

# Great Stagnation? or Technology Renaissance?



**Dawn or Doom 2**  
Purdue University  
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# DAWN | OR DOOM<sub>2</sub>

THE RISKS & REWARDS OF EMERGING TECHNOLOGIES

“Technological innovation has slowed dramatically! We’re in a Great Stagnation.”

“Technology is moving too fast. Robots will steal all the jobs!”



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“Technology is moving too fast. Robots will steal all the jobs!” \*

\* If, that is, artificial intelligence doesn’t first destroy the human race.

# **AUTO VS. HORSE.**

## **Six-Day Test Shows Motor Car Cheaper and More Efficient Than Animal.**

Complete results of the first official cost test ever held between an automobile and a horse and wagon has been duly certified to the Contest Board of the American Automobile Association and announced by Chairman Samuel M. Butler. The figures show standards of economy in automobile operation and give a striking illustration of the upkeep limit beyond which it is unnecessary for purchasers to tolerate.

The figures are instructive to those who take a keen interest in learning how cheaply a well-built car can be driven long distances. The Maxwell Model Q not only won the six-day test in a decisive manner from every angle at which it may be viewed, but covered almost three times as much ground at less cost than the horse and buggy.

# AUTOMOBILE.

Day.	Miles.	Gasoline.	Oil.	Cost.
1	67.4	5 gal.	1 pt.	\$1.00
2	76.1	5 gal.	1½ pt.	.92
3	76.3	6¼ gal.	1 pt.	1.12
4	80.	5¾ gal.	1 pt.	1.00
5	82.8	5½ gal.	1 pt.	1.07
6	75.3	5 gal.	1 pt.	1.09

457.9 miles at cost of.....\$8.20

Repairs .....	.00
Depreciation .....	8.24

Total cost .....	\$14.44
Cost per mile.....	.0315
Per passenger mile.....	.0157

# HOUSE AND BUGGY.

Day.	Miles.	Oats.	Hay.	Cost.
1	28.8	12 qts.	20 lbs.	.95
2	35.5	12 qts.	20 lbs.	.95
3	31.2	12 qts.	20 lbs.	.95
4	35.8	12 qts.	20 lbs.	.95
5	34.4	12 qts.	20 lbs.	.95
6	31.6	12 qts.	20 lbs.	.95

197.3 miles at cost of.....\$5.80

Repairs .....	.00
Depreciation .....	1.47

Total cost .....	\$7.27
Cost per mile.....	.0368
Per passenger mile.....	.0184

# Outline

- Current state of the economy — Is “**stagnation**” a 40-year phenomenon, a more recent development, or wrong altogether?
- **Moore’s Law**: A 50th Anniversary Assessment
- The **productivity** gap — health care and education
- The case for **optimism**
- Policy for innovation and renewed economic **growth**

“The Great **Stagnation.**”  
— Tyler Cowen

“The **Demise** of U.S. Economic Growth.” The  
Information Revolution was far less powerful than the  
Agricultural or Industrial Revolutions. And in any case,  
the Information Age may already have ended.  
— Robert Gordon

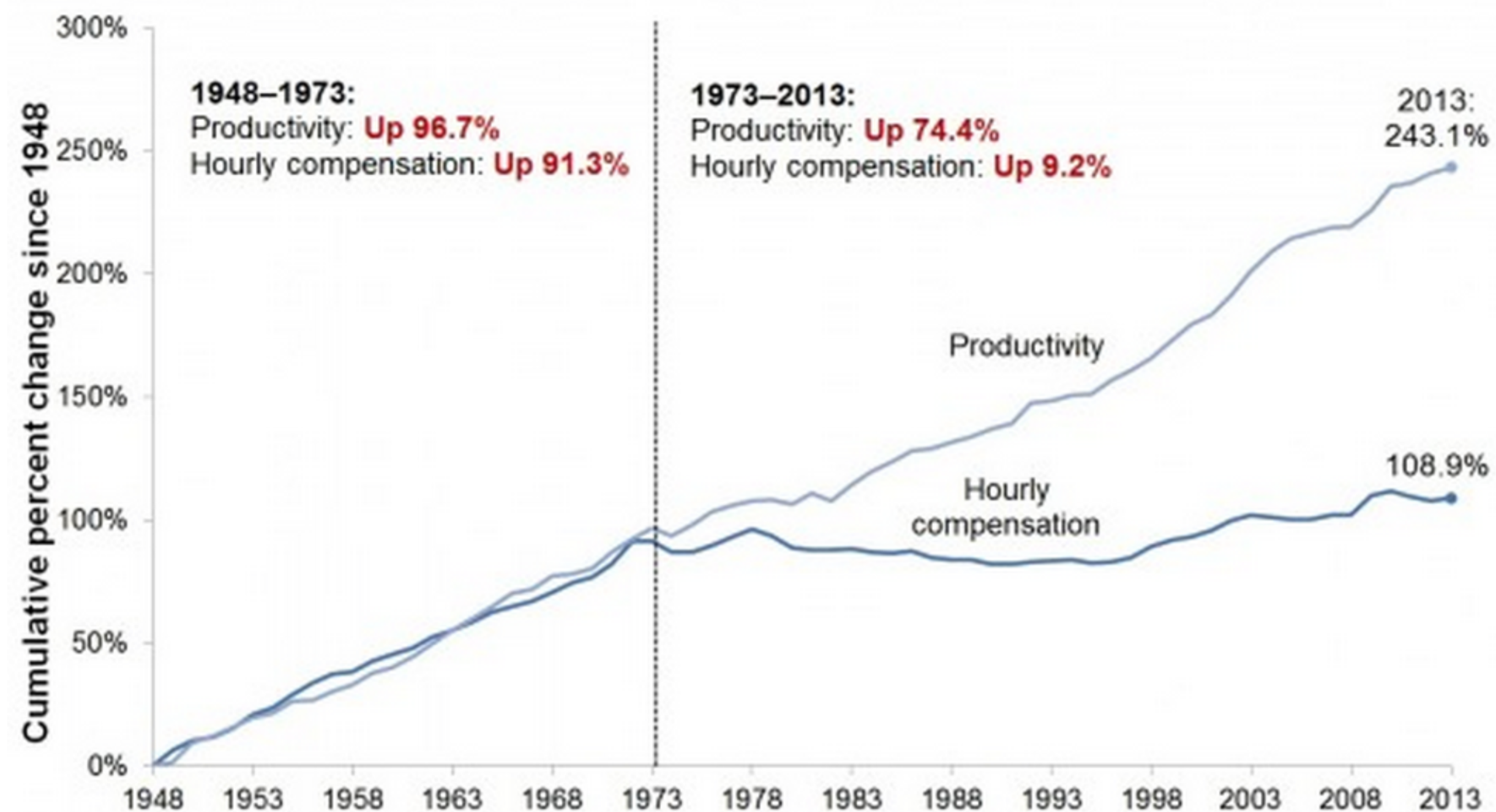
By 2005, we will view the Internet as no more important  
than the **fax machine.**  
— Paul Krugman, in 1998



# The Dismal View

## Workers produced much more, but typical workers' pay lagged far behind

*Disconnect between productivity and typical worker's compensation, 1948–2013*



**Note:** Data are for compensation (wages and benefits) of production/nonsupervisory workers in the private sector and net productivity of the total economy. "Net productivity" is the growth of output of goods and services less depreciation per hour worked.

