Where did the Productivity Growth Go? Inflation Dynamics and the Distribution of Income

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Productivity Growth vs. Median Real Wages and Median Real Household Income

- Labor's share of domestic income has been basically flat between 1997 and 2005. Implies CPH growth = LP growth
- But…
  - Real AHE growth has been zero for 5 years. Median wages grew at half the rate of productivity between 1995 and 2003
  - Median family income fell for five straight years between 2000 and 2004.
  - Big gap between the growth rates of real CPH and real ECI

- **So who is getting the benefits of productivity growth?**
  - **The conflict between mean growth and median growth poses a basic question: is it a measurement issue or an income distribution issue?**

A Preview: Macro then Micro

- First we look how productivity feeds into prices, wages, and profits
  - Simple accounting identity proves that productivity growth benefits workers equally whether it cuts inflation or boosts nominal wage growth.
  - An alternative outcome is that a productivity acceleration doesn't affect prices or wages, just profits.
  - We estimate price and wage Phillips curves, emphasizing productivity growth effects on both.
- The puzzle of mean vs. median leads us to the key question: Who actually gets the wages and profits? This takes us to the IRS data

A Simple Dynamic Model, see Part II pp. 9-14

- (Explain notation, levels vs. growth rates) Labor's Share:

  $S=(W/P)/\Theta$,

  $\theta = y - h$,

  $s = w - p - \theta$

- Wages and Prices:
  - This is *not* mean-reverting

$$p_t = p_{t-1} - a(L)(\theta_t-\theta_{t-1}) + cs_{t-1}$$

$$w_t = w_{t-1} + b(L)(\theta_t-\theta_{t-1}) - ds_{t-1}$$

$$\Rightarrow s_t = (1-c-d)s_{t-1} + (a+b)(L)(\theta_t-\theta_{t-1}) - (\theta_t-\theta_{t-1})$$

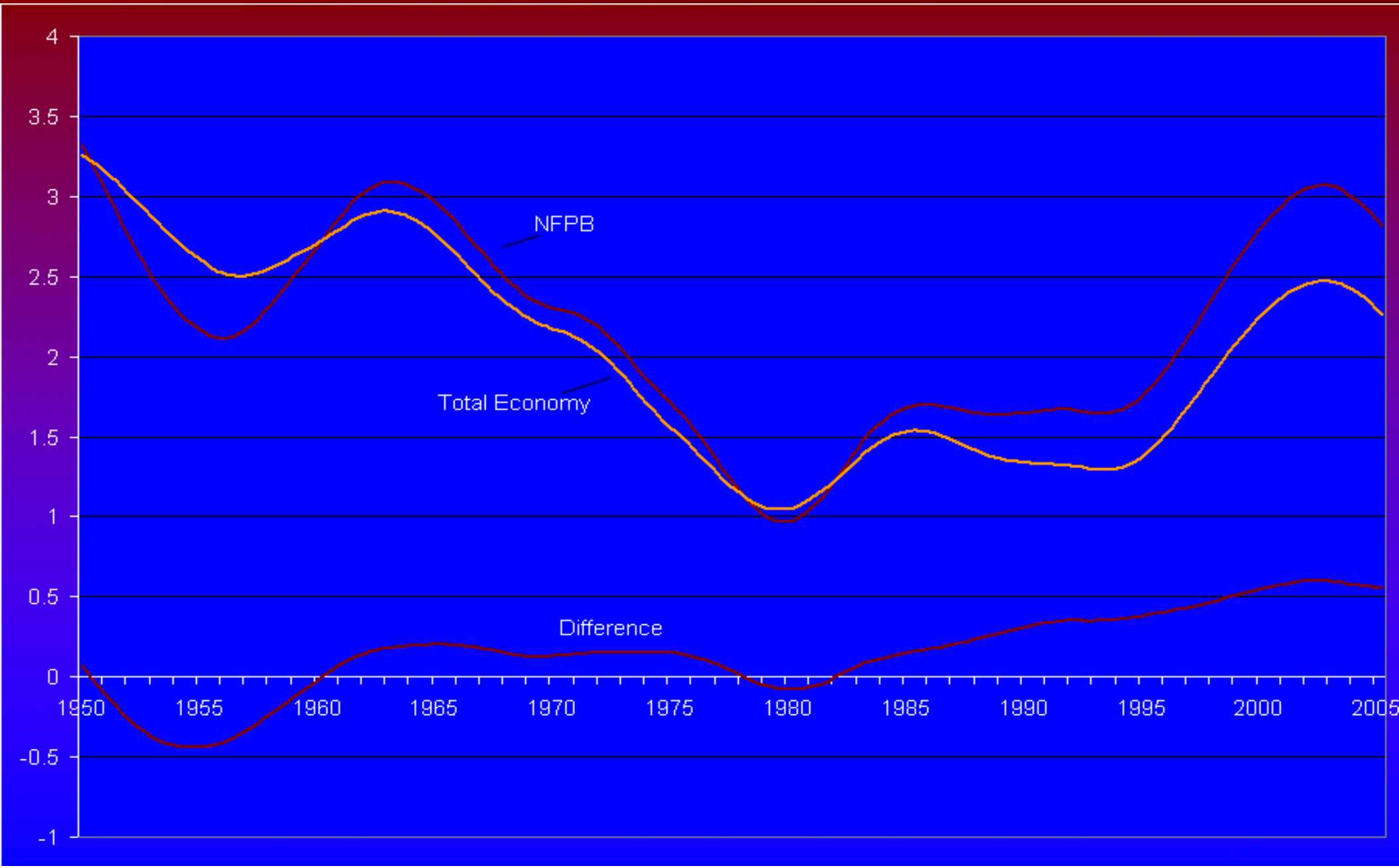
  -- s will find an equilibrium if $-1<1-c-d<1$

- Wage reactions and price reactions to productivity imply mirror reactions in s

The Enormous Discrepancy Between Productivity Growth and Real Wage Growth

- The basic puzzle: as of July 2005, NFPB productivity growth 2001:Q1-2005:Q1 was 3.89 and real AHE only grew at 0.49. How can we explain this enormous gap? Was there a massive shrinkage of labor's share?
- Explanation #1: data revisions. 2001-05 productivity growth was reduced from 3.89% to 3.44%
- Explanation #2: trend vs. actual. The H-P trend (6400 parameter) barely reached 3.0 percent when the actual 2001-2005 was 3.44%. See Figure 1.
- Explanation #3: Full economy productivity 0.5% slower than NFPB. Why? Look at Table 1 and Figure 1.

