Productivity and Related Economic Assumptions for the 2007 TPAM Report

Robert J. Gordon

Northwestern University and NBER

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Why We Must Translate Productivity to Real Wage Growth

- Real wage growth helps SS finances
- Rise in covered wages raises tax revenues
- Rise in covered wages raises benefits, but . . .
  - Lag between tax payments and benefits
  - After retirement, benefits no longer indexed to wages but rather to CPI

The "Real Wage" Identity and the 2006 Assumptions

■ The SS *"Real Wage Identity"*

Real wage growth (1.1) =

Total economy productivity growth (1.7)

- Growth in comp/GDP ratio (0.0)

- Growth in earnings/comp ratio (-0.2)

- Growth in hours/employ ratio (0.0)

- Growth in GDP deflator / CPI (-0.4)

(see 2003 TPAM p. 57 vs. TR pp. 88-89)

But Hasn't Productivity Been Growing Much Faster than that?

- Headline productivity growth refers to the Nonfarm Private Business (NFPB) Sector

- What matters for SS is productivity in the total economy, not NFPB sector

- Unfortunately the differential between total and NFPB productivity growth is not constant

  For instance, 1995-2006

  Total 2.17, NFPB 2.62, Diff -0.45

Further Deductions From Total Economy Productivity Growth in *RW Identity*

- A decline in earnings/GDP reduces the SS tax base relative to GDP (the numerator of productivity)

- A decline in hours per employee reduces real wage per employee relative to real wages per hour

- A decline in GDP defl/CPI reduces real CPI wage relative to productivity
  - Memo item: GDP/CPI = GDP/PCE * PCE/CPI

The Importance of Apparently Trivial Matters

- A demographer gets really agitated about the difference between a fertility rate of 1.6 and 2.0

- Yet that's the same order of magnitude as the difference in growth rate of the GDP deflator vs. the CPI

- And that also varies over history for reasons we partly understand

Outline of Talk

- ■ The Dynamics of Quarterly NFPB Data, Extracting the Underlying Trend
- ■ Understanding the Behavior of the postwar US NFPB productivity growth trend
  - □ Why did productivity growth revive after 1995 and again after 2001
  - □ Why has productivity growth slowed down in the last 10 quarters?
  - □ How much of the productivity achievement of the past 11 years was inherently a one-shot event?

From NFPB Productivity to Total Economy GDP

- Links Between NFPB Productivity and GDP, the *"Output Identity"*
    - We'll examine actual changes and trends in those changes, 1955-2006
- The links include core concerns of TPAM
    - Population growth
    - LFPR growth
    - Hours/employee growth
    - Unemployment rate change
    - Difference between total economy and NFPB productivity growth

Further Outline

- Additional economic assumptions that are unrelated to the "output identity"
  - Comp/GDP and Earnings/Comp
  - GDP Deflator Relative to CPI
  - Overall Rate of CPI Inflation

Topic #1: Behavior of Productivity Growth in Quarterly Data

- Important to understand the dynamics
- They have nothing to do with the NBER business cycle chronology
- The behavior of productivity is driven by the lag of hours behind output
- This was a popular topic of the early 1960s, when economists first noticed that firms were slow to adjust employment up or down

8-quarter Change in NFPB Output and Hours, 1955-2006

Key Implications of Lag in Hours Behind Output

- Productivity Growth is not Synchronized with the utilization of resources

- Because hours lag, productivity leads

- Productivity Growth is fastest at the beginning of the recovery

- The "early recovery productivity bubble"

Notice the
"Early Recovery Bubble",
8-qtr changes 1955-2006

Deciphering the Long-run Trend

- Summary of Growth Rates that You'll See on Next Chart for the LP Trend
  - 1955:Q1-1972:Q2   2.56
  - 1972:Q2-1995:Q4   1.59
  - 1995:Q4-2000:Q4   2.34
  - 2000:Q4-2004:Q2   2.79
  - 2004:Q2-2006:Q4   2.36
- Mean 1955:Q1-2006:Q4 2.05
- Max value 2.90 (01:Q4)
- Final value 2.23 (06:Q4)
- *NOTE:* 2003 TPAM coincided with the peak

8-quarter Actual LP Growth vs. the Average Trend
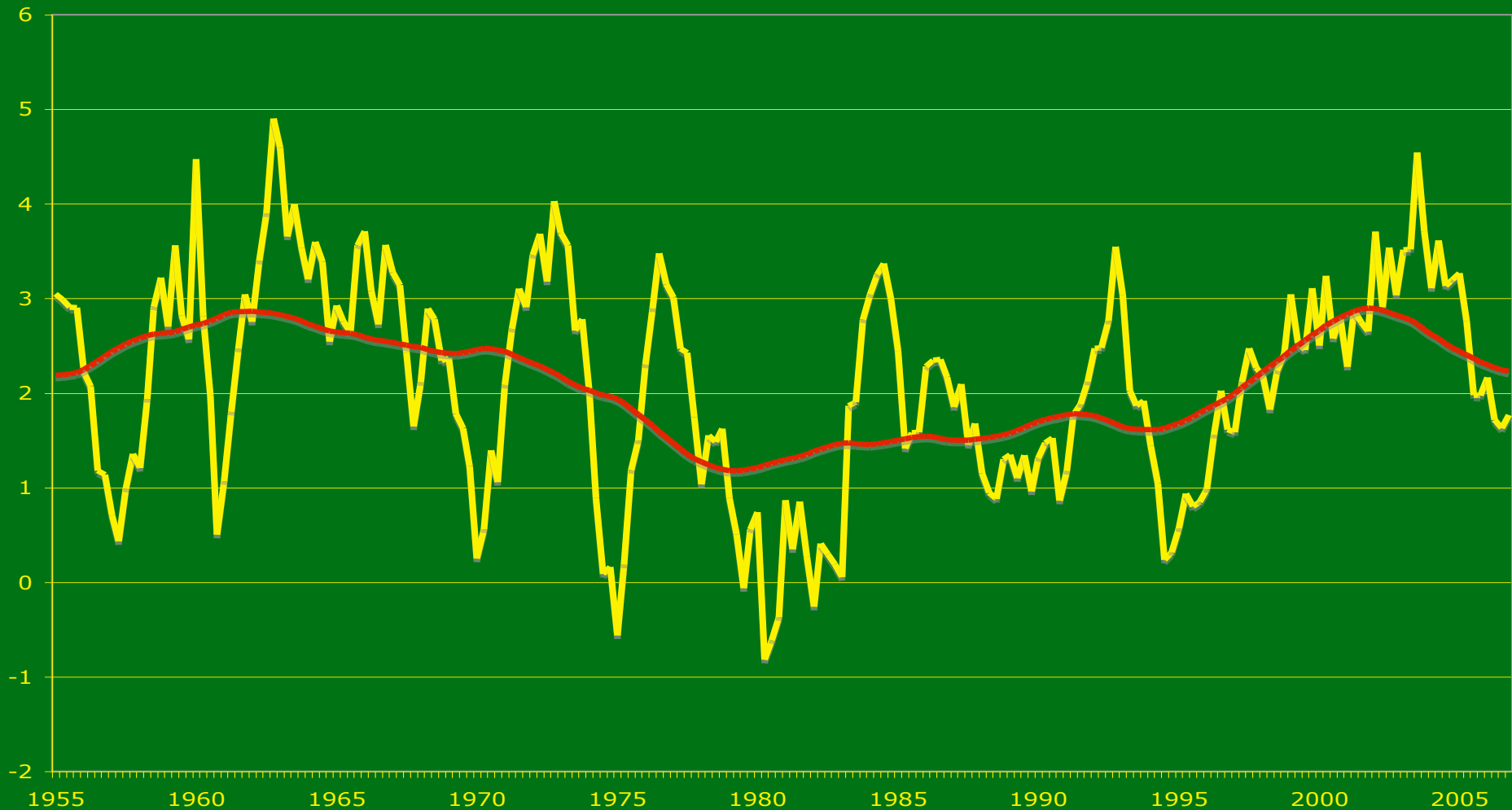
Comparing the two Methods: Harmony since 1995

The Early Recovery Bubble, How Much "Payback" is Left?