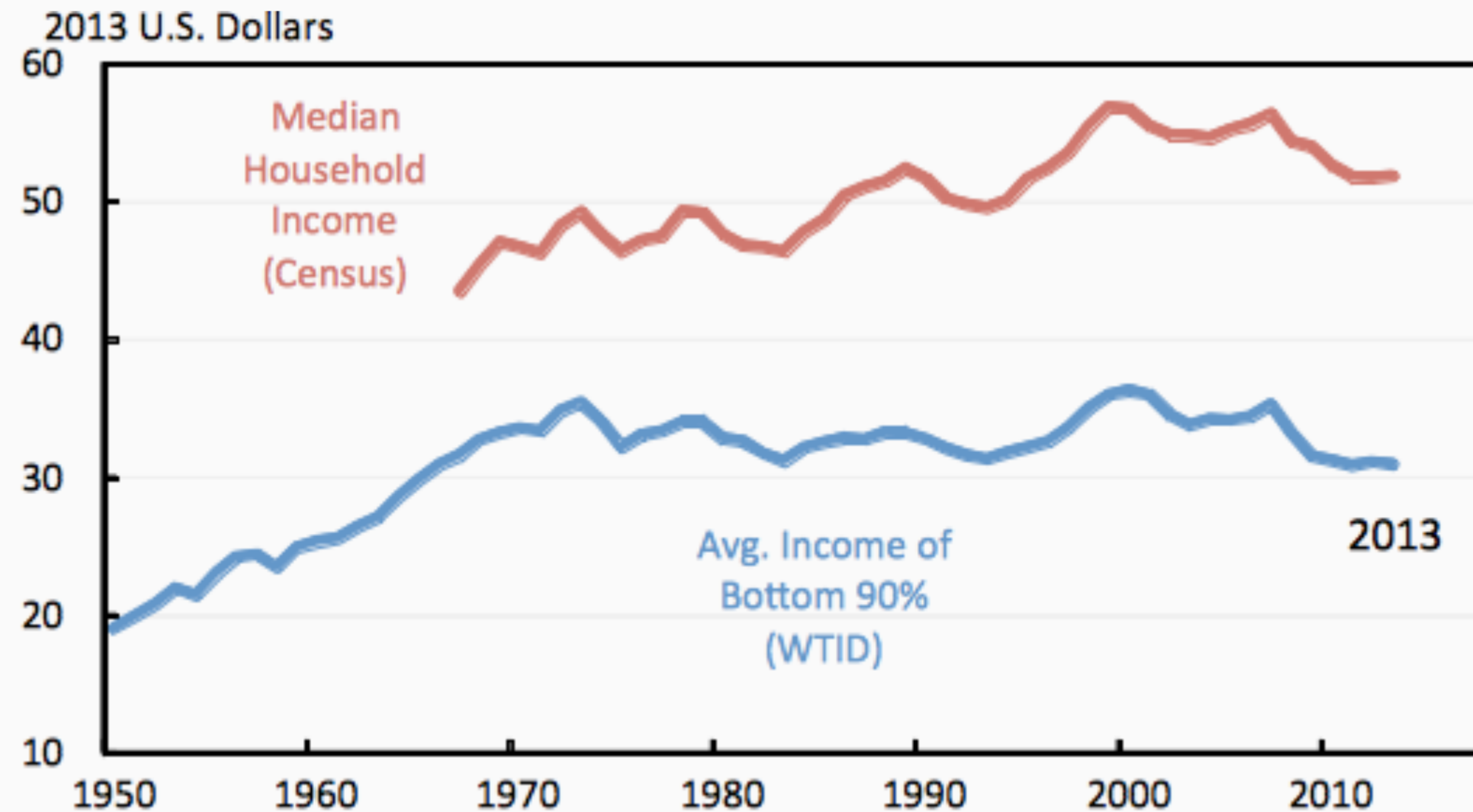
**Source:** EPI analysis of Bureau of Labor Statistics and Bureau of Economic Analysis data

Updated from Figure A in *Raising America's Pay: Why It's Our Central Economic Policy Challenge*

# The Dismal View, continued.

## The middle class is no better off than in 1968!

**Figure 1.** US middle-class income growth

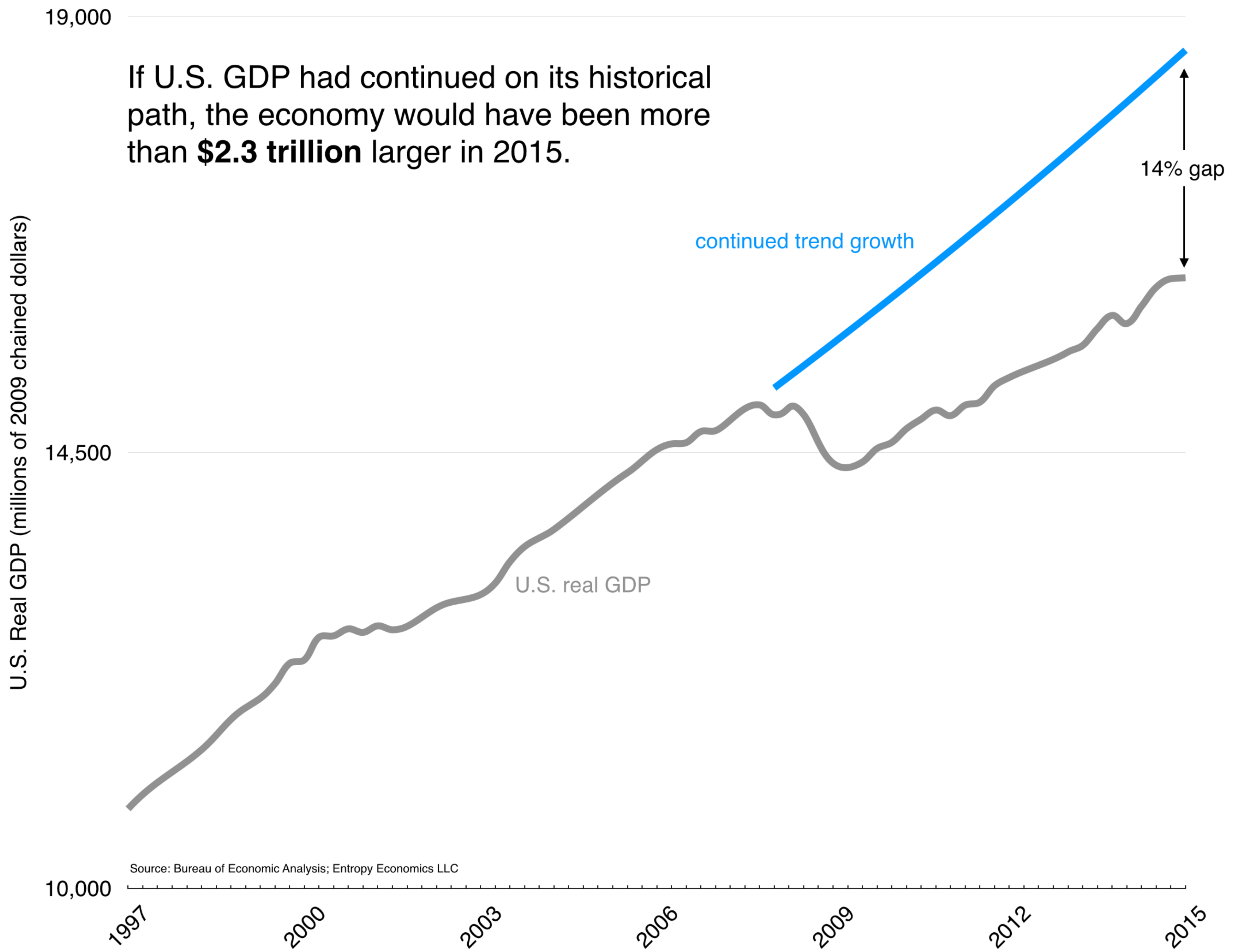


*Sources:* World Top Incomes Database, Census Bureau, Congressional Budget Office.

*Note:* Income levels from the World Top Incomes Database and the Census Bureau are deflated with the CPI-U-RS price index.

