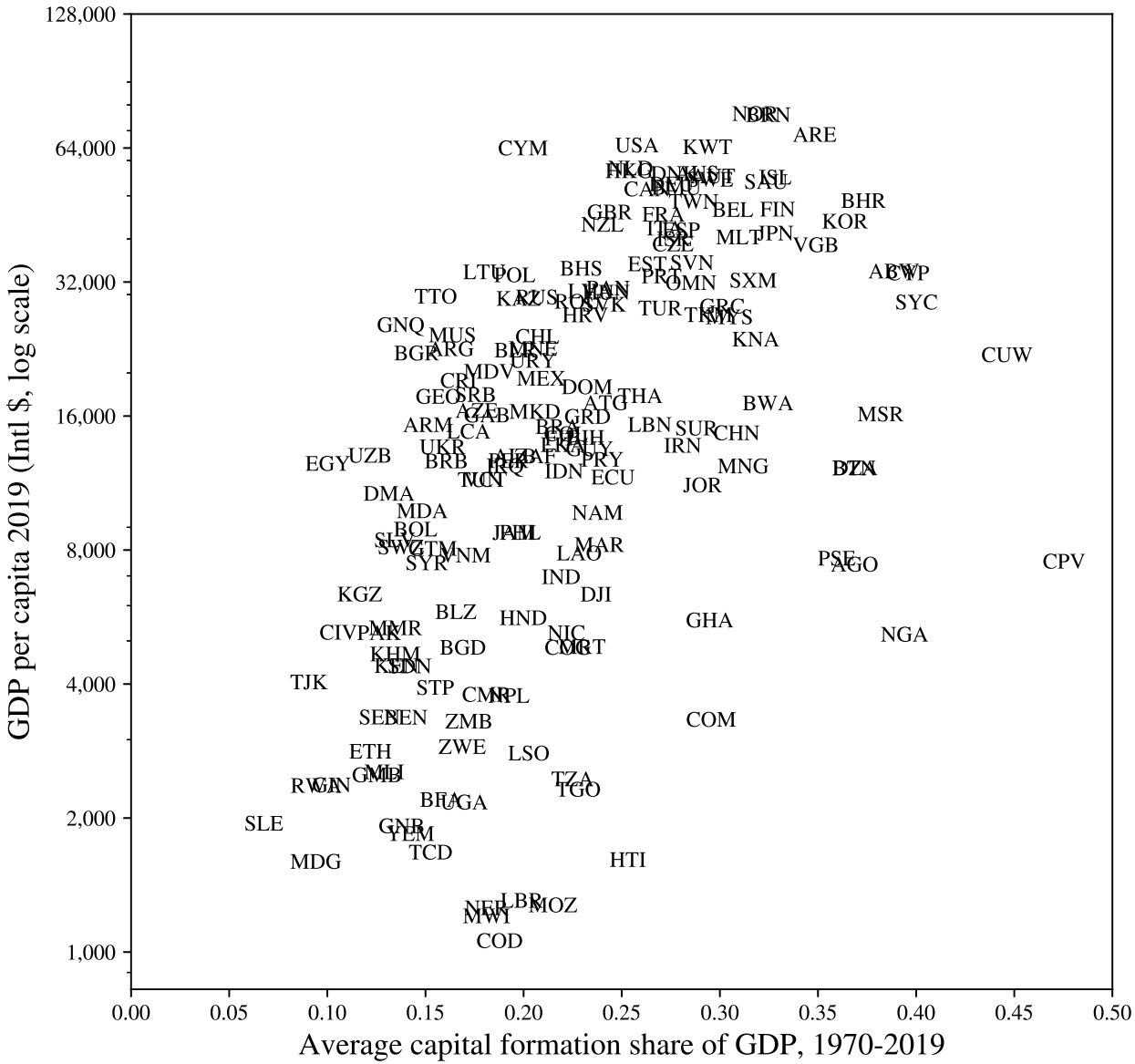
$$\log y_t^{BGP} = \underbrace{\left(\frac{\alpha}{1-\alpha} \log \left(\frac{s_I}{g_A + g_L + \delta} \right) + \log A_0 \right)}_{\text{Intercept}} + \underbrace{g_A}_{\text{Slope}} t.$$

so that the intercept tells us about differences in levels of GDP per capita, even if the growth rate (slope) is the same.