- 2000:Q4-2004:Q2, 14 quarter AAGR
  - Actual 3.51
  - Trend 2.79
  - Difference 0.72, or cumulatively 2.52
- 2004:2-2006:4, 10 quarter average
  - Actual 1.48
  - Trend 2.36
  - Difference -0.88, or cumulatively 2.20
- We've paid back 2.20/2.52 or 87% of the explosion above trend
- Terminal trend (2006:Q4) is 2.23; actual growth 2007-08 of 2.07 is consistent with that trend

From Dynamics to Substance: Sources of the Post-1995 Revival to 2000

- Close Agreement in Research Using Growth Accounting Methodology

- 75-80 percent of post-1995 revival was due to ICT investment

  - Direct Productivity Impact of ICT Production

  - Effect of "Capital Deepening," more ICT capital per worker across the economy

What are The Current Decompositions of IT Role?

- Acceleration 1973-95 to 1995-2000 (or 01)
  - IT Share O-S 112 percent
  - IT Share J-H-S current paper 78 percent
- Acceleration 1995-2000 (or 01) to 2000-2005
  - IT Share O-S -80 percent
  - IT Share J-H-S current paper -146 percent
- Something is fishy here – how could there be any fundamental connection between ICT investment and productivity growth?
  - Was there a one-shot character to the ICT boom of the late 1990s?
  - What caused the post-2000 upsurge of labor productivity in the wake of a collapse in ICT investment?

What Was Unique about 1995-2000: Computer Prices and the IT Share

- The chart for the rate of decline of computer prices shows the distinctly one-shot nature of the late 1990s boom

- The chart for the share of ICT investment in GDP shows the same thing

- This raises profound questions:
    - What has happened to Moore's Law? (J-H-S assume continues at rate between 1995-2000 and post-2000)
    - Is the 1995-2000 period even *relevant* for projections out to 2015 or 2025?
    - What caused the 2000-04 acceleration and is that period even *relevant* for future projections?

BEA Deflators for Computer Hardware and ICT Equip & Software, 1965-2006
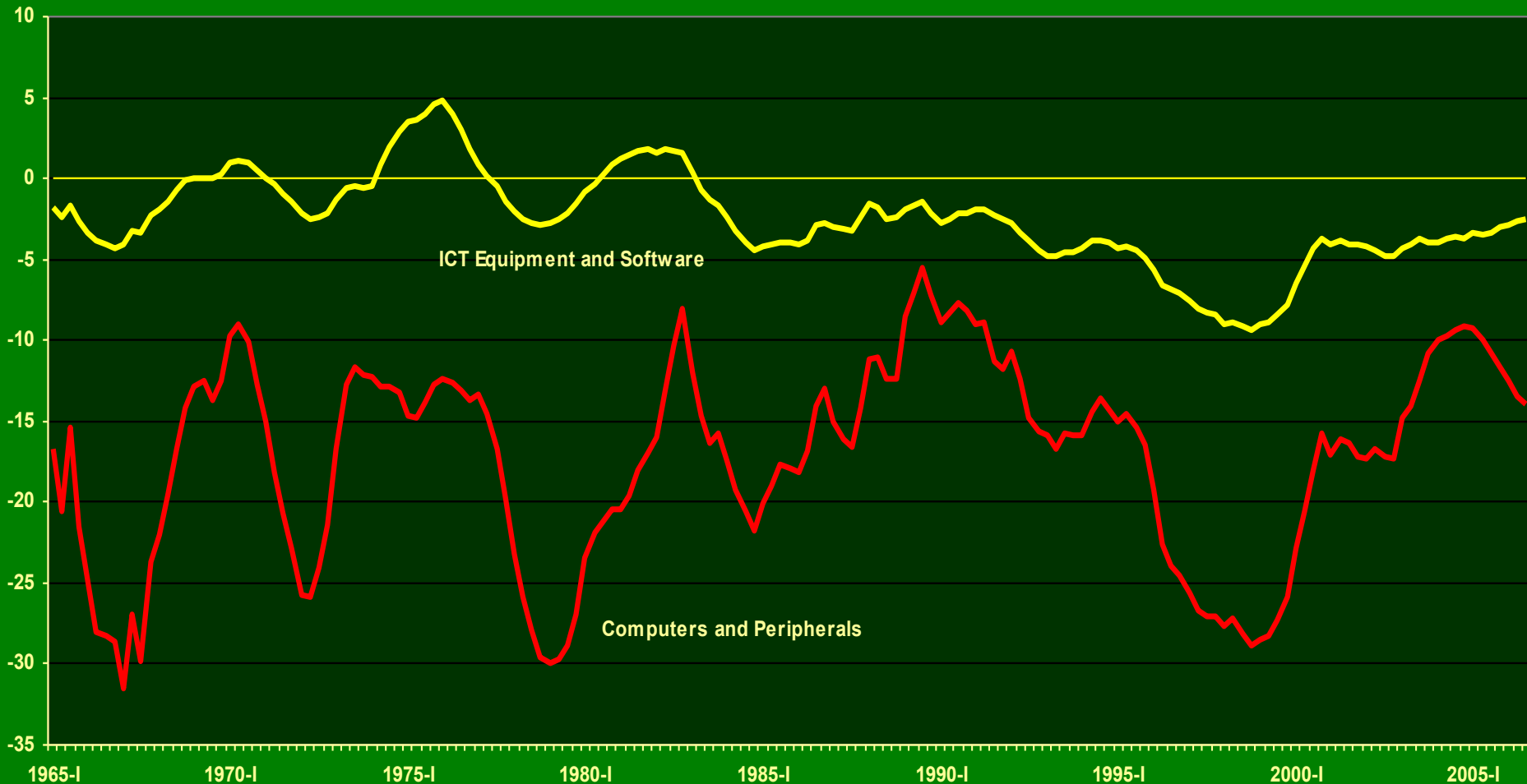
Nominal Share of ICT Investment in GDP, 1965-2006

My 2003 BPEA Paper Proposed Three Explanations for 2001-03

- **First Explanation: Cyclical Dynamics**
  - Productivity Always Grows Fastest in the Early Part of the Expansion
  - "Early Recovery Productivity Bubble"
- **Second Explanation: Savage Corporate Cost Cutting, Elements Unique to 2001-03 (compare to 1991-93)**
  - S&P Profits per Share
    - Rose from $33.96 in 1995 to $50.00 in 2000
    - Collapsed to $24.69 in 2001 and $27.59 in 2002
    - Since then have soared to $82.23 in 2006

Explanation of Cost-Cutting

- Post-2000 Collapse of stock market and profits
- Restatement of profits due to accounting scandals
- Sharp divergence NIPA profits from S&P Profits 1997-2000
- Extremely low ratio 2001-02 of S&P Reported Earnings to S&P Operating Earnings (One-time charges)
- Much higher ratio of executive compensation based on stock options, hence pressure to boost share price by cutting costs

Third Explanation, Delay and Intangible Capital

- Growth Accounting Requires that Full Productivity Payoff from Computers Occurs the Instant they Are Produced, Much Less Installed
- Others have emphasized complementary, unmeasured, and delayed investments in intangible capital
- Makes sense that a big invention, the late 90s marriage of computers and communication, would take time to have its full prody impact
  - My favorite example, airport check-in e-kiosks
  - Immelt of GE and Chambers of Cisco, "learning curve 3, 5, even 7 years"

Summary Explanation
of Productivity "Explosion"
of 2001-04

- "Early Recovery Productivity Bubble" was more prolonged than in the past

- Savage Corporate Cost Cutting

- Delayed impact of Intangible Capital created during 1990s ICT Boom

- These explanations are complementary but inherently temporary

My Conclusions About the Relevance of 1995-2000 and 2000-04

- The ICT boom of 1995-2000 was a unique event created by the invention of the internet. The fast decline in computer prices and high share of ICT investment will not happen again
- The full productivity payoff of the ICT investment bubble plausibly had a lag of three years or more, same timing as cost cutting
- Thus fast productivity and slow employment growth in 2001-03 were flip sides of the two big explanations, cost-cutting and intangible delay
- Layered on top of a standard cyclical early recovery bubble

Where Then Does that Leave Us?