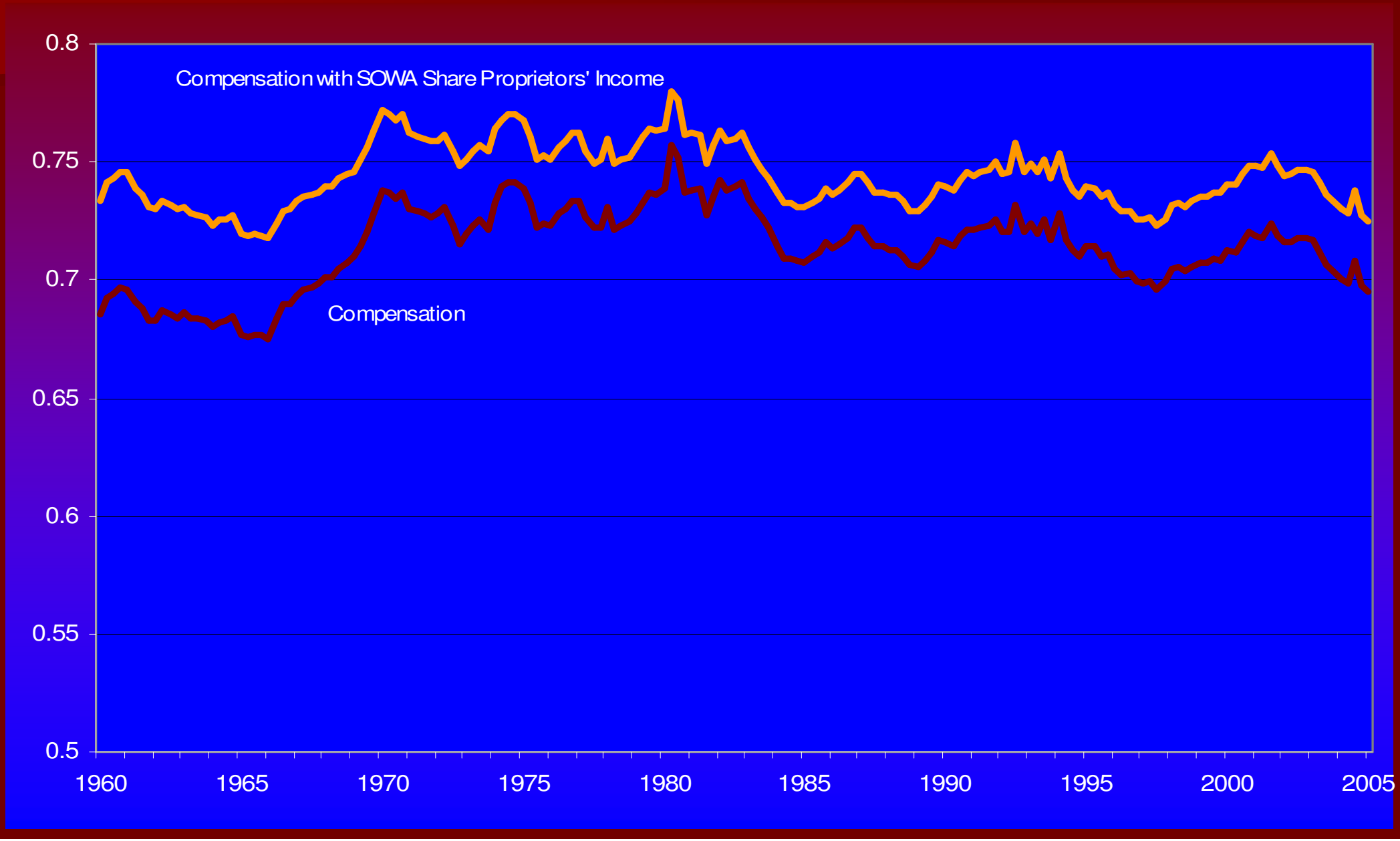
Productivity Growth in the Total and NFPB Economy, 1950-2005



Continuing the Resolution of the 3.89 vs. 0.49 Percent Requires the Micro Data Analysis

- Why have medians grown so much slower than means?
- Not just income and wealth are concentrated, but income *growth*
- 80-90% of the wage distribution does not experience growth near that implied by productivity

Labor's Share (Compensation divided by Domestic Income)



Some Things to Think About

- Apparent regime change around 1966
  - No good explanation so far
  - Our macro data analysis helps by linking labor's share increase in late 1960s to the productivity growth slowdown
- Share is similar now to 1996. Smoothly varied in small range for past 30 years
- So what's all the fuss about? It's not that capital is gaining relative to labor, it's *who* is getting labor's share

