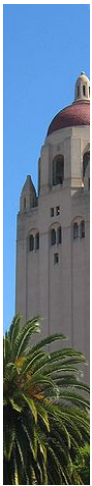


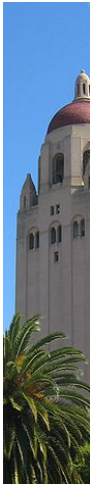
Optimal Population: An Empty Planet or 100 Billion People?

Charles I. Jones
Stanford GSB

June 2025
Torino Festival of Economics

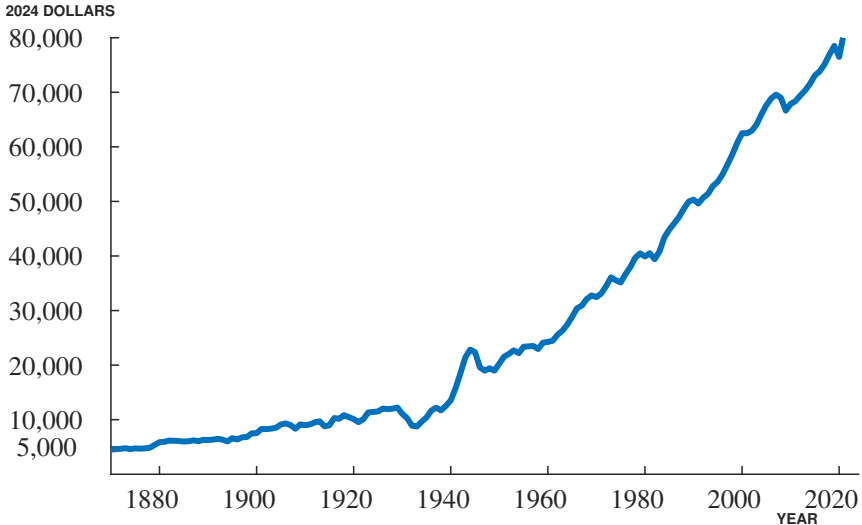
Outline

- People create ideas
  - Population growth and individual living standards
- Is a world of many happy people better?
- Optimal population

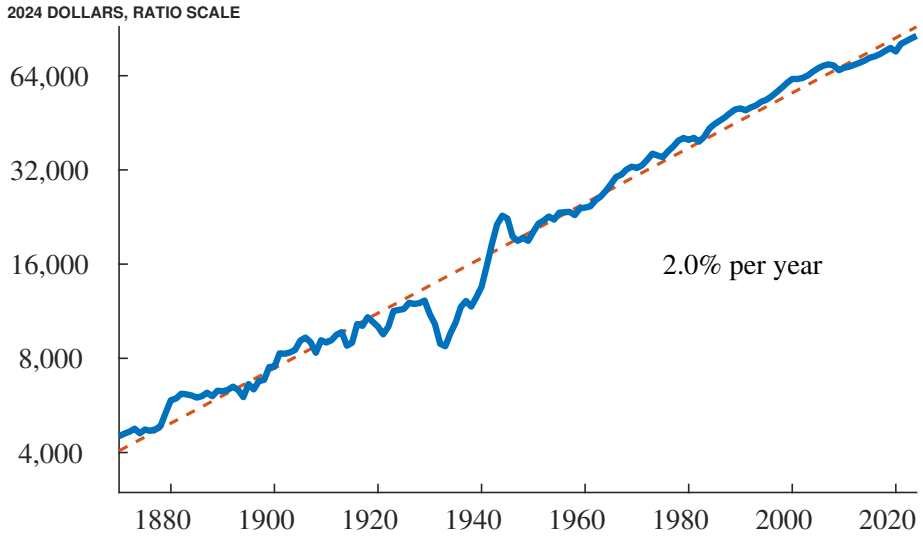


Surprising link between
population growth and economic growth

U.S. GDP per Person has Grown by a Factor of 16 since 1870



Average income per person in the U.S.



The Theory of Economic Growth

- Where does long-run growth come from?
  - The discovery of new ideas and technologies
- Ideas are special (Paul Romer, 2018 Nobel Laureate)
  - Standard goods: barrel of oil, hour of a surgeon's time
  - Ideas: calculus, design of the Covid vaccine, A.I. deep learning

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!

