The Slowest Potential Output Growth in U. S. History: Measurement and Interpretation

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Grateful for Invitation, Privileged to be here

- In the midst of a world economic crisis, it is a luxury for us to think about long-run economic growth issues in the US
- This paper addresses the need to forecast future productivity and potential GDP growth in logical steps
- How have trends changed over recent years and decades? That requires that we estimate trends in a formal way
- Everyone in the audience *must* have a copy of the paper, since I'll refer to equations and tables

The Industry of Decomposing Productivity Trends and Cycles

- Where is it?
- If I'm missing references, please let me know and I'd be delighted to include them. To separate trend from cycle is to revisit Okun's Law
- To forecast, one must know recent and current trends in each of the components of the Okun's law decomposition
- To estimate trends, one must use statistical detrending methods
- To relate future potential GDP growth to future productivity growth, one must have forecasts of the links between productivity and output
- ***THE OUTPUT IDENTITY***

  $Y \equiv Y/H * H/E * E/L * L/N * N$

The Pre-Broadway Tryout

- Let's separate trend from cycle in output and productivity in order to make sensible forecasts.
- I've been writing about this for years (1979, 1993, 2003), and preliminary presentations of the 2008 version were given as keynote speeches in Hangzhou China (9/19/08) and Budapest (Halloween 2008). This set of results has been de-bugged.
- The pre-Broadway tryouts are over; this is opening night in front of the true experts on this topic

The Title of the Paper: Slowest Potential Output Growth in U. S. History

- It's the slowest right now and will possibly be even slower over the next 20 years
- Yes, this symposium is about productivity growth, but I am here to convince you that potential GDP growth is important in its own right
- Potential Output is of Interest Separately from Productivity because it matters for:
  - LR government budget & Social Security exhaustion date
  - World balance of saving and investment
  - US as an economic engine for the world
  - LR US demand for investment, residential housing, infrastructure

The Slowest Potential Output Growth in U. S. History

- Potential Output = Trend Output = Y^*
- Until recently it was common for forecasters to project Y^* growth at 3 to 3.5 percent, some even projected 4 percent (including my ex-student, JP Morgan's J. Glassman)
- Yet the facts provide an unhappy reality
  - 1997-2008 actual Y growth only 2.75
  - Trend growth currently 2.5

What is Causing Slow *Y** Growth

- It was commonly assumed that US *Y** growth would slow due to less population growth
- But so far, population growth has not declined
- Instead, the culprits are slower growth in productivity, hours/employee, and LFPR
- Much of this paper develops methods and implements them to separate cyclical movements from underlying trends

Three Goals of the Lecture for the U. S.

- #1: Project US *Y** 2008-2028 and the components of the ***OUTPUT IDENTITY***
- *#2:* New interpretation of recent behavior of these components
- #3: Develop techniques for separating trends from cycles and analyzing the cyclical behavior of the components
- The paper does this in reverse order: detrending first, then interpretation, then forecasts

General Issues Raised by Projections for the U. S.

- The need to make future projections of e projections of Y^* raises a general issue: how much of the past is relevant?
  - We project future population assuming that baby boom of 1947-64 will not happen again
  - We assume Great Depression and WWII will never happen again
  - But what is the right time horizon to look backward at productivity growth?
  - US: fast 1947-72, slow 72-95, fast 95-2004, slow 2004-08. What happens next ???

Preliminaries: Total Economy not NFPB

- Look at equations starting on p. 9
- The output identity is a simple decomposition for the total economy
- But to link potential GDP to NFPB productivity involves extra terms that have no easy interpretation
- This paper (2008) differs from my previous paper using the same techniques (2003)

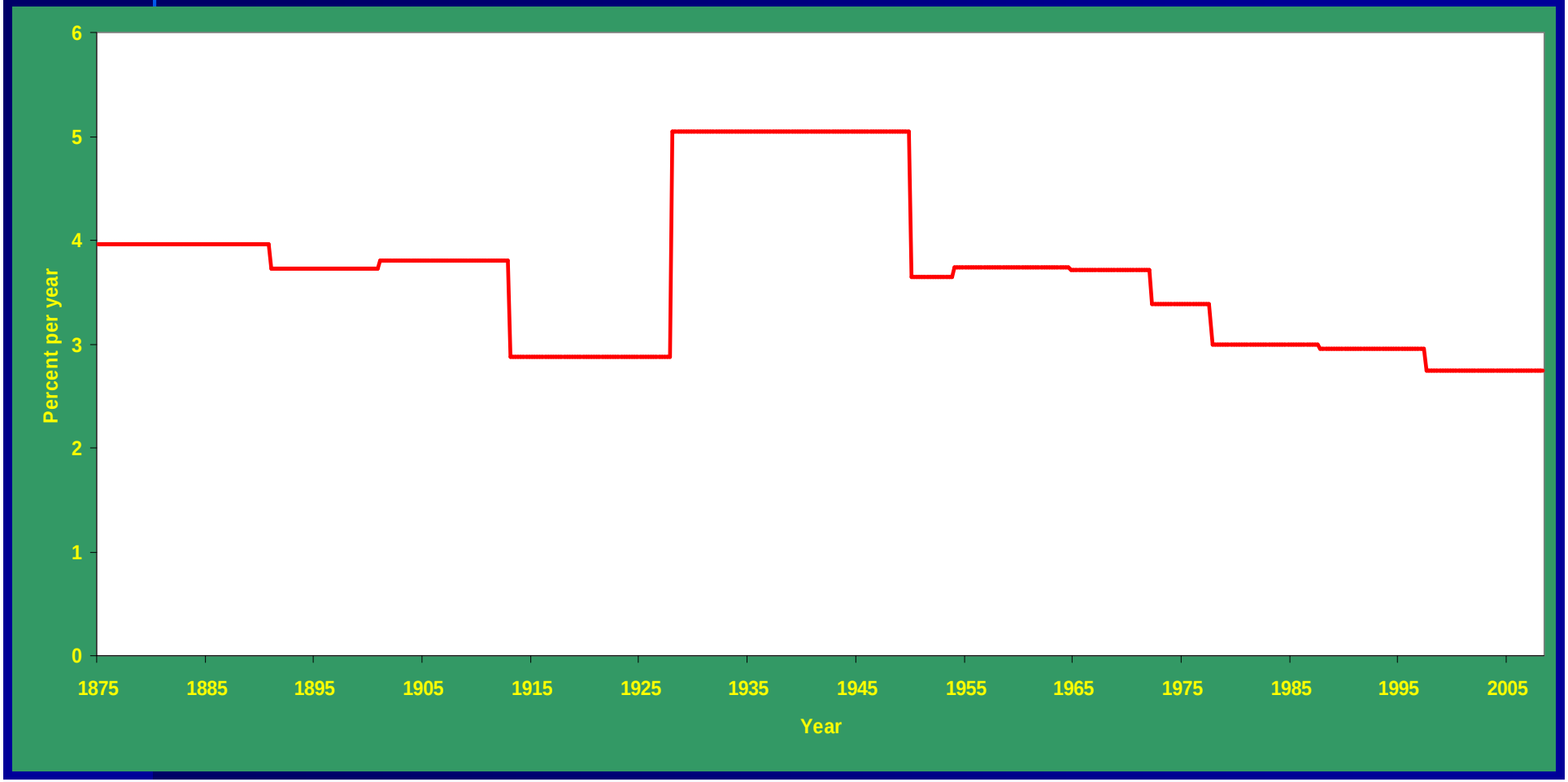
Topical Issues Addressed with this methodology

- Separate all components of "output identity" into trend, cycle, and residual
- Were "jobless recoveries" of 1991-92 and 2001-03 unusual?
- Was fast productivity growth 2001-03 just a repeat of 1991-92?
- How is the productivity growth slowdown of 2004-08 to be interpreted?