# Why the dismal view is probably wrong

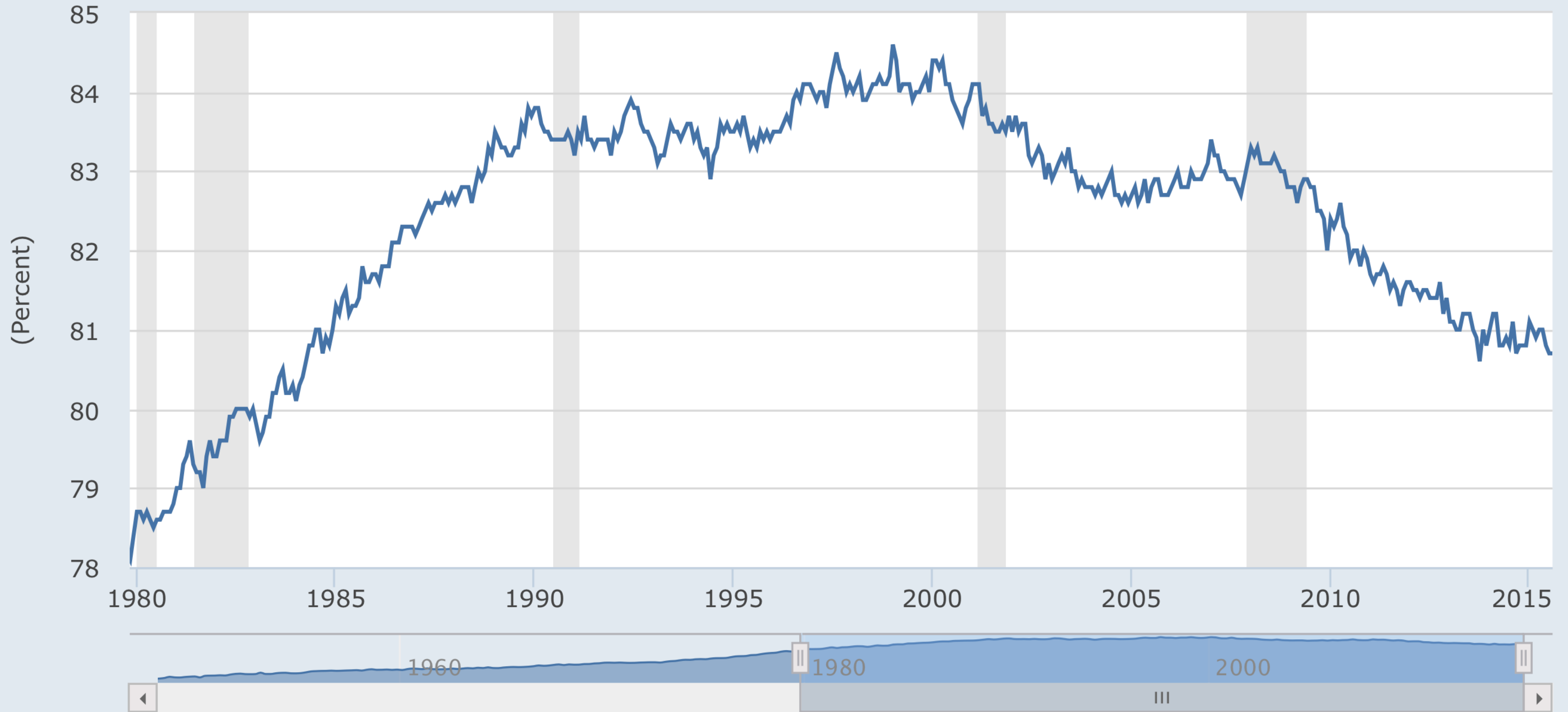
- The dismal view uses faulty price indexes. Merely using the **PCE** instead of CPI gives much **healthier picture**.
- Dismal view compares productivity apples with income oranges.
- Dismal view often doesn't count total compensation, including benefits, and often doesn't account for taxes.
- Dismal view doesn't count ~ **\$20 trillion** in 401(k), IRA assets.
- Dismal view doesn't account for shrinking household sizes.
- Real consumption per person **tripled** since 1968.
- Doesn't measure technological **innovation** very well.



Source: Bureau of Economic Analysis; Entropy Economics LLC



— Civilian Labor Force Participation Rate: 25 to 54 years



Source: US. Bureau of Labor Statistics

Shaded areas indicate US recessions - 2015 [research.stlouisfed.org](http://research.stlouisfed.org)



Stagnating incomes (recently)

1956  
IBM Rambac  
data storage  
system

capacity =  
3.75 MB

~ one digital  
song

rent one for  
\$3,200 per  
month!

\$30,000/month in today's dollars

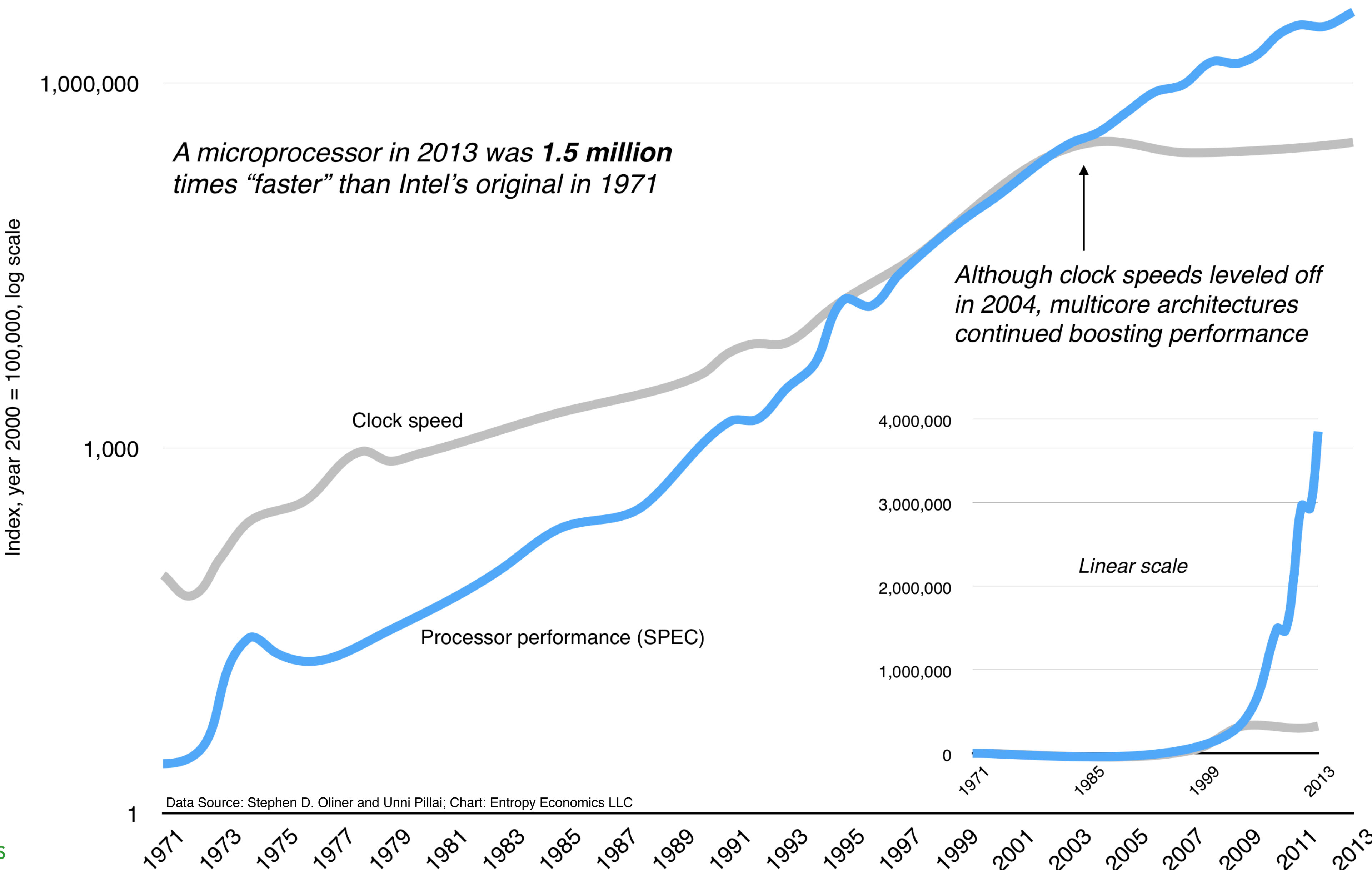


How much would an iPhone 6 have cost  
in 1995?

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in 1995?