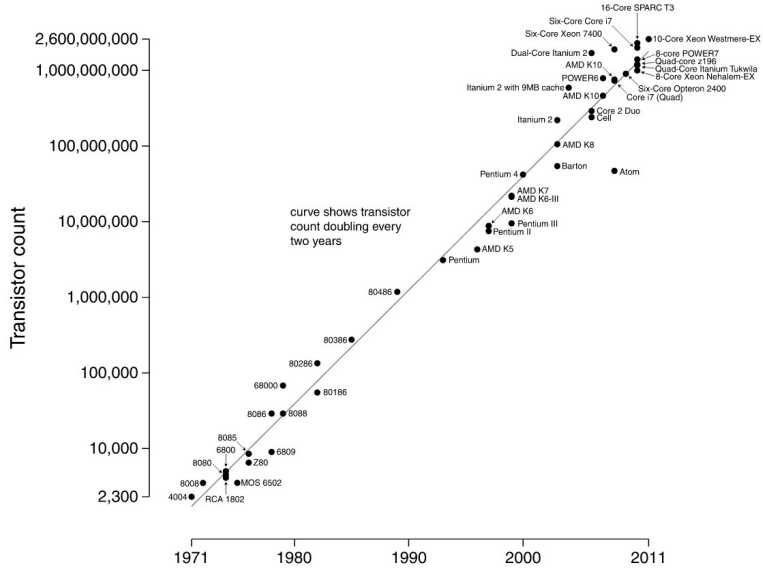
- Researchers, entrepreneurs, and inventors produce ideas
    - Long-run stock of knowledge depends on cumulative number of people who have searched for ideas.

- Key Insight:

$$\text{Income per person} \leftarrow \text{Ideas} \leftarrow \text{People}$$

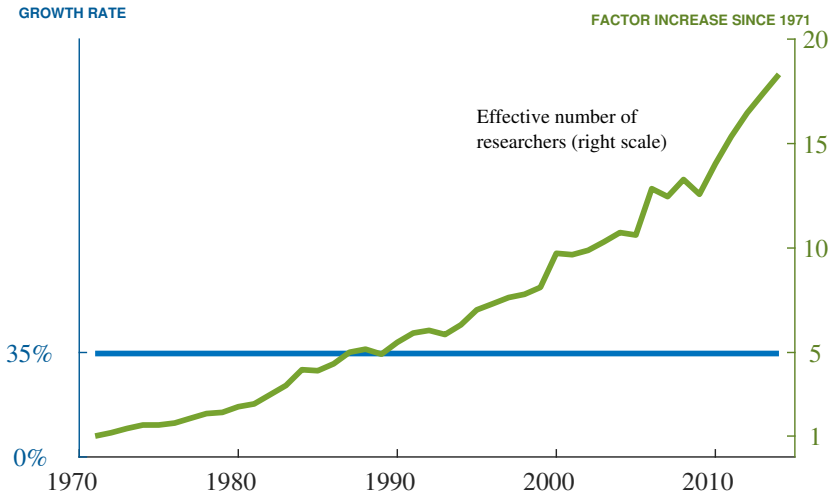
Growth in living standards $\leftarrow$ *growth in people finding ideas*

Example: The Steady Exponential Growth of Moore's Law



Evidence on Moore's Law

Research effort: 18x (+6.8% per year)



Bloom, Jones, Van Reenen, and Webb (2020)

The Ultimate Resource

- Why are we richer today than in the past?

