

**Potential Output:
Its Recent Behavior
and Future Growth**

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Northwestern University and NBER
WEAI Annual Meeting
San Francisco, July 1, 2019**

The Great Debate

About Future Growth

- How Fast Will Potential Real GDP Grow Over the Next Decade?
- The CBO predicts 1.9% p.a. 2018-2028
- The Fed has endorsed the same 1.9% as recently as its projections of June 19
- But the Administration and the *ERP* forecast 3.0% growth forever
- Both can't be right, but maybe *both* wrong
- The outcome matters for future standard of living, debt/GDP ratio

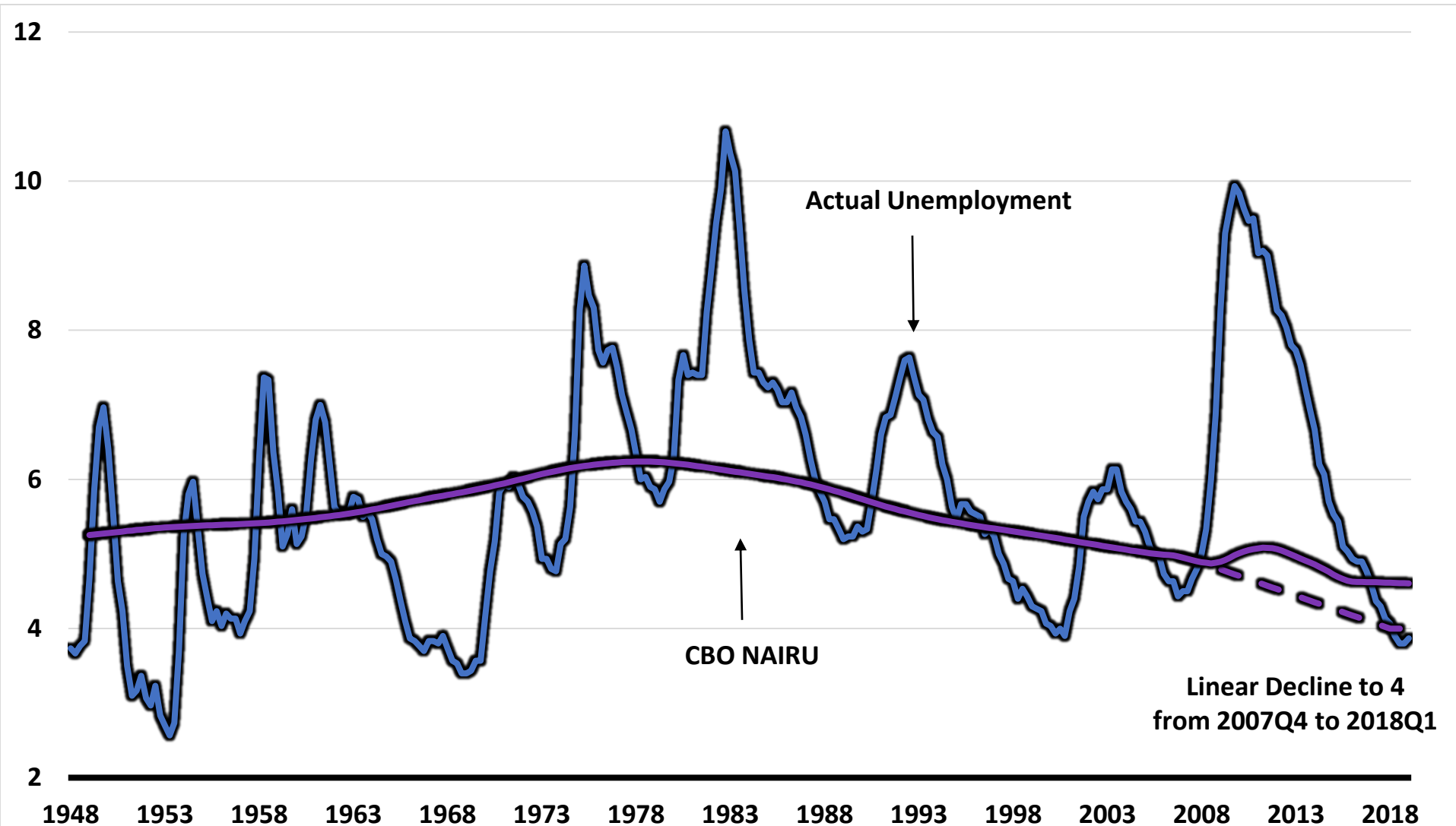
The Questions for Today

- **How Fast Has Potential Output Grown Since 2007? More Recently Since 2014?**
- **How Fast Will Potential Output Grow?**
 - **Puzzle #1, Future Labor Force Participation**
 - **Puzzle #2, Future Productivity Growth**
- **To Forecast Productivity Growth, We Have to Determine Why It Has Been So Slow**
- **Which Explanations Are Convincing? What Do They Imply for the Future?**

