Economic Growth in the Information Age

By
Dale W. Jorgenson
Harvard University
May 29, 2003
Economic Growth in the Information Age

INTRODUCTION:
Prices of Information Technology

THE INFORMATION AGE:
Faster, Better, Cheaper!

ROLE OF INFORMATION TECHNOLOGY:
IT Prices and the Cost of Capital

AMERICAN GROWTH RESURGENCE:
IT Investment and Productivity Growth

ECONOMICS ON INTERNET TIME:
The New Research Agenda
THE INFORMATION AGE: Faster, Better, Cheaper!

MOORE (1998): "If the automobile industry advanced as rapidly as the semiconductor industry, a Rolls Royce would get half a million miles per gallon, and it would be cheaper to throw it away than to park it."

INVENTION OF THE TRANSISTOR:
Development of Semiconductor Technology.

THE INTEGRATED CIRCUIT:
Memory Chips; Logic Chips.

MOORE'S LAW: The number of transistors on a chip doubles every 18-24 months (Pentium 4, released November 20, 2000, has 42 million transistors).
Transistor Density on Micro Processors and Memory Chips
HOLDING QUALITY CONSTANT
Matched Models and Hedonics

SEMICONDUCTOR PRICE INDEXES:
Memory and Logic Chips.

COMPUTER PRICE INDEXES:
The BEA-IBM Collaboration.

COMMUNICATIONS EQUIPMENT:
Terminal, Switching, and Transmission.

SOFTWARE:
Prepackaged, Custom, and Own-Account.
Relative Prices of Computers and Semiconductors, 1977-2000

All price indexes are divided by the output price index.

All price indexes are divided by the output price index.

All price indexes are divided by the output price index.
ROLE OF INFORMATION TECHNOLOGY: IT Prices and the Growth of Output.

OUTPUT SHARES OF IT:
Computers, Communications Equipment, Semiconductors, Software, and IT Services.

OUTPUT CONTRIBUTION OF IT:
IT versus Non-IT Value Added.

OUTPUT CONTRIBUTION BY TYPE:
Computers, Communications Equipment, Semiconductors, Software, and IT Services.
Value Added Shares of Information Technology by Type, 1977-2000

Share of current dollar gross domestic product.
Industry Contributions to Value Added Growth

Domar-weighted contributions of industry value added

Note: Services is the capital service flow from Household and Government IT capital.
Industry Contribution to Value Added

Average annual percentage growth rates, weighted by the value share.

<table>
<thead>
<tr>
<th>Period</th>
<th>Non IT</th>
<th>IT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977-1990</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990-1995</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995-2000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ROLE OF INFORMATION TECHNOLOGY: 
IT Prices, Investment, and Productivity.

INPUT SHARES OF IT:
Computers, Communications Equipment, and Software.

CAPITAL CONTRIBUTION:
IT versus Non-IT Capital Services.

CAPITAL CONTRIBUTION BY TYPE:
Computers, Communications Equipment, and Software.
Capital Input Contribution of Information Technology

Average annual percentage growth rates, weighted by income shares.
Note: Industries sorted by IT capital contribution.
AMERICAN GROWTH RESURGENCE: IT Investment and Productivity Growth.

TOTAL FACTOR PRODUCTIVITY:
IT-Production versus Non-IT Production.

SOURCES OF U.S. ECONOMIC GROWTH:
Capital Input, Labor Input, and TFP.

AVERAGE LABOR PRODUCTIVITY GROWTH:
Capital Deepening, Labor Quality, TFP.
Sources of U.S. TFP Growth

Annual Average Contribution (%)

1977-1990

1990-1995

1995-2000

Reallocation of Non-college Educated Labor

Reallocation of College Educated Labor

Reallocation of Non-IT Capital

Reallocation of IT Capital

Wgt Sectoral TFP (Other)

Wgt Sectoral TFP (IT Producers)
Industry Contributions to Productivity, 1977-2000

Note: Industries sorted by productivity contribution.
Sources of TFP Growth by Country

US Canada UK France Germany Italy Japan

Non-ITFP ITFP
ECONOMICS ON INTERNET TIME: The New Research Agenda.

• The Solow Paradox -- we see computers everywhere but in the productivity statistics -- versus the Information Age.

• Equity Valuations and Growth Prospects: accumulation of intangible assets versus irrational exuberance.

• Widening Wage Inequality: capital-skill complementarity versus skill-biased technical change.

• Modeling IT and the semiconductor industry: permanent versus transitory contributions to economic growth.