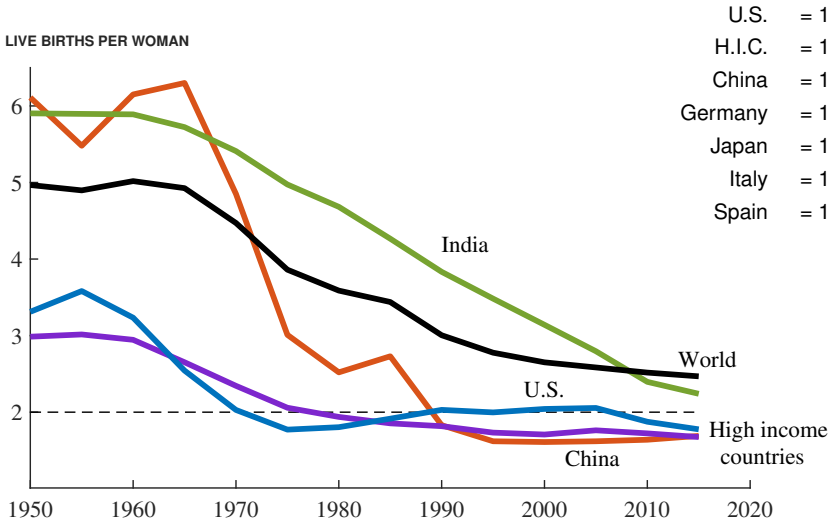
  More people $\Rightarrow$ more new ideas $\Rightarrow$ higher income / person

  - Growth rate of income per person depends on growth rate of researchers, and therefore ultimately on the population growth rate

- But what is the future of world population?

  - Conventional wisdom 10 years ago: level off at 10 or 12 billion
  - Modern view: negative population growth!

The Total Fertility Rate (Live Births per Woman)



U.S. = 1.8
H.I.C. = 1.7
China = 1.7
Germany = 1.6
Japan = 1.4
Italy = 1.3
Spain = 1.3

What happens to economic growth if population growth is negative?

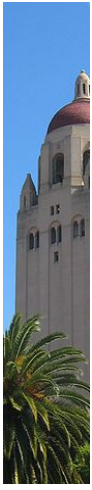
- Positive population growth $\Rightarrow$ **Expanding Cosmos**
  - Growing population $\Rightarrow$ growing research $\Rightarrow$ rising living standards
  - Exponential growth in both living standards and population

Optimistic future – fill the cosmos with ever richer people

- Negative population growth $\Rightarrow$ **Empty Planet** (the end of humanity)
  - Number of researchers stops growing $\Rightarrow$ economic growth ceases

Living standards stagnate for a population that vanishes

- Profound difference between a world of 2.2 kids per family vs 1.9 kids per family!



More happy people $>$ few happy people

Making people happy versus making happy people

- Economists typically focus on individual wellbeing $\Rightarrow$ “GDP per person”
- Philosophers are more open minded:
  - Making people happy = economists and philosophers
  - Making (more) happy people = philosophers
- “The greatest good for the greatest number”

Example: Japan versus Mexico since 1960

- Economic growth
  - Japan: 6 times richer than in 1960 (“growth miracle”)
  - Mexico: Only 3 times richer

Example: Japan versus Mexico since 1960

- Economic growth
  - Japan: 6 times richer than in 1960 (“growth miracle”)
  - Mexico: Only 3 times richer
- Population
  - Japan: Only 30% more people
  - Mexico: Tripled its population!
- Which country has done more to increase welfare? Not so clear!

Counting people in a broader measure of economic growth

- "The greatest good for the greatest number" values both number of people and living standards per person

- Broader growth measure

$$g_{total} = g_{income\,per\,person} + v \times g_{population}$$

  where v is the coefficient that values population growth

- Theory suggests calculating v based on how much people themselves value living.
  - Example: U.S. government (EPA, Transportation) values lives at $10 million each

Measuring the v coefficient

$$v = \frac{\text{Value of a year of life}}{\text{Consumption per person}} = \frac{\$10 \text{ million / } 40 \text{ years}}{\$50{,}000} = 5$$

- Each percentage point of population growth is worth 5pp of income growth!

