The Future of U.S. Economic Growth

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U.S. GDP is well below pre-recession projections

Potential and Actual Real GDP
Seasonally adjusted, 2009$

Source: Haver and Fernald (2013). CBO 2007 has been adjusted from 2000$ to 2009$
U.S. GDP is well below pre-recession projections

Potential and Actual Real GDP
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CBO Potential 2007
Fernald Potential (2013)
Q3
Real GDP

What’s long-run growth rate?

Source: Haver and Fernald (2013). CBO 2007 has been adjusted from 2000$ to 2009$
Big picture: Steady growth for 140 years

GDP per Person (ratio scale, 2009 dollars)

1.95% per year

Year
(Simplified) growth accounting from Jones (2002)

- Production function for output
  \[ Y = A^{1-\alpha} K^\alpha (hN)^{1-\alpha} \]

- (World) production function for ideas
  \[ \dot{A} = Rf(A) = \delta R A^\phi \]

- If \( \dot{A}/A = g_A \) is constant, \( \gamma = 1/(1-\phi) \),
  \[ L = \text{pop. of idea-producing countries} \]
  \[ \rightarrow A = \text{const} \cdot R^\gamma = (R \& D \text{ Intensity})^\gamma L^\gamma \]
Most growth 1950-2007 is transition dynamics

\[ y^* \approx \left( \frac{K}{Y} \right)^\beta \cdot h \cdot (\text{R&D intensity})^\gamma \cdot L^\gamma \]

<table>
<thead>
<tr>
<th>Solow</th>
<th>Lucas</th>
<th>Romer/AH/GH</th>
<th>J/K/S</th>
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<tbody>
<tr>
<td>2.0</td>
<td>0.0</td>
<td>0.3</td>
<td>1.2</td>
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<tr>
<td>(100%)</td>
<td>(0%)</td>
<td>(16%)</td>
<td>(61%)</td>
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<td>(23%)</td>
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Educational attainment already plateauing

The shape of the idea production function, $f(A)$

Gordon (2012) and Cowen (2011)
- Most important, easily-discovered ideas are behind us

\[ \dot{A} = R f(A) = \delta R A^\phi \]
19th c Inventions were, indeed, valuable
Future: shape of idea production function key

\[
\dot{A} = R f(A) = \delta R A^\phi
\]

The shape of the idea production function, \( f(A) \)

Gordon (2012) and Cowen (2011)
- Most important, easily-discovered ideas are behind us

Jones (2002) : Historically, \( \phi < 0 \)
- Continuing growth from rising \( R \) and education
- Slower growth because we’ve been growing above steady state

The stock of ideas, \( A \)
But the future need not look like the past

$$\dot{A} = Rf(A)$$

The shape of the idea production function, $f(A)$

The past

Today

Increasing returns

GPT “Waves”

Run out of ideas

The stock of ideas, $A$
Robots and Machine Learning?

- Could affect shape of idea production function
  - Machines learn how to learn
- Could affect effective research effort
  - Labor not a constraint on researchers
- Could replace labor in production function for goods

\[ Y = AK^\alpha (L_1^{\beta_1} L_2^{\beta_2} ... L_n^{\beta_n})^{1-\alpha} \]
What about Great Recession?

Productivity slowed prior to G.R

Decline in real R&D modest
What is a reasonable 10-20 year forecast?

- Müller and Watson (2013) suggest an 80 percent prediction set for growth in GDP/capita (using post-WWII data)
  - 10 years 0.9-3.4
  - 25 years 1.2-2.8
- Projections for GDP per hour typically lower than historical average (sample periods may vary)
  
  Fernald (2013) 1.6 %/yr
  Byrne, Oliner, Sichel (2013) 1.6
  Gordon (2014) 1.3
  Jorgenson, Ho, Samuels (2013) 1.3
Conclusion: What’s the “new normal”?

- Slower growth? Educational attainment, developed-country R&D intensity, population all slowing
- Faster growth? Rise of China, India, other emerging economies implies rapid growth in world research
- Uncertain? Shape of idea production function

- There may well be a new normal, but the Great Recession doesn’t have much to do with it.
  - Rather, the 2-percent per capita benchmark might never have been steady state
Productivity growth slowed in early 2000s

Business Sector Labor Productivity
Cumulative growth since 1984Q4

Source: BEA and Fernald (2012)