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A.I. & Economic Growth

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Artificial Intelligence and Economic Growth

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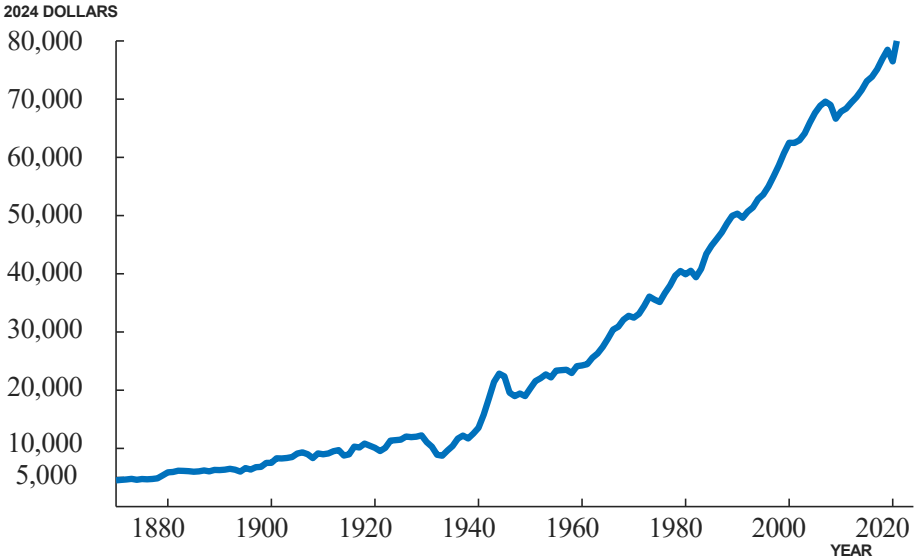
Outline

- Background: The Theory of Economic Growth
  - How do economists understand the sustained rise in living standards for the past 150+ years?

- A.I. and Economic Growth
  - What might the next 25 years look like?

The Theory of Economic Growth

U.S. GDP per Person



The Theory of Economic Growth

- Ideas are special (Paul Romer, 2018 Nobel Laureate)
  - Standard goods: laptop computer, hour of a surgeon's time
  - Ideas: design of the Covid vaccine, ChatGPT-5

Ideas are infinitely usable: invent once, use many times

- Implication for economic growth:

Living standards determined by total number of ideas

Each invention potentially makes everyone better off

E.g. semiconductors, the WWW, solar panels

Where do ideas come from? People!

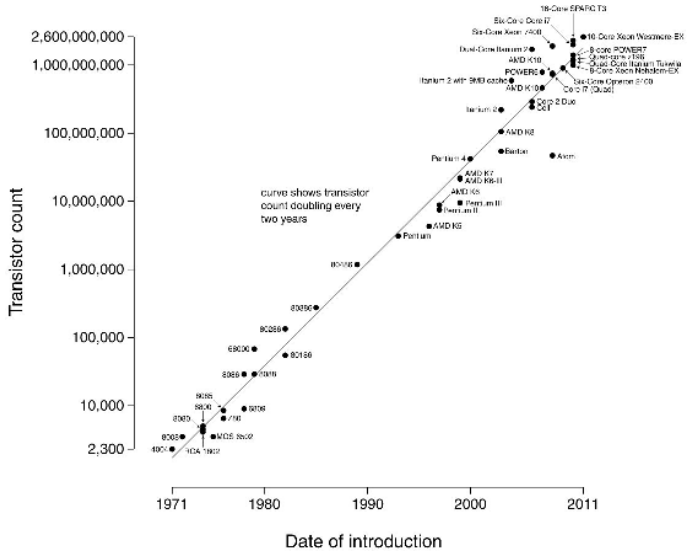
- Researchers, entrepreneurs, and inventors produce ideas
  - Long-run stock of knowledge depends on cumulative number of people who have searched for ideas.

- Key Insight:

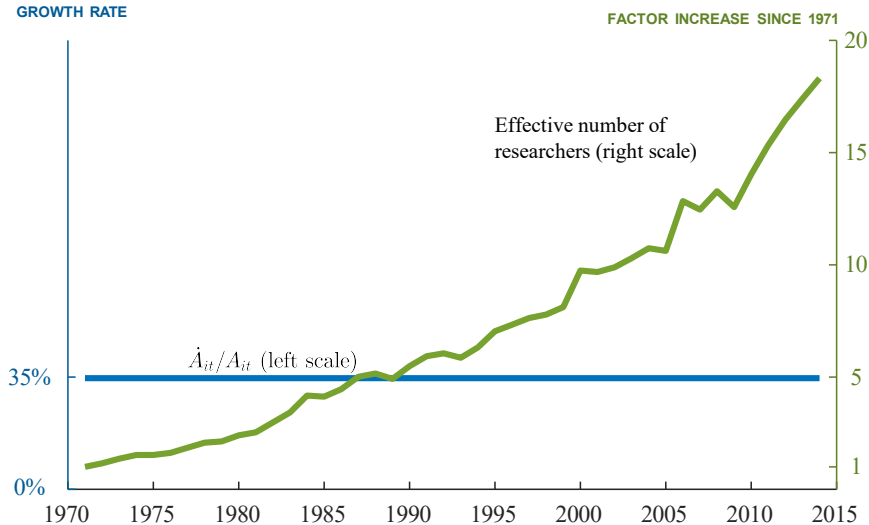
Income per person ← Ideas ← People

Growth in living standards ← growth in people finding ideas

Moore's Law – Steady exponential growth



Research Effort and Moore's Law



Implications for Growth Theory

- Where does long-run growth come from?