To begin: History of U.S. Growth in *Y** since 1875

- Can't Use Statistical Trends like H-P
  - Distortion in Great Depression and WWII
  - Standard HP quarterly parameter of 1600 implies that *Y** growth declines from +3% in 1929 to *minus 7% per year* in 1933
- Solution: calculate log-linear trends between benchmark years 1875, 1891, 1901, 1913, 1928, 1950, and 1954.
- Post-1954 trends taken from research reported later
- See Table 1 and Figure 1

Trend Real GDP Growth between Benchmark Years and Quarters, 1875-2008



Questions about This History

- The most dramatic episodes are slow growth 1913-28 and fast growth 1928-50
  - Contradicts real business cycle theory about Great Depression
  - Raises puzzle about 1913-28, a dynamic period when electricity was applied in manufacturing often cited by Abramowitz, David, and Wright
- Otherwise stable growth 1975-1913 and 1950-72, then continuous slowing down

Using the "Output Identity" to Link Income per Capita to Productivity

- *(1) $Y = Y/H * H/E * E/L * L/N * N$*
- Four of five of these exhibit procyclical behavior (not population 16+)
- BUT concept of productivity usually discussed in U.S. is for NFPB sector
- This equation works as long as our data are for *total economy productivity* and *total economy hours per employee.*

The Output Identity Allows us to . . .

- Estimate trends in any of the variables, call x the log of a variable and x^* its trend
- Δx is the growth rate of the actual value and Δx^* is the growth rate of the trend
- $\Delta(x-x^*)$ is the growth rate of the ratio of actual to trend for any variable, e.g., the log growth rate of the "GDP gap"
- We estimate regressions with $\Delta(x-x^*)$ as the dependent variable for four components of the output identity (excluding population)

Simplest Method to Measure Trends: TTB Method

- TTB is log-linear Trends through Benchmark quarters
- These Benchmark Quarters are those when unemployment roughly equal to the natural rate (actual U going down, not up)
- Turn to Table 2, shows 7 periods
- The output identity introduces the question – why doesn't growth in *Y/N* equal historical growth in *Y/H* in every year or historical interval?

Some of What We Learn from Table 2

- Real GDP growth slowed down as in Table 1 and the chart
- The five components must add up to real GDP growth by definition
- Productivity growth soared after 1995 but real GDP continued to slow down
- Hours per employee were strongly negative in 2 periods, moderately negative in 2 periods, near zero otherwise
- Employment rate barely moves, by assumption in choosing benchmark quarters

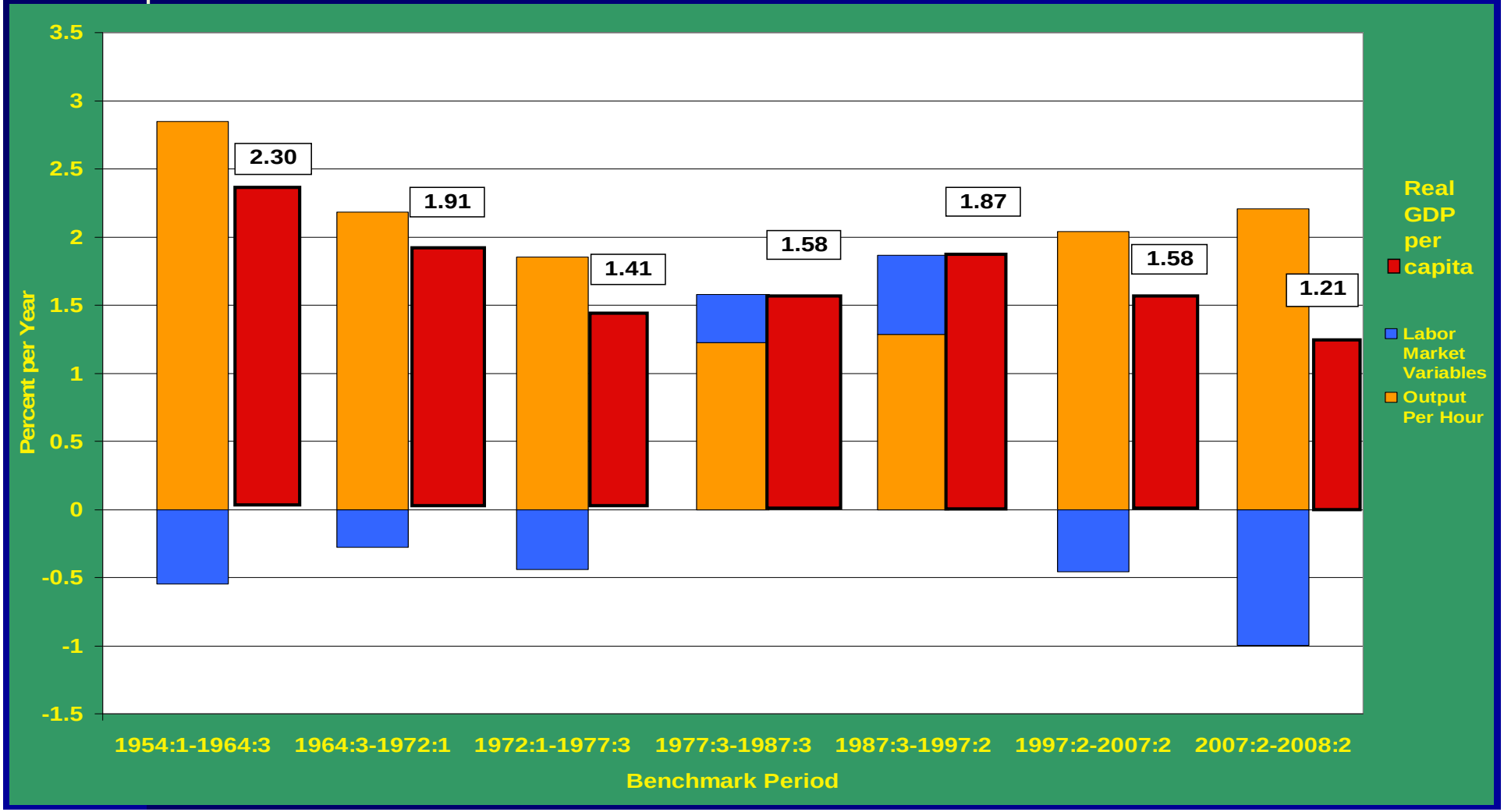
More About Table 2

- LFPR rose strongly 1964-87, not since then (this raises growth in *Y/N* relative to *Y/H* before 1987 and reduces it since 1987)
- Note negative correlation between trend growth in hours per employee and LFPR
- Working-age Population growth peaked before 1977 but held up relatively well 1997-2007

Table 3: How is *Y/N* Related to *Y/H* for Total Economy?