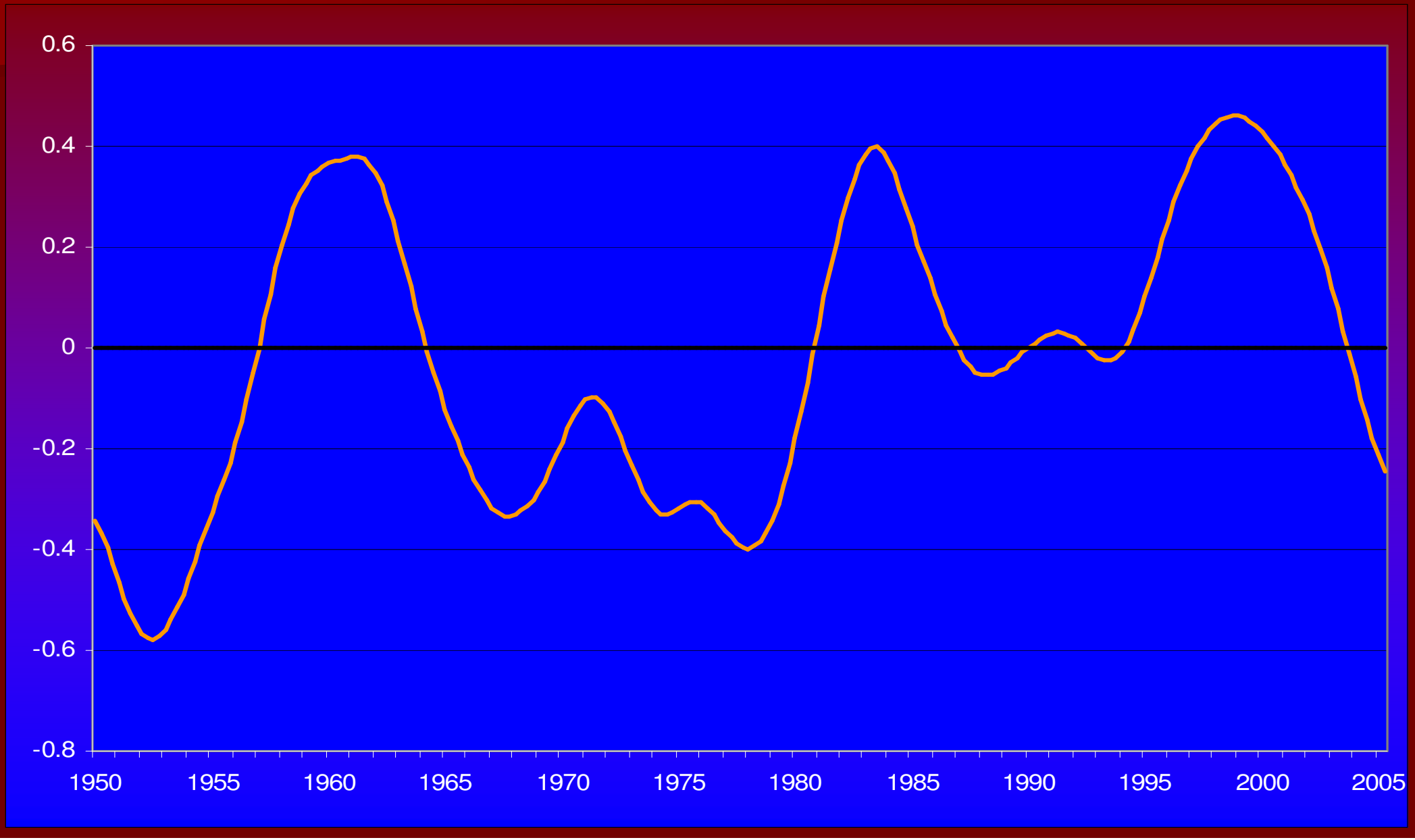
The Inconsistent Wage Indexes, see Table 2

- CPH, ECI, and AHE all tell different stories
  - AHE only covers production/non-supervisory
- ECI is smoother than CPH, but not linked to NIPA data
- 1979-2005 average growth rates from Table 2: prody 2.05, CPH 1.32, ECI 1.02, AHE 0.34
- Abraham et al. (1999) argue that most of the AHE-CPH gap is due to AHE's sample
  - Production workers not only make less, but have less growth

The Natural Rate Phillips Curve

- Natural rate hypothesis merged with supply shocks back at BPEA in the 1970s
- $p_t = a(L)p_{t-1} + b(L)D_t + c(L)z_t + e_t$
  - D is demand (unemployment), z is supply shocks, e i.i.d error
  - Restrict sum of LDV to unity, D^N_t is natural rate – implies constant inflation
  - Z_t variables defined relative to zero
- Supply shocks are food-energy, imports, medical care, 2 year change in productivity trend, Nixon dummies (what's new in this paper?)

