

Technology, Productivity, and the “New Economy”:

Comments on

Jorgenson-Stiroh-Ho

and

Oliner-Sichel

John Fernald

Federal Reserve Bank of Chicago

Papers make two contributions

- Updated ‘state-of-the-art’ growth accounting:
 - Evidence of a new economy? Yes.
- “Structured guesses” about future labor productivity
 - Bring discipline and principle to discussions
 - JSH: 2.2 percent per year (range 1.3 to 3 percent) over next decade
 - OS: Conservative guess for steady state growth about 2 percent; could easily be higher.

My comments

- Similarities and differences in approach
- Growth-accounting assumptions
- Uncertainty about projections

Similarities and Differences

- Lots of similarities...
 - Standard growth accounting
 - Similar methodologies for steady-state/long-run projections
- ...and relatively minor differences
 - Slight differences in inputs and output
 - OS are more explicit about semiconductors, and use explicit multi-sector model for projections
 - JSH consider a wider range of scenarios

Growth Accounting Assumptions

- Constant returns, perfect competition
- No “utilization margin”
- No internal adjustment costs

Recent macroeconomic literature considers deviations from these assumptions

What Does Aggregate TFP Measure?

1. Technology change
2. Unobserved changes in utilization
3. Scale effects
4. Reallocation of inputs across uses
5. Adjustment costs to changing inputs

Basu, Fernald, Shapiro on late 1990s

Augmented growth accounting:

- Utilization, returns to scale, and reallocation contribute nothing
- Capital adjustment costs slowed annual output growth 0.6 percent per year

On balance, technology accelerated 0.6 percentage points *more* than TFP from 1995-1999.

Conclusions from growth accounting

- TFP and technology definitely accelerated
 - Labor productivity accelerated because of *both* TFP and capital-deepening
- Assuming CRS/perfect competition and no utilization is fine for late 1990s
- If internal adjustment costs important, then technology accelerated *more* than TFP

Projecting Productivity Growth

Two main issues

(1) Capital Deepening

- Use neoclassical steady-state model predictions

(2) Total Factor Productivity

- Will the future look like the past? Which past?

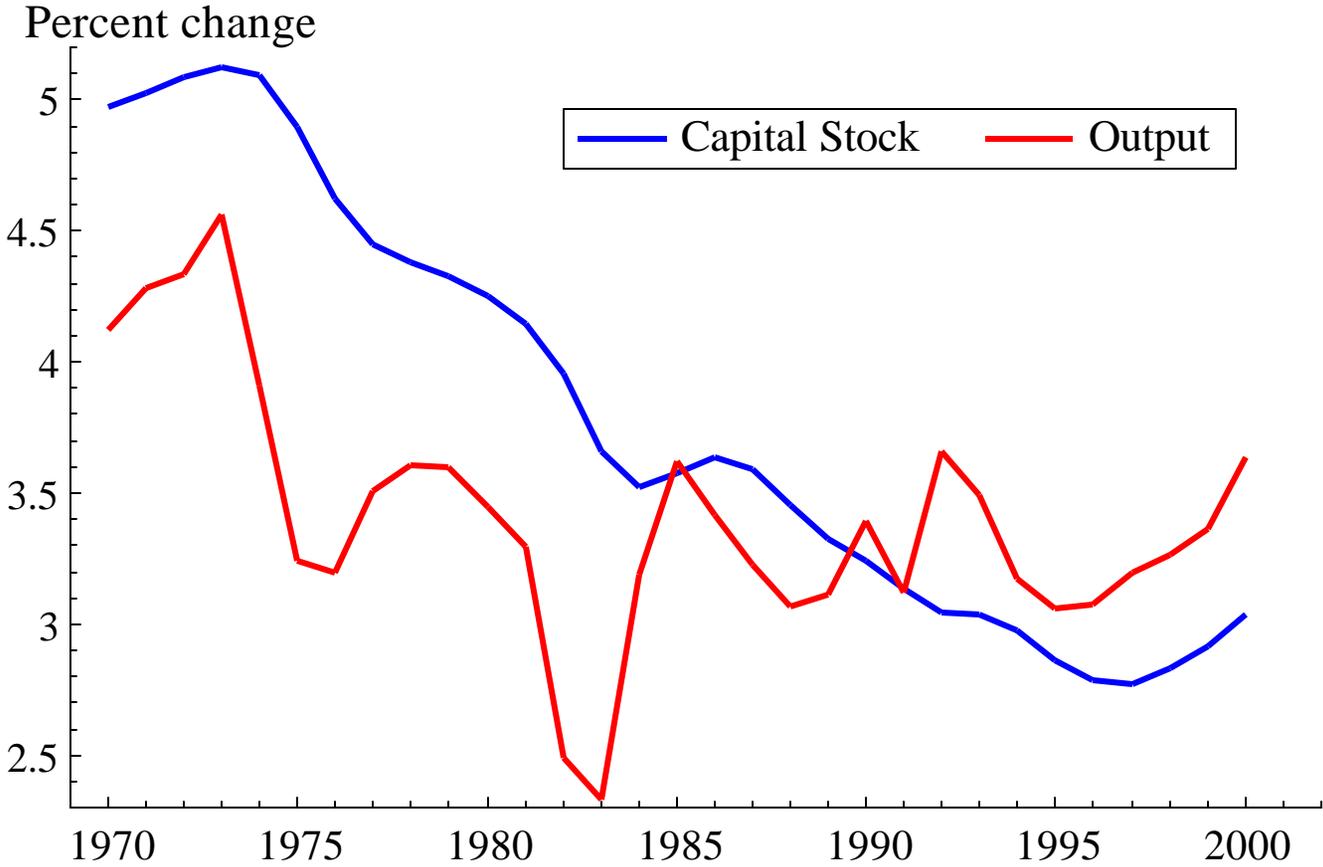
Estimates in both papers are reasonable. But probably understate uncertainty.

