Productivity and Innovation: Recent Puzzles

Dan Sichel
Wellesley College and NBER
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Productivity data and Innovation: Key Questions

• What do national productivity data imply about innovation in key sectors?

• Is this credible?

• What should we do?
Answers

• What do productivity data imply about innovation?
  Pace is very slow

• Is this credible?
  No

• What should we do?
  Continue improving price measurement and expand measurement framework
• National data provide framework for measuring pace of innovation.

**Primal:**
\[ \Delta Y_t = \alpha \Delta K_t + (1-\alpha) \Delta L_t + \Delta mfp_t \]

**Dual:**
\[ \Delta P_t = \alpha \Delta r_t + (1-\alpha) \Delta w_t - \Delta mfp_t \]
Tracking Innovation in National Data

- Implement multi-sector version of primal MFP decomposition. [Byrne, Oliner, and Sichel (2013)]

- Start with latest Fernald MFP data for Business Sector adjusted for utilization. [Fernald (2012)]

- Generate MFP by industry for:
  - High-tech (computers, communications, semiconductors)
  - Intellectual property (software, R&D, and ELA)
  - Other output

- Uses all official data; rough-and ready (illustrative)
## Multifactor Productivity Growth

<table>
<thead>
<tr>
<th></th>
<th>Average Annual Percent change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>.6</td>
</tr>
<tr>
<td><strong>High-tech</strong></td>
<td>12.3</td>
</tr>
<tr>
<td>Semiconductors</td>
<td>28.0</td>
</tr>
<tr>
<td>Computers</td>
<td>15.7</td>
</tr>
<tr>
<td>Communications</td>
<td>1.7</td>
</tr>
<tr>
<td><strong>Intellectual property</strong></td>
<td>2.1</td>
</tr>
<tr>
<td>Software</td>
<td>5.8</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>0.5</td>
</tr>
<tr>
<td>ELA originals</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>0.3</td>
</tr>
</tbody>
</table>

Source: Illustrative update of Byrne, Oliner, and Sichel (2013), using all official data.
• Taken literally, **MFP** results imply exceptionally slow innovation.

• Gordon (2016): Slow innovation points to bleak future for improvements in productivity and living standards.
Is this story credible?

• Only if key variables measured correctly

• Understate price decline ➔ understate *MFP* growth

• Understate *MFP* growth ➔ understate pace of innovation
Two problems

• **Solow Paradox 2.0:** “We can see innovation everywhere but in the productivity statistics.”

• **Mismeasurement:** Strong evidence that key variables are mismeasured.
Mismeasurement of high-tech prices

- **Semiconductors:**
  - Byrne, Oliner, and Sichel (2015)
  - PPI matched-model misses market and product changes
  - 2008-13: PPI understates price decline by 35 pp

- **Communications equipment**
  - Byrne and Corrado (2015)
  - 2010-14: BEA understates decline by 9 pp
Mismeasurement of high-tech prices

• **PC’s tablets, and phones**
  - Byrne, Oliner, and Sichel (2016 – for NBER Summer Institute, preliminary results)
  - Significant understatement of price declines

• **Data storage devices**
  - Byrne (2015)
  - BEA understates decline by 18 pp 2009-14

• **Special-purpose electronics**
  - Byrne (2015)
  - PPIs show no declines
  - Highly implausible
Mismeasurement of Intellectual Property Prices

- **Software**
  - Official prices show no price decline over past decade.
  - Copeland (2013) suggests more rapid declines.

- **R&D**
  - Official indexes generally rely on business output deflator.

- **ELA (Entertainment, Literary, & Artistic originals)**
  - Very little known
Case Study: Semiconductor Prices and MFP Growth

NBER Digest, July 2015.
Implications for MFP growth in Semiconductors

Dual MFP, Semiconductors
(percent change over period shown)

What should we do?

1. Continue improving price measures for high-tech, intellectual property and other goods and services.
   • Also, import and export prices.

2. Expand framework as needed to better capture ongoing innovation.
   • Leads to deeper issues.
Deeper (even harder) Issues

- Google, Facebook, etc.
- Cloud computing
- Digital services & trade
- Broader coverage of intangibles
- Health care

Fixing these issues will make estimates of MFP growth and innovation more credible.
Conclusion: Return to 3 Q’s

- What do official measures imply about innovation?
  - Very slow

- Is this credible?
  - No

- What should we do?
  - Continue to improve price measurement
  - Expand framework to better capture ongoing innovation
  - Will improve broad measures of innovation

- CRIW/NBER conference on Accounting for Innovation in March 2017
  - Call for papers still open
Byrne, David M., 2015, “Domestic Electronics Manufacturing: Medical, Military, and Aerospace Equipment and What We Don't Know about High-Tech Productivity,” Federal Reserve Board, FEDS Notes, June 2.


Byrne, David M., 2015, “Prices for Data Storage Equipment and the State of IT Innovation,” Federal Reserve Board, FEDS Notes, July 1.


Corrado, Carol, Goodridge, Peter, and Jonathan Haskel, 2011. “Constructing a Price Deflator for R&D: Calculating the Price of Knowledge Investments as a Residual.” Imperial College discussion paper 2011/07.
