Session 5:

The Economics of Ideas

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<u>Outline: The Economics of Ideas</u>

- Objects and Ideas

- The Idea Diagram
  - Ideas
  - Nonrivalry
  - Increasing Returns
  - Problems with Pure Competition

- How does the nonrivalry of ideas change how we think about economics?

Solow and Romer

- Robert Solow (1950s)
  - Capital versus Labor
  - Cannot sustain long-run growth
  - Nobel prize, 1987

- Paul Romer (1990s)
  - Objects versus Ideas
  - Sustains long-run growth
  - Wide-ranging implications for intellectual property, antitrust policy, international trade, the limits to growth, sources of "catch-up" growth
  - Nobel prize, 2018

Objects versus Ideas

Objects versus Ideas

- Objects
  - Most goods: iPads, houses, oil, computers, capital, labor
  - The economics of objects underlies Adam Smith's invisible hand theorem

- Ideas
  - Instructions or recipes — designs for making/using objects
  - Sand: from beaches/glass to computer chips
  - Other examples: design of iPad, architectural plan for a house, method for turning oil into plastic, management techniques of Walmart, oral rehydration therapy

The Idea Diagram

Ideas $\rightarrow$ Nonrivalry $\rightarrow$ Increasing returns $\nearrow$ Long-run growth

$\searrow$ Problems with pure competition

Ideas

Reading: Paul Romer, "Economic Growth"

- Objects = raw materials (atoms), Ideas = instructions

- How many potential ideas are there?

  - Chemical exploratory synthesis

  - Romer's "ideal chemical refinery"

Ideas (continued)

- The amount of raw material available — oil, sand, atoms of carbon, oxygen, and so on — is finite

- But the number of ways of arranging these raw materials is virtually infinite

  Romer's insight: Economic growth is sustained by discovering better and better ways to use the finite resources available to us

Nonrivalry

Nonrivalry

- Objects (most goods) are rivalrous

  - Your use of a container ship to deliver Lenovo laptops means I cannot use that same container ship to deliver microwave ovens

  - Gives rise to scarcity, a central focus of economics

- Ideas are nonrivalrous = infinitely usable

  - One architect's use of the Pythagorean Theorem in designing a building does not reduce the "amount" of the theorem available to anyone else

  - The PCR (polymerase chain reaction) technique for replicating strands of DNA can be used by 1 lab, 10 labs, or 1000 labs simultaneously

Example: Cross-docking

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- By studying logistics carefully and experimenting with different alternatives, Walmart concludes that cross-docking will cut costs by 2% (for example)

  - This idea can then be applied to one distribution center, or two distribution centers, or 100 distribution centers

  - It does not get "depleted" by using it multiple times

  - Only needs to be "invented" once

  - In fact, Walmart's use of the cross-docking technique doesn't reduce the "amount" of cross-docking that Target can do

Excludability

Excludability

- The extent to which someone has property rights over a good and can legally restrict its use

- Nonrivalry says ideas can be used by many people simultaneously. But society may provide property rights that lead to legal restrictions on this

- Nonrivalry vs. Excludability
    - Nonrivalry is an intrinsic characteristic — from nature
    - Excludability (the extent of property rights) is a feature of the institutions chosen by society

    Are ideas scarce in the same way that objects are?

Increasing Returns

Increasing Returns

- Suppose Asthma Inc. is developing a new drug for treating asthma (affects about 10% of the population)

  - Coming up with the successful, new chemical formula is the hard part — rough estimates suggest an average cost of \$2 billion to develop a new drug

  - Once developed, just an object, subject to standard CRS production

  - Example: \$2 billion R&D cost, then \$1 per dose in manufacturing costs

- Constant returns after invention implies increasing returns including invention

  - \$2 billion dollars $\rightarrow$ 1 dose

  - \$4 billion dollars $\rightarrow$ about 2 billion doses!

  - Doubling inputs far more than doubles output!

Revisit our standard Production Function

- Familiar notation, but now let A_t denote the "stock of knowledge" (i.e. the cookbook of recipes)

$$Y_t = F(K_t, L_t, A_t) = A_t K_t^{1/3} L_t^{2/3}$$

- Constant returns to scale in K and L holding knowledge fixed. Why?

$$F(2K, 2L, A) = 2 \times F(K, L, A)$$

- But therefore increasing returns in K, L, and A together!

$$F(2K, 2L, 2A) > F(2K, 2L, A)$$

- Economics is quite straightforward:
  - Replication argument + Nonrivalry $\rightarrow$ CRS to objects
  - Therefore there must be IRS to objects and ideas

Problems with Perfect Competition

- Adam Smith's fundamental Invisible Hand result

- Why do increasing returns pose a problem?
  - What if Asthma Inc. charges marginal cost?

  - What if Asthma Inc. charges $100 per dose?

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  ○ Under perfect competition, markets lead to the best of all possible worlds (well, Pareto optimality at least)

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  ○ Prices allocate scarce resources to their best uses

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    Covers the variable cost but not the fixed cost of R&D
    $\rightarrow$ negative profits $\rightarrow$ no research

  ○ What if Asthma Inc. charges \$100 per dose?

    Many people who would purchase the drug at marginal cost (\$1) will not purchase at the higher price $\rightarrow$ inefficiency (deadweight loss)

Problems with Perfect Competition (continued)

There must be a wedge between price and marginal cost so firms can recover the fixed cost of inventing new ideas

A single price cannot simultaneously provide the appropriate incentives for research and allocate scare resources efficiently

We no longer live in the Best of All Possible Worlds —
there is an important role for institutions beyond free markets

How to Address Problems with Perfect Competition?

- What do firms do to address these issues with perfect competition?