- Turn to Table 3
- Now compare annual growth rates in *Y/N* and *Y/H* for the same time intervals
- By definition any discrepancies must be equal to three labor market variables taken together
- Labor-market variables explain changing relationship between growth in *Y/N* and *Y/H*
- Important Issue – is *Y/H* growth negatively correlated with net contribution of labor market variables?
- Next slide presents the numbers of Table 3

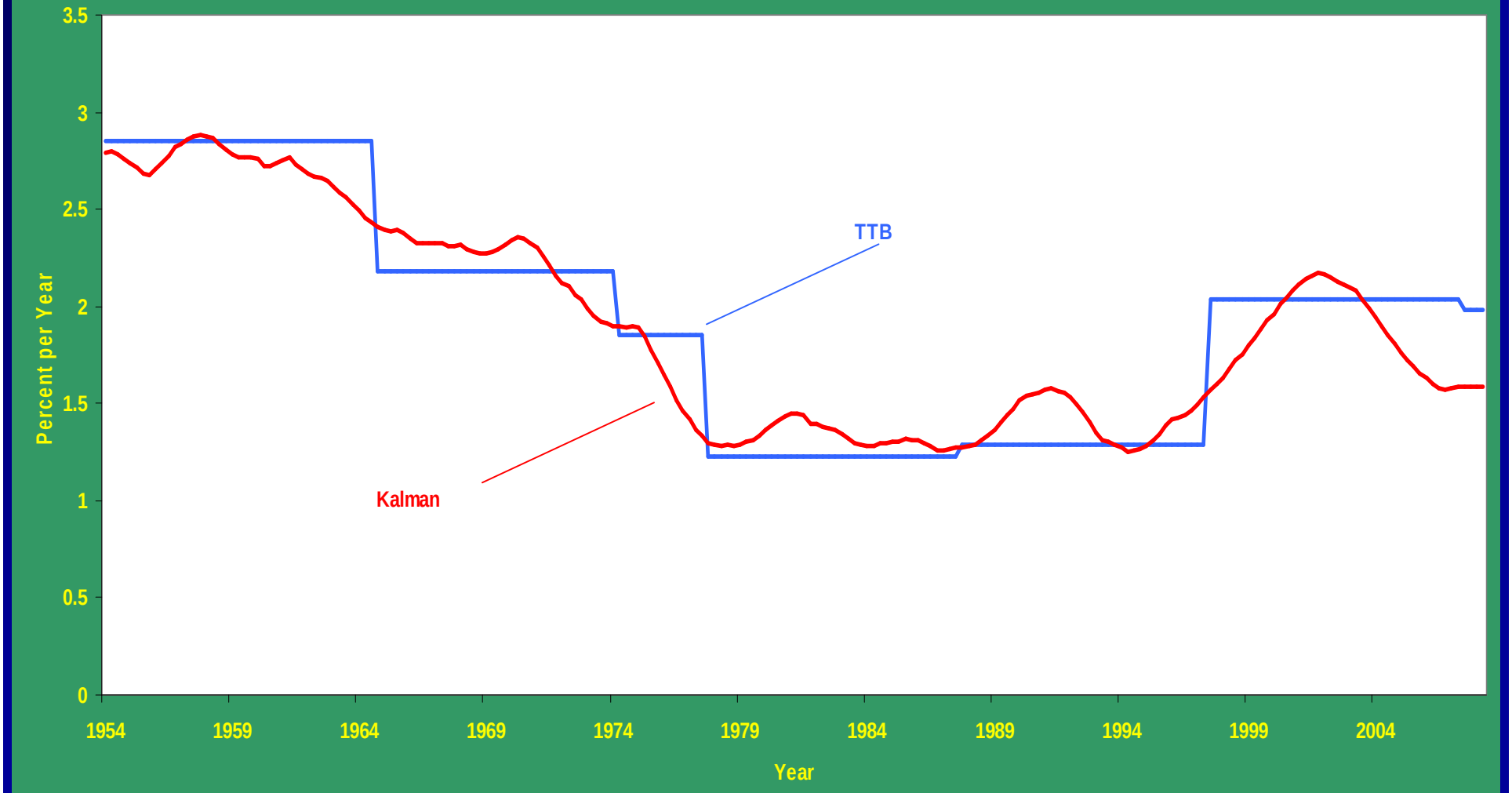
Table 3 in Color: How *Y/N* Grows Differently than *Y/H*



Next we turn to results of statistical trends

- Hodrick-Prescott filter
  - Bends too much at standard parameter of 1600
  - Even a parameter of 6400 bends too much, esp in 1978-83
- Kalman filter
  - Allows feedback from other variables, we allow feedback from GDP $\Delta(y-y^*)$

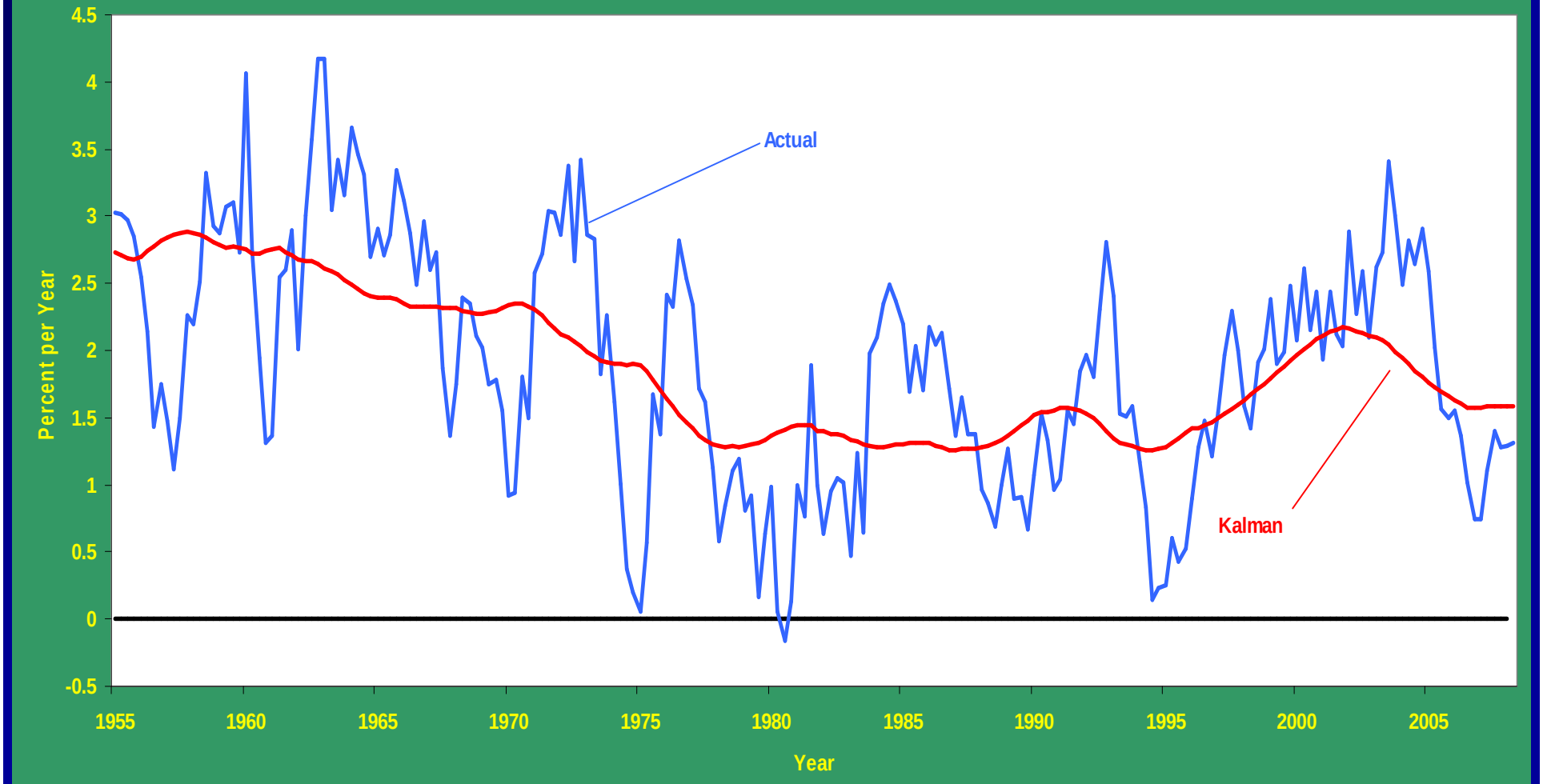
Productivity Trends: TTB vs. Kalman (TE not NFPB)