Economic growth = Research productivity × Research effort

35% or 2% ↓ (falling) ↑ (rising)

- Ideas are getting harder to find

We have to invest ever-rising resources in R&D just to maintain a constant rate of economic growth

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

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A.I. could help!

A.I. and Economic Growth

Two insights regarding A.I. (Aghion, B. Jones, and C. Jones, 2019)

- A.I. is the latest form of 200+ years of automation
  - Automation = replace labor in particular tasks with machines and algorithms
  - *Past:* textile looms, steam engines, electric power, computers
  - *Future:* driverless cars, paralegals, pathologists, maybe researchers, maybe everyone?

- A.I. may be limited by Baumol's cost disease ⇒ bottlenecks
  - *Baumol:* growth constrained not by what we do well but rather by what is essential and yet hard to improve

Bottlenecks and Weak Links

- Firm production requires the successful completion of a number of tasks
  - A weak link framework
  - Failing at sourcing inputs or quality control or timely delivery or other tasks can be very detrimental
  - Examples: the O-ring of the space shuttle Challenger, or Amazon's DNS problem last week
- Successful automation allows fast computers or powerful machines to perform tasks instead of people
  - Large cost savings in long run — machines get better rapidly
  - Talented people are the scarce input

The bottlenecks are the source of scarcity and hence earn high returns

What would A.I. accelerating economic growth look like?

- Near-term productivity boosts from A.I.
  - Software: 25% productivity improvements already
  - In the next decade(!): A.I. agents that can automate most coding?
  - Virtuous circle: code up even better A.I. algorithms (infinitely usable)

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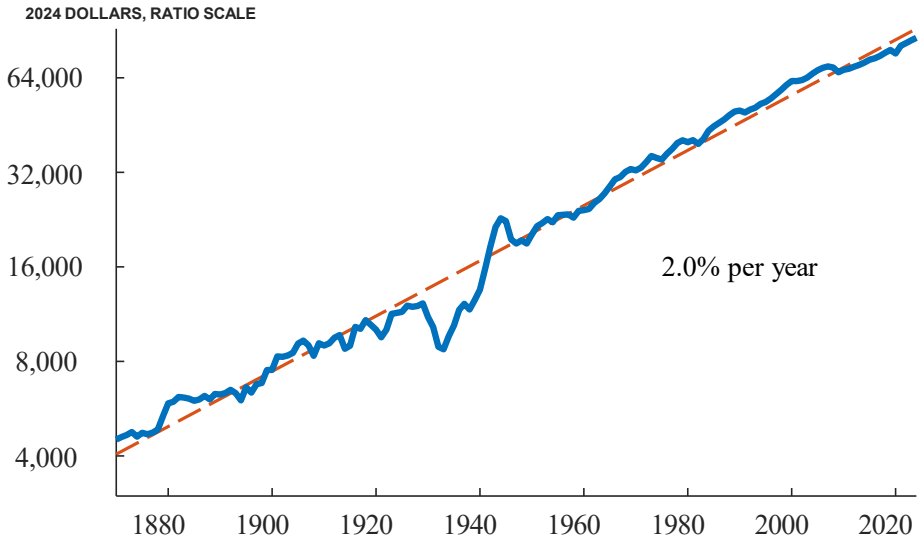
  - Virtuous circle: code up even better A.I. algorithms (infinitely usable)
- Billions of virtual research assistants, running 100x faster than us
  - Automate most cognitive tasks ⇒ invent new ideas
  - E.g. better chips, robots, medical technologies, etc.
  - A.I. + robots ⇒ automate physical tasks
- Potential to raise growth rates substantially over the next 25 years?

Bottlenecks and Baumol Effects

- Economic history ⇒ may take longer than we expect
  - Electricity and computers changed the economy over 50 years
- Automation has been going on for 150 years with no speed up in growth
  - Electricity, engines, semiconductors, the internet, smartphones
  - Yet growth always 2% per year
- Maybe those great ideas are what *kept* growth from slowing
  - Perhaps A.I. = latest great idea letting us maintain 2% growth for a while longer. (pessimistic view, but possible)

Average income per person in the U.S.