- We can't base future projections on simple averages that are dominated by 1995-2004
- We should pay attention to what's happening to the trend as the actual numbers after 2004:Q2 roll in
- Cyclical "Payback" is almost complete. Any further actual numbers < 2.1 will pull down the trend further
- More so than in 2003, TPAM is justified in estimating future productivity growth based on a long horizon looking into the past

(NEW SLIDE)

- Need to translate from NFPB productivity to total economy productivity

- The history is given in Table 1 at the back of the handout

- Top section shows productivity growth by major sector

- Bottom section shows changes in labor's share (compensation / GDP)

To Project Potential GDP, Need Total Economy Productivity
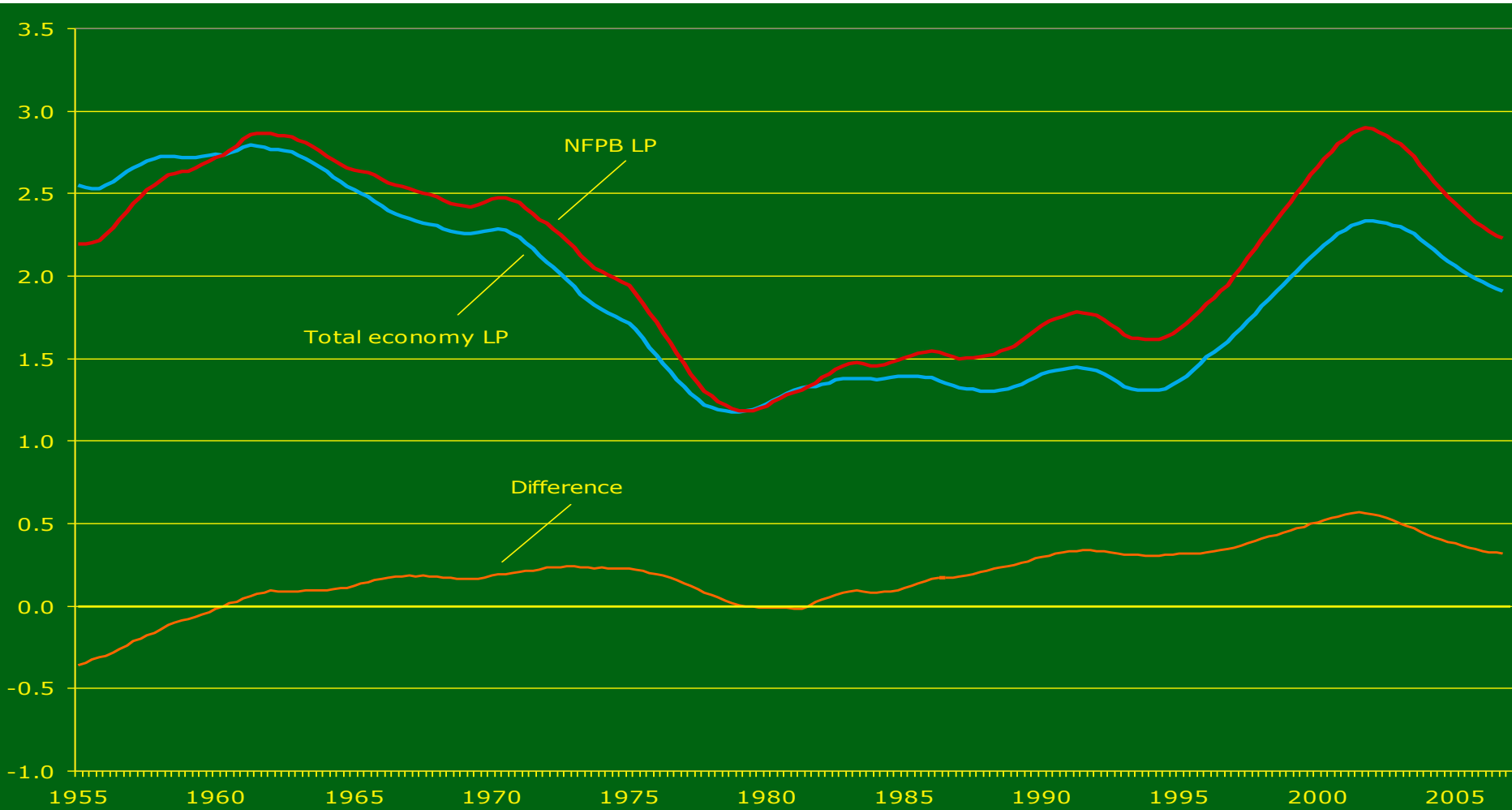
Implications for Potential GDP Growth

- Labor Productivity Growth
  - 2.0 percent over 10 years, maybe less over 25
- Total economy productivity = NFPB – 0.3
    - 2.0 – 0.3 = 1.7
    - Alternatively 1.9 – 0.2 = 1.7
- Thus the current Trustee's number seems better justified than it did four years ago

The Case for Productivity Pessimism: Diminishing Returns

- Clearly Moore's Law accelerated in the late 1990s but has since decelerated
- Even if Moore's Law continues at its previous pace, who needs all that speed?
- There's nothing I need to do that I can't do on my 3-yr-old laptop, except read the keys!
- I can't buy a new computer because much of my software would have to be reinstalled (by whom?) to work with Vista

A Classic Case of Diminishing Returns

- My PC that produced this set of slides has at least 1000 times the power as my first 1983 PC

- But there is a fixed factor, my brain and my ten fingers.

Since Windows 95 and Office 97, What has Changed?

- Virtually nothing has changed except fine-tuning

- The "Great Invention" of 1995-2000 was the *marriage* of the PC with communications

- The "intangible capital" hypothesis argues that it took a long time for people to figure out how to make the hardware useful

Since 2000, Distinguish Productivity from Consumer Benefits

- Games, iPods, downloading videos, etc., may be great for consumers but it doesn't raise productivity

  □ Possible source of "new product" bias in CPI

- Consumer broadband indirectly raises business productivity by raising the demand for Amazon-type software

ICT is not the First Industry to Encounter Diminishing Returns

- Commercial aircraft will always need two pilots
- Trucks will always need one driver
- Many services still require in-person contact: doctors, nurses, dentists, lawyers, professors, management consultants, bartenders, wait staff, barbers, beauticians
- Others need contact between an object and a person: grocery cashiers, valet parkers, auto repair, lawn maintenance, restaurant chefs, and every kind of maintenance from home roofers to Delta Airlines mechanics repairing engines.

As Diminishing Returns Set in, The Hurdle Rises

- To Growth the Stock of Inventions at a rate of 10% per year:
  - With 100 existing inventions, we need 10 new ones per year
  - With 110, we need 11
  - With 120, we need 12
  - And with 200, we need 20 new ones per year
- Continuous Increase in the "Hurdle"

What are the Next Great Inventions, You Tell Me

- **There's the great telecom convergence**
  - Cable, phone, broadband all provided by one company, consumer convenience
  - Surely soon there will be no need for wires inside the house, just a big wireless router next to the electric meter
  - Indeed electric and gas meters will be read automatically
- **But this is all small and incremental**

(NEW SLIDE)

Demise of the "Labor Quality" Factor

- In accounting for the sources of long-term productivity growth, economists divide up the contribution of physical capital and human capital (residual called "total factor productivity")

- For the past century, improved educational attainment ("human capital") has contributed 0.25 to 0.40 of annual growth

But That Is Coming
to an End

- Thursday *Wall Street Journal*, p. A2
- Steady growth in educational attainment at age 30 by year of birth (slowdown esp. for males)
  - 1900 8.5 years
  - 1950 13.2
  - 1975 13.9

Links between NFPB and Total Economy

- The *Output Identity*

- In its Simplest Form Makes Output *(Q)* Equal to the product of:
  - Productivity *(Q/A)*
  - Hours per Employee *(A/E)*
  - Employment Rate *(E/L),* that's just *(1 – U/L)*
  - Labor-force Participation Rate *(L/N)*
  - Working-age Population *(N)*

- Hiding Inside the Output Identity are Numerous Useful Trend and Cyclical Relationships

Five-term Output Identity Cannot be Used for Empirical Analysis

- Productivity data for the NFPB sector
- Expand the identity to identify NFPB variables and links to total economy:

$$Q \equiv \frac{Q^B}{A^B} \cdot \frac{A^B}{E^B} \cdot \frac{E}{L} \cdot \frac{L}{N} \cdot N \cdot \frac{Q/E^P}{Q^B/E^B} \cdot \frac{E^P}{E}$$