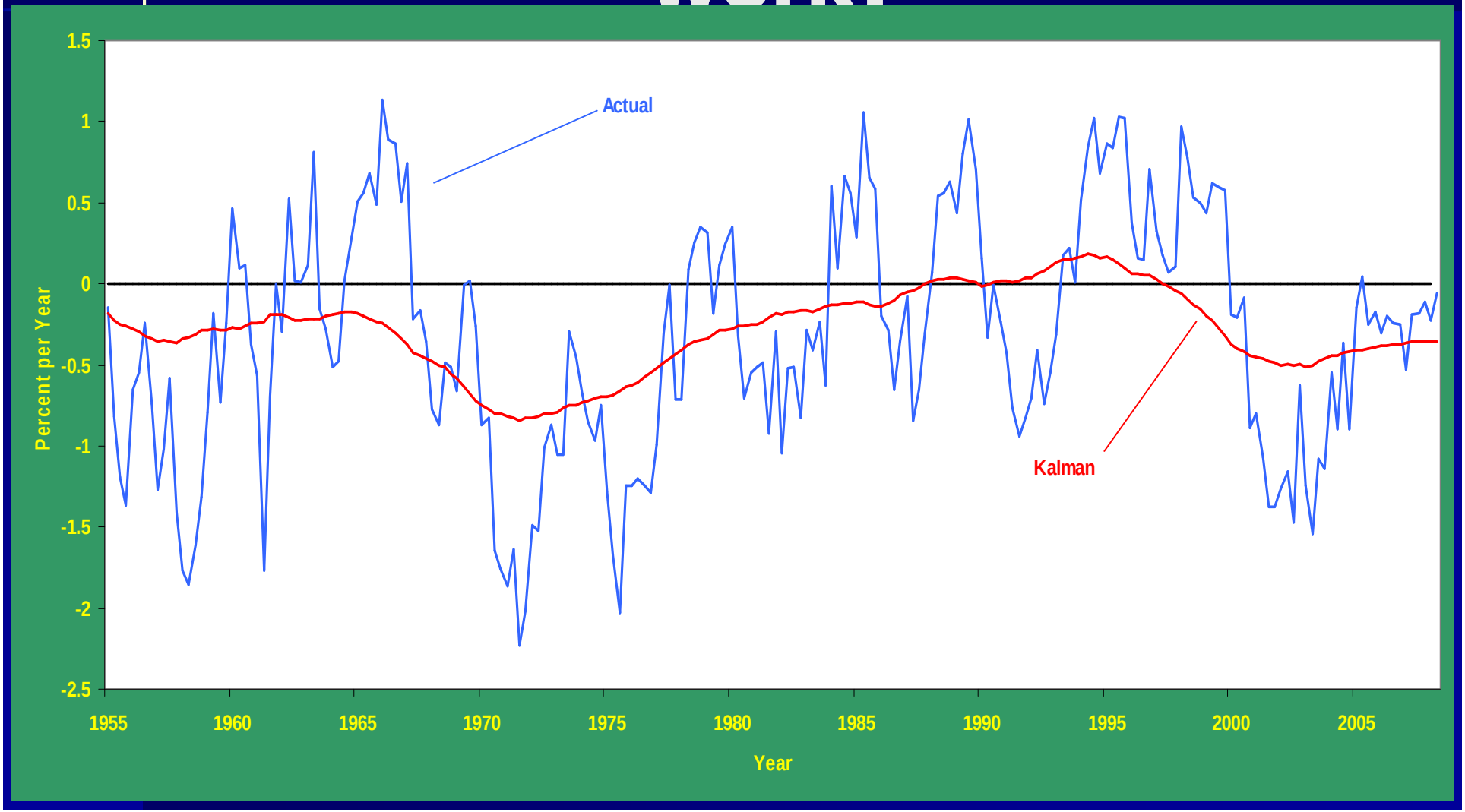
Next Charts Show Components of Output Identity

- Each chart plots the Kalman trend against the 8-quarter change in the actual value
- Also shown in the paper (in the bottom frame of Figures 4-7 and 9) are the ratios of the *level* of actual to trend

