

26 June

Output ← inputs: Labor

- L growth: current
 - Currently baby boomer retirement
 - Offset until 2009 by immigration
- Long-run L growth: from desired family size.
 - 2.1 children per family = LR stability
 - Target now 2 per family in US → very little future growth
 - In Japan target was 2 per family by 1966 → realized < 2
 - → population now falling!

Output ← inputs: Capital

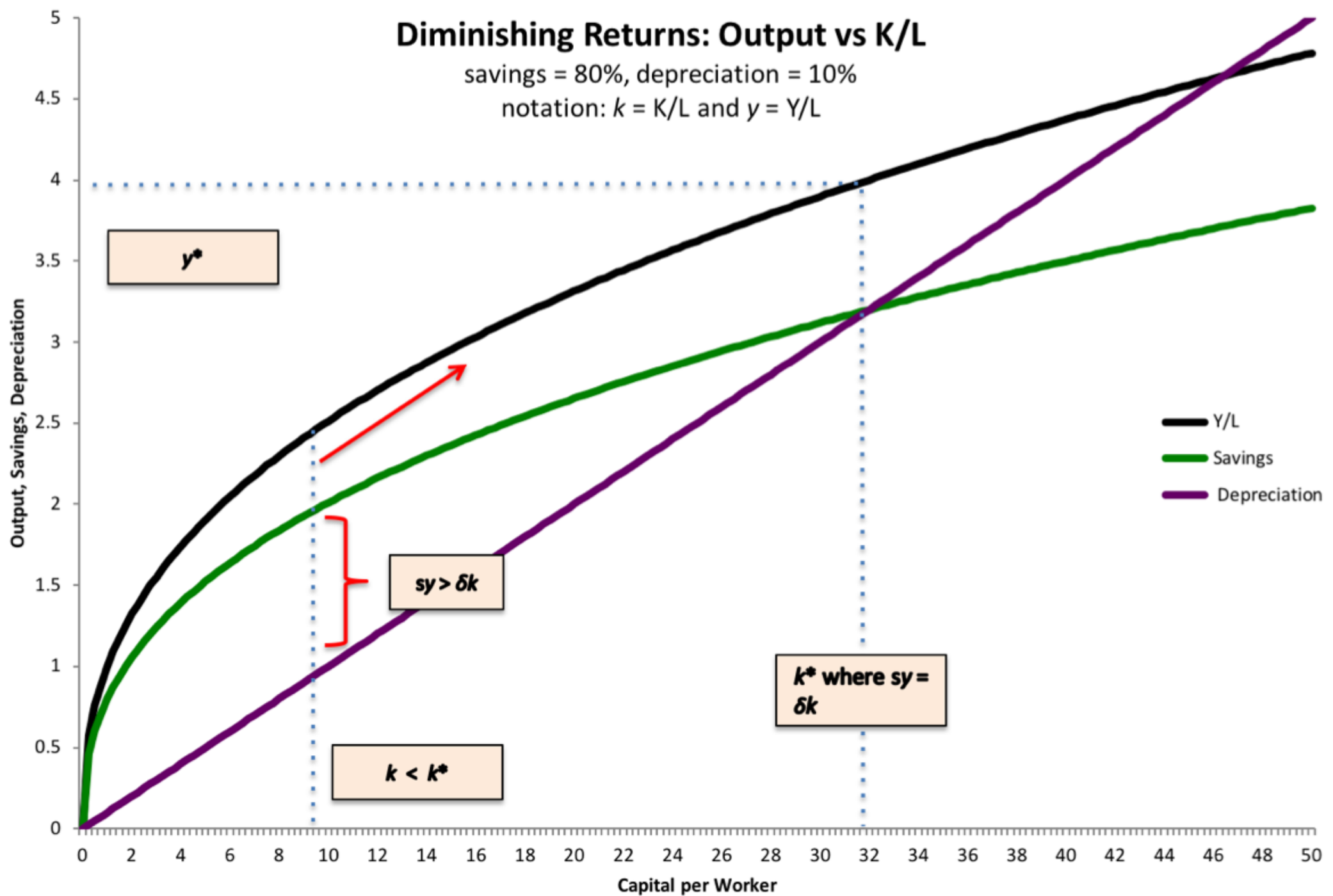
- K capital from investment
 - Investment $\approx 1/6$ GDP in US
- BUT
 - Depreciation
- AND
 - Diminishing returns

Formal model: graphing

- $Y = f(K, L, \text{TFP})$
- $I = S = sY$ but we have depreciation δ
- So net is $I - \delta K$

