Productivity Growth over the Next Decades

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U.S. Long-Run Economic Growth

The Theory of Economic Growth

• Ideas are special: **infinitely usable** (Paul Romer, 2018 Nobel Laureate)
  - Standard goods: computer, barrel of oil, hour of a surgeon’s time
  - Ideas: calculus, design of Covid vaccine, latest ML algorithm

• Implication for economic growth:
  - **One computer** ⇒ **make one worker more productive**
    Need 1000 computers for 1000 workers
  - **One new idea** (e.g. invention of electricity)
    ⇒ **make any number of people more productive**.

• Income per person ← Ideas ← People

\[ \text{Growth in } \frac{Y}{L} \leftrightarrow \text{growth in people finding ideas} \]
The Future of Economic Growth?

• **Headwinds**
  - Ideas are getting harder to find
  - Rising investment in IPP (infinitely usable goods)
  - Educational attainment is leveling out
  - Population growth slowing. Negative in the future?

• **Tailwinds**
U.S. Total Factor Productivity

**Manufacturing**
1990-2003: 1.6%
2003-2021: 0.4%

**Private business sector**
1990-2003: 1.1%
2003-2022: 0.6%
Ideas are getting harder to find

\[
\text{Economic growth} = \text{Research productivity} \times \text{Research effort}
\]

e.g. 2% ↓ (falling) ↑ (rising)

• We have to invest ever-rising resources in R&D just to maintain a constant rate of economic growth
  ○ Moore’s Law: Research effort 18x higher in 2010s than 1970s
  ○ True in other areas: agriculture, health innovations, and firms

• Red Queen Theory: we have to run faster and faster to stay in the same place, i.e. to maintain 2% overall growth
Research Employment in Select Economies

- **United States**
  - 1981-2002: 3.2%
  - 2002-2014: 2.1%

- **European Union (15 countries)**
  - 1981-2002: 3.7%
  - 2002-2015: 3.1%

- **Japan**
  - 1981-2002: 3.3%
  - 2002-2015: 0.5%
Investment in Infinitely Usable Ideas

SHARE OF GDP

YEAR

0% 1% 2% 3% 4% 5% 6% 7%


Software and Entertainment

Government R&D

Private R&D
Components of the 2% growth in GDP per person

- Human capital per person: 0.5 pp
- Employment-Pop Ratio: 0.2 pp
- TFP: 1.3 pp

U.S. Historical Growth Accounting
U.S. Historical Growth Accounting

Components of the 2% growth in GDP per person

Components of the 1.3% TFP growth

The long-run component of growth is only 15% of historical growth = 0.3pp!
The Future of Economic Growth?

• Tailwinds
  - China and India – each as populous as U.S. + Europe + Japan
    In 2013-16, Tsinghua University: more of the 10 percent most highly cited papers in STEM than any other university
  - How many future Steve Jobs and Jennifer Doudnas are waiting to realize their potential?
  - Artificial intelligence?
Misallocation in the United States

- Sandra Day O’Connor, Supreme Court Justice (1981–2006)
  - Graduated 3rd in her class at Stanford Law School, 1952
  - Only job offer in the private sector: legal secretary

- Consider white men in U.S. business:
  - 1960: 94% of doctors, lawyers, and managers
  - 2010: 60% of doctors, lawyers, and managers

- Over the past 50 years, the U.S. allocation of talent has improved!
  Accounts for
  - 40% of growth in GDP per person, and
  - 20% of growth in GDP per worker

Hsieh, Hurst, Jones, and Klenow (2019 *Econometrica*)
Artificial Intelligence?

- Can machines augment or even replace people in finding ideas?
  - Theoretically possible
  - Virtuous circle that can potentially raise growth rates

- But history suggests caution
  - Automation has been ongoing for 200 years — stable growth
  - Steam engine, electricity, internal combustion, semiconductors
  - Maybe A.I. is the latest great idea that will allow 2% growth to be sustained a bit longer

Aghion, Jones, and Jones (2019)