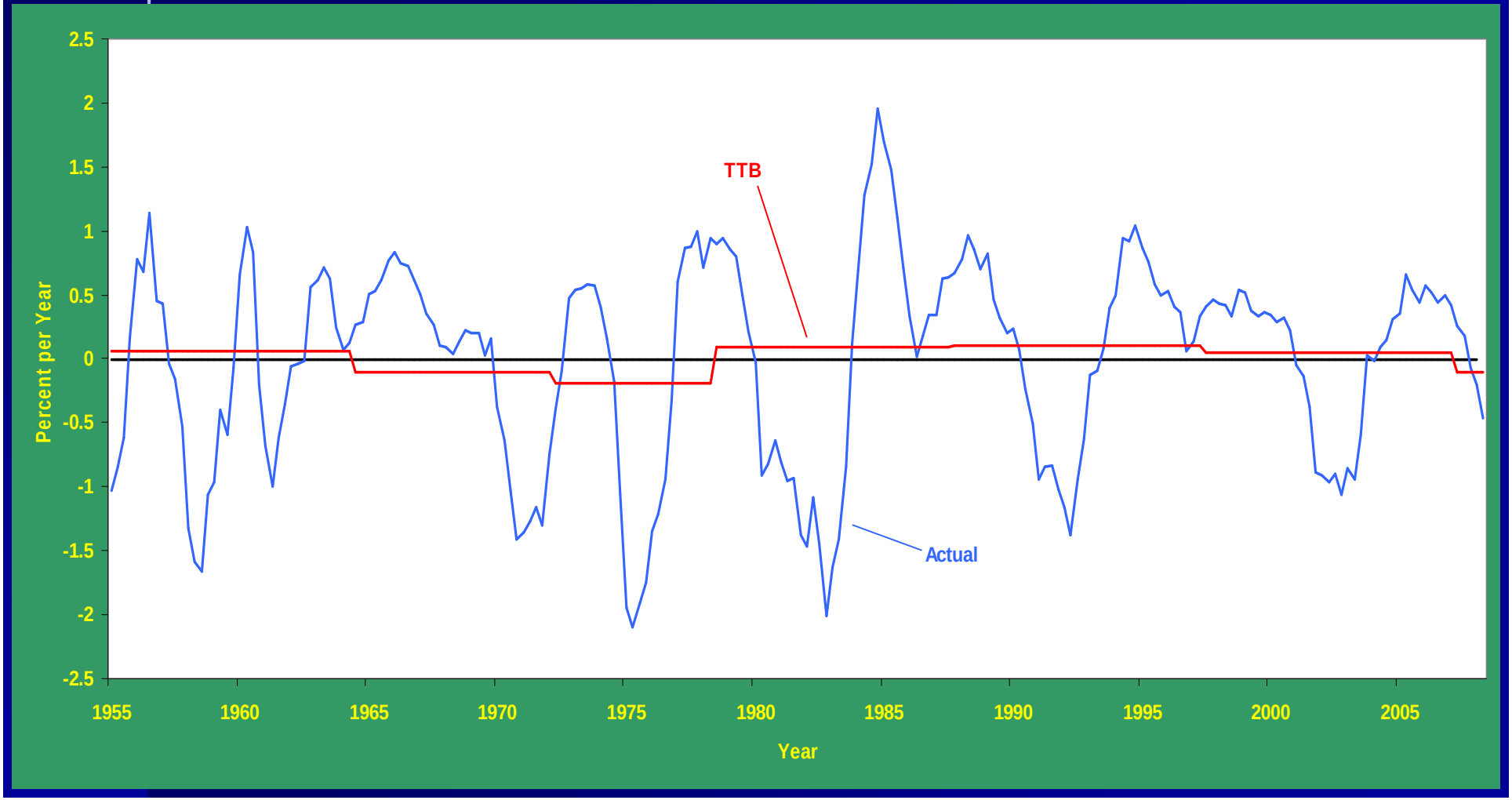
Kalman Trend vs. Actual 8-Quarter Changes for TE *Y/H*



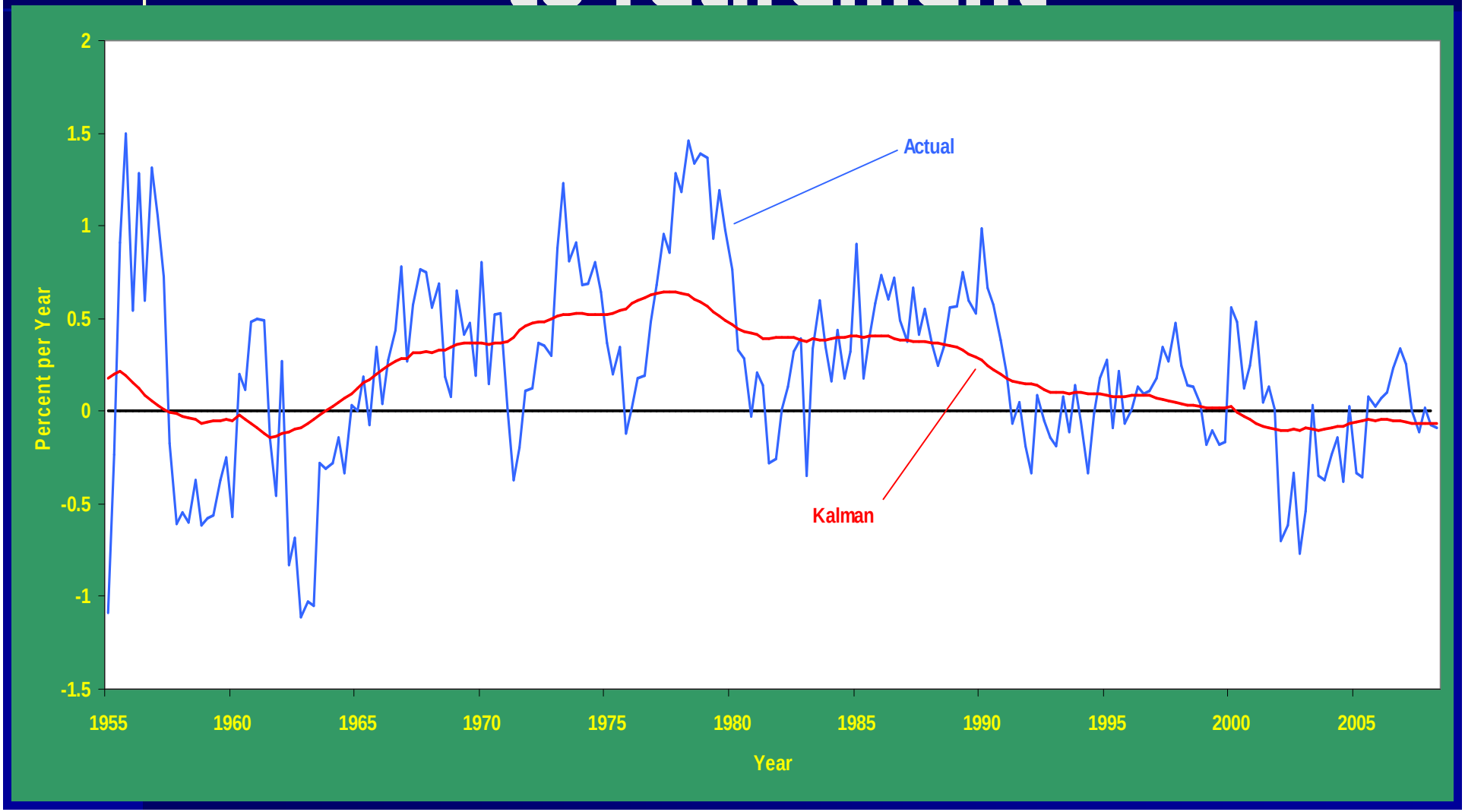
Trend TE Hours/Employee: benefit starvation => PT work?