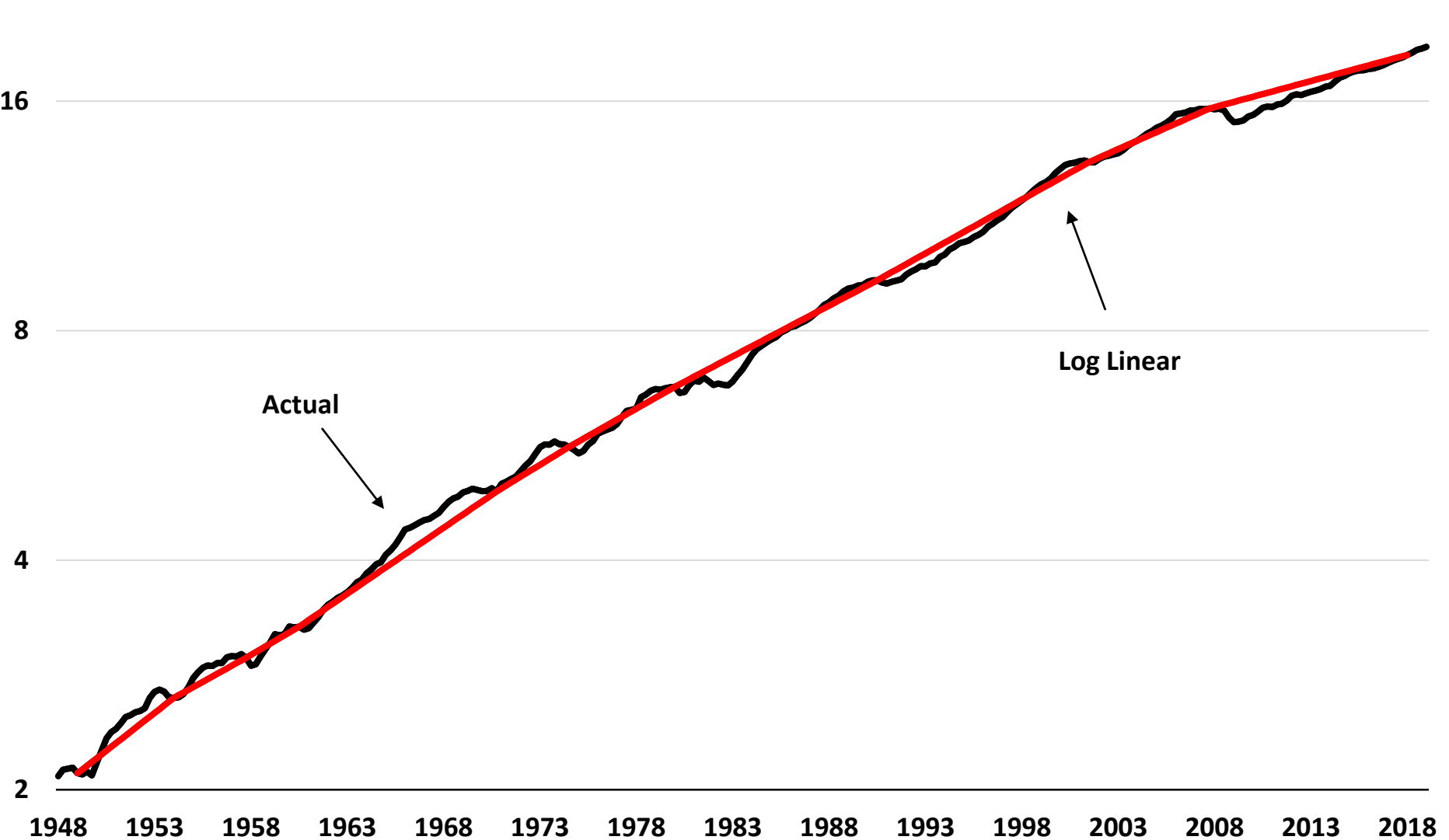
Measuring Potential Output

- Every Reference Here to Output is to the **AVERAGE** of GDP and GDI
- Output is at Potential when Unemployment is at the NAIRU, defined as a condition of stable inflation