Around **\$5 million.**

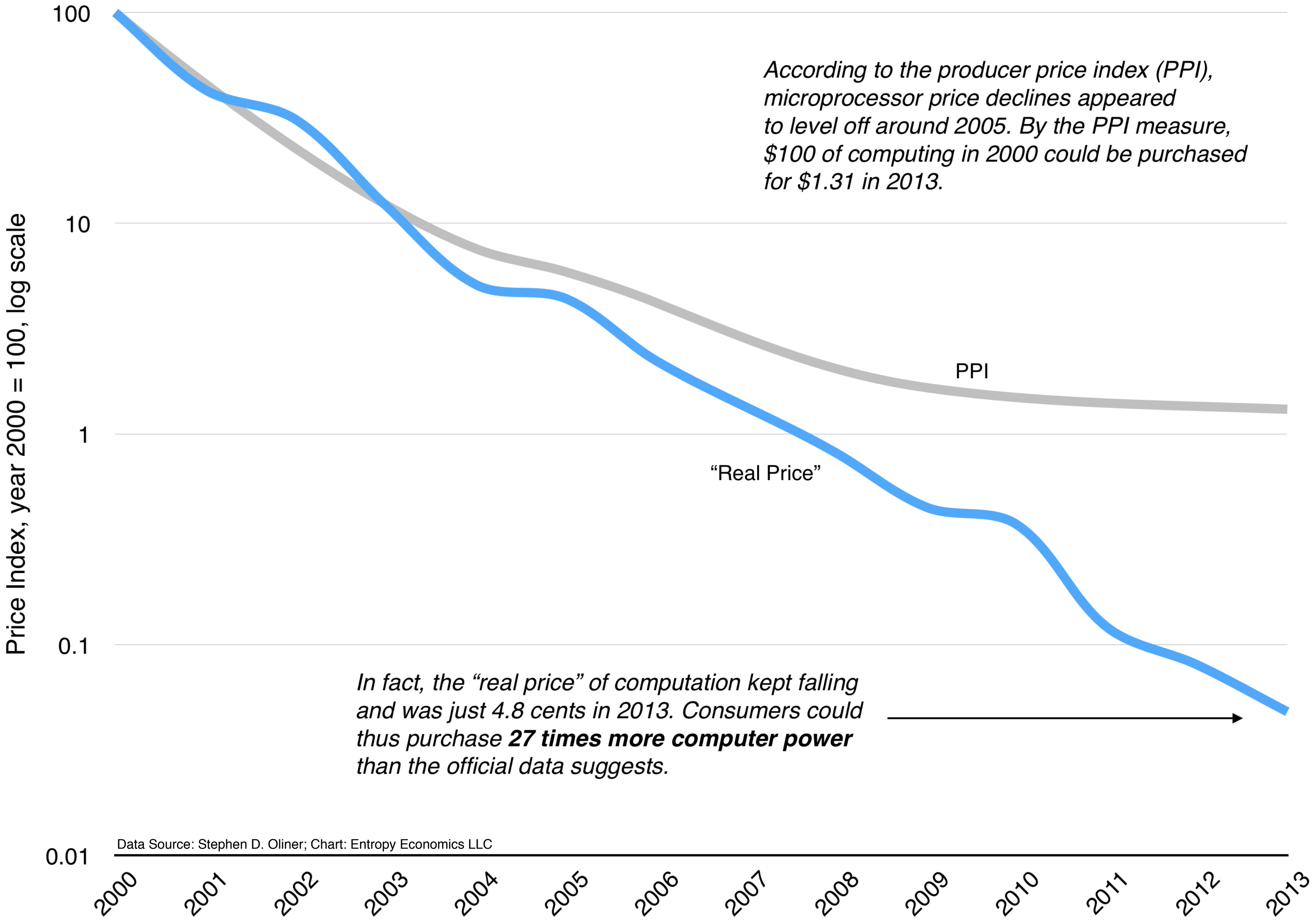
# Leading Edge Microprocessor Performance



Data Source: Stephen D. Oliner and Unni Pillai; Chart: Entropy Economics LLC



# Microprocessor Prices



# Market Value of Seven American Tech Firms

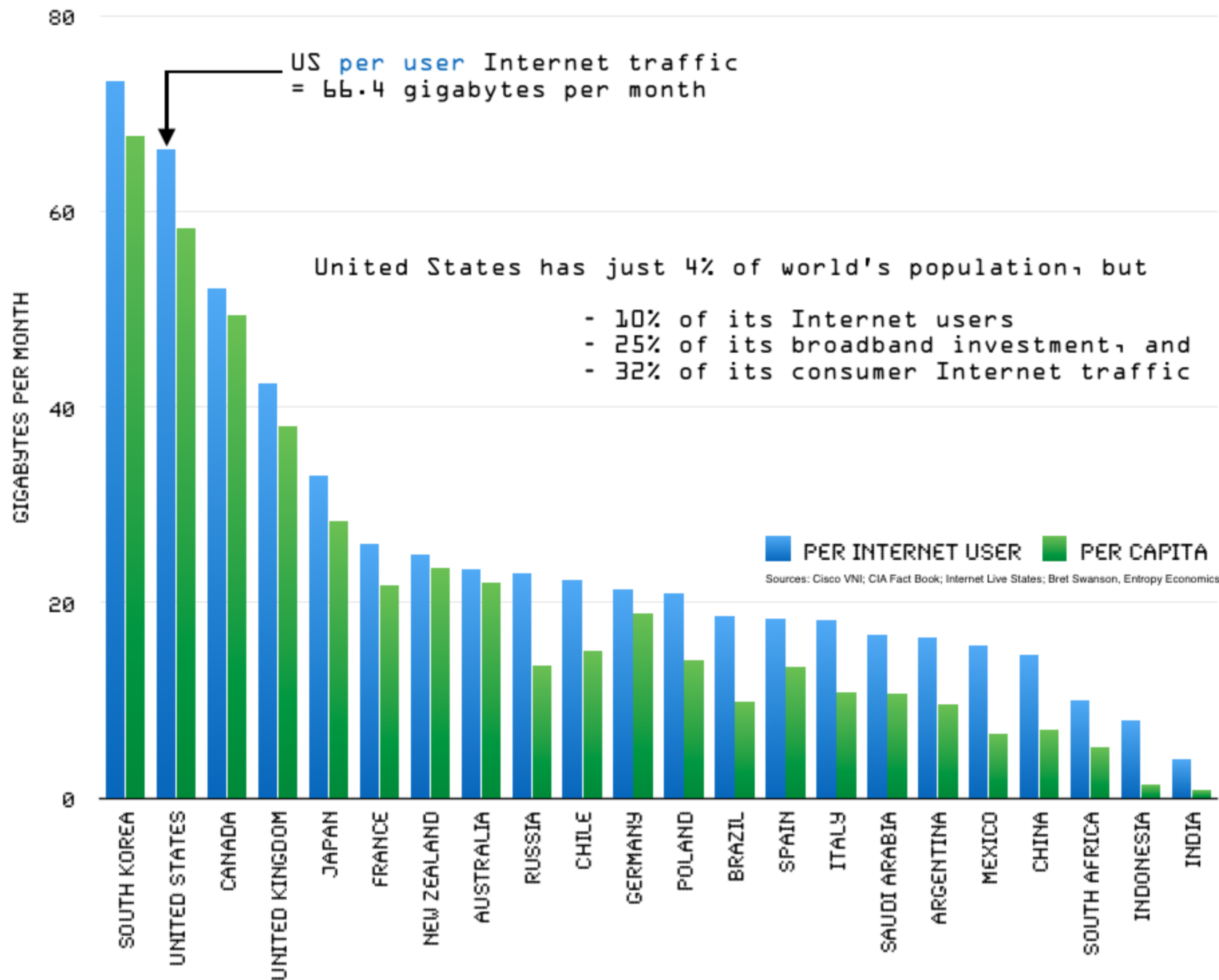
Apple	746.05 B
Google	455.80
Microsoft	376.69
Facebook	265.32
Amazon	225.02
Oracle	175.05
Intel	139.66
<b>Total</b>	<b>\$2.38 trillion</b>