  Surprisingly high valuation of lives

- For countries less rich than the U.S., v is lower, but only slightly
  - Italy: $v = 4$ (each year of life is worth 4x per capita consumption)
  - Average country: $v = 3$

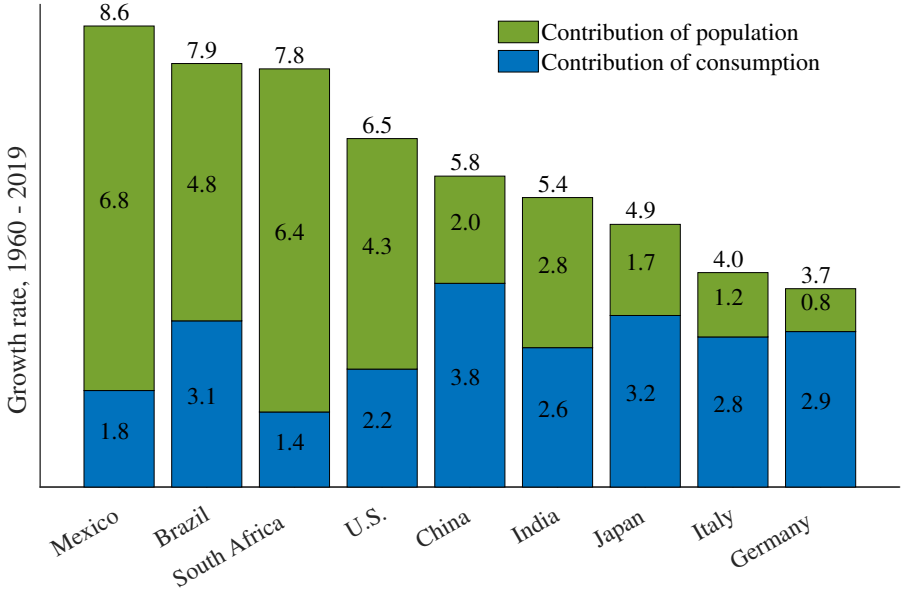
Broader growth rates for select countries, 1960–2019

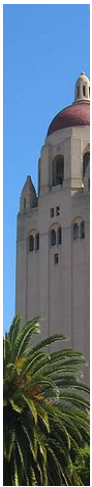
$$g_{total} = g_{income\ per\ person} + v \times g_{population}$$

	g_{total}	g_{income}	g_{pop}	v	$v \cdot g_{pop}$
United States	6.5	2.2	1.0	4.4	4.3
Mexico	8.6	1.8	2.1	3.4	6.8
Japan	4.9	3.2	0.5	3.8	1.7
Italy	4.0	2.8	0.3	3.9	1.2
Germany	3.7	2.9	0.2	4.0	0.8

Average annual growth rates, in percent.

Broader growth rates for select countries, 1960–2019





Optimal population?

How many people should we have?

A world of 100 billion people?

- Imagine a world of 100 billion people in cities the density of Paris
- What fraction of the world's habitable land would we use?

A world of 100 billion people?

- Imagine a world of 100 billion people in cities the density of Paris
- What fraction of the world's habitable land would we use? **5%**

A world of 100 billion people?

- Imagine a world of 100 billion people in cities the density of Paris
- What fraction of the world's habitable land would we use? **5%**
- Could we feed those people? How much more productive than the Netherlands agricultural sector is required?

A world of 100 billion people?

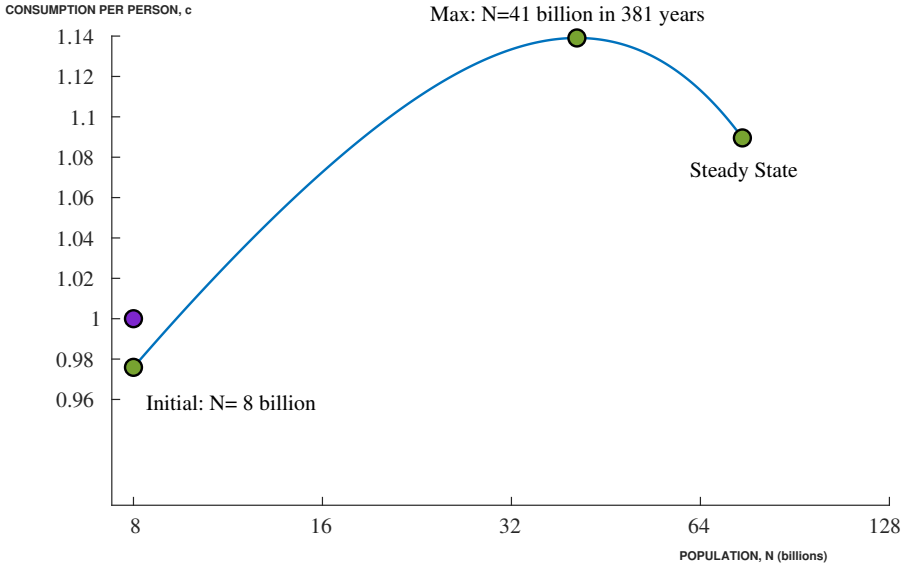
- Imagine a world of 100 billion people in cities the density of Paris
- What fraction of the world's habitable land would we use? **5%**
- Could we feed those people? How much more productive than the Netherlands agricultural sector is required?
  - With meat and vegetables/grains: **+30%**
  - With a vegetarian diet: **current productivity is sufficient**