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  - Trade secrets to keep monopoly and sell at markup
    - Fixed cost to produce ideas vs. fixed costs to produce objects
  - Price discrimination (e.g., by country, by income of customer)
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  - Patents grant monopoly profits for a time to allow firm to recoup initial investment
    - How long to grant monopoly? Innovation vs. restricted supply
  - R&D subsidies and public-private joint ventures
    - How to know which ideas to subsidize?

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- How do these issues differ for poor vs. rich countries

Questions for Discussion

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- What are "meta-ideas" and why are they important?

- Natural resources, climate change, and ideas — how do they interact?

- Data is also nonrival — what are the implications?

Meta-Ideas

- Meta-Ideas: Ideas for shaping the creation of new ideas

- Institutions are themselves ideas — invented and evolving

  - The free market

  - The patent system

  - The National Science Foundation and National Institutes of Health

  - Research prizes — Longitude, Lindbergh, X Prize, Kremer

- What other meta-idea does Paul Romer suggest? Why does he think this might be useful?

- Better institutions lead to

  - ↓ Misallocation ⇒ ↑ TFP (last class)

  - ↑ Innovation ⇒ ↑ TFP (next class)

Natural Resources and Economic Growth

Metal detector

The Economist industrial commodity-price index, real* $ terms, 1845-50=100
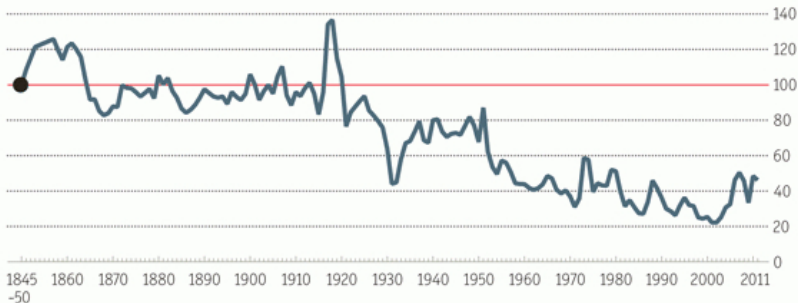
Source: *Economist*, "Resource prices" Oct 14th 2011.
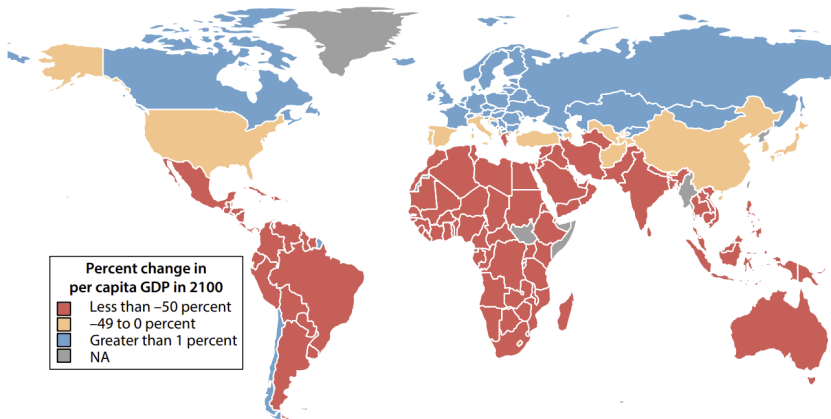
Climate Change and Ideas

Reading: "Ten Facts about the Economics of Climate Change"
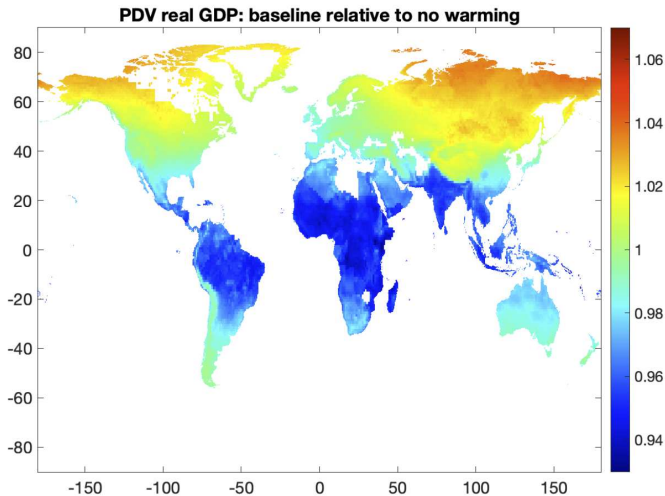
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Reading: "Ten Facts about the Economics of Climate Change"

- Takeaways?
  - A global problem: all regions contributing now: U.S./Europe more historically, China more today
  - Economic damages could be very large, highly uncertain
  - Poor countries are likely to be hardest hit
  - Carbon tax!

Potentially Huge Effects on Levels of GDP by 2100

Percent change in per capita GDP in 2100
- Less than −50 percent
- −49 to 0 percent
- Greater than 1 percent
- NA

Alternative Estimate — very different!

Cruz and Rossi-Hansberg, 2021

The Nonrivalry of Data (WSJ)

Reading: "Should Consumers Be Able to Sell Their Own Personal Data?"

The Nonrivalry of Data (WSJ)

Reading: "Should Consumers Be Able to Sell Their Own Personal Data?"

- Just like ideas, data is nonrival

- Data is used in the production of ideas (ML algorithm for detecting cancer)

- Firms may have incentives to hoard data to protect market share

- Consumers can balance privacy concerns with social gains from broad use

Questions for Review

- What is the key distinction between objects and ideas, and why is this distinction important?

- What is nonrivalry, and how does it lead to increasing returns?

- Why is there a tension between increasing returns and perfect competition?

- How does a careful consideration of the economics of ideas lead to a failure of Adam Smith's invisible hand result?

- What are meta-ideas and why are they important?