Germany ~ \$1.8 trillion

Australia ~ \$1.2 trillion

India ~ \$1.6 trillion

# INTERNET TRAFFIC AROUND THE WORLD — 2014



# Reasons for Optimism

**More Moore** — compensate for atomic limits with new materials, designs, state variables, parallel architectures

**Internet of Things** — apply the Internet to the other 80% of the economy

**Software** — will continue to “eat the world”

**Virtual Reality** — the next phase in Web content

**Cryptocurrencies** — a new financial platform for the Web, and everything else

**Energy** — continue shale revolution, unleash nuclear, plus real entrepreneurial energy tech

**App-ification of Medicine** — the transformation of health care into an information industry

# Health Holding Us Back

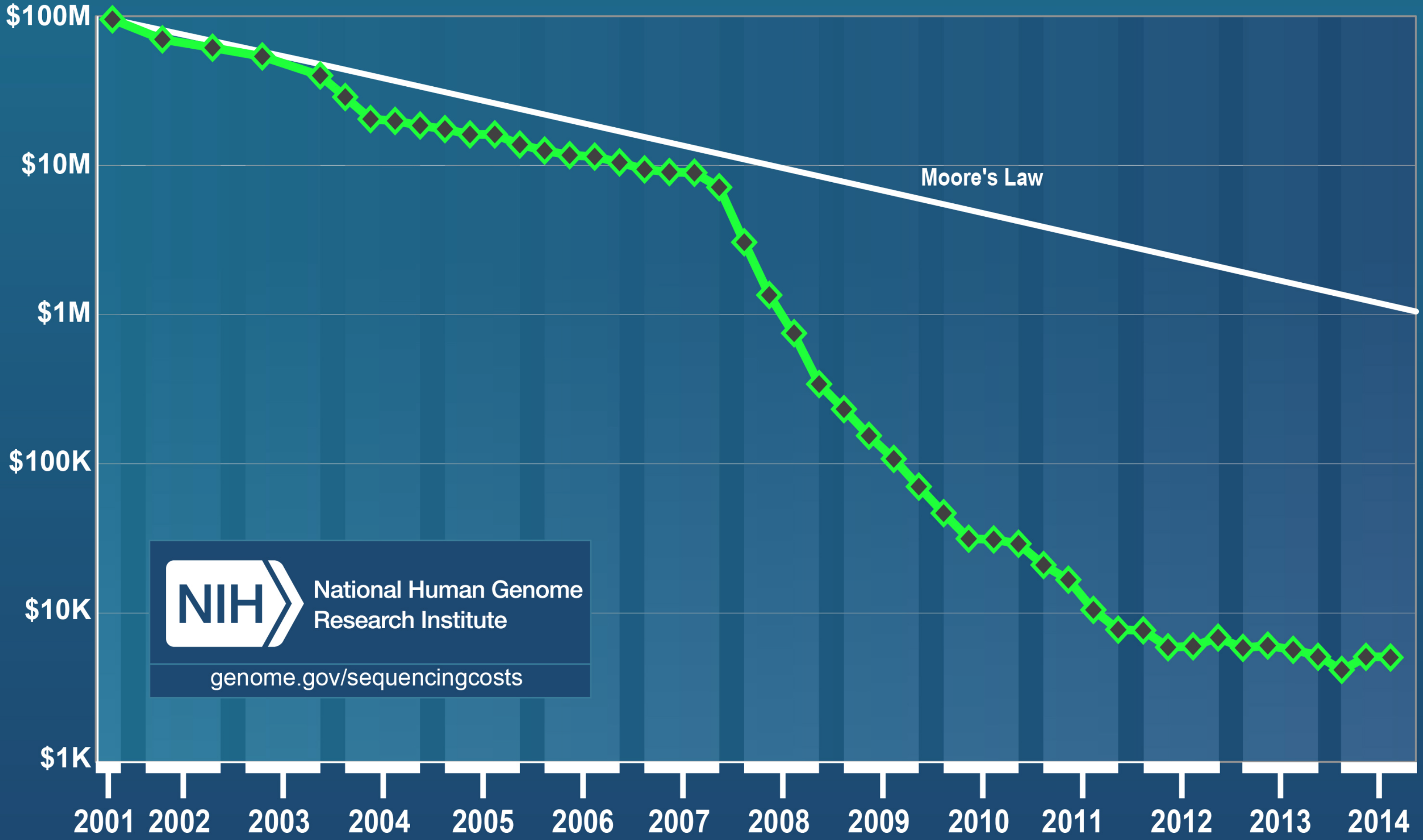
- Between 1990 and 2010, while the rest of the U.S. economy enjoyed annual productivity gains of around 2%, American **health care productivity actually declined 0.6% per year**. Over 20 years, that's a productivity differential of around 60%.
- Since health care is one-sixth of the economy, if we could raise its productivity, we could significantly boost the economy.



# App-ification of Medicine

- Smartphones and Personal Technology
- Big Data, Social Data
- The Code of Life
- The App-ification of Health Care

# Cost per Genome



# Digital Policy

Internet historic success story . . .

U.S. leads the world across the board in digital infrastructure, consumer usage, and entrepreneurship

\$1.3 trillion in broadband investment since 1996

Bipartisan approach worked!

But now FCC changing course, imposing Internet regulation

Net Neutrality, Title II, Spectrum — trying to snatch defeat from the jaws of victory

# More policy questions

Privacy

Security

IoT

Labor and liability law for the peer-to-peer economy (Lyft, Uber, Airbnb)