- Mix effect – ratio of output per employee: total/NFPB sector
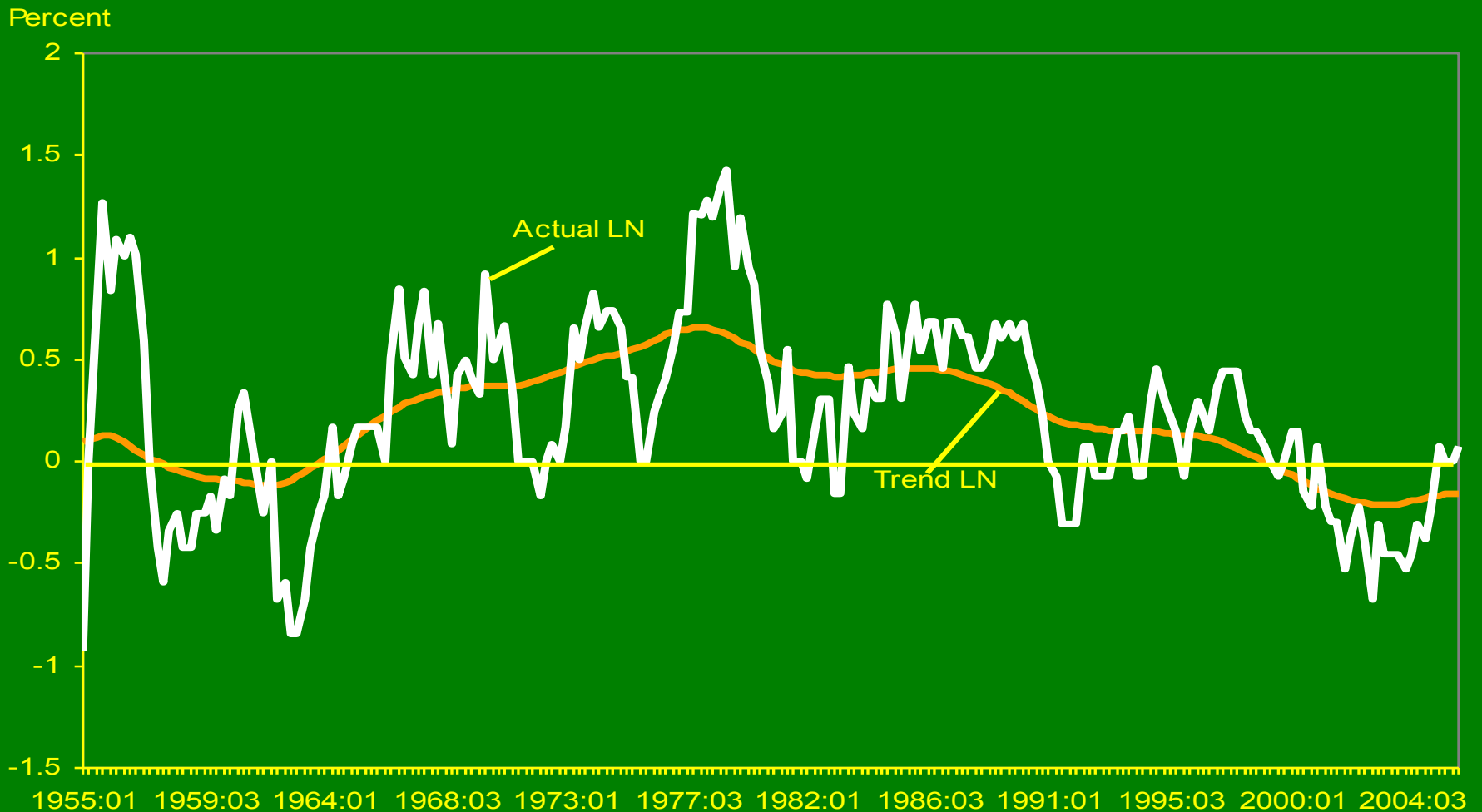- Employment ratio of payroll to household