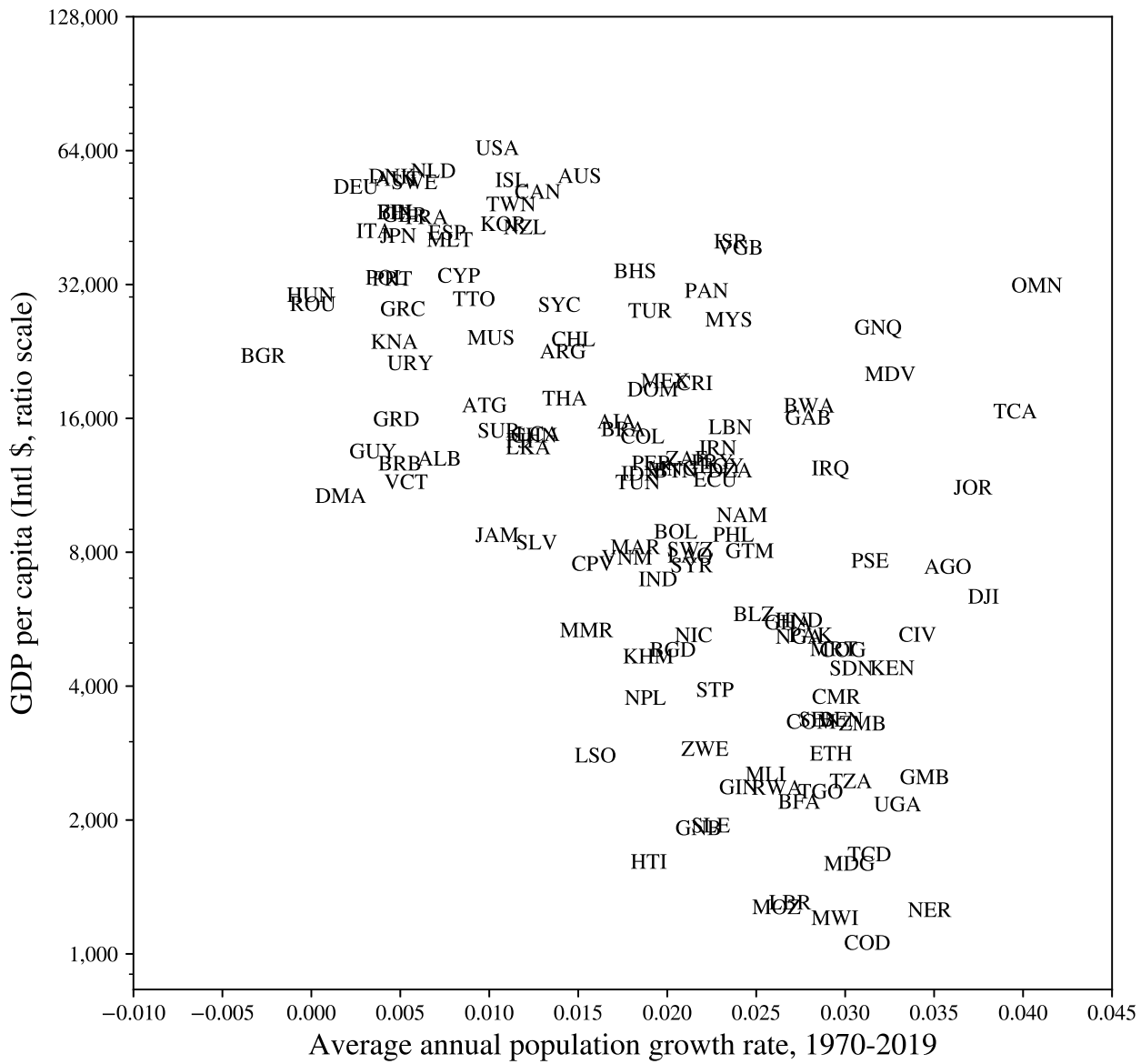
- All else equal, a higher s_I should imply a higher level of GDP per capita
- All else equal, a lower g_L should imply a higher level of GDP per capita

Other parameters matter but are harder to measure.

