Information Technology and the Productivity Expansion

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WORLD KLEMS Project
Established at Harvard on August 19-20, 2010

What’s New?
70 NAICS Industries Covering 1960-2007

After the Crash
The IT Boom, the Dot-Com Crash, and the Recovery
Established:
August 19-20, 2010

41 Economies:
U.S., Australia, Canada, Japan, and Korea
27 Economies of the EU
Argentina, Brazil, Chile, and Mexico
China, India, Indonesia, Turkey, and Taiwan

Country Data Bases:
Labor, Capital, Energy, Materials and Services
IT-RELATED INDUSTRIES

IT-Producing Industries

Computer and peripheral equipment manufacturing
Communications equipment manufacturing
Semiconductor and other electronic component manufacturing
Software publishing
Information and data processing services
Computer systems design and related services

IT-Using Industries

Construction
Machinery
Motor vehicles bodies and trailers and parts
Other transportation equipment
Miscellaneous manufacturing
Printing and related support activities
Wholesale Trade
Retail Trade
Air transportation
Water transportation
Truck transportation
Transit and ground passenger transportation
Pipeline transportation
Other transportation and support activities
Broadcasting and telecommunications

Federal Reserve banks credit intermediation and related activities
Securities commodity contracts and investments
Insurance carriers and related activities
Rental and leasing services and lessors of intangible assets
Legal services
Miscellaneous professional scientific and technical services
Management of companies and enterprises
Administrative and support services
Waste management and remediation services
Educational services
Hospitals Nursing and residential care facilities
Social assistance
Performing arts spectator sports museums and related activities
Other electronic products
Newspaper; periodical; book publishers
NON-IT INDUSTRIES

Farms
Forestry fishing and related activities
Oil and gas extraction
Mining except oil and gas
Support activities for mining
Utilities
Wood products
Nonmetallic mineral products
Primary metals
Fabricated metal products
Electrical equipment appliances and components
Furniture and related products
Food and beverage and tobacco products
Textile mills and textile product mills
Apparel and leather and allied products
Paper products
Petroleum and coal products

Chemical products
Plastics and rubber products
Rail transportation
Warehousing and storage
Motion picture and sound recording industries
Funds trusts and other financial vehicles
Ambulatory health care services
Amusements gambling and recreation industries
Accommodation
Food services and drinking places
Other services except government
Federal General government
Federal Government enterprises
S&L General Government
S&L Government enterprises
Real estate
Household
ROLE OF INFORMATION TECHNOLOGY: Growth of Output

OUTPUT SHARES OF IT:
Computers, Communications Equipment, Semiconductors, Software, Information and data processing services, Computer systems design and related services

OUTPUT CONTRIBUTION BY TYPE:
Computers, Communications Equipment, Semiconductors, Software, Information and data processing services, Computer systems design and related services

OUTPUT CONTRIBUTION OF IT:
IT-Producing, IT-Using, and Non-IT Value Added
Value Added Shares of Information Technology by Type, 1960-2007

Share of Current Dollar Value Added.
Industry Contributions to Value Added Growth

Value added weighted contributions of industry value added.

- **1960-1995**
  - Information and data processing services: 0.02
  - Computer systems design and related services: 0.01
  - Computer and peripheral equipment manufacturing: 0.02
  - Communications equipment manufacturing: 0.01
  - Semiconductor and other electronic component manufacturing: 0.01
  - Software publishing: 0.02

- **1995-2000**
  - Information and data processing services: 0.3
  - Computer systems design and related services: 0.3
  - Computer and peripheral equipment manufacturing: 0.1
  - Communications equipment manufacturing: 0.01
  - Semiconductor and other electronic component manufacturing: 0.01
  - Software publishing: 0.01

- **2000-2007**
  - Information and data processing services: 0.01
  - Computer systems design and related services: 0.01
  - Computer and peripheral equipment manufacturing: 0.01
  - Communications equipment manufacturing: 0.01
  - Semiconductor and other electronic component manufacturing: 0.01
  - Software publishing: 0.01
Industry Contributions to Value Added Growth

Value added weighted contributions of industry value added.

Annual Contribution (%)

1960-1995
1995-2000
2000-2007

Non-IT Industries
IT-Using Industries
IT-Producing Industries
Comparison of Production Possibility Frontier and Aggregate Production Function


- **Aggregate Production Function Value-Added**
- **Aggregate Production Possibility Frontier Value-Added**
GROWTH IN THE NEW MILLENNIUM: IT Investment and Productivity Growth

TOTAL FACTOR PRODUCTIVITY:
IT-Producing, IT-Using, and Non-IT Production

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

AVERAGE LABOR PRODUCTIVITY GROWTH:
Capital Deepening, Labor Quality, TFP
Industry Contributions to Productivity Growth

Domar weighted productivity.