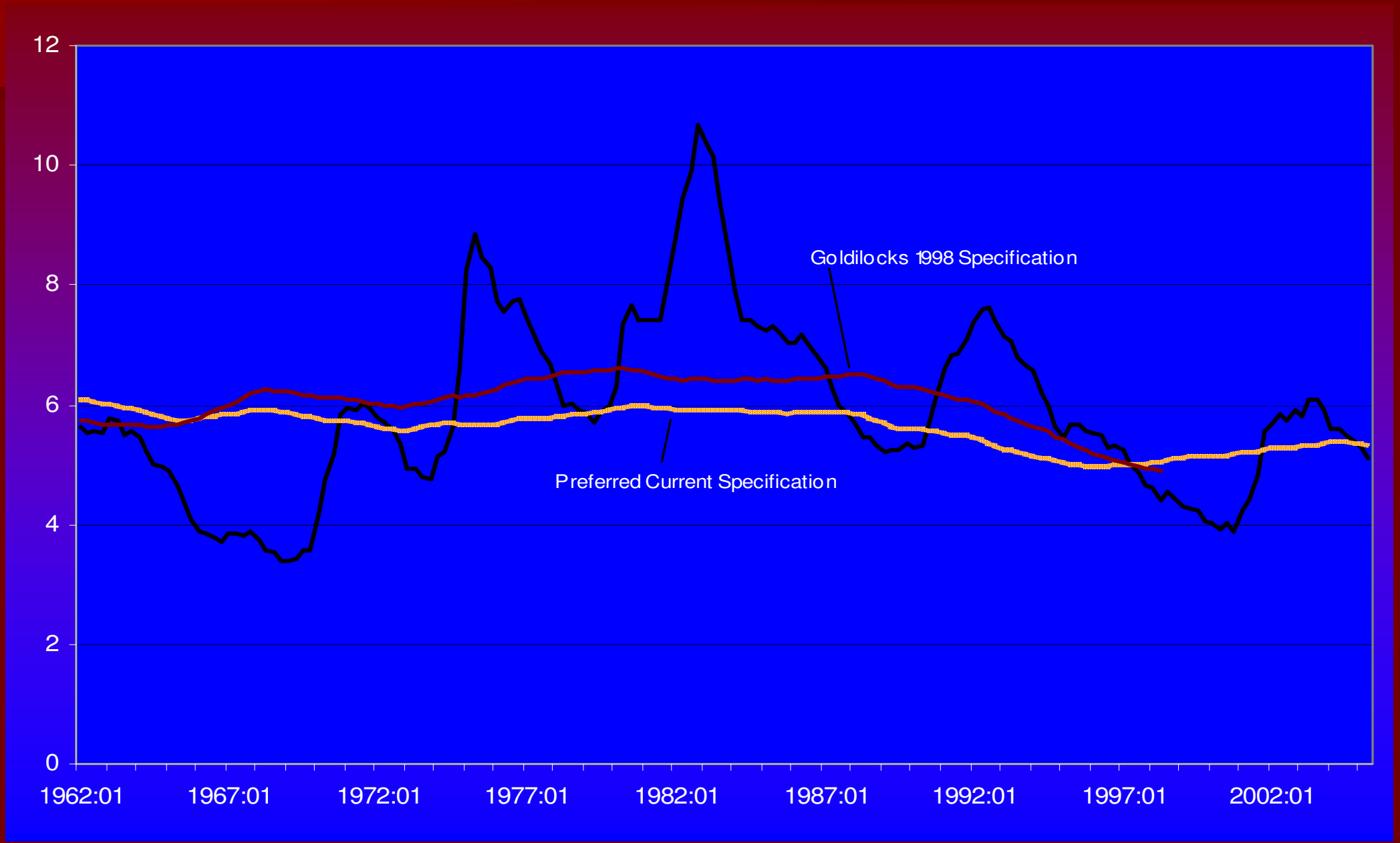
Productivity Acceleration (bottom frame Figure 5)



Allowing the NAIRU to Vary

- The Kalman smoother:
- $p_t = a(L)p_{t-1} + b(L)(U_t - U^N_t) + c(L)z_t + e_t$
- $U^N_t = U^N_{t-1} + v_t$, $E(v_t)=0$, $var(v_t)=\sigma^2$
- 2005:Q2, our natural rate is 5.3% – current unemployment is 4.9%
- Let's look at how today's estimate of the TV-NAIRU compares to "Goldilocks" seven years ago . . .

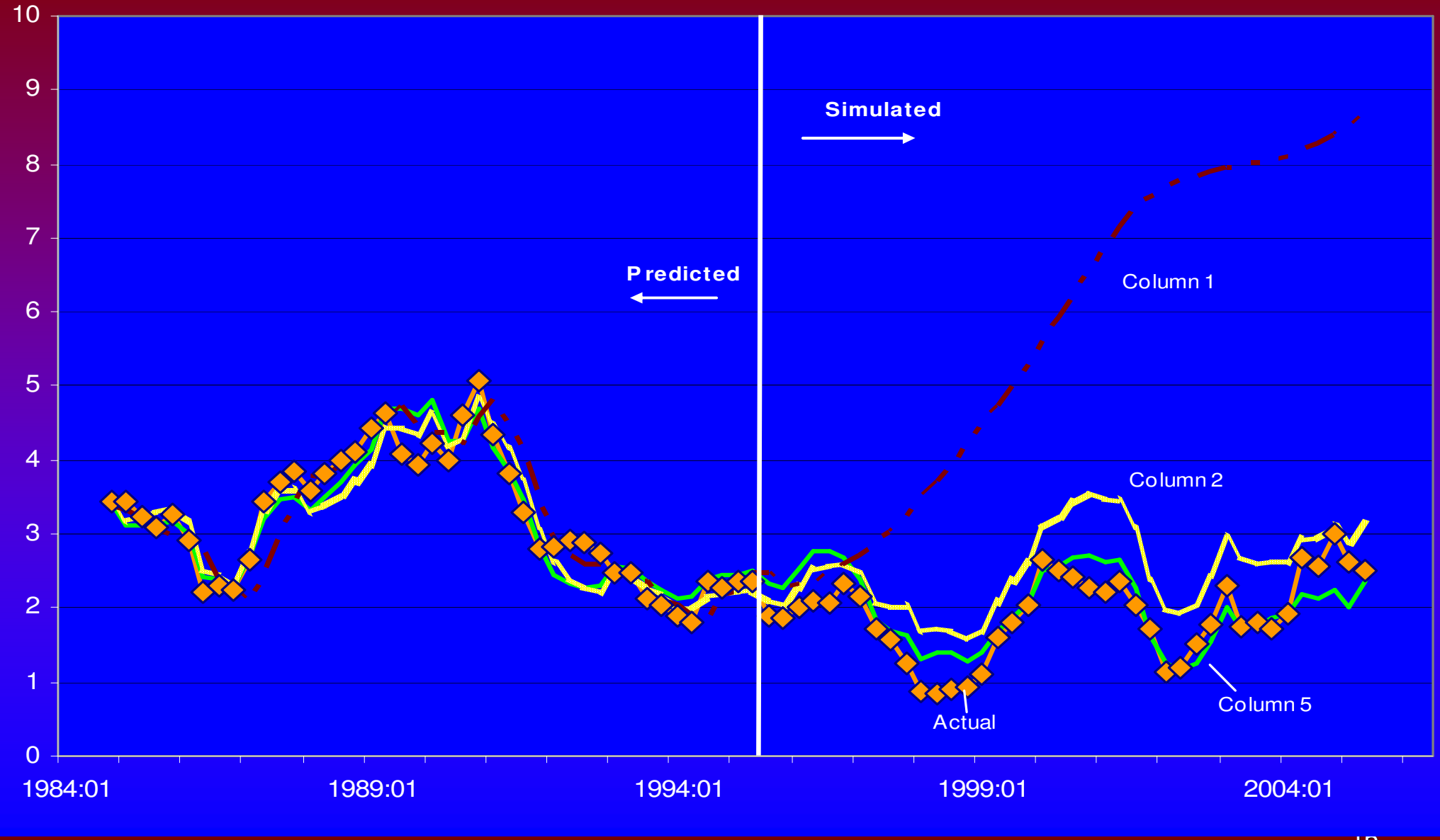
Today's TV-NAIRU vs. Goldilocks version in 1998 (Figure 7)