The Novelty here
is to Display the Seven
Components

- We'll look through each of them, plotting actuals (8-qtr MAs) vs. trends
- We'll pay special attention to what has happened to each over the past six years
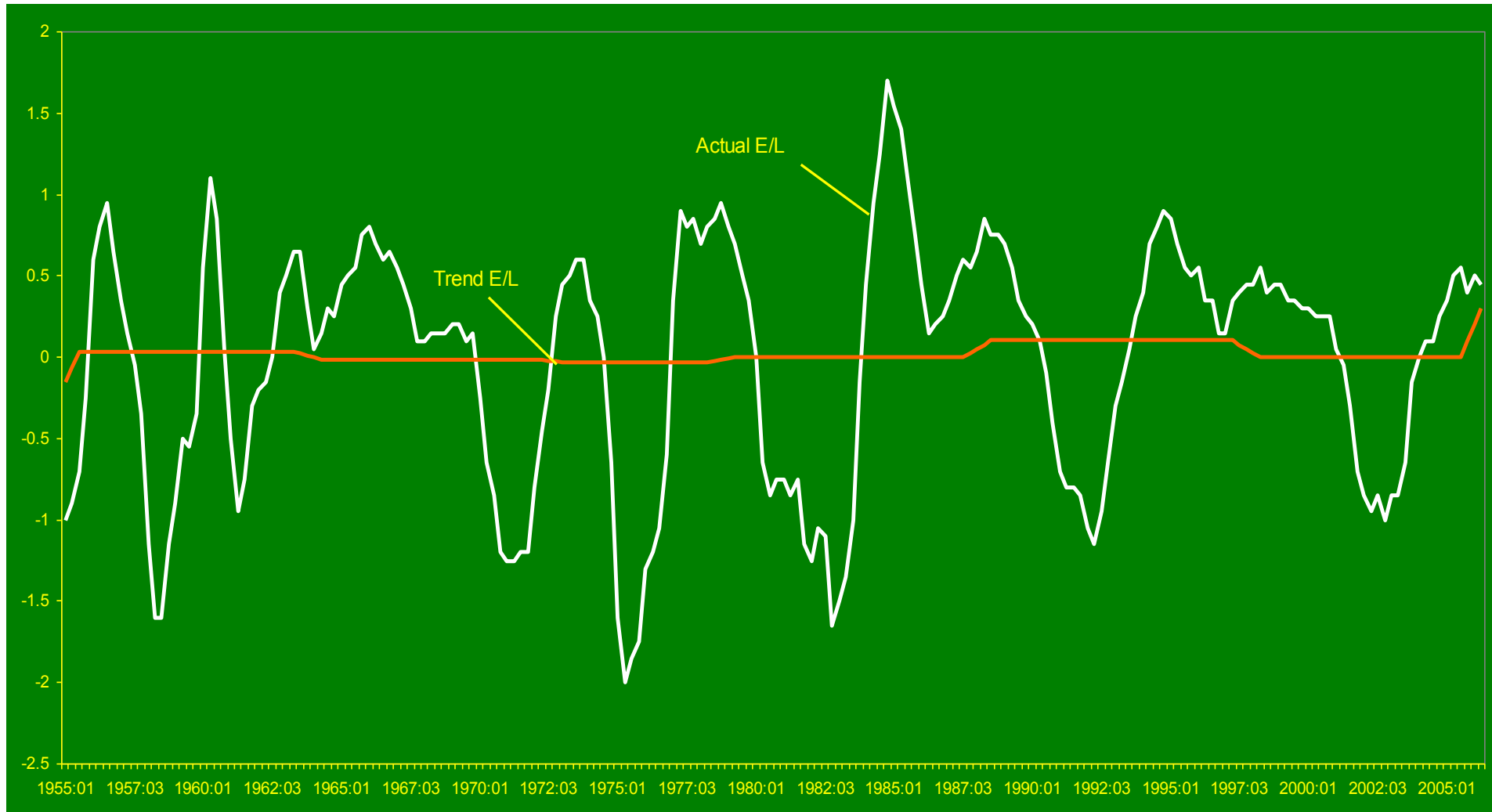- Then we'll multiply them together to see what has happened to potential real GDP growth
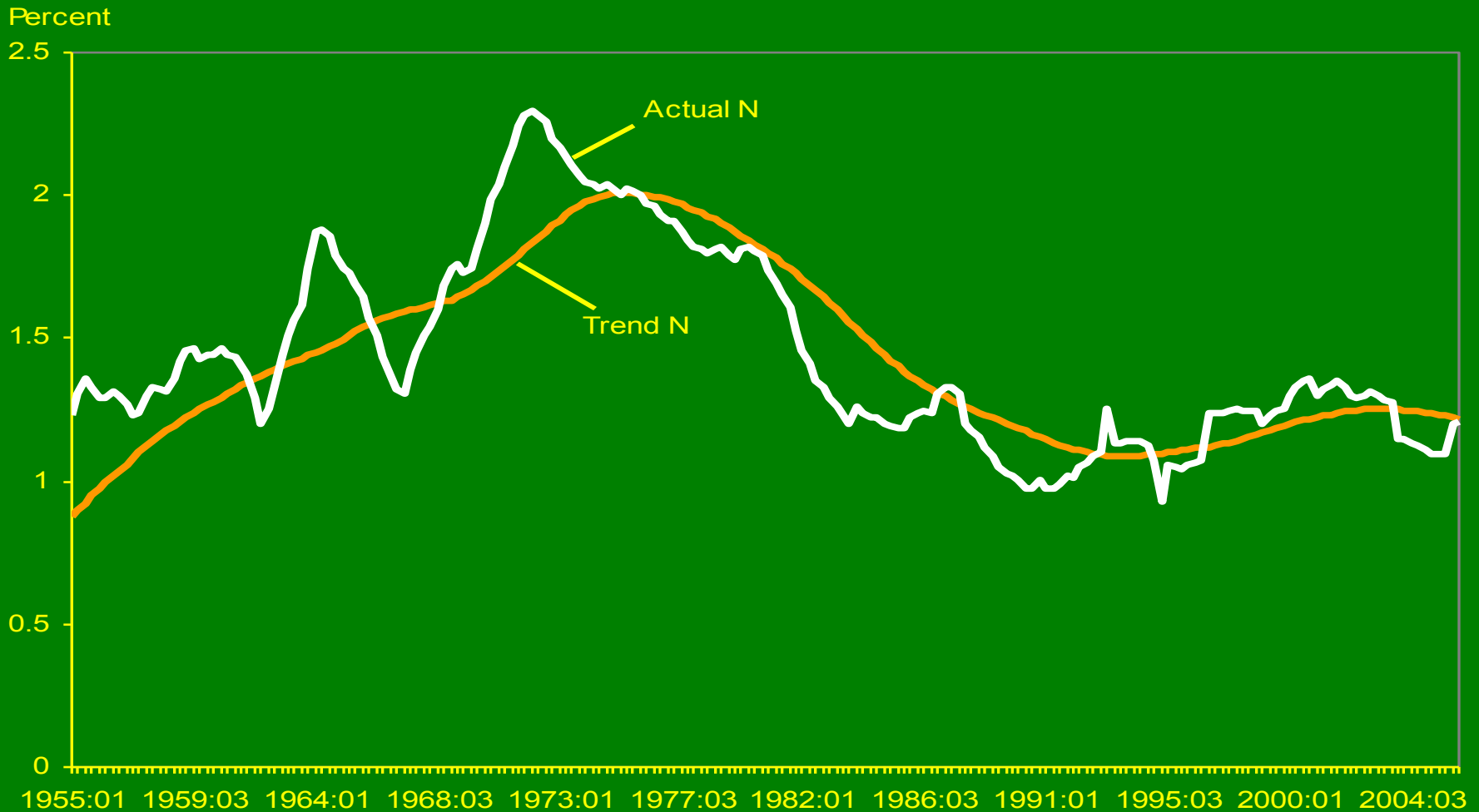
Actual vs. Trend Growth for Hours per Employee
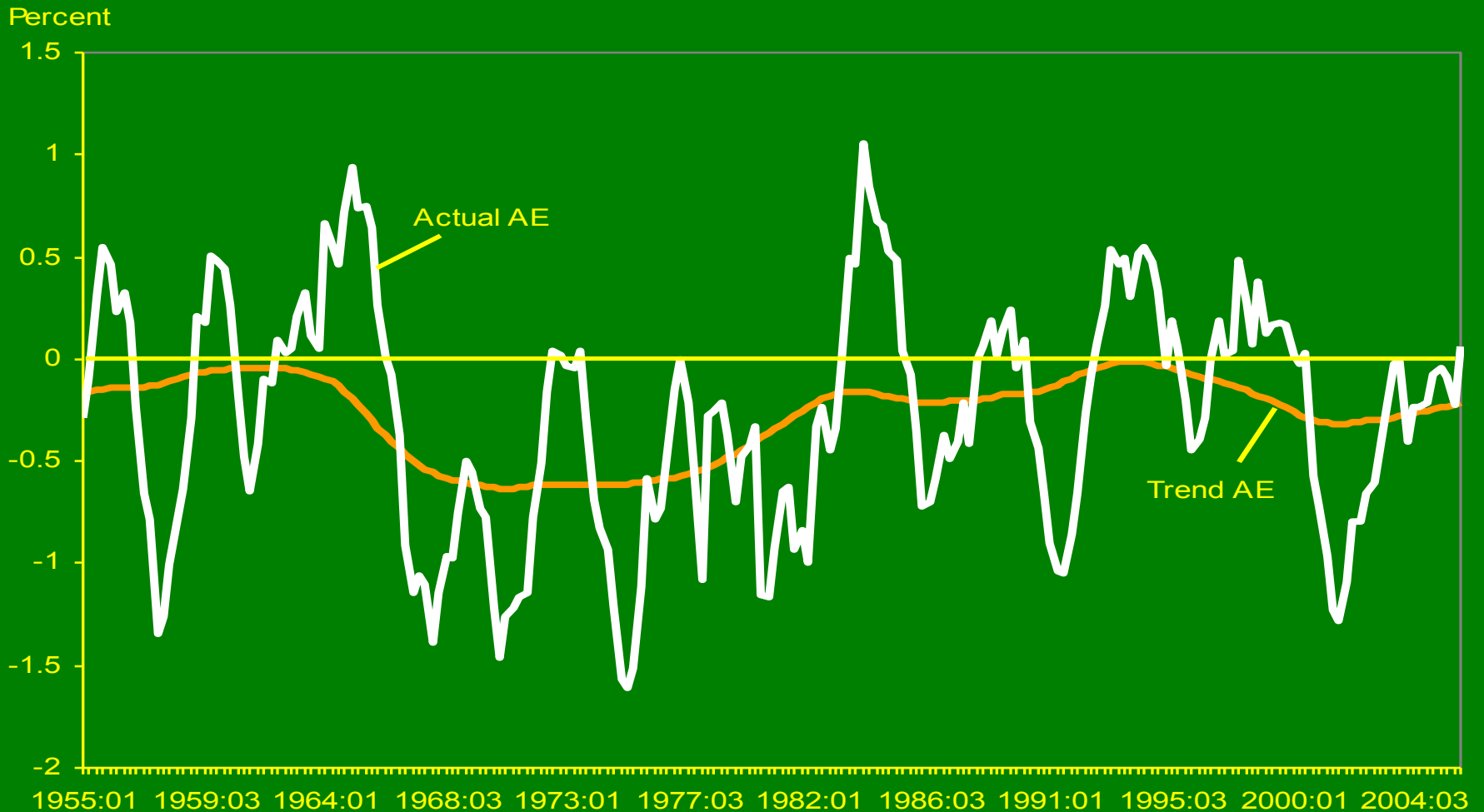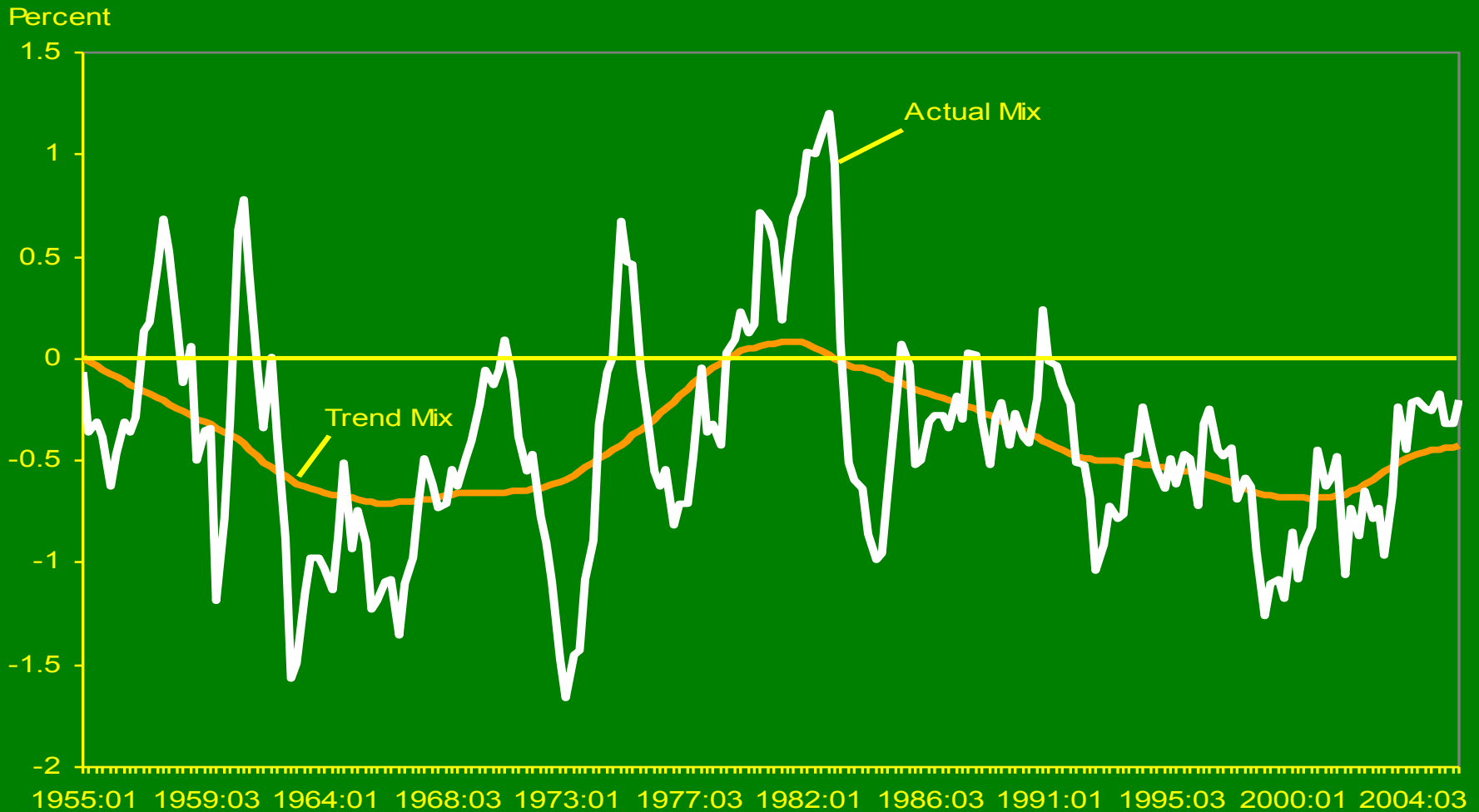
Actual vs. Trend Growth
for Labor Force Participation
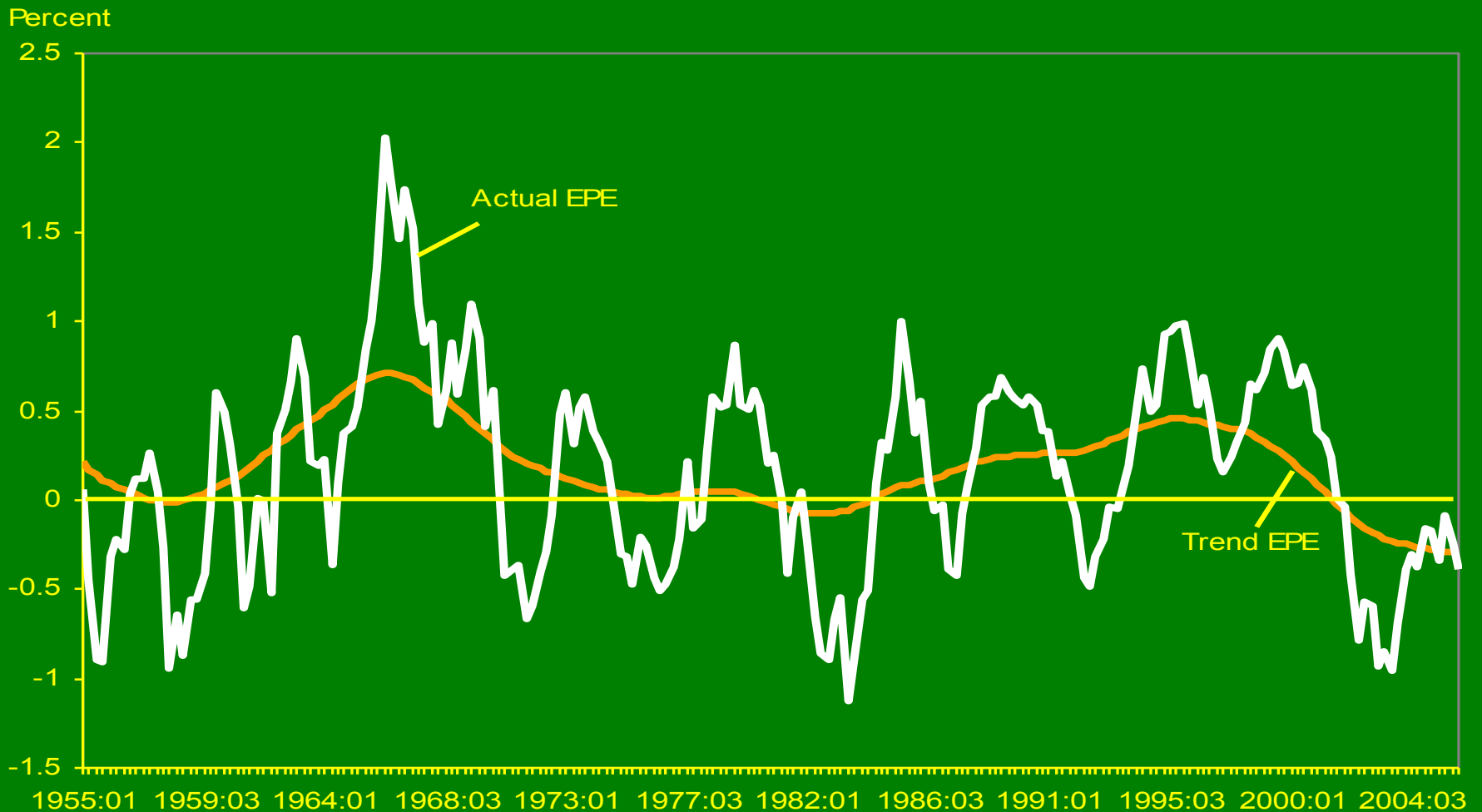
Actual vs. Trend Growth for the Employment rate

