TEACHING HUMAN DIGNITY SERIES:

Are There Too Many People in the World?
What Economics Can Tell Us
Population Worries: Today

“As the population grows—and demand for water and land increases—it will be difficult to increase food production in a sustainable way. Furthermore, climate change will contribute to more erratic and extreme weather patterns, such as unprecedented droughts and floods that reduce available farm land, and will create more challenges for farming.”

A Practical Guide to Population and Development
(Population Reference Bureau, 2014)
Population Worries: 1968

“The battle to feed all of humanity is over. In the 1970’s hundreds of millions of people will starve to death in spite of any crash programs embarked upon now.”

*The Population Bomb*
(Paul Ehrlich, 1968)
Population Worries: 1923

- US population by 1964 would reach 214 million—which would be “beyond the maximum agricultural possibilities”
- Unless checked, world population would reach an unsupportable 3 billion by 2000

*Mankind at a Crossroads*
(Edward East, 1923)
“Now population, when it grows, moves with a certain uniform impetus...it must outstrip all physical conditions and bounds; and the longer it continues, the more severely must the ultimate check be felt...I do not say that the failure of our coalmines will be the only possible check. Changes here, or in other parts of the world, may, even before the failure of our mines, reduce us to a stationary condition, and bring upon us at an earlier period the sufferings and dangers incident to our position. But such a grievous change, if it does not come before, must come when our mines have reached a certain depth.”

The Coal Question: An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of our Coal Mines (Stanley Jevons, 1866)
Thomas Robert Malthus

• Economist, father of population economics
• Anglican priest
• Prophet of doom -- the “Dismal Science”
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Key idea:
- Human Petri dish – competition for scarce food
- In equilibrium
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- Key idea:
  - Human Petri dish – competition for scarce food
  - In equilibrium

- Perhaps the first, and most well known, of many erroneous predictions by economists!
Why? Malthus’ “Famous Nonsense”

Food supply grows “arithmetically”
Why? Malthus’ “Famous Nonsense”

- Food supply grows “arithmetically”
- "Unchecked" populations grows “geometrically"
Checks on Population

- Large population declines to subsistence
- Small population grows to subsistence

Food, Population vs Time
- Declining Food Per Person
- Rising Food Per Person
- Subsistence Food Requirement

Teaching Human Dignity
What Really Happened Since Malthus?

Food, Population

Exponential Growth in Food, Output

Exponential Growth in Population

Food per Person

Subsistence Food

Growth in Food per Person Well Beyond Subsistence

Teaching Human Dignity
8-Fold Increase in World Population

Sources: DeLong (1998) and United Nations (World at Six Billion, 2016)
120-Fold Increase in World Income

Sources: DeLong (1998) and CIA (World Factbook, 2016)
15-Fold Increase in Average Income

Average Income Per Capita (Relative to 1800)

Year

Note: Calculated from previous sources.
Why Was Malthus Wrong?
New Technologies from the Industrial Revolution...
... and the Agricultural Revolution
Dirty and Clean Technologies
# Comparing Countries Reveals...

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<th>GDP/person</th>
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## Comparing Countries Reveals...

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Comparing Countries Reveals...

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<th>US in 1850</th>
<th>US</th>
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<td>Primary Schooling</td>
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<td>63%</td>
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The Importance of Growth

• Every single country that has high average living standards today was poor in 1850.

• These countries all improved their average living standards by experiencing a century or more of per capita economic growth.

\[
\text{per capita economic output} = \frac{\text{economic output}}{\text{total population}}
\]

• None of these countries attained per capita economic growth merely through long-term population reductions (reducing the denominator). Something deeper happened to increase the numerator.
What Makes Economies Grow?

- Economic growth = growth in economic output per person
- What makes economies grow? Is it more physical capital (factories)?
Capital and Growth
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Capital and Growth

• When labor is fixed, each extra unit of capital produces a smaller increase in output
• This is called *diminishing marginal returns*, and it is one of the most empirically-verified phenomena in all of economics
• We also call it *decreasing returns to scale*: as the scale of our factories doubles, our output less than doubles
Capital and Labor Together
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Capital and Labor Together

- If we increase both capital and labor, then the best we can do is *constant returns to scale*
- We double our inputs, and we get double our output
In a world of constant returns to scale, we can’t have *per capita* economic growth.

The best we can do in that world is to match any increases in population by a proportionate increase in production: *per capita* is constant.