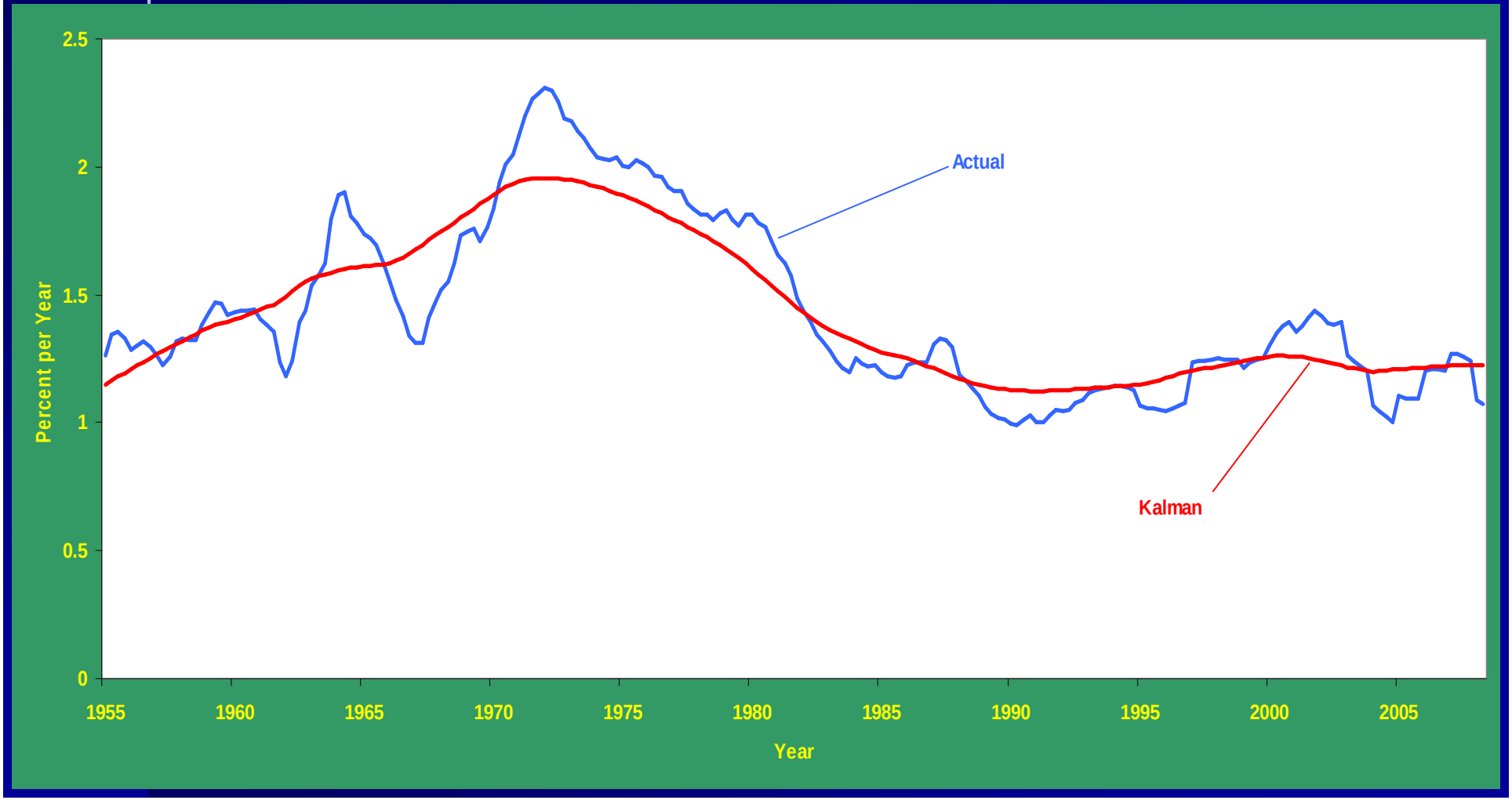
The Trend Employment Rate (E/N): Nothing Happens by Assumption (Based on NAIRU)



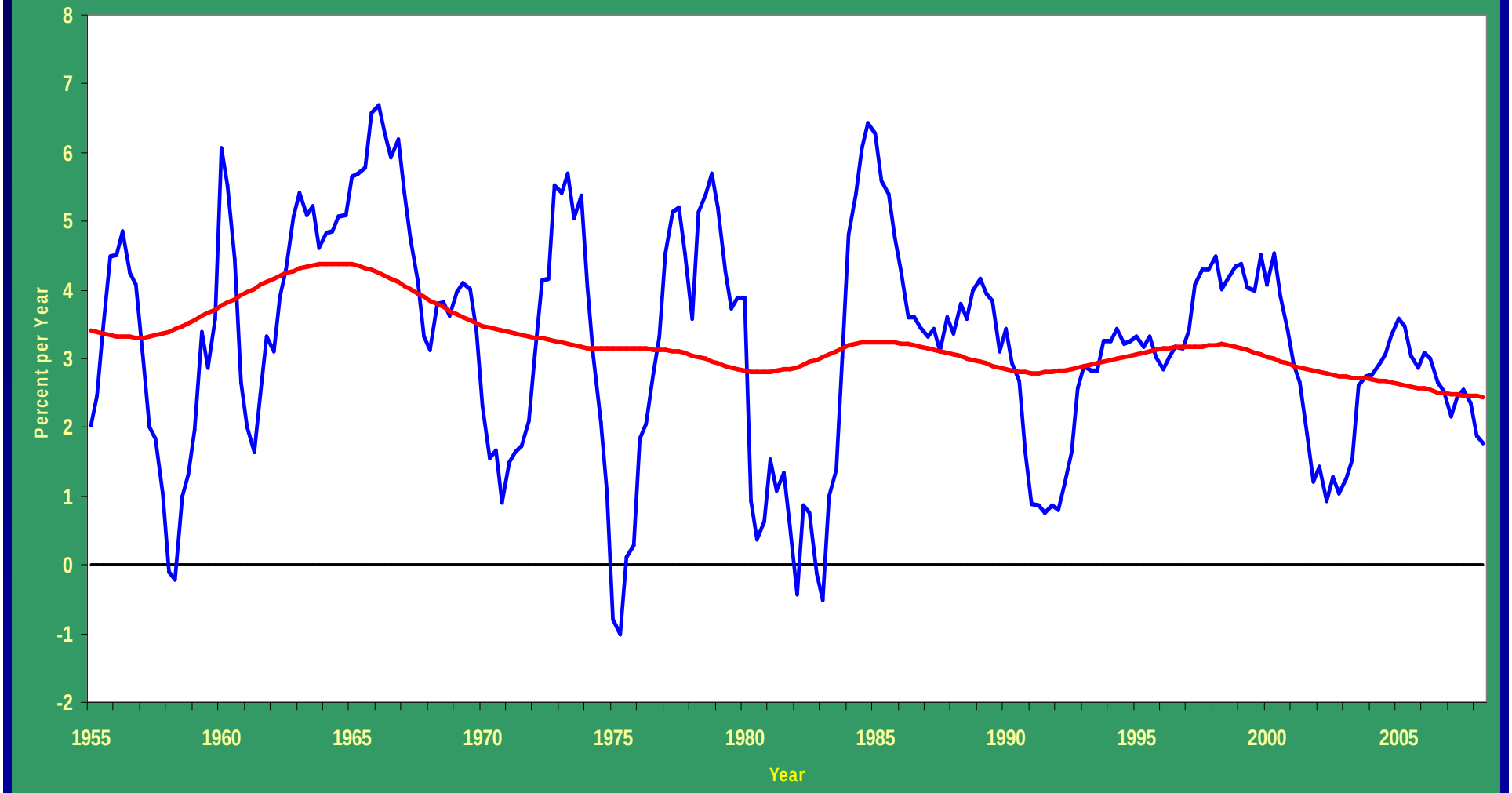
Trend for LFPR: The Women Entered but now transition to retirement



Population Growth: No Business Cycles but it Matters in Future Forecasts



Adding Components for Real GDP (Figure 9)