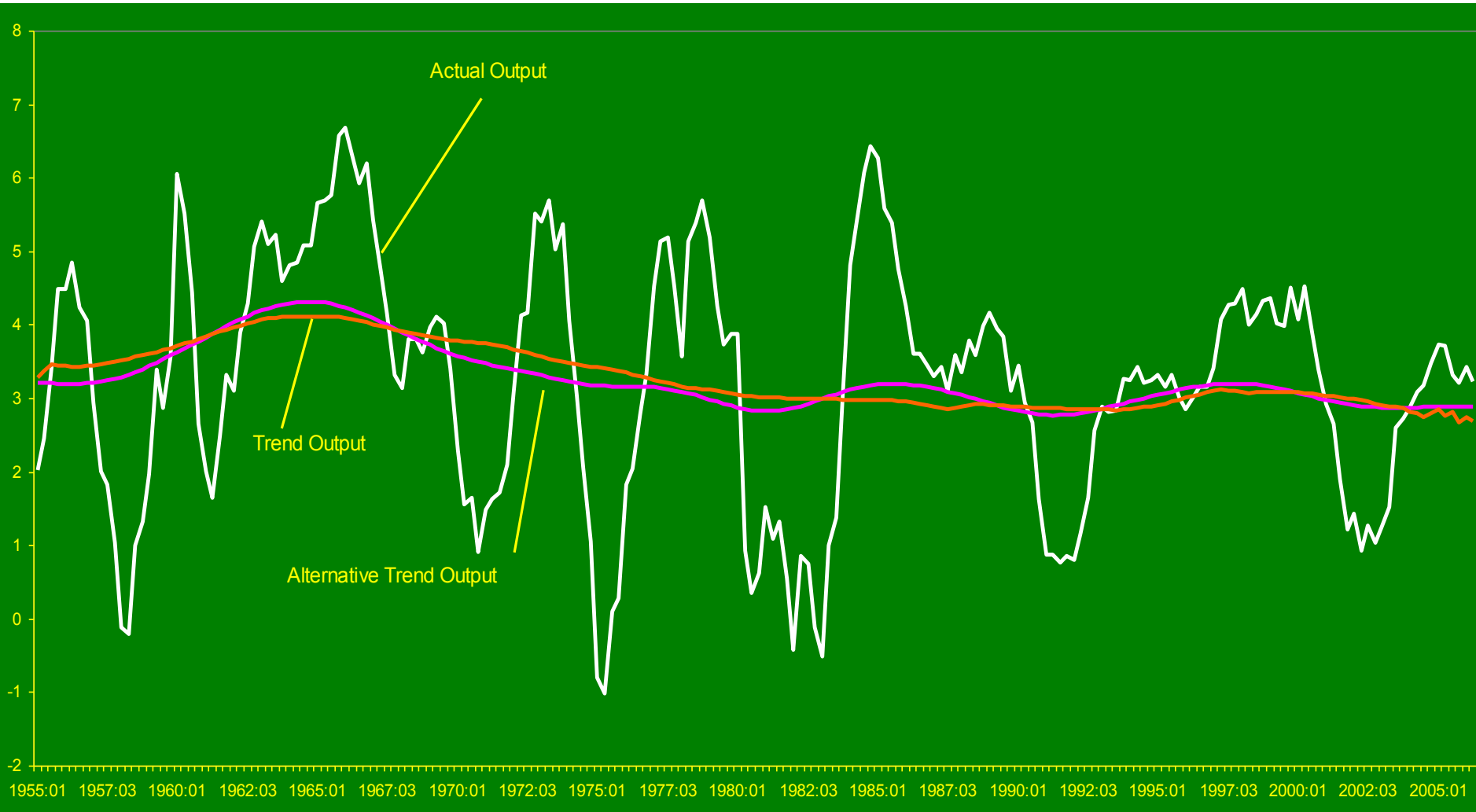# Actual vs. Trend Growth
for Working-Age Population