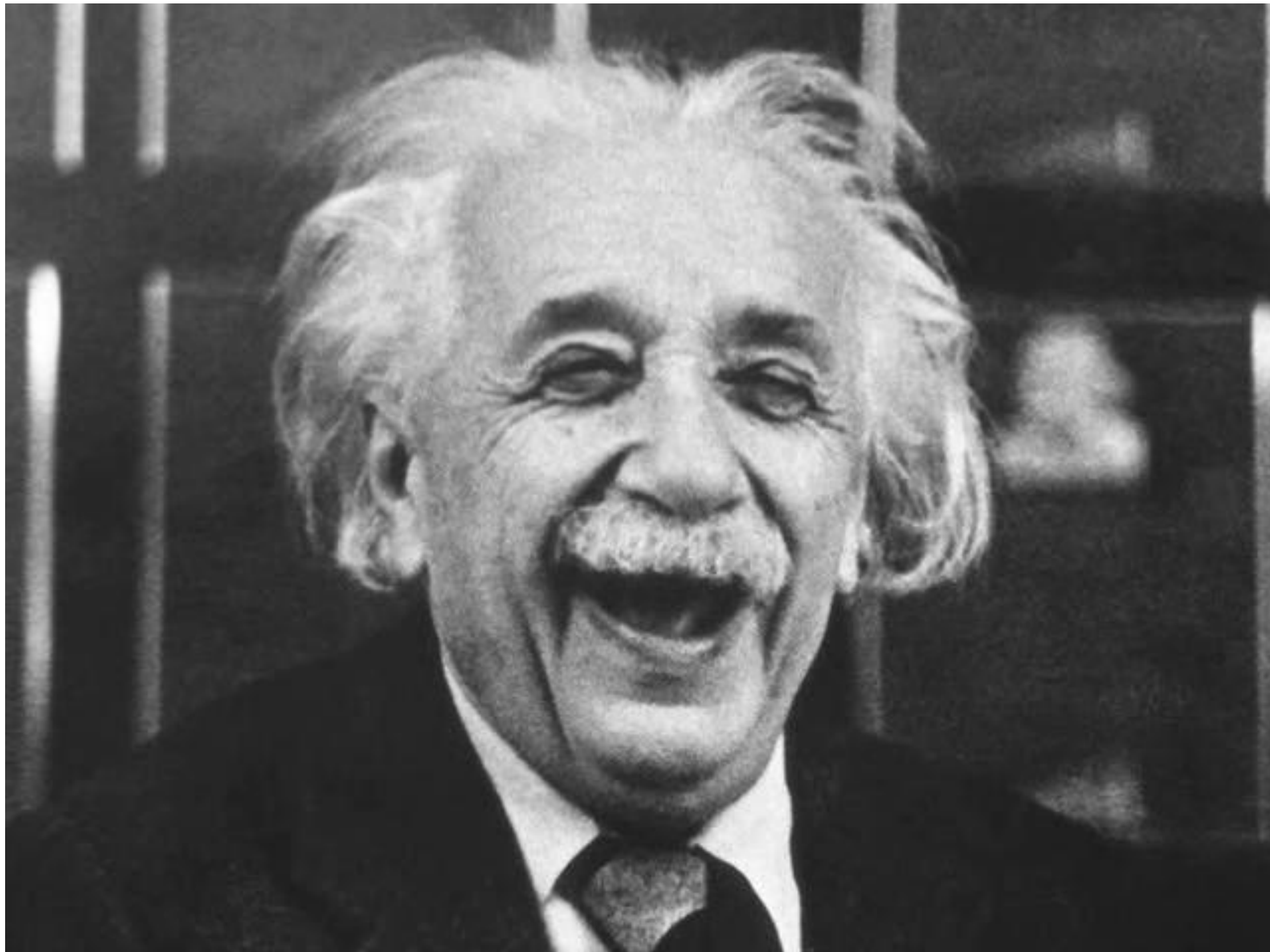
robo-cars, drones, 3D printing

Bitcoin and financial regulation

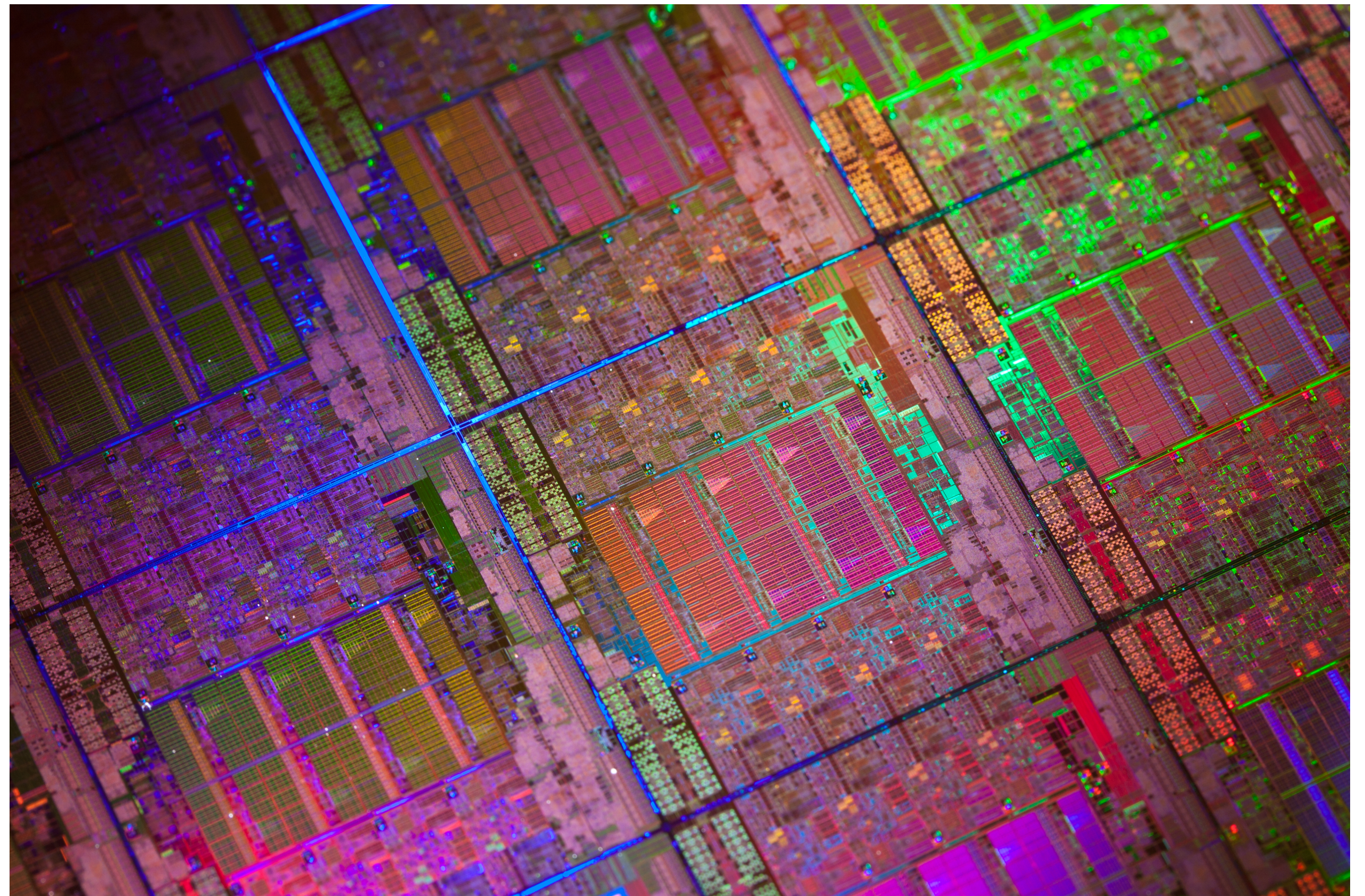
FDA, health insurance, bio-ethics