Conclusion About Real GDP Trend

- Slowdown from 4.4 in early 1960s to 2.6 now
- Viewed over decades, productivity growth is negatively correlated with labor force growth
- Hours per Employee growth also negatively correlated with LFPR growth
- Population Growth Decline has barely started, but immigration makes any forecast murky

How do Components React to Changes in Output Gap? (revisiting Okun's Law)

- First method in Table 4, look at cyclical deviations in quarters that have peak and trough deviations for Q
- Regressions are preferable: Specification written as equation (7) on p. 28

$$\Delta x'_t = \sum_{i=1}^{4} \alpha_i \Delta x'_{t-i} + \sum_{j=0}^{4} \beta_j \Delta q'_{t-j} + \phi x'_{t-1} + \sum_{k=1}^{7} \gamma_k D_k + \varepsilon_t$$

Specification of Regressions

- Dependent variables in Table 5 are first differences of ratios of actual to trend
- $\Delta x'_t = \Delta(x_t - x^*_t)$
- In order from left to right
  - *H/E, E/L, L/N,* Aggregate *H, Y/H*
- Specification in equation (7) on p. 28:

$$\Delta x'_t = \Sigma a_i \Delta x'_{t-1} + \Sigma \beta_j \Delta y'_{t-j} + \varphi x'_{t-1} + \Sigma \gamma_k D_k + \varepsilon_t$$

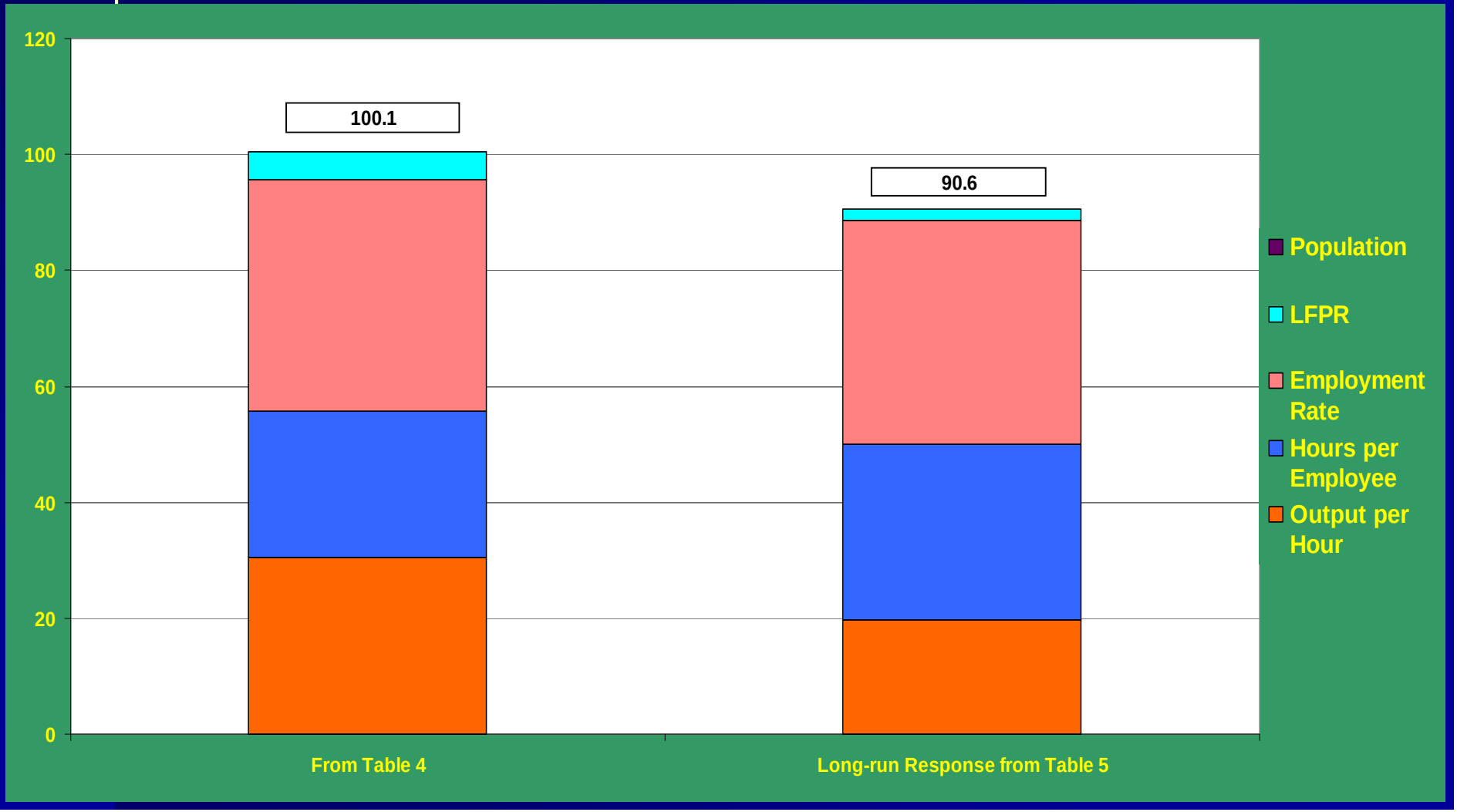
Motivation of End-of-Expansion Effect

- Firms consistently overhire in last stage of business expansion
- Defined as interval between peak of growth cycle and NBER peak
- Makes productivity growth low at EOE and relatively fast during recession and early recovery
- Dummy variables *1/M* and *-1/N*, sum to zero
- Developed in Gordon (1979)

Aspects of Regression Results in Table 5

- Shown are sums of coefficients
- ** indicates significance at 1 percent, * indicates significance at 5 percent
- Note significance of EOE dummy variables in most but not all periods
- Bottom of table shows EOE coefficients when they are all forced to be equal
- Summary of Responses from Tables 4 and 5 on the next slide