Levels and capital formation rates



Levels and population growth rates



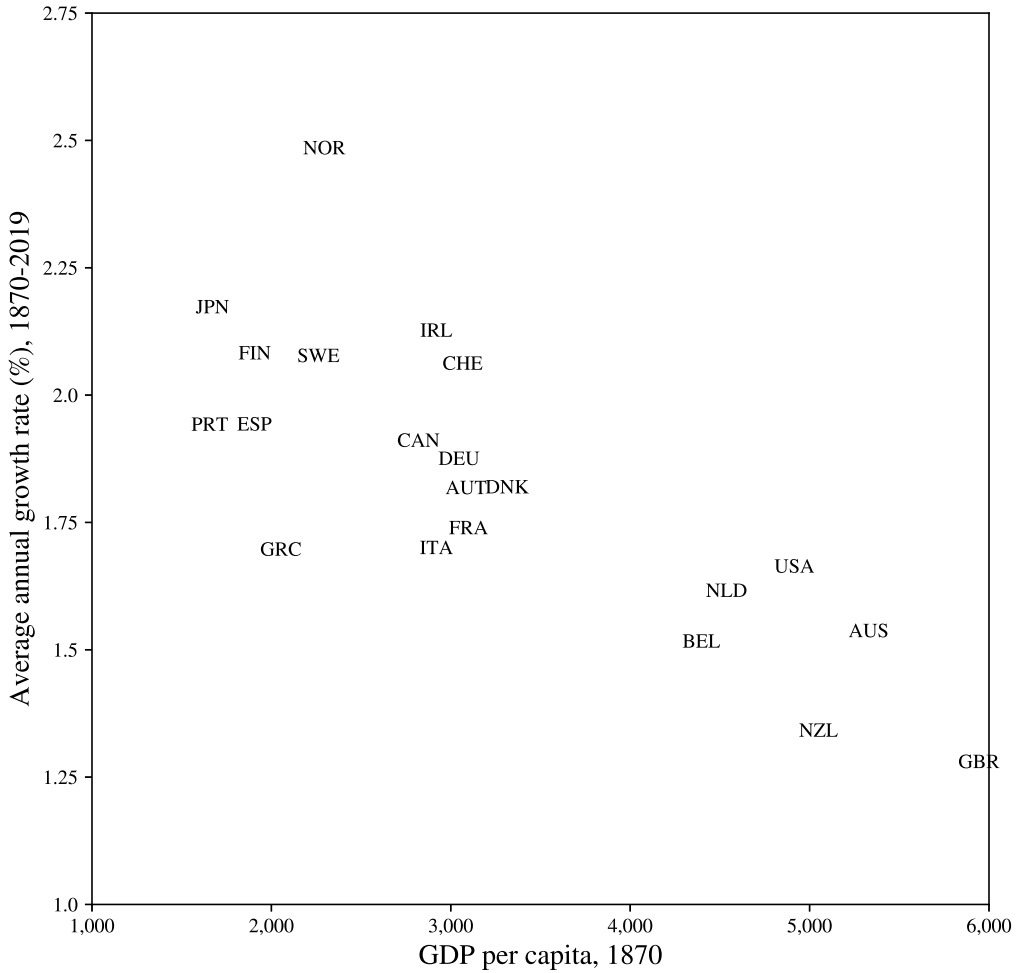
Growth rates an initital levels

If the *only* thing that differed across countries was initial K_0/A_0L_0, then:

- Countries with low K_0/A_0L_0 would have a low *level* of GDP per capita
- Countries with low K_0/A_0L_0 would have a high growth rate of GDP per capita because of transitional growth
- So we'd expect to see that growth rates were negatively related to the level of GDP per capita