# The Most Powerful Force in the World — Compound Growth



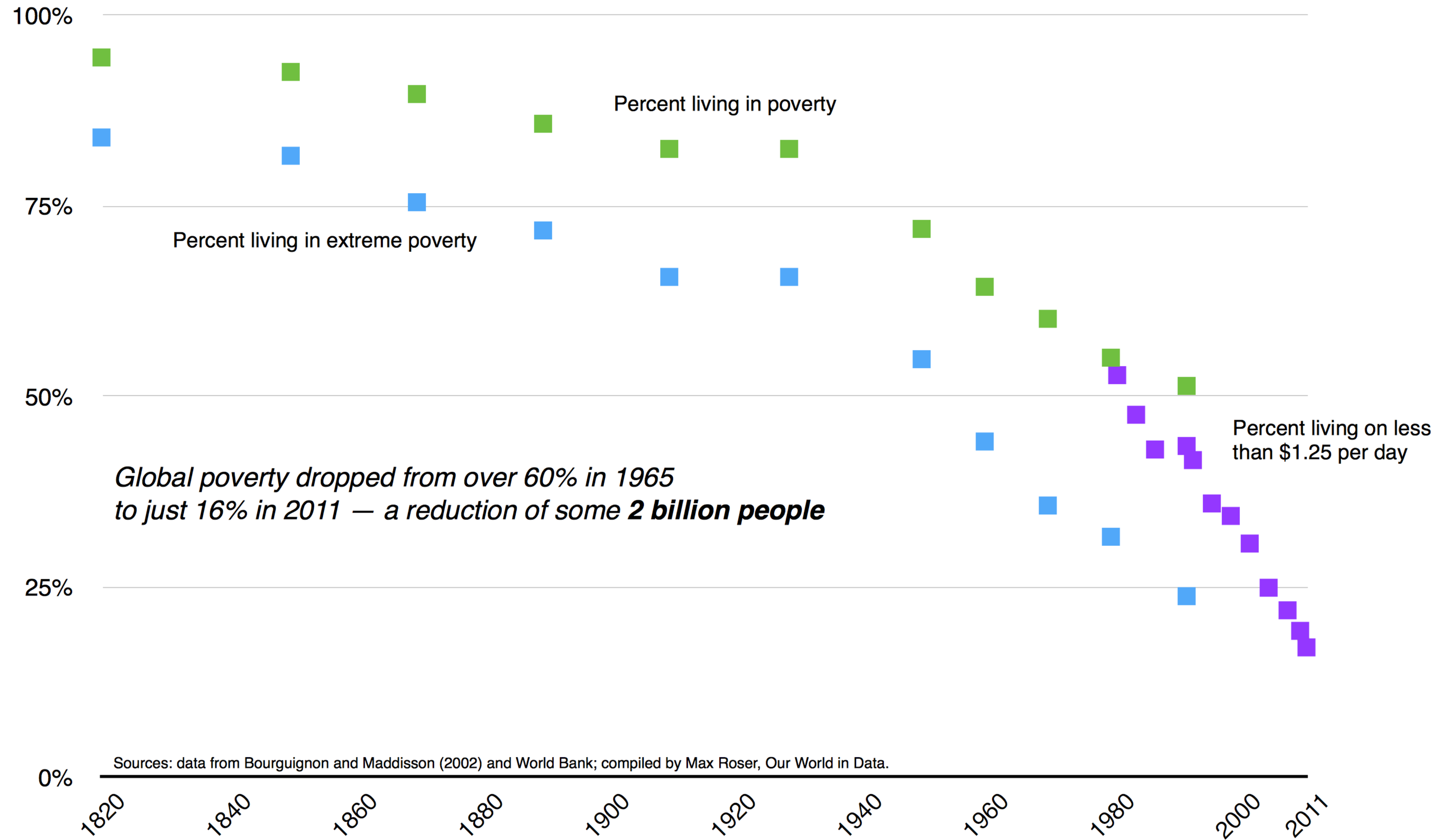
Einstein

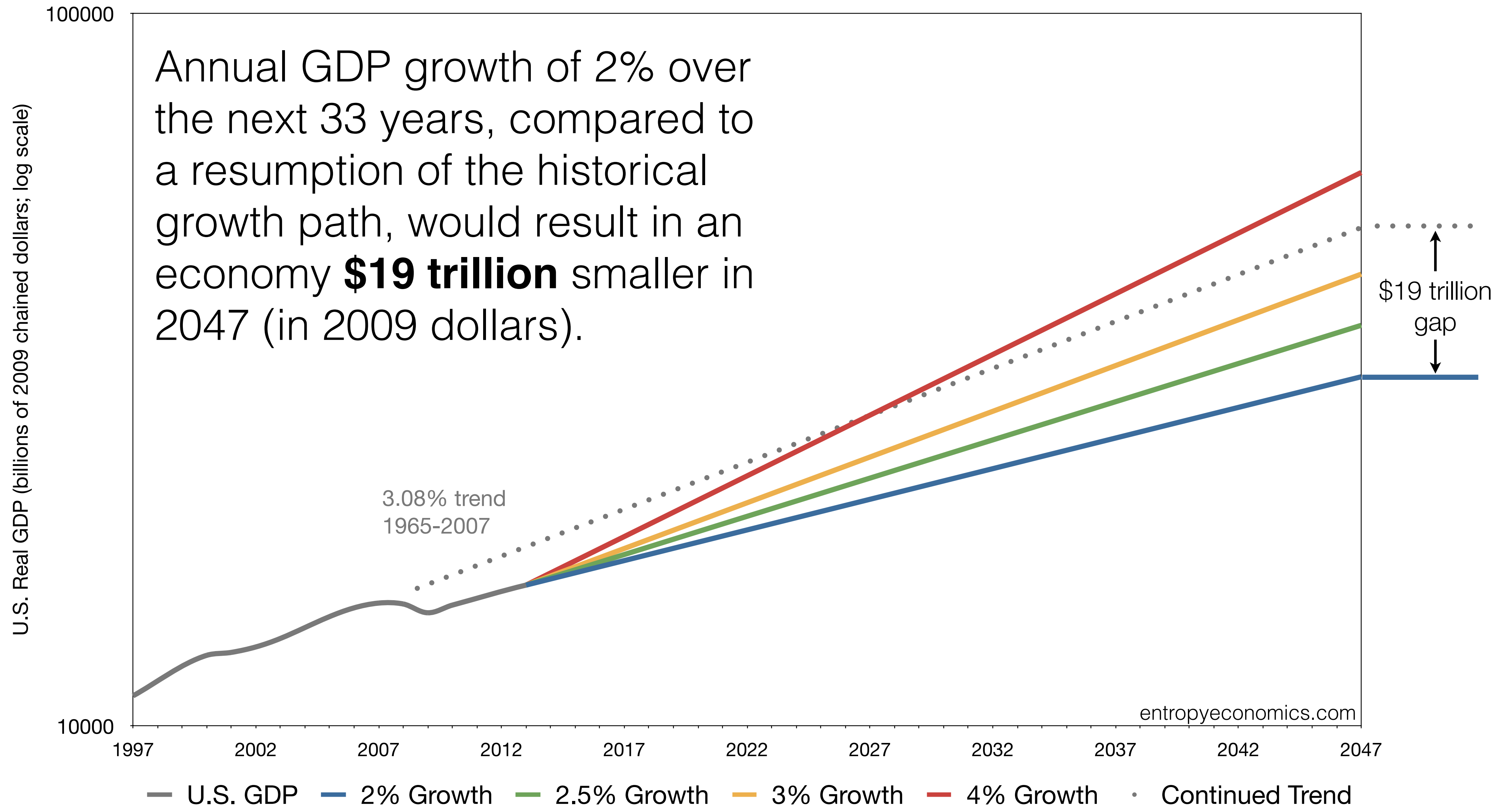


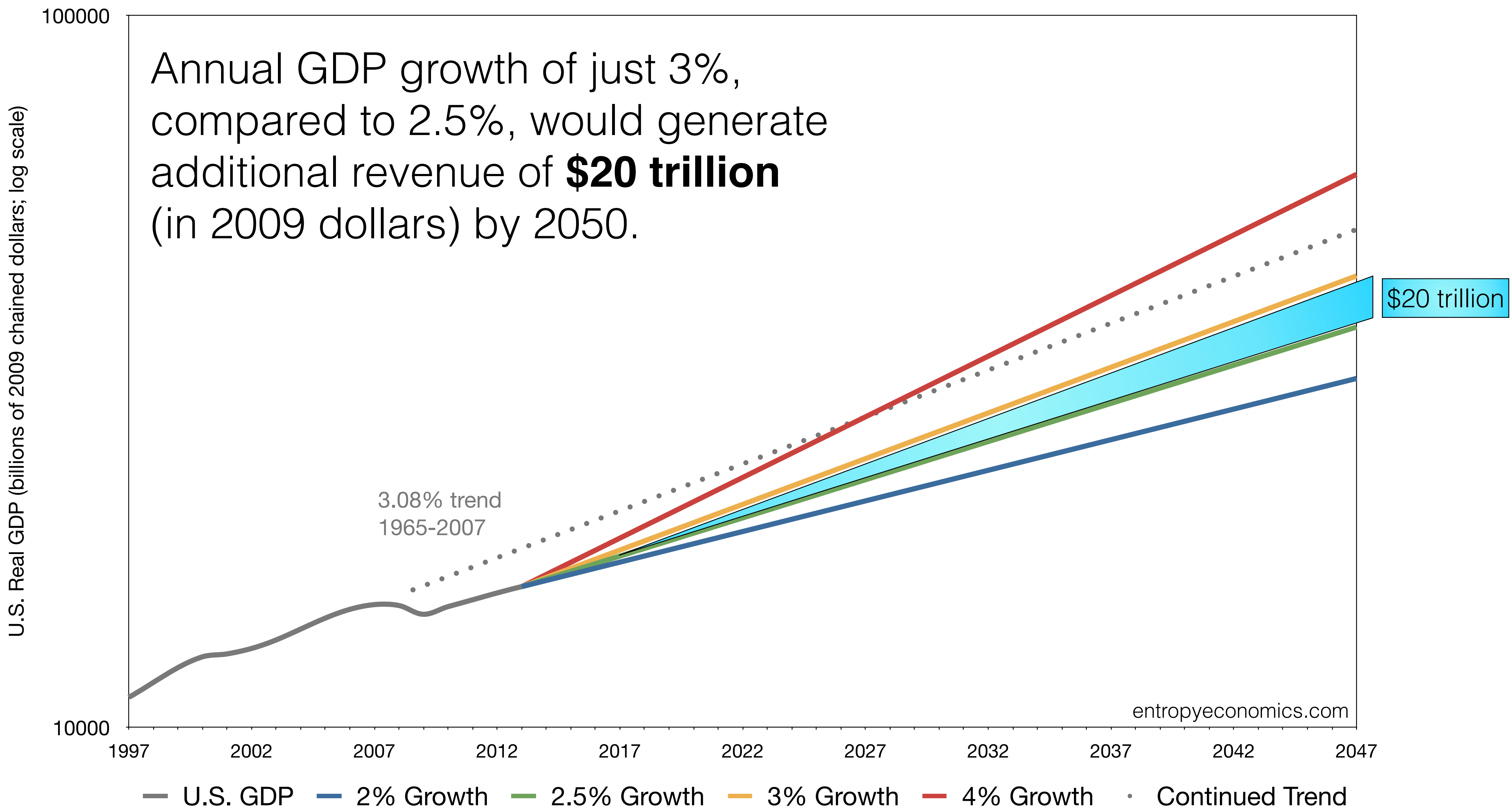
Moore's law



