IT and Productivity: Where are we and where do we go from here?

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Digital Productivity Workshop
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Agenda

- The “Productivity Paradox”
- The Data Speak
- Computerization is More Than Computers
- Towards a Research Agenda
The “Productivity Paradox”

“We see the computer age everywhere except the productivity statistics”

-- Bob Solow, 1987
Moore’s Law and the Demand for Computer Power

Source: Brynjolfsson and Yang, 1996, (Updated)
Disaster Stories and Success Stories

“The Plural of Anecdote is Data”

-- George Stigler, 1962
Information Technology and Productivity: The Data Speak

Computers are associated with greater productivity...

Productivity (relative to industry average)

IT Stock (relative to industry average)
Typical Cobb-Douglas Production Function

\[ \ln Y = \beta_{IT} \ln K_{IT} + \beta_{non} \ln K_{non} + \beta_L \ln L + \beta_M \ln M + \epsilon \]

Where

- \( K_{IT} \) is IT Capital
- \( K_{non} \) is non IT capital
- \( L \) is Labor
- \( M \) is Materials

Typically estimated in a panel format (firms or industries)
Meta analysis: 41 estimates in 20 papers

“The bottom line result from this paper is that IT does matter, but one must be careful about putting too much weight on any given estimate...the emerging consensus that IT played a critical role in the U.S. productivity revival remains intact.”

Today, Productivity is Soaring

U.S. Labor Productivity Growth

<table>
<thead>
<tr>
<th>Period</th>
<th>Percent per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974-1995</td>
<td>1.5</td>
</tr>
<tr>
<td>1996-2000</td>
<td>2.5</td>
</tr>
<tr>
<td>2001-2003</td>
<td>4.0</td>
</tr>
</tbody>
</table>
The “Productivity Paradox” is history

We now see computers everywhere in the productivity statistics.
But what explains the variation across firms?
Computerization > Computers

Information Technology Capital (10%)

Technological Complements (15%)

Organizational Assets (75%)
Including Human Capital, Business Processes, Culture

*Intangible Assets are more important in the Information Economy*

Image by Ralph Clevenger
Better Data Needed

In the physical sciences, when errors of measurement and other noise are found to be of the same order of magnitude as the phenomena under study, the response is not to try to squeeze more information out of the data by statistical means; it is instead to find techniques for observing the phenomena at a higher level of resolution.

The corresponding strategy for economics is obvious: to secure new kinds of data at the micro level.

-- Herbert Simon, 1984
## Cost Structure of a Large IT Project

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Cost ($millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hardware</strong></td>
<td>Application, Web, and database servers including storage</td>
<td><strong>$0.8</strong></td>
</tr>
<tr>
<td><strong>Software</strong></td>
<td>ERP application Suite License (HR, Financials, Distribution) 1,000 regular trained users, 2,000 casual users</td>
<td><strong>$3.2</strong></td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td>9 months to complete pilot site including process engineering, apps configuration, and testing 30 external consultants as $1,200 a day 30 internal staffers at an average salary of $100,000</td>
<td><strong>$9.3</strong></td>
</tr>
<tr>
<td><strong>Deployment</strong></td>
<td>3 external consultants at 9 sites for 3 months 9 internal staffers at each site for 6 month 5 days of user training at an average burdened user salary of $50,000 3 full-time training staff at an average burdened salary of $100,000</td>
<td><strong>$7.5</strong></td>
</tr>
<tr>
<td><strong>Start-up Costs Total</strong></td>
<td></td>
<td><strong>$20.5</strong></td>
</tr>
</tbody>
</table>

Source: Gormely et al.
Analysis of Organizational Assets

Sample: 1167 large firms over 10 years (10,473 observations)

» Four Principal Types of Data

- Revenues and Market Value from S&P’s Compustat II
- Computer Capital from Computer Intelligence
- Ordinary Capital, Labor, other Assets, R&D from S&P’s Compustat
- Organizational Assets from surveys we conducted

» Part of 5 year, $5 million project at MIT

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- Additional support from the U.S. National Science Foundation
Business Performance depends on \textit{Both} IT and “Organizational Capital”

1. \textit{The “Digital Organization”}
   A distinct corporate culture and organizational practices are found at most (but not all) heavy users of computers and Internet

2. \textit{Higher Productivity and Higher Market Value}
   Firms that adopt the \textit{Digital Organization} have higher performance

3. \textit{IT and Digital Organization are Complements}
   Firms that adopt the \textit{Digital Organization} and simultaneously invest more in IT have \textit{disproportionately} higher performance
Interactions between IT and Digital Organization

High IT and Digital Org.
Towards a Research Agenda

1. Finer-grained analyses
2. Quasi-experiments
3. Systematic links between levels of analysis
4. Mapping information flows and their effects
5. Measuring the effects of public disclosures
6. Better tools for measurement and management
7.
8.
9.