Convergence in rich countries

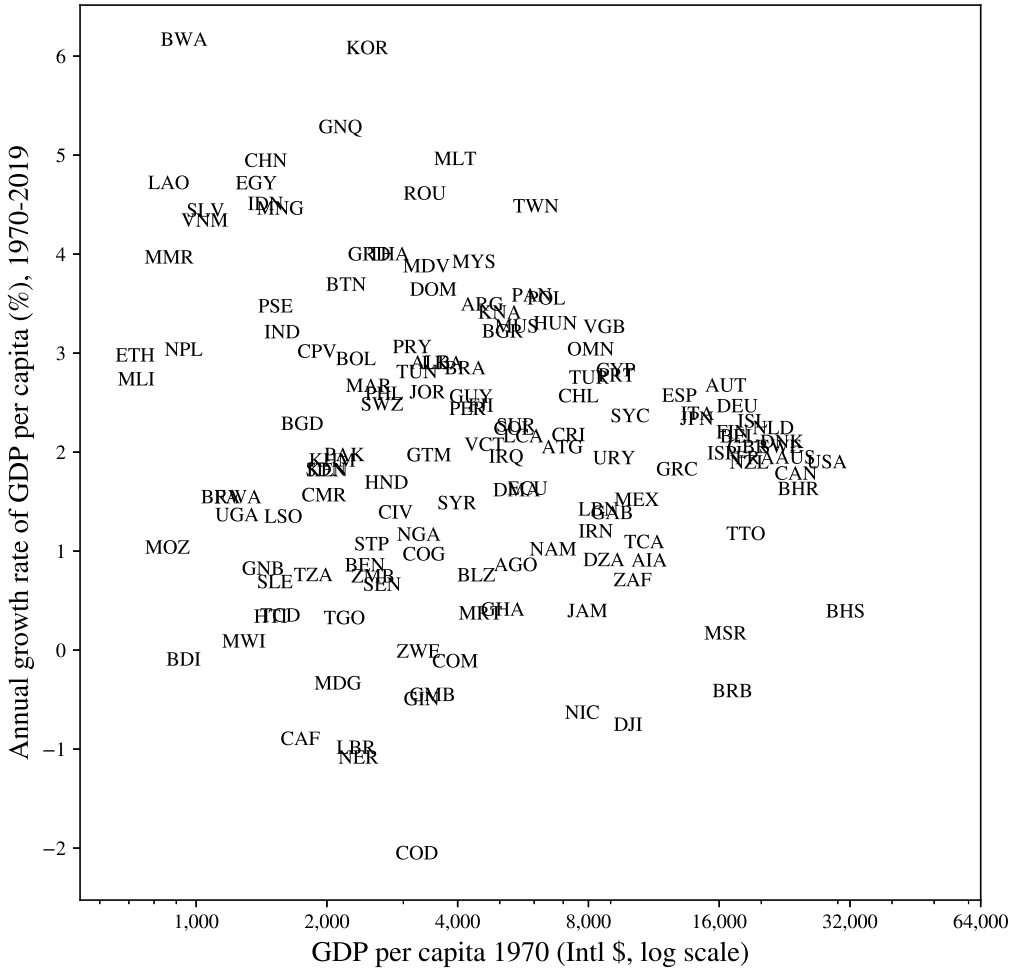
This is for a set of currently rich countries from 1870 to 2018



Why does this have to work?