# Global Poverty Plunged Over Last Half Century

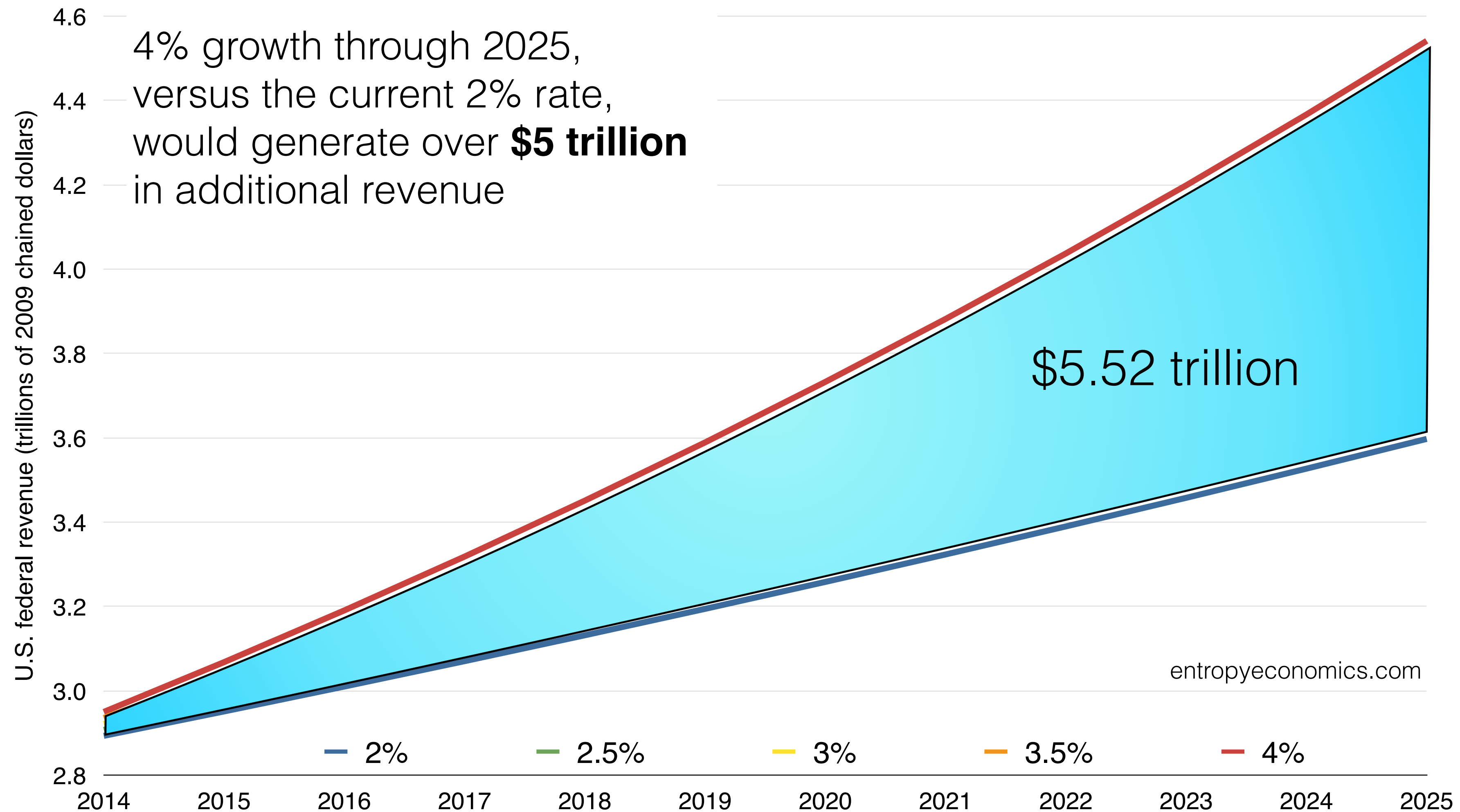




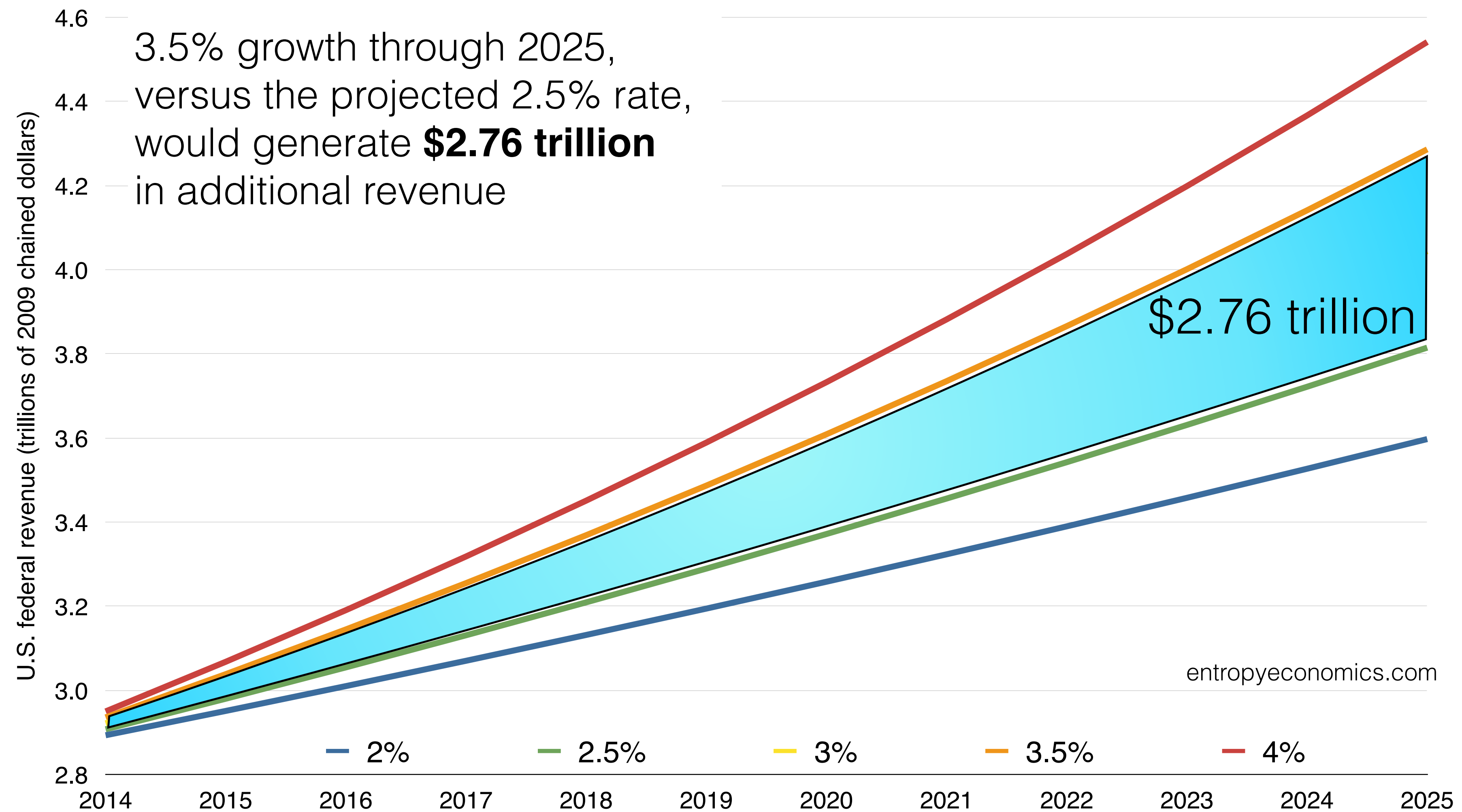




# The Ten-Year Difference



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