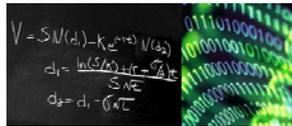
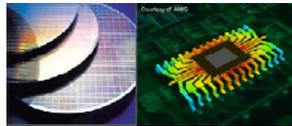




Center for the Study of Innovation and Productivity
Federal Reserve Bank of San Francisco



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*The views expressed here are those of the presenter and should not be attributed to the Federal Reserve Bank of San Francisco or the Federal Reserve System.

Technology Innovations: Powering or Pummeling the Economy?



- A subject of prime importance to the Federal Reserve
 - Technological change is THE key driver of productivity growth
 - Productivity growth determines the economy's "speed limit"

Technology Innovations: Powering or Pummeling the Economy?



- Of particular importance to FRBSF
 - FRBSF in 2002 founded **CSIP**:
Center for the **S**tudy of **I**nnovation and **P**roductivity
- FRBSF uniquely situated – both geographically and intellectually – to study these topics
 - Silicon Valley
 - Skills and interests of Economic Research staff

CSIP Mission and Goals



CSIP seeks to

—promote a better understanding of innovation and productivity and their links to the performance of national and regional economies and the behavior of firms and labor markets—

- **Primary means of serving our mission is:**
 - ❖ **Supporting and Promoting Research** on topics related to Innovation and Productivity

Technology Innovations: Powering or Pummeling the Economy?



What economic research – done at CSIP and elsewhere – has to say....

Economic Effects of Tech Change:

“The Good, the Bad, and the Ugly”



The Good



- Technological Change is THE driver of long-run growth in national output per worker (productivity growth) and therefore living standards.
 - U.S. Productivity Growth has averaged 2.5% a year since 1949, implying a doubling in output per worker every 25 years.
 - ❖ For example, 100 years ago it took over 30 labor-hours to produce 100 bushels of corn. Today, it takes less than 3 labor-hours.
 - Real Income per capita in the U.S. was \$7,000 in 1949. Today it is over \$30,000, a four-fold increase.

The Good



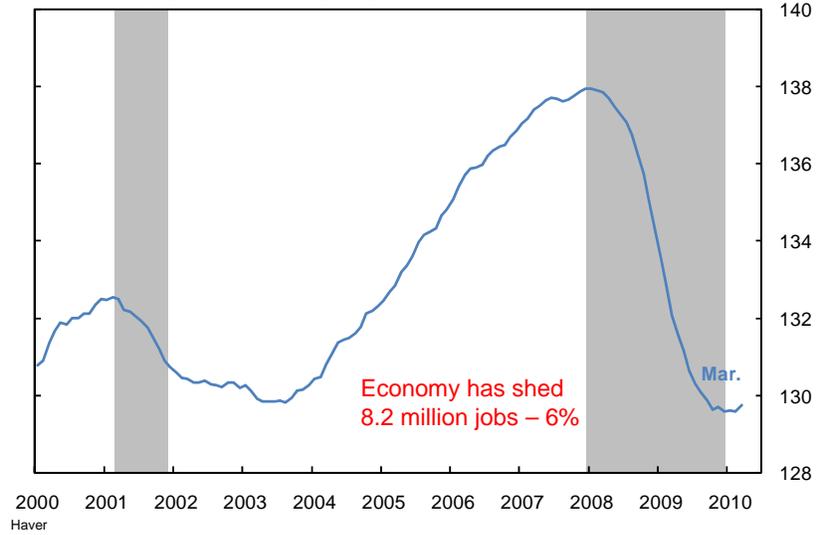
- Powered us through the recession...
 - While main inputs into production of goods & services – labor and capital use – plummeted over the past 2 years...
([chart 1](#), [chart 2](#))

Economy's Use of Labor is WAY down...



Nonfarm Payroll Employment

Millions of employees, Seasonally Adjusted

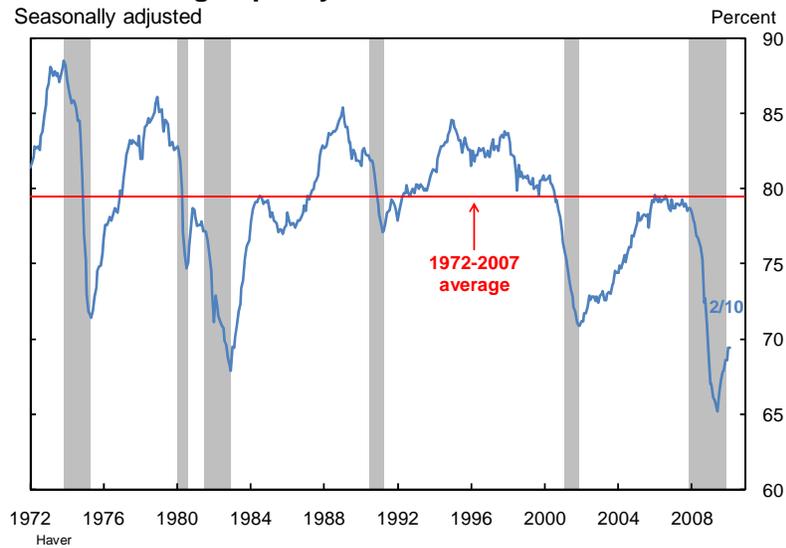


Economy's Use of Capital also WAY down...