- Construction
- Wholesale Trade
- Management of companies and enterprises
- Rental and leasing services and lessors of intangible assets
- Educational services
- Waste management and remediation services
- Performing arts spectator sports museums and related…
- Other electronic products
- Water transportation
- Truck transportation
- Pipeline transportation
- Machinery
- Other transportation and support activities
- Transit and ground passenger transportation
- Printing and related support activities
- Newsprint; periodical; book publishers
- Other transportation equipment
- Air transportation
- Social assistance
- Hospitals Nursing and residential care facilities
- Miscellaneous manufacturing
- Legal services
- Administrative and support services
- Broadcasting and telecommunications
- Securities commodity contracts and investments
- Federal Reserve banks credit intermediation and related…
- Motor vehicles bodies and trailers and parts
- Insurance carriers and related activities
- Newspaper; periodical; book publishers
- Educational services
- Waste management and remediation services
- Performing arts spectator sports museums and related…
- Other electronic products
- Transportation and support activities
- Machinery
- Pipeline transportation
- Truck transportation
- Water transportation
- Other electronic products
- Performing arts spectator sports museums and related…
- Waste management and remediation services
- Educational services
- Rental and leasing services and lessors of intangible assets
- Management of companies and enterprises
- Wholesale Trade
- Construction
Sources of U.S. Economic Growth

Annual Contribution (%)

1960-1995
- Non-college Labor
- College Labor
- Non-IT Capital
- IT Capital
- Aggregate TFP

1995-2000

2000-2007

- Non-college Labor
- College Labor
- Non-IT Capital
- IT Capital
- Aggregate TFP
GROWTH AT THE INDUSTRY LEVEL: Value Added and Productivity Growth

VALUE ADDED GROWTH:
IT-Producing Industries

PRODUCTIVITY GROWTH:
IT-Producing Industries

CHANGE IN PRODUCTIVITY GROWTH:
IT-Using Industries
Industry Contributions to Value Added Growth, 1960-2007

- Household
- Wholesale Trade
- Retail Trade
- Real estate
- S&L General Government
- Miscellaneous professional scientific and technical activities
- Broadcasting and telecommunications
- Semiconductor and other electronic equipment
- Securities commodity contracts and derivatives
- Computer and peripheral equipment
- Federal Reserve banks credit
- Ambulatory health care services
- Administrative and support services
- Machinery
- Insurance carriers and related activities
- Chemical products
- Software publishing
- Management of companies and enterprises
- Computer systems design and related activities
- Motor vehicles bodies and trailers and related equipment
- Other services except government
- Farms
- Truck transportation
- Hospitals Nursing and residential care
- Rental and leasing services and lessors
- Air transportation
- Construction
- Food services and drinking places
- Utilities
- Fabricated metal products
- Food and beverage and tobacco products
- Accommodation
- Plastics and rubber products
- Federal General government
- Other transportation and support services
- Legal services
- Other electronic products
- Miscellaneous manufacturing
- Electrical equipment appliances and components
- Information and data processing
- Textile mills and textile product mills
- Educational services
- Social assistance
- Other transportation equipment
- Amusements gambling and related activities
- Paper products
- S&L Government enterprises
- Printing and related support activities
- Warehousing and storage
- Communications equipment and services
- Performing arts spectator sports and entertainment activities
- Nonmetallic mineral products
- Furniture and related products
- Mining except oil and gas
- Petroleum and coal products
- Motion picture and sound recording industries
- Federal Government enterprises
- Waste management and remediation services
- Forestry fishing and related activities
- Apparel and leather and allied products
- Wood products
- Water transportation
- Support activities for mining
- Pipeline transportation
- Rail transportation
- Newspaper; periodical; book publishing
- Transit and ground passenger transportation
- Funds trusts and other financial intermediation
- Primary metals
- Oil and gas extraction

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
THE NEW RESEARCH AGENDA: Economics on Internet Time

IT PRODUCTION:
Permanent vs. Transitory Changes

IT UTILIZATION:
Trade and Services to the Forefront

TANGIBLE AND INTANGIBLE ASSETS:
Beyond Software and R&D

IMPLICATIONS FOR MACROECONOMICS:
Retire the Aggregate Production Function?