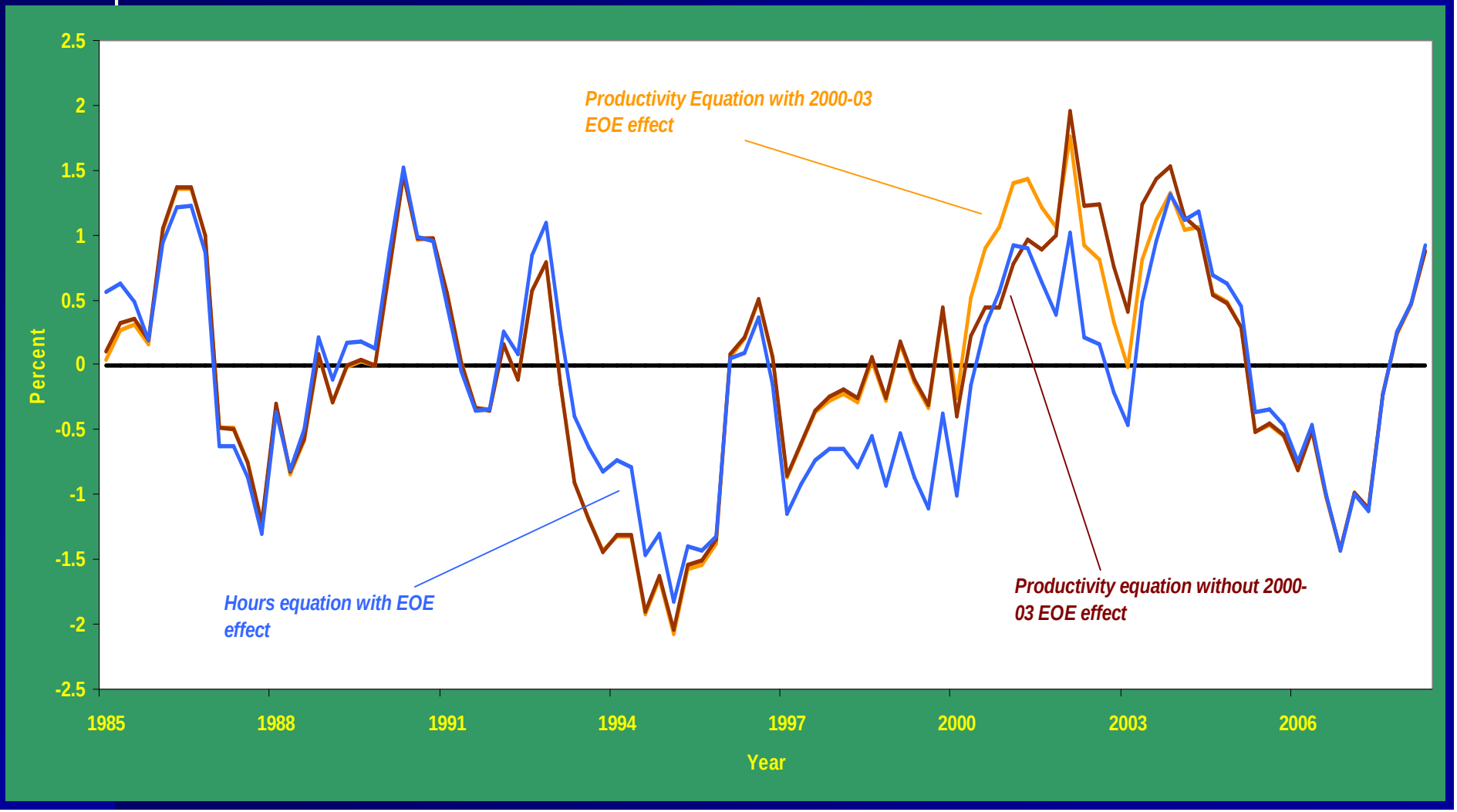
The 2008 Version of Okun's Law



"Early Recovery Productivity Bubble"

- Table 7
  - Top panel shows change in productivity relative to trend in first four quarters of recovery
  - Bottom panel the next eight quarters (i.e., quarters 5 through 12)
- On average 1.59 points vs. -0.11 points
- Largely explained by the productivity equation, relying on response to output change and to EOE effect
- Unusual about 2001-04, growth stayed above trend in next eight quarters

Cumulative Equation Errors, 1985-2008



Now the Explanations of Changes in Productivity Trend

- 1995-2000 productivity growth revival, consensus that it was driven by production and use of ICT equipment
- *Negative* contribution of ICT investment to productivity acceleration in 2001-2004
- 2001-2004 further increase in trend growth
  - Savage corporate cost cutting
  - Intangible capital hypothesis

Explaining the Two Hypotheses

- Cost Cutting in 2001-03
  - Employment declined until mid-2003 while output increased
  - Result: unusual upsurge of productivity
  - Profits had been propped up by accounting scandals, then collapsed
  - More of manager pay relied on stock options than 10 years earlier
  - Great pressure to revive profits and stock prices by cutting costs, leading to massive layoffs
- Oliner-Sichel-Stiroh (2007 BPEA) support: cross-industry positive correlation profit decline and employment decline

Complementary Intangible Capital Hypothesis

- Benefits of late 1990s ICT investment was delayed
- "Learning lag" in how to use ICT investment, development of software
- Many of benefits of 1995-2000 ICT investment occurred with a lag in 2001-03
- Explains how output could grow with employment declining

Why Productivity Trend Growth Slowdown 2004-07?

- Profits revived, reducing pressure for cost cutting. Employment grew again
- Intangible capital: delayed benefits of 1995-2000 investment boom gradually ended
- ICT investment did not revive; returned to pre-1995 values as share of GDP

Why Did Productivity Grow Faster than Trend 2007-08?

- Employment declined slowly and steadily January, 2008 until now
- Real GDP grew in first half 2008
- Strong productivity growth, but temporary
  - GDP growth in early 2008 represents shift to exports
  - Capital intensive, high productivity
  - Composition effect, exports of commodities use little labor

Back to Original Topic: Future Growth in Potential Output, see Table 9

- Key assumptions: population growth, productivity, hours per employee
- No assumed change in employment rate
- Future Growth Rates that we need to forecast:
  - TE Output per Hour
  - TE Hours per Employee
  - LFPR
  - WA Population

Thoughts about TE Productivity

- Ponder the actual growth rates
  - 1987:3 – 1997:2 1.31
  - 1997:2 – 2004:2 2.42
  - 2004:2 – 2008:2 1.34
- On which period should we base future forecasts?

Surely there are Reasons to Disregard 1972-87 but what about 1987-97??

- Economy torn apart 1972-87
  - Price controls and their termination
  - Food price shocks
  - Oil shocks
  - Productivity growth slowdown
  - Killer interest rates 1980-1982
- But 1987-97? Core of the Solow Computer-Productivity Paradox
- Why Couldn't 1987-97 occur in 2008-18?

Inherent Problems in Extrapolating 1997-2004

- The spike in ICT investment / GDP in 1995-2000 collapsed 2002. No growth in that ratio since 2002
- Savage cost-cutting was a one-time event
- Intangible capital is basically a delay hypothesis. There must be something to be delayed

Jorgenson Optimism according to *Time* magazine

- Still ample room for big productivity payoff for ICT investment in medical care, universities, government
- We're all experts on universities
  - Low-hanging fruit has been plucked
    - Card catalogues => rows of computers
    - We've replaced secretaries by hordes of IT experts to help faculty and students
    - Increase productivity? Raise student-faculty ratio

Tales of Medical Care

- My provider: Northshore University Healthcare System
- Fully computerized by 2003, won national prize for extent
- Paperless, prescriptions zapped to Walgreens, no paper referrals
- Yet let me tell you from 3 weeks in the hospital in May, 2008 . . .

Arbitrary Choice of Future Productivity Growth Rate

- Actual fact 1.7 1987-2008
- I choose 1.6, not as low as 1987-97 or 2004-08
- This translates to roughly 2.0 for NFPB productivity
- Note that the difference between NFPB and TE moves with NFPB

Projections of Hours, Employment, Population

- This round of forecasts lean on current BLS projections 2006-16 for pop & LF.
- Numerous debates about the SS Trustee projections are skipped over in this version, especially about immigration
- Pop 0.9, LF -0.1, hours -0.05
- Table 9 puts it together

Conclusion: Should I tell my students a new story?

- Rule of 70
- U. S. *Y/N* 1929-2007 = 2.16 AAGR
- This means standard of living doubles every 32 years
- When my 20-year old students are 84, their *Y/N* will be quadruple today
- But will this happen in light of today's forecast of *Y/N* growth of 1.45?