Manufacturing Capacity Utilization

Seasonally adjusted



The Good

- Powering us through the current downturn...

→ While main inputs into production of goods & services – labor and capital use – have plummeted over the past 2 years...

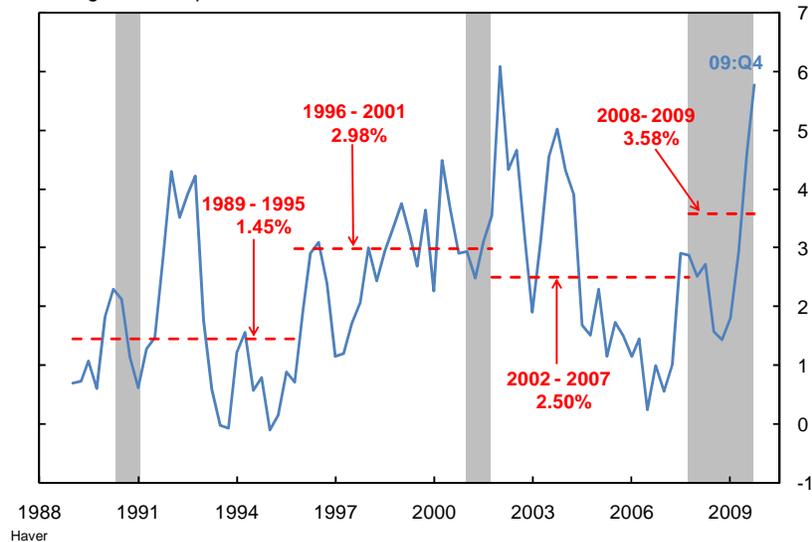
→ productivity growth actually has been quite strong during recession...

([chart](#))

But Productivity Remains High...

Labor Productivity

% Change from 4 quarters earlier; nonfarm business sector

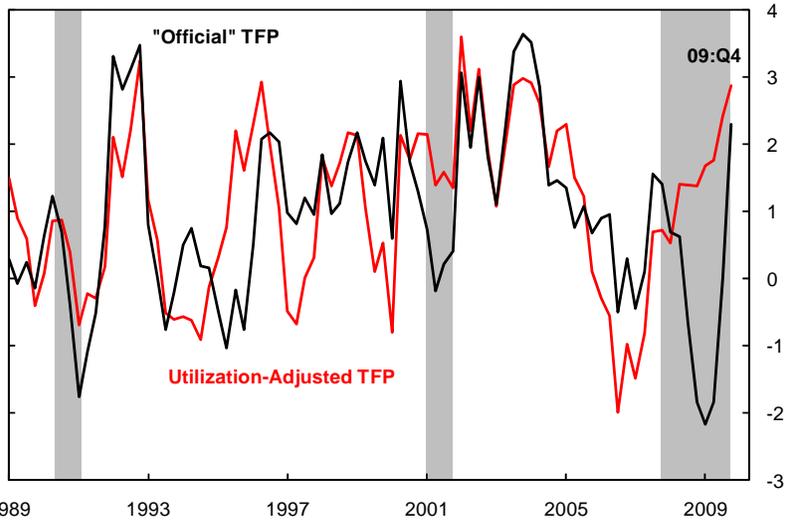


Productivity even higher adjusted for Capital



"Total-Factor" Productivity Growth

Official (Red) vs, FRBSF Utilization-Adjusted Series (Blue)



John Fernald, FRBSF Vice President and CSIP Research Scholar

The Good

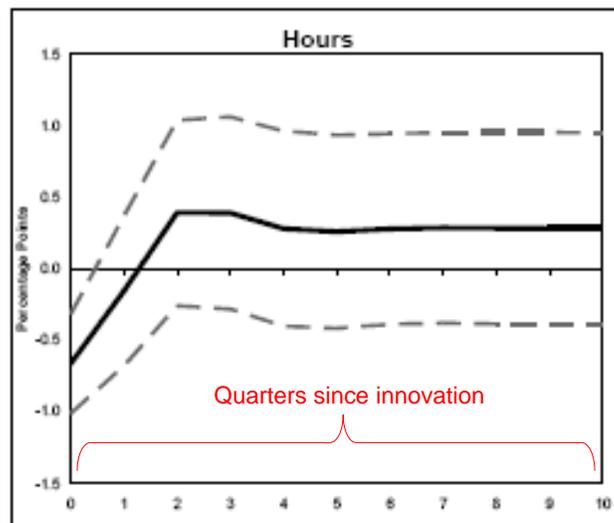


- Powered us through the current downturn
- Without extraordinary productivity growth, recession would have been far deeper