Inflation Equation Results, see Table 3

- Naïve Phillips curve (col 1) is soundly rejected
- Past Goldilocks version (col 2) is improved
- Preferred version is in column 5
- Productivity enters with -1.3 sum of coefficients
- Equation is completely stable
  - We allow each coefficient to change and entire equation to shift at 1983:Q4
  - No slope change except for FAE
- Simulation mean error is 0.1
- **1995-2000: Productivity growth revival lowers inflation by 0.5%**

Post-Sample Dynamic Simulations (this is Figure 6)



Wage Equations, see Table 4

- We use trend unit labor costs – change in CPH minus trend productivity growth is the dependent variable
  - *Both* CPH and LP are noisy. This paper always replaces actual productivity with trend
- Much more noise than inflation equation – R^2 drops from 0.94 to 0.57
- Simulations are ugly – mean error near 3
- Productivity acceleration significant and negative

Implied Equation for Labor's Share, see Table 5

- Difference between TULC and inflation is change in labor's share
- Lagged tls coefficients sum to -0.87 – equation is stable
- Sum of productivity terms from wage and price equations is negative
- Negative correlation with business cycle, see
  - The old countercyclical wage argument

Counterfactual Simulations (Table 6)

Table 6

Effects of Counterfactual Simulations that Impose Zero Values on Trend Productivity Change, Simulation Mean values and Four-Quarter Terminal Values, 1965:Q1-1980:Q1 and 1995:Q3-2005:Q2

Variable and Concept	Simulation 1965:Q1 - 1980:Q1		Simulation 1995:Q3 - 2005:Q2	
	Mean Change in Percent	Final Quarter 4-Quarter Change	Mean Change in Percent	Final Quarter 4-Quarter Change
A. NFPB Deflator				
1. Actual	5.34	9.39	1.55	2.31
2. Factual Simulation	5.52	9.41	1.57	2.32
3. Counterfactual Simulation	4.24	6.73	2.76	4.03
4. Factual Simulation Error (1-2)	-0.18	-0.02	-0.02	-0.01
5. Effect of Productivity Change (2-3)	1.28	2.68	-1.19	-1.71
B. Trend Unit Labor Cost				
1. Actual	5.47	8.65	1.82	3.57
2. Factual Simulation	5.49	9.07	1.61	2.66
3. Counterfactual Simulation	4.03	6.06	2.99	4.57
4. Factual Simulation Error (1-2)	-0.02	-0.42	0.21	0.91
5. Effect of Productivity Change (2-3)	1.46	3.01	-1.38	-1.91
C. Change in Trend Labor Share				
1. Actual	0.13	-0.74	0.27	1.26
2. Factual Simulation	-0.03	-0.34	0.04	0.34
3. Counterfactual Simulation	-0.21	-0.67	0.23	0.54
4. Factual Simulation Error (1-2)	0.16	-0.40	0.23	0.92
5. Effect of Productivity Change (2-3)	0.18	0.33	-0.19	-0.20

The Micro Side: Inequality and the Income Distribution

- To whom do the benefits of productivity growth accrue?
- Our contribution is a measurement of income inequality with a direct comparison to productivity growth
- Thus we focus on which percentiles of the income distribution received real income gains
- We started noting that medians grew much slower than averages. Here we uncover the nuts and bolts of why this happened

Sources of Income Inequality: IRS Microfile Data

- Cross-sectional data for 1966-2001
  - Heavily oversamples rich
  - Allows analysis of top .1% or .01%
  - 100-200,000 returns per year
- This study is based on roughly 5 million data points, a few more than the typical time series inflation equation!
- The IRS micro data file provides every type of income on tax returns – wages & salaries, rent, interest, dividends, business income, pensions
- ~90-95% of tax units file each year