Actual vs. Trend Growth for the "Mix Effect"

Actual vs. Trend Growth for Payroll vs. Household Employment

Two Measures of Trend Potential GDP Growth

Potential GDP vs. Productivity

- Potential GDP growth *(Δq*)* ranged from:
  - 4.03 in 1963-72 to 2.69 in 1987-94
  - Differences accounted for by
    - Productivity (peak 1954-63)
    - Population growth (peak 1972-78)
    - LFPR (peak 1972-78)
  - Offset by hours/employee (peak 1963-72)
- Currently growth rate is 2.9 percent by one measure and 3.0 percent by the other

Back to The Real Wage Identity and the 2006 Assumptions
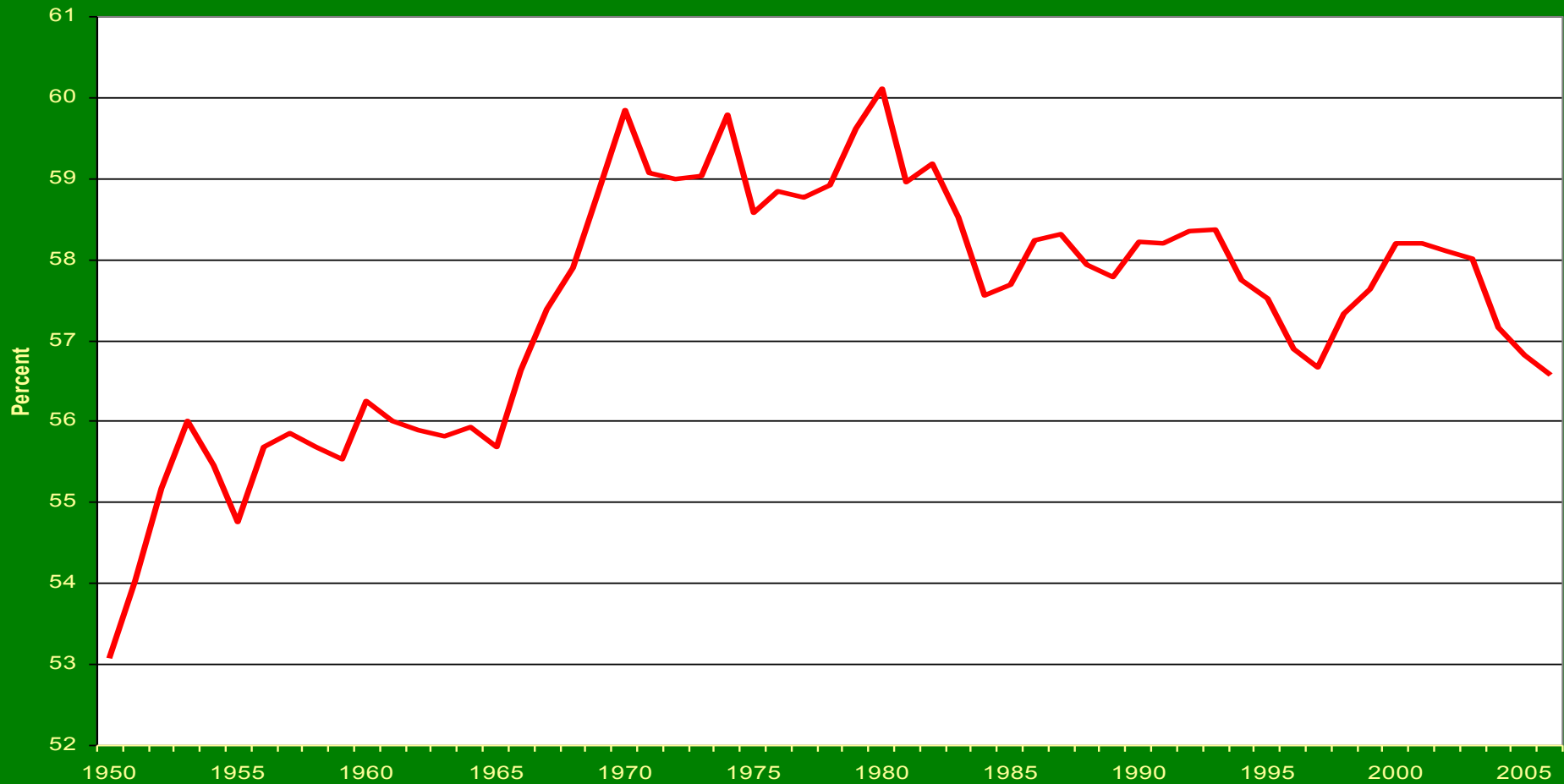
■ The SS *"Real Wage Identity"*

Real wage growth (1.1) =

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- Growth in comp/GDP ratio (0.0)
- Growth in earnings/comp ratio (-0.2)
- Growth in hours/employ ratio (0.0)
- Growth in GDP deflator / CPI (-0.4)

The Easy One:
Comp/GDP Ratio

Share of Employee Compensation in Gross Domestic Income, 1950-2006

Lots of Economics about Labor's Share

- Many Economic Models Imply Long-run Constancy of Labor's Share
- In fact the share has been constant during the postwar years
  - Even more true when part of proprietor's income is included
- One-time jump in 1960s not well understood