- The output gap is zero when the unemployment gap is zero
- So measuring potential output starts with the NAIRU

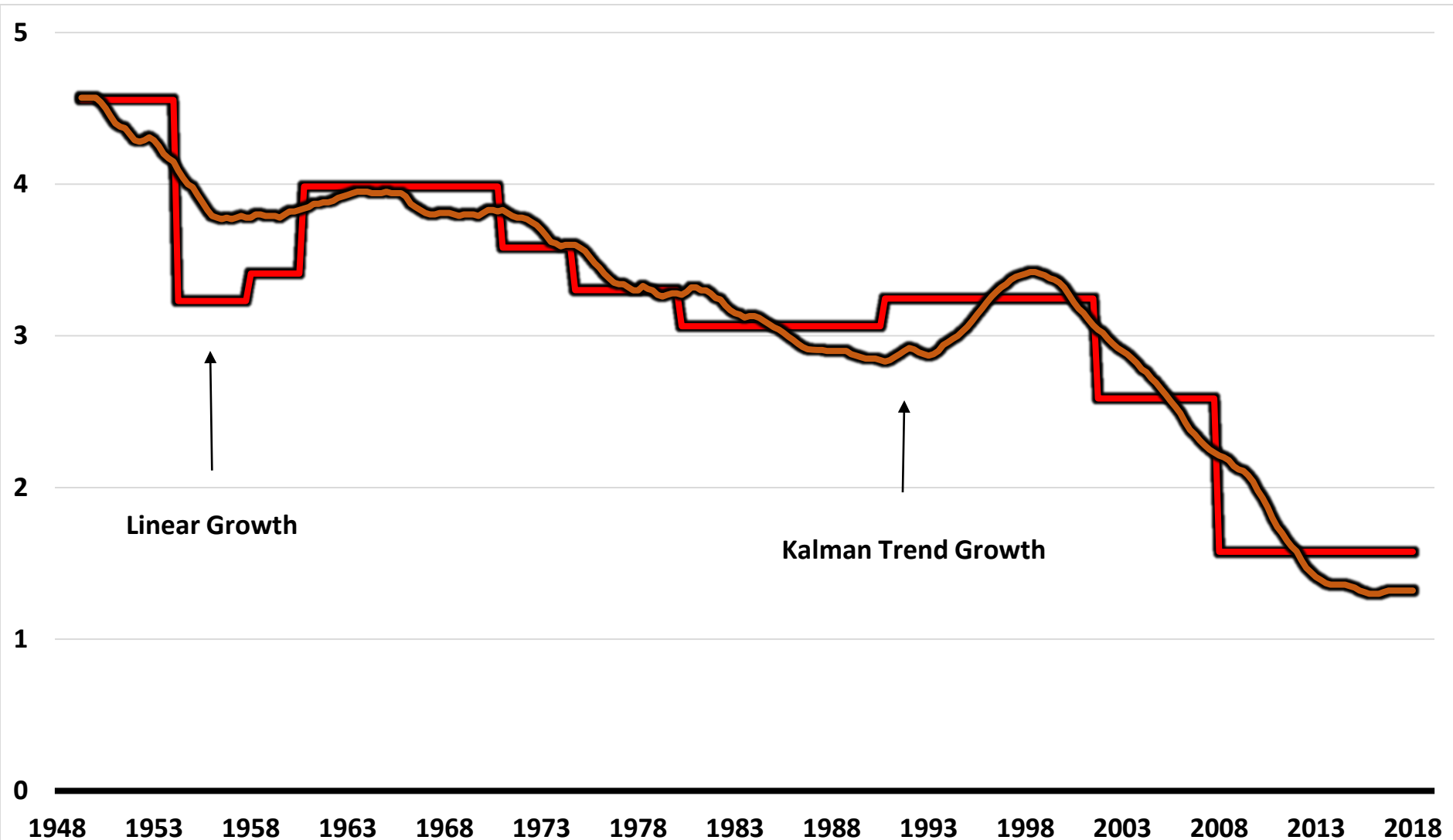
The CBO Long-run NAIRU, 1948-2018, Adjusted Down for 2007-2018