Maybe we need *increasing returns to scale* to get *per capita* economic growth.
Increasing Returns to Scale

- Under increasing returns to scale, if we double all of our inputs, we more than double our outputs.
- That means that each worker gets more than they used to.
- That means long-term economic growth!
Knowledge

• Maybe there’s another input to production we’ve forgotten, that gives increasing returns
• We’ve covered the physical *stuff* that goes into production (raw materials, factories, etc).
• We’ve covered the *labor* that manipulates that physical stuff
• What about the *instructions* for manipulating that stuff? What about *knowledge*?
Knowledge and Growth
Knowledge and Growth
Knowledge and Growth
Knowledge and Growth

$x^2 + y^2 + 2dx + 2ey + f = 0$

$a = \pi r^2$
Knowledge and Growth
Knowledge and Growth

\[ x^2 + y^2 + 2dx + 2ey + f = 0 \]

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E=MC^2
Knowledge and Growth

\[ x^2 + y^2 + 2dx + 2ey + f = 0 \]

\[ a = \pi r^2 \]
Knowledge and Growth
Knowledge is Non-rival

• Thomas Jefferson on Knowledge:
  • “It’s peculiar character. . . is that no one possesses the less, because every other possesses the whole of it. He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine receives light without darkening me.”
How do We Produce More Knowledge?
How do We Produce More Knowledge?

• Maybe important knowledge comes when a genius has a “Eureka!” moment.
• In that case, we can produce more knowledge by making sure there are more geniuses.
How do We Get More Geniuses?
“As for the Arts of Delight and Ornament, they are best promoted by the greatest number of emulators. And it is more likely that one ingenious curious man may rather be found among 4 million than 400 persons.”

William Petty, 1682
“One can hardly imagine, I think how poor we would be today were it not for the rapid population growth of the past to which we owe the enormous number of technological advances enjoyed today... If I could re-do the history of the world, having population size each year from the beginning of time on some random basis, I would not do it for fear of losing Mozart in the process.”

E.S. Phelps, 1968
A Natural Experiment

• We need a natural experiment:
• Several areas start with the same technology
• But they have different initial populations
• We let them develop over the long-term
• Then, after a few thousand years, we drop in and see whether the places that started with higher populations now have better technology, or worse technology
110,000BC – 8,000BC

• Last Ice Age
• Ice Bridges and Land Bridges
• 4 Connected Regions
• Population density everywhere: 0.03 people per square kilometer
• Technology everywhere: stone-age technology
110,000BC – 8,000BC

- Last Ice Age
- Ice Bridges and Land Bridges
- 4 Connected Regions
- Population density everywhere: 0.03 people per square kilometer
- Technology everywhere: stone-age technology
8,000BC

- Ice Bridges Melt
- Sea Levels Rise
- Land Bridges Drown
- 4 Separated Regions
The Experiment Begins...
1500 AD: 4 Connected Regions Again!
Who Has the Best Technology?
Who Has the Best Technology?
Who Has the Best Technology?

- Early modern technology
  - Agriculture, cities, elaborate calendars
Who Has the Best Technology?

Agriculture, cities, elaborate calendars

Early modern technology

Hunter gatherers with good stone tools
Who Has the Best Technology?

- Early modern technology
  - Agriculture, cities, elaborate calendars
- Hunter gatherers with good stone tools
- Bad stone tools
A higher population increases the probability of big discoveries of useful knowledge.
Competition and Interaction

• More generally, economics is about two forces:
  • Rivalrous Competition
  • Fruitful Interaction

• We’re used to thinking about the competition part: that’s what makes us sure that more people means less for each person.
Competition and Interaction

• But more people also means more potential *interactions*
• Interactions can create value:
  • Generate knowledge
  • Exchange goods and services
Competition and Interaction

• And here’s the crucial point: as the number of people increases, the number of potential interactions between people increases faster than the number of people
  • 2 people: 1 interaction
  • 3 people: 3 interactions
  • 4 people: 6 interactions
  • 5 people: 10 interactions
Competition and Interaction

- Population: n
- Potential interactions: n(n-1)/2
- Increase in potential interactions that we get from population n increasing to population n+1 is larger than the decrease in the share of the pie from population n increasing to n+1
“We should be most concerned about building a healthy society in which people can interact and learn from each other, in which we avoid greed while pursuing sharing. In this society, a new life can be received as a blessing, not a curse.”