Convergence in all countries

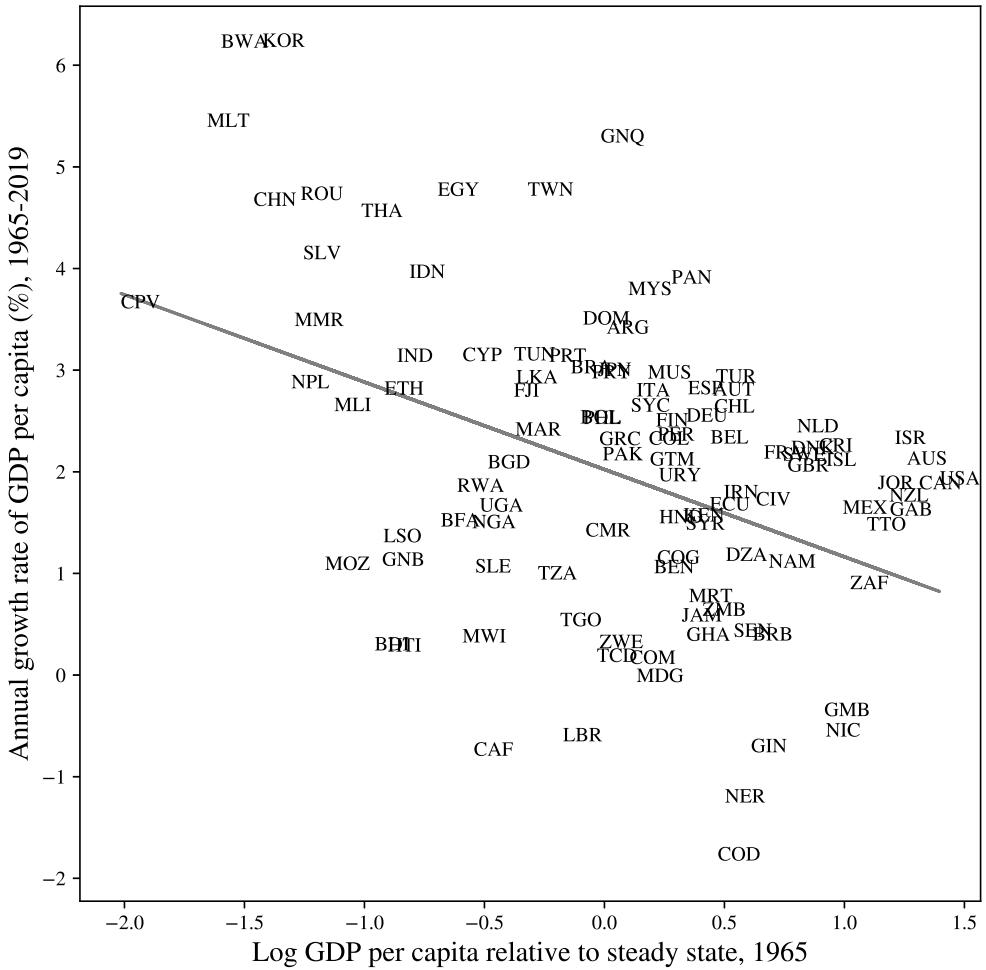
But for countries in general it does not work



This doesn't work because steady states are different. Not everyone is headed to the same BGP.