With technological progress over the next century,
the world could conceivably support 100 billion people

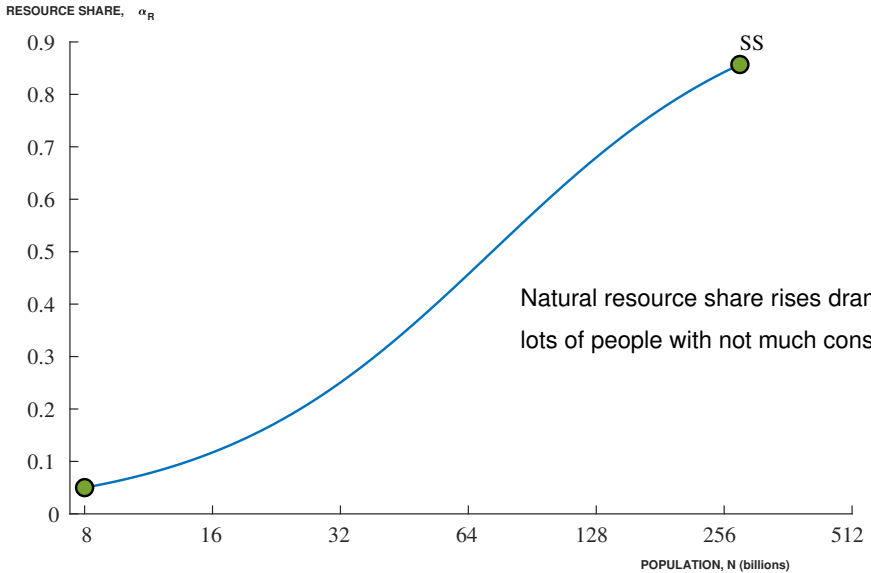
What is the optimal long-run population size?

- Important factors to consider:
  - **Empty Planet:** We have kids because we love them. Evidently $\Rightarrow$ empty planet!
  - **Ideas:** More people $\Rightarrow$ more ideas $\Rightarrow$ everyone richer
  - **Total Utilitarian view:** happy, flourishing people are socially desirable independent of how parents feel
  - **Sustainability:** resource depletion, climate change, diversity loss, physical space per person. Finite planet $\Rightarrow$ no long-run growth!
  - **Individual freedom:** To what extent is it morally acceptable for the government to tax / subsidize to push people away from their privately optimal choices?

A model simulation of a possible future



Natural Resource Share of World GDP (simulation)



Natural resource share rises dramatically:

lots of people with not much consumption

In conclusion...

- Our current path = **Empty Planet**
  - Living standards stagnate for a population that ultimately vanishes
  - The end of humanity
  - This is a choice, and we could make a different one
- We value lives very highly — presumably new people would as well
  - Changes how we think about economic growth in Mexico versus Japan
- Because people produce ideas, more people $\Rightarrow$ richer not poorer
  (at least until very high levels of population)
  - So not facing a trade-off!

References

- Jones (2022) “The End of Economic Growth? Unintended Consequences of a Declining Population”
- Adhami, Bils, Jones, and Klenow (2025) “Population and Welfare: Measuring Growth when Lives are Worth Living”
- Eden, Jones, and Klenow (in progress) “Optimal Population: An Empty Planet or 100 Billion People?”