Diminishing Returns: Output vs K/L

savings = 80%, depreciation = 10%
notation: $k = K/L$ and $y = Y/L$



Implications

- **In Long Run**

- Capital Accumulation Can't Produce Growth

- **In Long Run**

- Hit ceiling for labor quality
- Education & training & experience can't produce growth

- **Total Factor Productivity**

- Is ALL THAT MATTERS

Formal Model: For empirics

- $Y = A K^\alpha L^{1-\alpha}$ where $0 < \alpha < 1$ which gives diminishing returns
 - Cobb-Douglas function, typical US value $\alpha = 0.3$

$$\bullet \mathbf{g_Y = g_A + \alpha g_K + (1-\alpha) g_L} \quad \text{where } \mathbf{g} \text{ is growth rate}$$

$$\bullet \text{definition of TFP} = \mathbf{g_A} \quad (= g_Y - \alpha g_K - (1-\alpha) g_L)$$

Data in Fred

- LF: <https://fred.stlouisfed.org/graph/fredgraph.png?g=hOVa>
- Capital Intensity, Mfg: <https://fred.stlouisfed.org/series/MPU9900082>
- I , δ and $I-\delta$
 - Nominal: <https://fred.stlouisfed.org/graph/fredgraph.png?g=hOVd>
 - Log: <https://fred.stlouisfed.org/graph/fredgraph.png?g=hOVf>
- Share GDP: <https://fred.stlouisfed.org/graph/fredgraph.png?g=hOVh>
- Productivity (Non-Farm): <https://fred.stlouisfed.org/series/MPU4910013>
- LProd: <https://fred.stlouisfed.org/graph/?g=hOYF>

3 snapshots of TFP data

- An EU – US comparison
- Business Labor Productivity
 - which includes any boost from more capital per worker
- Dale Jorgenson study (he's the doyen of productivity studies)

Productivity at 1% pa as an approximation. This ignores capital accumulation so total growth will be greater. The paper analyzes ICT (info & computer tech). What is clear is that TFP is **not** in the 2+% range needed for strong growth. **But** these data don't pick up the earlier time period so are they really a good comparison with the 1950s and 1960s? In general, limited data mean TFP studies focus on narrow questions, here it's an EU-EU comparison rather than TFP itself.

Table 7, Contributions to total factor productivity growth in ICT producing, ICT using and Non-ICT industries, EU-4 and U.S.

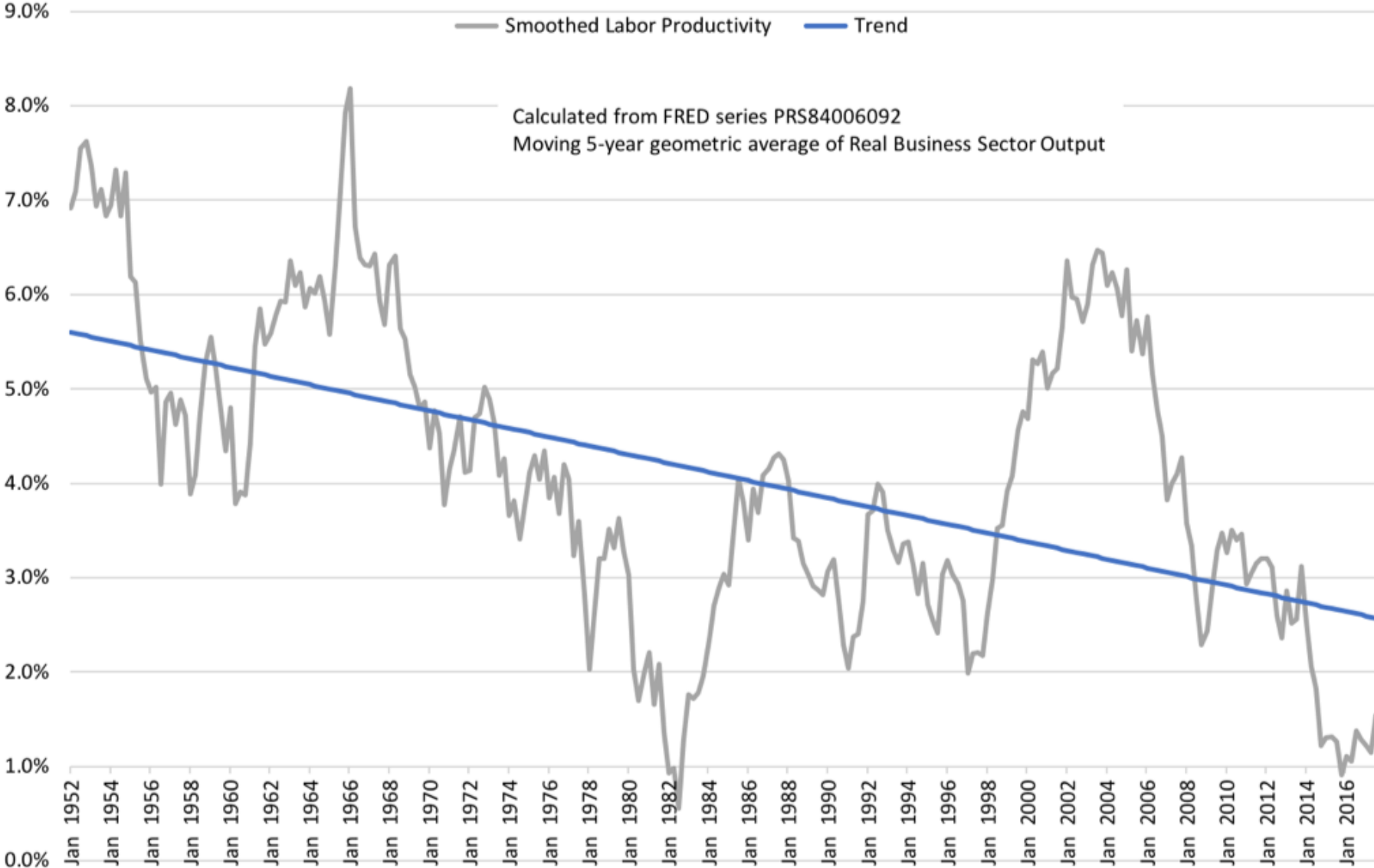
	1979-1995			1995-2000			Change 1995-2000 over 1979-1995		
	EU-4	U.S.	US-EU	EU-4	U.S.	US-EU	EU-4	U.S.	US-EU
Total economy	0.94	0.26	-0.67	1.07	1.05	-0.02	0.13	0.79	0.66
ICT producing	0.30	0.35	0.06	0.53	0.71	0.18	0.24	0.36	0.12
ICT using	0.17	-0.15	-0.31	0.19	0.68	0.50	0.02	0.83	0.81
Non-ICT	0.48	0.06	-0.42	0.35	-0.34	-0.69	-0.13	-0.40	-0.27