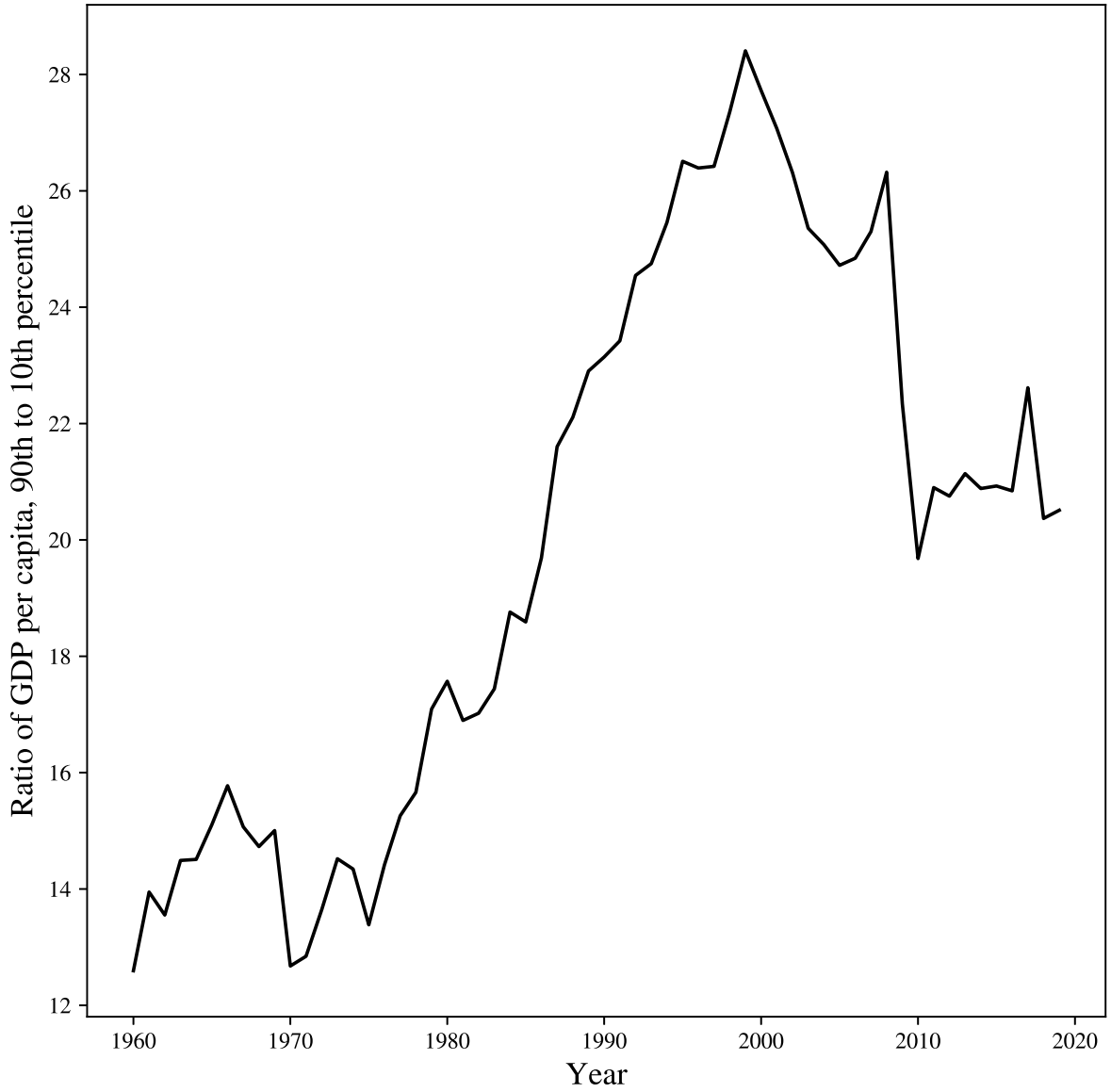
Conditional convergence

But it does (kind of) work if we compare the growth rate of each country to how far from it's *own* steady state they start out,



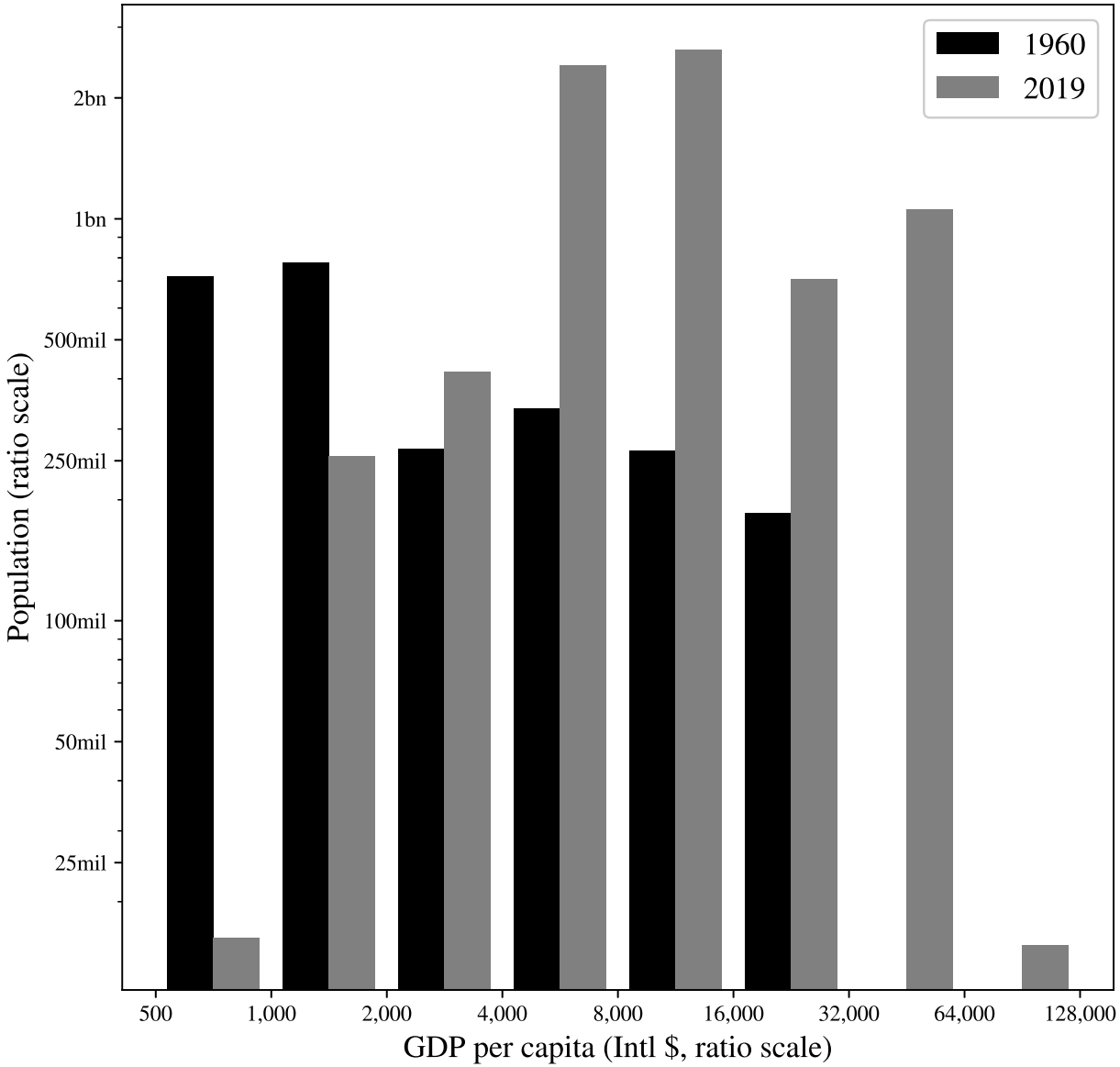
How unequal is GDP per capita across countries?