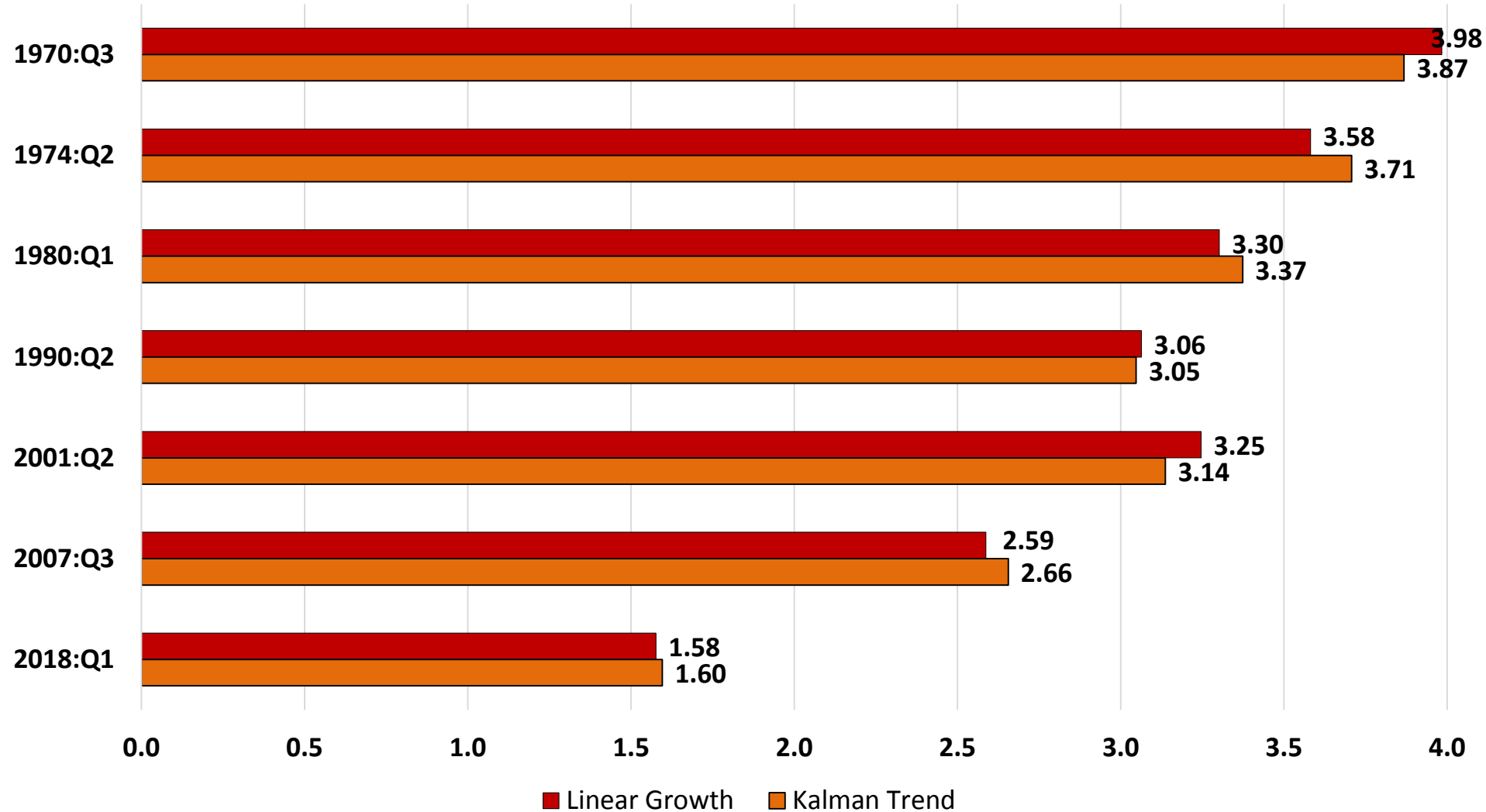
Take End-of-Expansion Quarters with Zero Gap and Connect Them