Notes: An industry's contribution is calculated as industry total factor productivity growth weighted by the industry's value added share.

Source: see Appendix A

Inklaar, Robert, Mahony O', and Marcel Timmer. 2003. "ICT and Europe's Productivity Performance Industry-Level Growth Account Comparisons with the United States." GGDC Research Memorandum 200368. Groningen Growth and Development Centre. p 22

Smoothed US Labor Productivity



Education, Participation, and the Revival of U.S. Economic Growth (2016)

[Dale Jorgenson](#), [Mun Ho](#) and *Jon D. Samuels*, [NBER Working Paper](#) No. 22453

Abstract: Labor quality growth captures the upgrading of the labor force through higher educational attainment and greater experience. We find that **average levels of educational attainment** of new entrants remain high, but **will no longer continue to rise.** Growing educational attainment will gradually disappear as a source of U.S. economic growth. We find that the investment boom of 1995-2000 drew many younger and less-educated workers into employment. Employment rates for these workers declined during the recovery of 2000-2007 and dropped further during the Great Recession of 2007-2009. **Based on estimates of labor quality growth, growth in total factor productivity, and growth in capital quality, we project labor productivity to grow at 1.3% per year. This implies a GDP growth rate of 1.8%.**

Varying methods and data, consistent picture

- TFP Growth in the US has slowed down
 - Data suggest about 1% level
- **THE question**: will it increase in your future?

China

	1981-1991	1991-2001	2001-2007	2007-2011	1981-2011
<u>Factor contributions to value-added growth (ppts)</u>					
Value-added growth (%)	8.81	8.85	11.37	9.37	9.41
- Capital input:	5.83	7.01	9.45	10.83	7.61
- Stock	5.83	7.08	9.54	10.82	7.65
- Capital quality (composition)	-0.00	-0.07	-0.08	0.01	-0.04
- Labor input:	1.12	1.12	0.59	0.77	0.97
- Number (homogenous)	1.07	0.69	0.54	-0.60	0.61
- Labor quality (composition)	0.06	0.43	0.05	1.37	0.36
- Aggregate TFP	1.86	0.72	1.32	-2.22	0.83

So ... How do we increase TFP?

- R&D
 - Do “apps” raise TFP?
 - Evidence very weak
 - Displacing previous forms of advertising, small net gain
- Urbanization
- Education
- International Trade