Capital Deepening

- JSH assume $\downarrow \ln Y = \downarrow \ln Z_R$ (Reprod. cap stock)
 - Multi-sector model won't, in general, deliver that prediction, but may be close (Whelan)
- OS use (related) predictions from multi-sector model
- Even over a decade, capital stock and output may grow at 'substantially' different rates

Output and Reproducible Capital Stock

10-Year Moving Averages



Projecting TFP Growth is Difficult...

- Will technology change in *production* of IT be as rapid as it has been recently?
- What effect will *use* of IT have?
 - How elastic is demand? (Both papers assume nominal shares are fixed).
 - Does IT affect TFP in the non-IT economy?
 - Are the effects *growth rate* or *level* effects?
- What other innovations will there be?

Jorgenson-Stiroh-Ho Scenarios

- *Benchmark*: Future looks like 1990-2000
 - Labor productivity = 2.2 percent per year
- *Optimistic*: Future looks like 1995-2000
 - Labor productivity = 3 percent
- *Pessimistic*: Future looks like 1973-1995
 - Labor productivity = 1.3 percent

Note: 1959-2000, max. 10-year growth = 3.2% (1961-1971), min = 1.3% (1973-83)

Technical Details

- Most important reason numbers don't match history is capital accumulation
 - *Insufficient* capital accumulation in 1990s relative to neo-class. model, especially second half (Output grew faster than capital stock)
 - Labor productivity “should” have been 0.4 percent larger 1990-2000 (0.6 percent from 1996-2000).
- Other details (IT shares, demographics, etc)

Oliner-Sichel “Structured Guesses”

- Benchmark assumptions more conservative
 - Roughly same IT share as JSH (5.1 percent)
 - Assume IT prices fall (and TFP rises) at 1991-95 rates--less than full 1990s average
 - Labor productivity grows at 2 percent rate
- Alternative (still conservative) assumptions give 2.7 percent rate.

Will next decade look like projections?

- Actual outcomes could be much worse
 - Really bad and protracted business cycle (Depression)
 - Society gets sated with semiconductors
 - No other big innovations come along

Will next decade look like projections?

- Actual outcomes could be even better
 - High technology growth rates since mid-1990s continue ...
 - ...or even increases, as the internet/networks/cheap computing/etc. eventually do “change everything”
 - New innovations in nanotechnology, biotech, management and organization, etc

Conclusions

- The two papers turn out to be very similar in methodology and results
- Reasonable point estimates for trend productivity growth are in 2 to 2-1/2 percent range.
- But actual outcomes are, not surprisingly, very very uncertain

adjustment costs

Price declines at 1996-2000 rates
Still no TFP acceleration outside IT
products

Measured TFP Growth

$$= \left(\begin{array}{c} \text{True technology} \\ \text{Change} \end{array} \right) + \left(\begin{array}{c} \text{Variations in} \\ \text{Utilization} \end{array} \right) + \left(\begin{array}{c} \text{RTS and} \\ \text{Reallocation Effects} \end{array} \right) + \left(\begin{array}{c} \text{Factor} \\ \text{Adjustment Costs} \end{array} \right)$$