The Labor Market, Jobs, and Meaningful Work

- Bottlenecks and jobs
  - Jobs are collections of complementary tasks.
  - Even if A.I. automates a large share of tasks, humans do the remainder
  - “Weak links” ⇒ wages can remain high — radiologists! — at least for a while
- The world where A.I. “changes everything” is a world where GDP is incredibly high
  - The size of the pie available for redistribution is enormous (transition hard?)
- As we get richer, we naturally work less — this is a good thing!
- But there is also good, meaningful work
  - We may choose to value experiences involving people (arts, music, sports)
  - Retirement!

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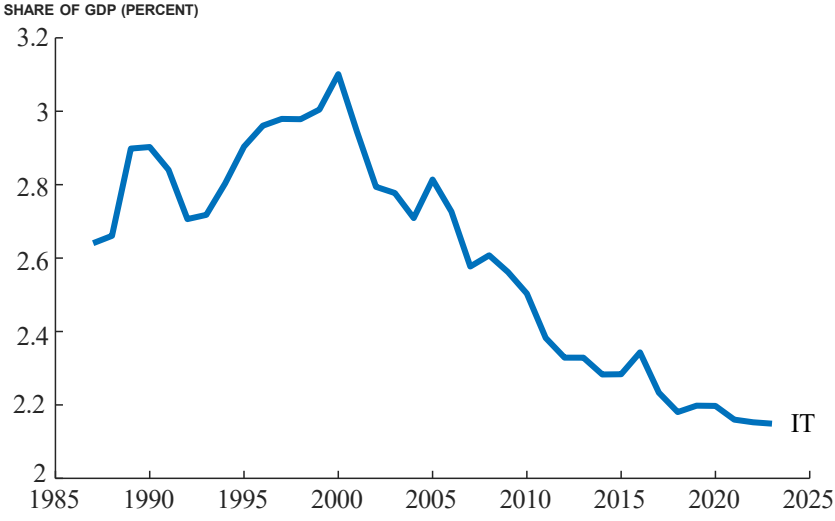

Consistent with bottlenecks and weak links! (Jones and Tonetti)

Catastrophic Risks?

Can we use economic analysis to think about the serious risks?

Two Versions of Existential Risk

- Bad actors:
  - Could use Claude/GPT-8 to cause harm
  - E.g. design a virus that is more lethal than Ebola and takes 3 months for symptoms
  - Nuclear weapons mangeable because so rare; if every person had them...
- Alien intelligence:
  - How would we react to a spaceship near Pluto on the way to Earth?
  - “How do we have power over entities more powerful than us, forever?” (Stuart Russell)

A Thought Experiment (Jones, 2024 AERI)

- AGI more important than electricity, but more dangerous than nuclear weapons?

- The Oppenheimer Question:
  - If nothing goes wrong, AGI accelerates growth to 10% per year
  - But a one-time small chance that A.I. kills everyone
  - Develop or not? What risk are you willing to take: 1%? 10%?

What does standard economic analysis imply?

Findings:

- Log utility: Willing to take a 33% risk!

  (Maybe entrepreneurs are not very risk averse?)

- More risk averse ($\gamma = 2$ or 3), risk cutoff plummets to 2% or less
  - Diminishing returns to consumption
  - We do not need a 4th flat screen TV or a 3rd iphone.
    Need more years of life to enjoy already high living standards.

- But 10% growth $\Rightarrow$ cure cancer, heart disease
  - Even $\gamma = 3$ willing to take large risks (25%) to cut mortality rates in half
  - Each person dies from cancer or dies from A.I. Just total risk that matters. . .

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- Better intuition
  - VSL = $10 million
  - To avoid a mortality risk of 1% ⇒ WTP = $1\% \times \$10 \text{ million} = \$100,000$
  - This is more than 100% of a year's per capita GDP
  - Xrisk over two decades ⇒ **annual investment of 5% of GDP**
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Incomplete: ignores the "effectiveness" of mitigation

but intuition is correct; see paper.

Final Thoughts

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- How much did the internet change the world between 1990 and 2020?
  - How much will A.I. change things between 2015 and 2045? More or less?
  - I believe the answer is much more
  - Just because changes take 30 years instead of 5 years does not mean that the ultimate effects will not be large

- Are we massively underinvesting in mitigating risks?
  - Easy to justify spending 1/3 of 1% of US GDP = $100 billion!
  - Exernalities and race dynamics: A.I. labs do not internalize the risks to all of us
  - Should we tax GPUs and use the revenue to subsidize safety?

Talk based on material from several papers

- Growth and ideas
  - Jones (2022) “The Past and Future of Economic Growth...”
  - Bloom et al (2020) “Are Ideas Getting Harder to Find?”
- A.I., growth, and existential risk
  - Aghion, B. Jones, and C. Jones (2019) “Artificial Intelligence and Economic Growth”
  - Jones (2024) “The A.I. Dilemma: Growth versus Existential Risk”
  - Jones (2025) “How much should we spend to reduce A.I.’s existential risk?”
  - Jones and Tonetti (in progress) “Past Automation and the Future of A.I.”