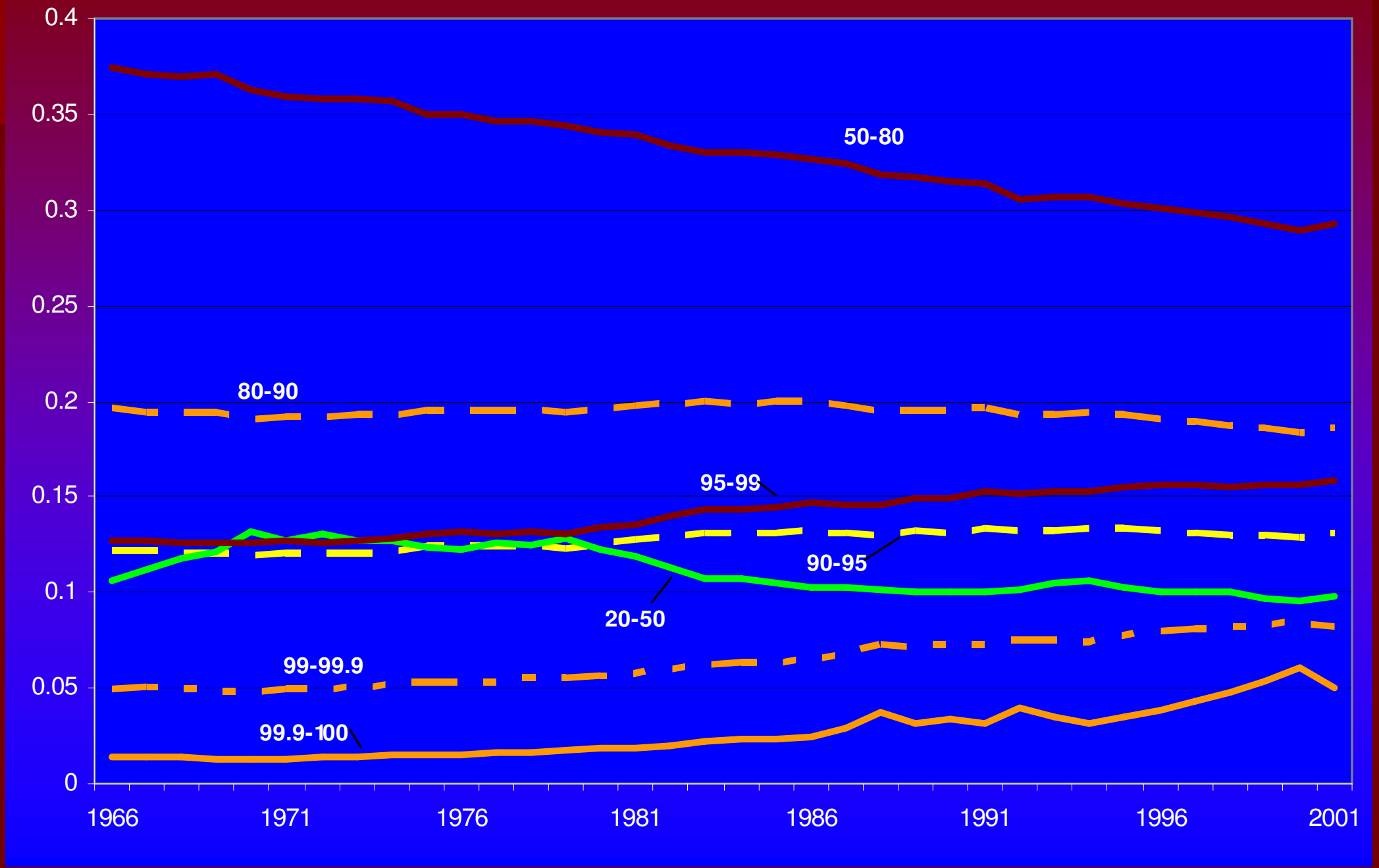
Advantages of IRS Data over CE/CPS Data Used by Others

- Other papers (except Saez) understate increase in inequality
- CE/CPS data are top-coded, e.g., $35,000+ in 1972-73 (Krueger-Perri)
- Recall bias may vary with income
- IRS data are linked to actual records, W-2s and 1099's
- What do we add?
  - Eliminating negative nonlabor income
  - Adjusting IRS income for fringe benefits and changing hours