GDP per capita of the 90th to the 10th percentile



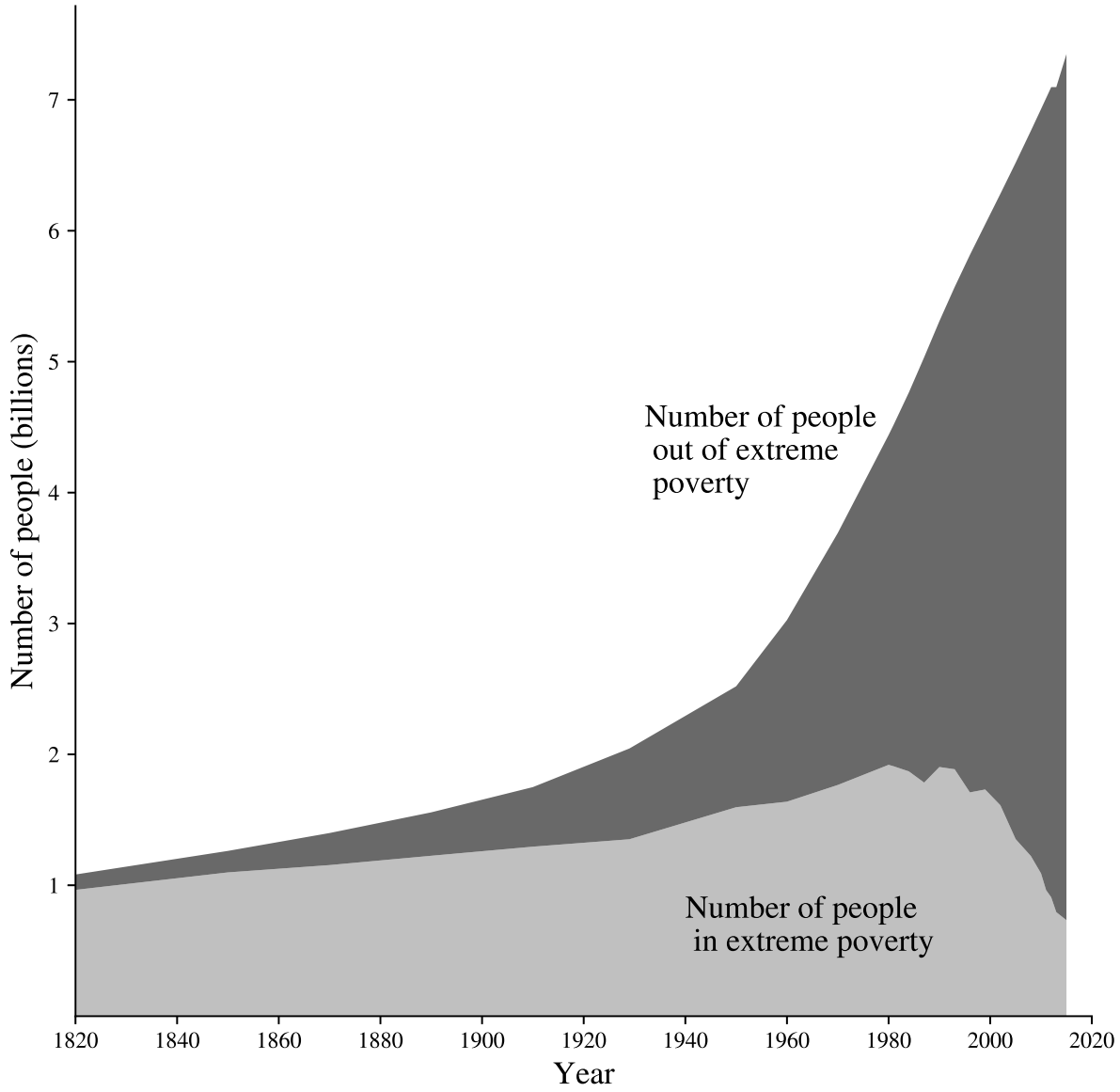
How much higher is GDP per capita in general?