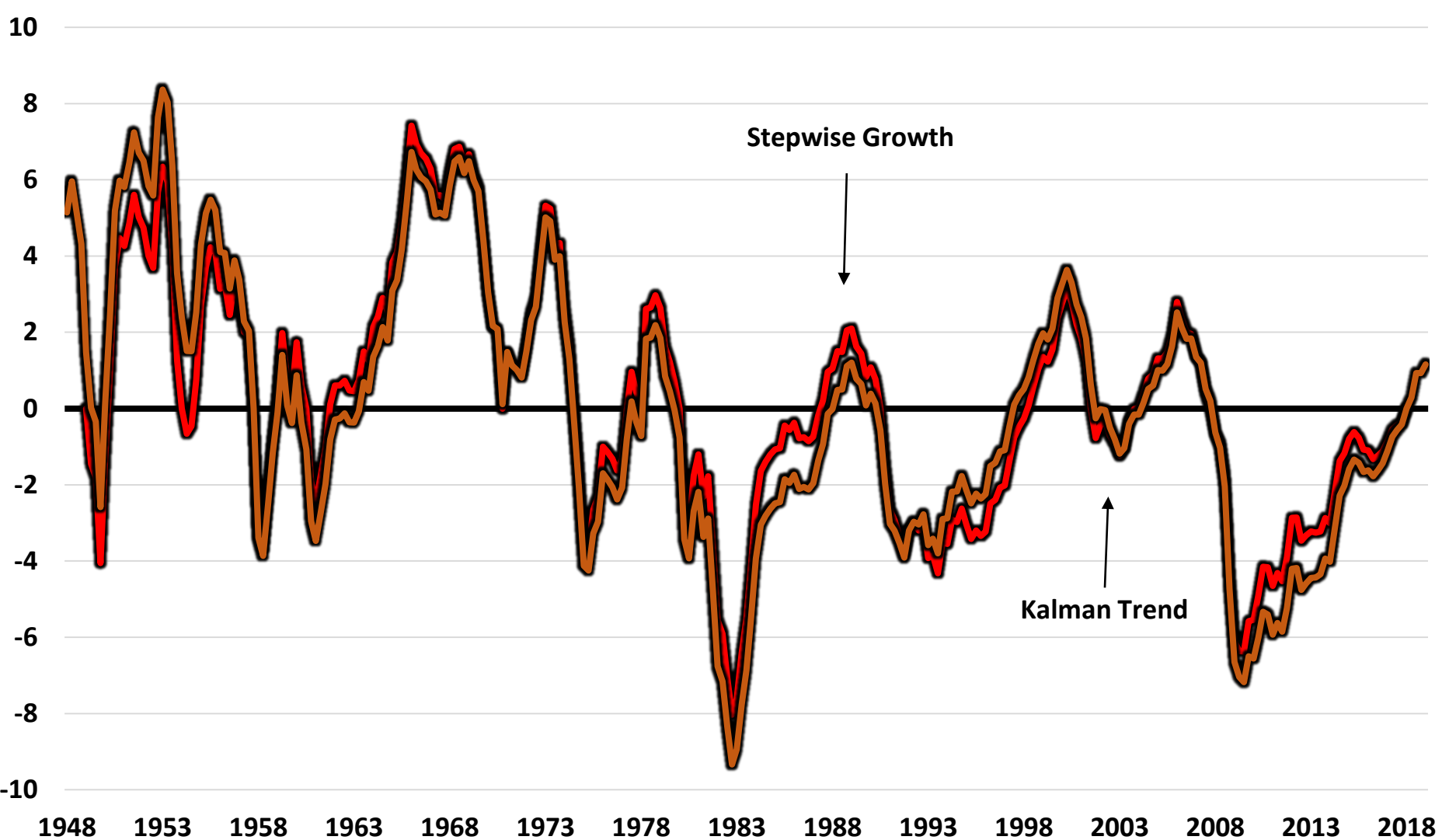
Alternative to Stepwise Series, Preferable to Use Kalman Filter