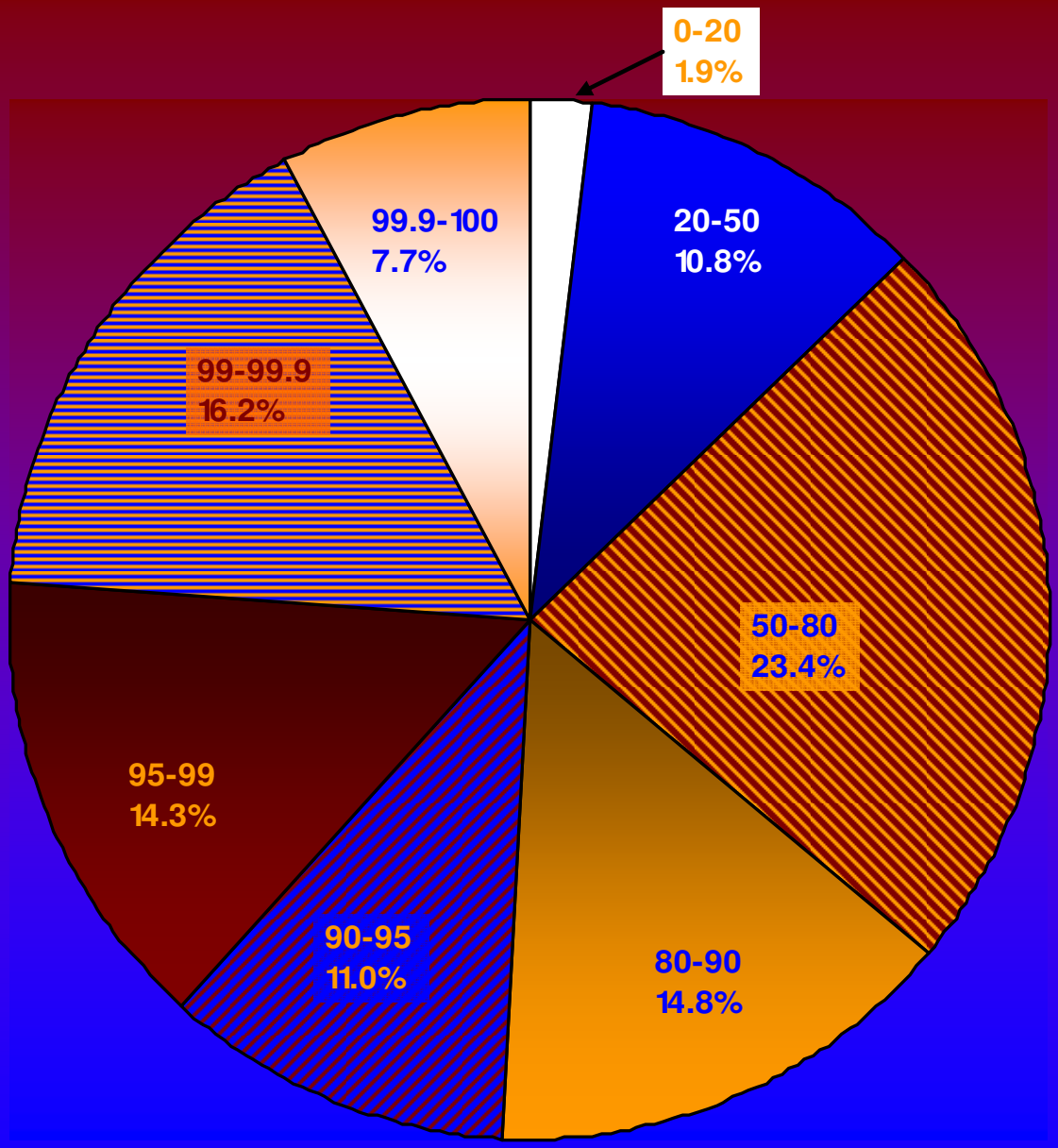
Income Shares by Quantile

- Divide distribution at 20, 50, 80, 90, 95, 99, 99.9th percentiles
- 1966-2001 trends:
  - Income transferred from bottom 90% to top 10%
  - Top 0.1% share nearly quadrupled
  - 50-80 falls from 37% to 30%
  - 80-90 and 90-95 roughly fixed

Income Shares by Quantile



Shares of New W&S, 1997-2001



What About Productivity?

- Adjust W&S upwards as wages take smaller share of compensation (~0.4%)
  - No assumption about level of W&S/Comp, just that change is same for everyone
- Add +0.22% for change in hours per tax unit
  - Assume changes in hours affect all equally
- Full economy productivity averaged 1.54%, compensation/GDP rose from 56% to 59%. Compensation should follow productivity

Almost Nobody Keeps Up

- The headline result: *only the top 10% have experienced adjusted real income gains equal to or faster than productivity growth*

- 90th percentile grows at 1.77%, 95th at 2.06%
- Everybody else slower than 1.54%
- Productivity growth has not raised median wages – adjusted growth of median is only 0.9%
- Could people be moving up across percentiles enough to account for this?