Number of people living at different levels of GDP per capita



How many people live in absolute poverty?

Number of People Living in or out of Extreme Poverty, 1820-2015



What drives growth?

Growth is a combination of transitory growth and long-run growth:

$$g_y = \underbrace{\alpha(g_K - g_A - g_L)}_{\text{Transitory}} + \underbrace{g_A}_{\text{Long-run}}$$

- We can put numbers of each term
- Assume $\alpha = 0.3$
- We can measure, g_y, g_K, and g_L
- We can infer g_A from the equation; it has to hold

Accounting for the U.S.

	Growth rate (in percent):					
Annualized growth:	1955-1965 (1)	1965-1975 (2)	1975-1985 (3)	1985-1995 (4)	1995-2005 (5)	2005-2015 (6)
	United States					
GDP per capita (g_y)	2.15	2.04	2.49	1.93	2.32	0.72
Breakdown of GDP per capita growth:						
Productivity (g_A)	2.25	1.90	2.73	2.10	2.59	0.75
Transitory ($\alpha(g_K - g_A - g_L)$)	-0.10	0.15	-0.24	-0.17	-0.28	-0.03
Breakdown of transitory growth:						
Capital (g_K)	3.50	3.37	2.88	2.51	2.74	1.48
Productivity (g_A)	2.25	1.90	2.73	2.10	2.59	0.75
Labor (g_L)	1.58	0.99	0.93	0.98	1.07	0.84

Accounting for Japan

	Growth rate (in percent):					
Annualized growth:	1955-1965 (1)	1965-1975 (2)	1975-1985 (3)	1985-1995 (4)	1995-2005 (5)	2005-2015 (6)
	Japan					
GDP per capita (g_y)	7.64	6.25	3.37	2.77	0.98	0.57
Breakdown of GDP per capita growth:						
Productivity (g_A)	7.57	4.75	2.89	2.40	0.83	0.75
Transitory ($\alpha(g_K - g_A - g_L)$)	0.08	1.50	0.48	0.38	0.15	-0.18
Breakdown of transitory growth:						
Capital (g_K)	8.79	10.99	5.31	4.02	1.48	0.12
Productivity (g_A)	7.57	4.75	2.89	2.40	0.83	0.75
Labor (g_L)	0.96	1.23	0.81	0.36	0.15	-0.03

What drives growth?

What do we learn?

- Even for Japan, which had a big transition to a higher BGP, capital accumulation and transitory growth was relatively small
- Some of what happened was that A_0 kept going up, so there was some transition in the level of productivity
- Ultimately the growth rate of productivity is important for long-run growth
- Capital accumulation and transition are relevant for catching up
- We need to study productivity levels and growth in detail