The Bad

- Technological Change can be disruptive in short-run, even causing job losses
 - “John Henry Effect”: Innovations allow businesses to produce more output with same labor, but flip side is they allow businesses to produce same output with less labor.
 - Recent economic research, some done here at **CSIP**, has found that past episodes of rapid technological change have led to short-run declines in employment. ([chart](#))

Estimated Response of Employment to Technology Innovations



Source: Basu, [Fernald](#), & Kimball, *American Economic Review* (2006)

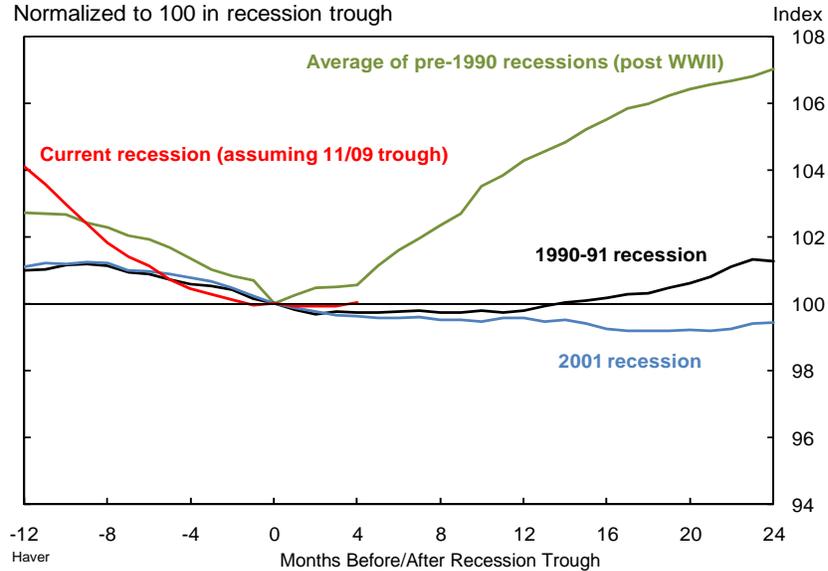
The Bad

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 - John Henry Effect has been blamed for prolonged “jobless recovery” following previous two recessions (1991 and 2001). ([chart](#))

Another Jobless Recovery?

Private Nonfarm Payroll Employment

Normalized to 100 in recession trough



The Bad



- And many expect it to cause jobless recovery from latest recession

“When workers become more efficient, it's normally a good thing. But lately, it has acted as a powerful brake on job creation. And the question of whether the recent surge in productivity has run its course is the key to whether job growth is finally poised to take off.”

– *Washington Post*, March 31

The Ugly



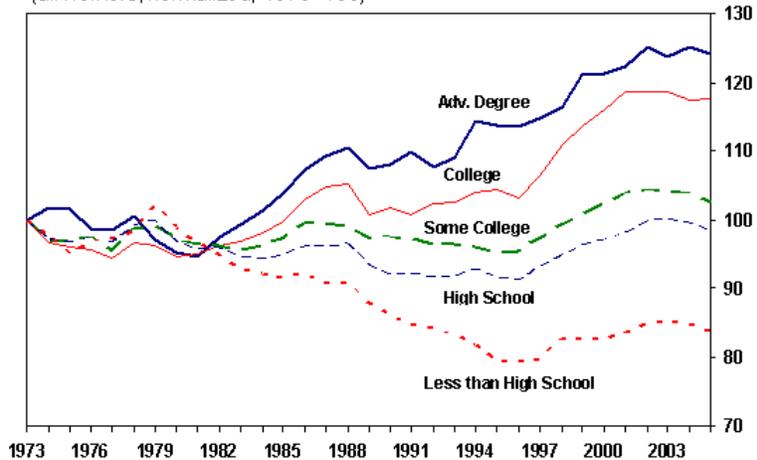
While technological change is good for all in long-run, gains are not uniform

- Relative winners and losers: U.S. income distribution has become much more highly skewed over the past 30 years.
 - ❖ In 1978, the top 1% of wage-earners accounted for 6.4% of total U.S. earnings
 - ❖ In 2004, the top 1% accounted for 12.4%!
(Based on Social Security records. Kopczuk, Saez, & Song, *Quarterly Journal of Economics*, 2010)
- Much debate about causes of this, but research has found one important factor is “skill-biased” technological change:
 - ❖ Notion that innovations of past 25 years (e.g., computers) have disproportionately favored high-skilled workers.
 - ❖ Evidence: Returns to education have ballooned over past 25 years ([chart](#))

Returns to Education have Ballooned over past 25 Years

Figure 2: Real Hourly Wages by Education

(all workers, normalized; 1973=100)



Source: Economic Policy Institute

From 11/6/2006 speech by Janet Yellen, FRBSF President

Technology Innovations: Powering or Pummeling the Economy?

Short Answer: Yes!

Slightly Longer Answer:

The Good

- Technological Innovations are key driver of productivity growth in U.S., which in turn is key driver of improved living standards in recent decades...

The Bad

- But...like all changes, technological change can be disruptive, entailing short-run adjustment costs...

The Ugly

- and reshuffling of economy's winners and losers.



CSIP's Virtual Headquarters

www.frbsf.org/csip