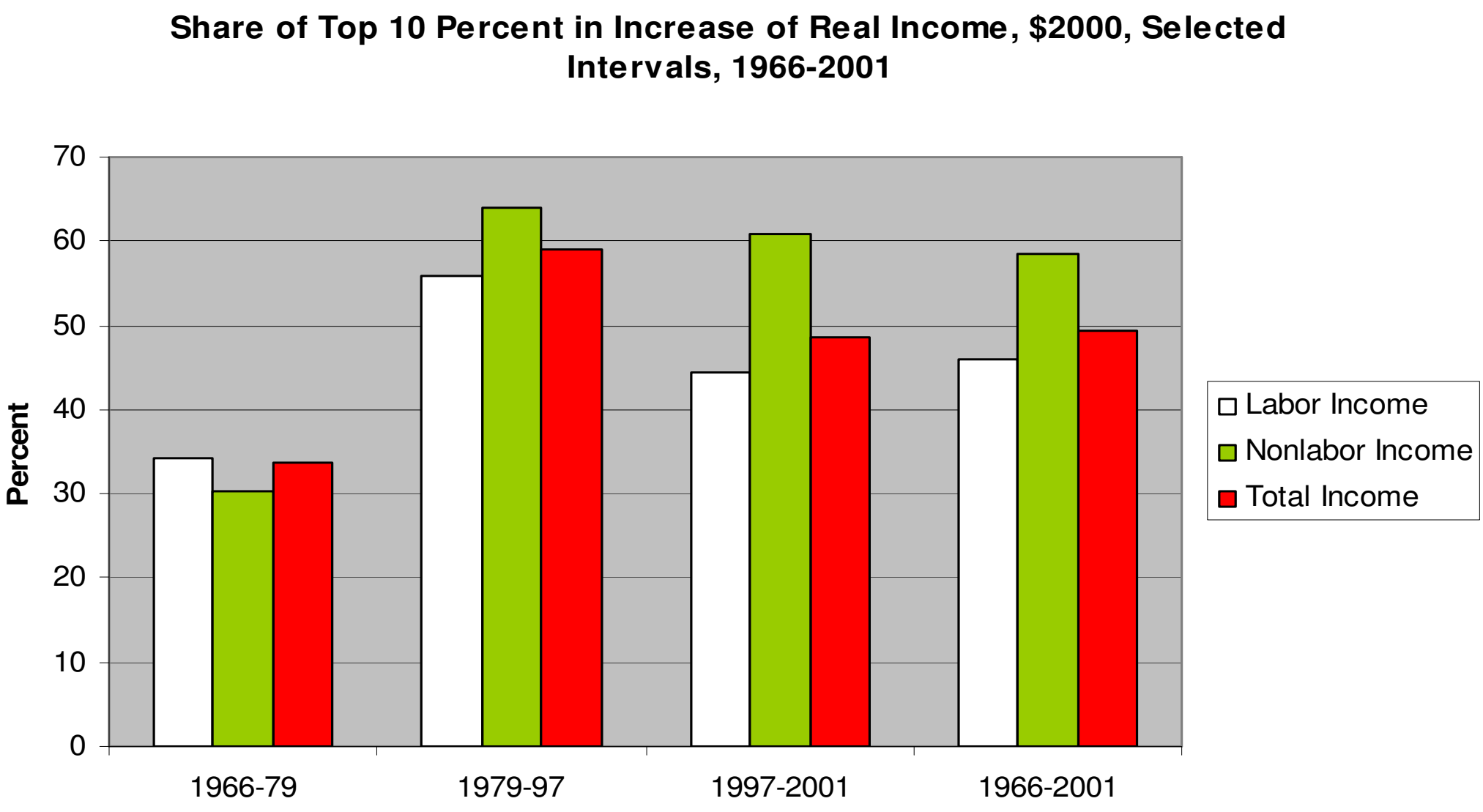
Adjusted Growth Rates

Year	Adjusted Percentiles 20	50	80	90	95	99	99.9	Percent Wage Share of Compensation
1966	7,242	23,667	42,127	52,683	63,367	99,872	220,653	90.5
1972	8,554	27,059	49,960	63,817	77,094	120,862	270,320	88.1
1979	8,916	26,402	53,717	69,531	84,790	137,918	342,009	83.7
1987	8,353	26,562	57,064	76,457	96,591	169,973	517,644	82.6
1997	8,496	26,436	58,549	82,285	108,012	215,039	692,955	83.1
2001	9,335	28,559	63,715	90,473	120,630	239,982	806,157	83.2
Percent Change	28.9	20.7	51.2	71.7	90.4	140.3	265.4	
Average Annual Growth Rate	0.73	0.54	1.18	1.55	1.84	2.50	3.70	
Hours Adjusted Growth	0.95	0.76	1.40	1.77	2.06	2.72	3.92	

Gap Between Productivity and Hours-Adjusted Growth

Years	20	50	80	90	95	99	99.9
'66-'72	1.89	1.35	1.96	2.31	2.38	2.29	2.50
'72-'79	-0.37	-1.32	0.07	0.26	0.39	0.92	2.39
'79-'87	-2.45	-1.56	-0.88	-0.45	0.00	0.98	3.55
'87-'97	-1.39	-1.61	-1.30	-0.83	-0.44	0.79	1.36
'97-'01	0.75	0.33	0.51	0.77	1.16	1.14	2.18
Average	-0.62	-0.81	-0.17	0.20	0.49	1.15	2.35

Labor vs. Nonlabor vs. Total Income



Income Mobility: IRS Panel Data, 1979-1990

- Random sample, 8,000-40,000 matches
- Enormous variation in growth rates, standard deviation 150 for adjacent years
  - Too few observations/too much variance to examine top quantiles
- Expect higher median growth than cross-sections show
- Adjusted median growth only 0.34%, vs. growth of -0.38% in cross section
  - Inner quartile range: -2.2% to 20.5%
  - Productivity growth of 1.26%

Extensions and Further Considerations

- First extension: Income Mobility
  - The Basement and Penthouse
  - While inequality was increasing, there was no change in mobility (SOWA summarizes 2002 study by Bradbury-Katz)
  - About 50% in penthouse are still there one decade later
  - About 3% make it from basement to penthouse in one decade and vice versa
- Bottom Line: Increased inequality has not been offset by increased mobility

Second Extension: Consumption Inequality

- Median income growth is slow, but we clearly consume far more now than 35 years ago
- Upward bias in CPI and hence PCE
- However, measures of consumption inequality (see Krueger-Perri 2002) do not include consumer durables, housing, health, and education, hence they understate the increase in consumption inequality
- Debate in literature: Attanasio *et al* find increase in consumption inequality in 1990s, overturn Krueger-Perri findings

Third Extension: Sources of Increased Income Inequality

- The top and the bottom are pulling apart
- At the bottom:
  - Reduced fraction of unionization
  - Immigration
  - Free trade, imports
  - Lower real minimum wage (not in paper)
- What about the top 1 percent?

The leading hypothesis in the Economics Literature is Skill-Biased Technical Change (SBTC)

- Why is this plausible theory wrong?
- Look at occupational distribution of income gains (SOWA 2002-2003)
  - Fully half (49%) of income gains in the occupational group "managers"
  - Almost none in occupational groups related to computers
- Our conclusion supported by Card-DiNardo (*JOLE* 2002), published out of our discussant's office
  - "The evidence linking rising wage inequality to SBTC is surprisingly weak"

Further Doubts on SBTC

- Why hasn't Europe experienced the same increase in inequality?
- Inequality increased fastest between 1977 and 1992, exactly when productivity growth was slow
- Analysis shows income moved to top 5% of distribution, smaller group than SBTC implies
- CEO compensation rose 100% between 1989 and 1997, whereas math and computer sciences occupations rose only 4.8%

The University of Chicago Has the Answer

- Sherwin Rosen on the "Economics of Superstars"
- Entertainment and sports stars, technical change in a different form, increasing the audience (cable TV for sports, worldwide distribution for movies)
- Superstars include top-paid lawyers, doctors, even economists who refuse to leave Harvard when offered megabucks to go to Columbia

Conclusions and Further Research

- A Productivity acceleration reduces inflation and unit labor costs
  - Ambiguous effect on labor's share, more precise research needed
  - Productivity slowdown of 1965-79 added to inflation acceleration of 1970s (along with FAE, imports, unwinding of Nixon controls)
- Not just income and wealth are concentrated, but real income *growth*
- Not just true of capital income, also of wage and salary income
- 80-90% of the wage distribution does not experience growth near that implied by productivity growth