Ratio of Earnings to Compensation

Share of Total Earnings to Total Compensation, 1950-2006
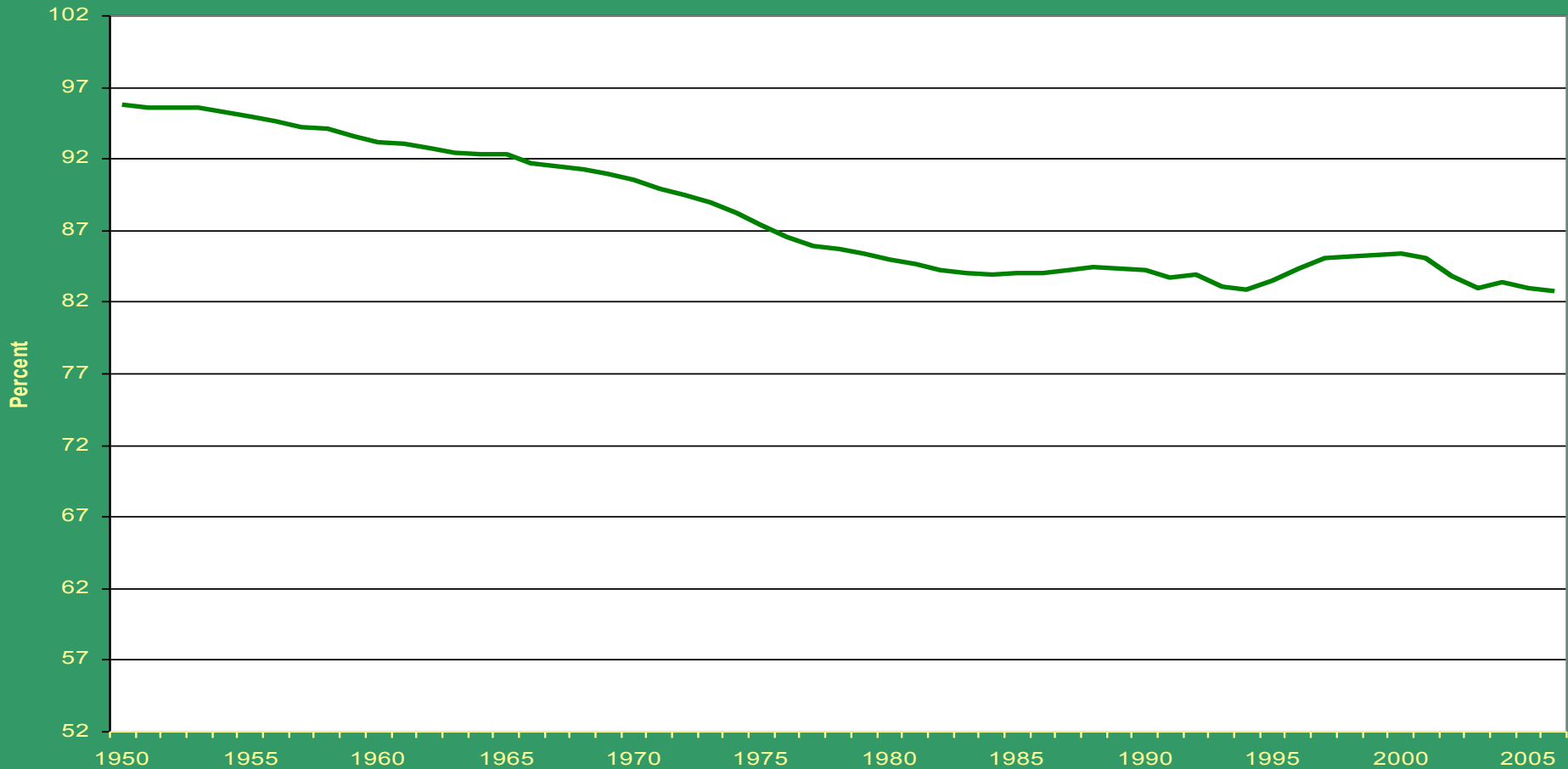
- Trustees assume continued -0.2
- After 75 years that would take the ratio down from the current 83 percent to 71 percent
- The ratio has no changed since 1980
  - Result of turnaround in importance of pension benefits (see TPAM 2003, p. 63)
- We should consider changing to 0.0

Actual vs. Trend Growth for Hours per Employee
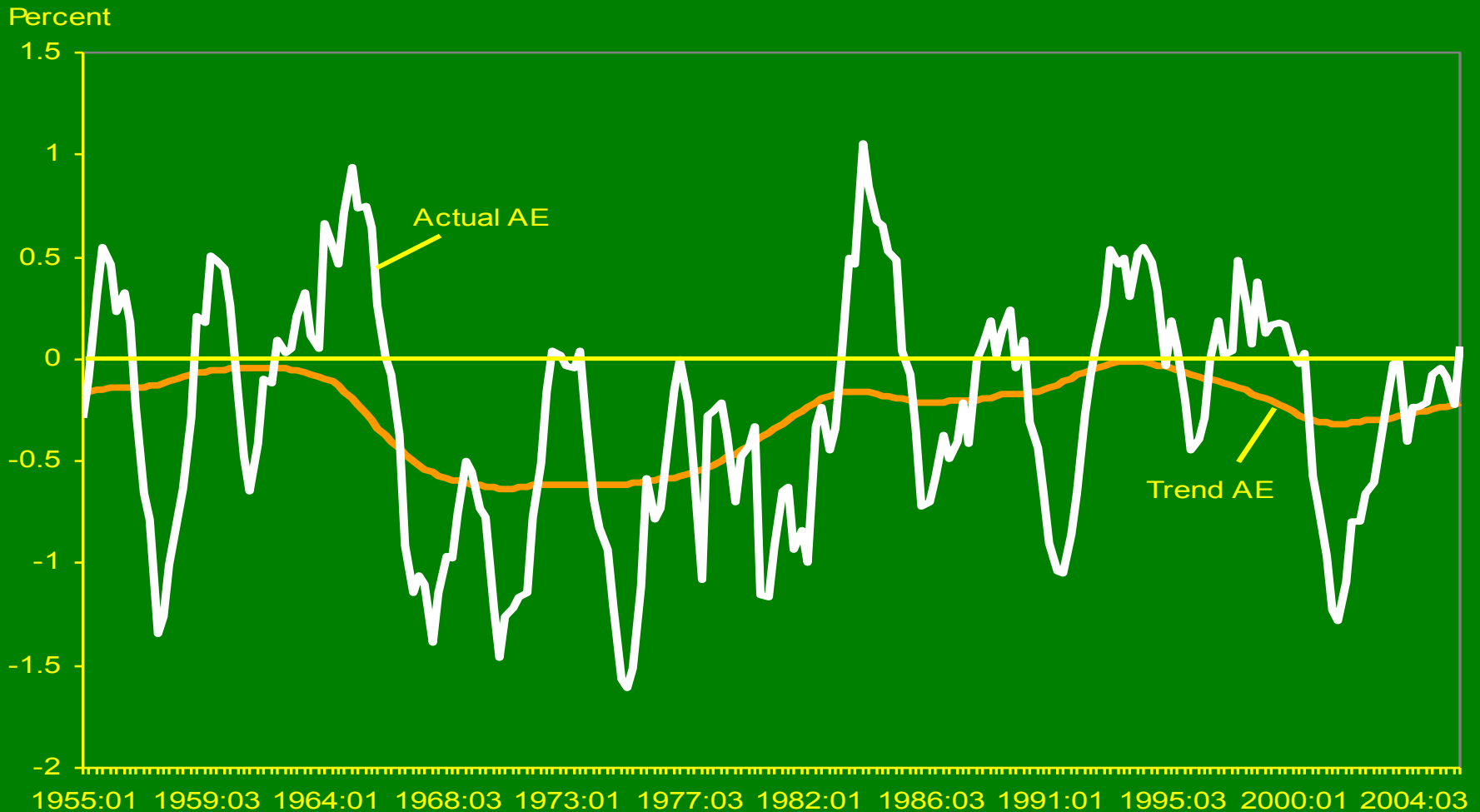
Considerations for
Hours per Employee

- This combines length of work week with percentage of vacation time

- Length of work week is partly a mirror image of the 1960-85 increase in female LFPR

- Women have been moving toward full-time jobs

- But American exceptionalism regarding the length of vacations

- Consider changing from 0.0 to -0.1 percent

The GDP Deflator / CPI Growth Differential

- Turn to table on p. 69 of 2003 TPAM Report

- Main Points

  - Soc Sec Benefits indexed to CPI-W

  - CPI-U vs. CPI-W slight methodological differences in the past, not now

  - CPI-U and CPI-W are never revised

Comparisons with CPI

- **BLS provides two indexes using current methods to assess bias in CPI in earlier years**
  - □ CPI-U-X1 uses current housing treatment, useful before 1978
  - □ CPI-RS uses current methods back to 1978
- **PCE deflator uses CPI information with moving weights**
- **1977-2000 GDP deflator grew slower than PCE deflator mainly because of computer prices**

Features of the History

- Difference between the PCE deflator and CPI-W is a major contributor to the PCE/CPI difference

- Difference between CPI-W and CPI-RS is small now (by design) but was very large in 1977-82

- Methodological improvements in CPI should have reduced differential with PCE deflator but have not

(NEW SLIDE)

- Table 2 shows the history of the deflator vs. the CPI for the same periods as Table 1

- This compares the NFPB deflator (which grows more slowly than the GDP deflator) with the PCE deflator and with the CPI

2002-06 Data to Update 2003 TPAM p. 69

- GDP Deflator   2.70
- PCE Deflator   2.53
- CPI-U   2.85
- CPI-W   2.82
- CPI-RS   2.85
- Implied CPI-W-RS   2.82

Actual vs. Trustees

- Trustees assumption has been raised from -0.3 to -0.4

- Average GDPD vs. CPIW-RS 1992-2002 was -0.34, consistent with 2003 TPAM recommendation of -0.3

- This number was only -0.12 in 2002-06

- Consider reducing the differential from -0.4 to -0.3 or even -0.2