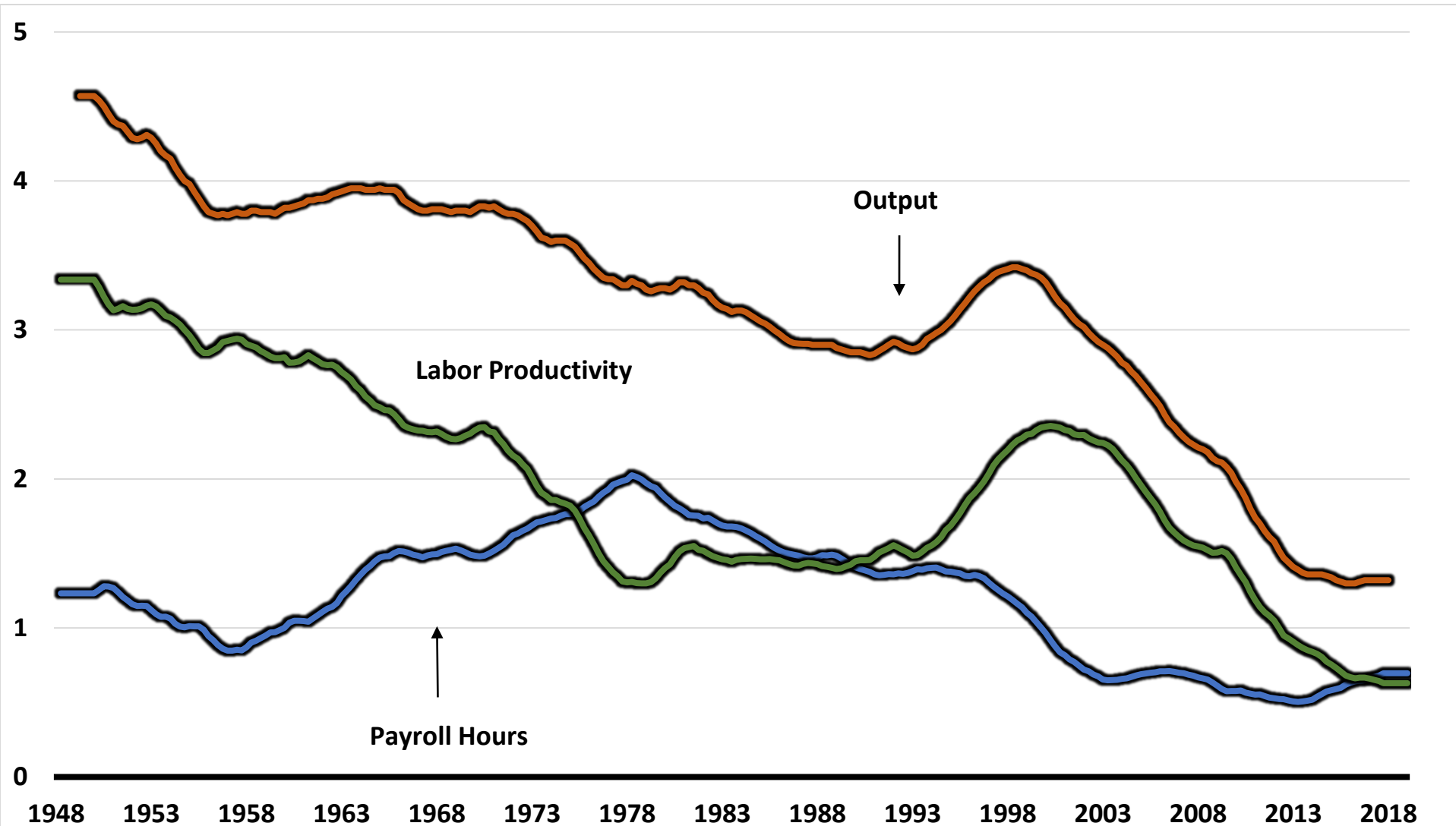
For All Business Cycles Since 1960, Both Methods Give Same Answer



The Output Gap? Both Methods Provide the Same Answer



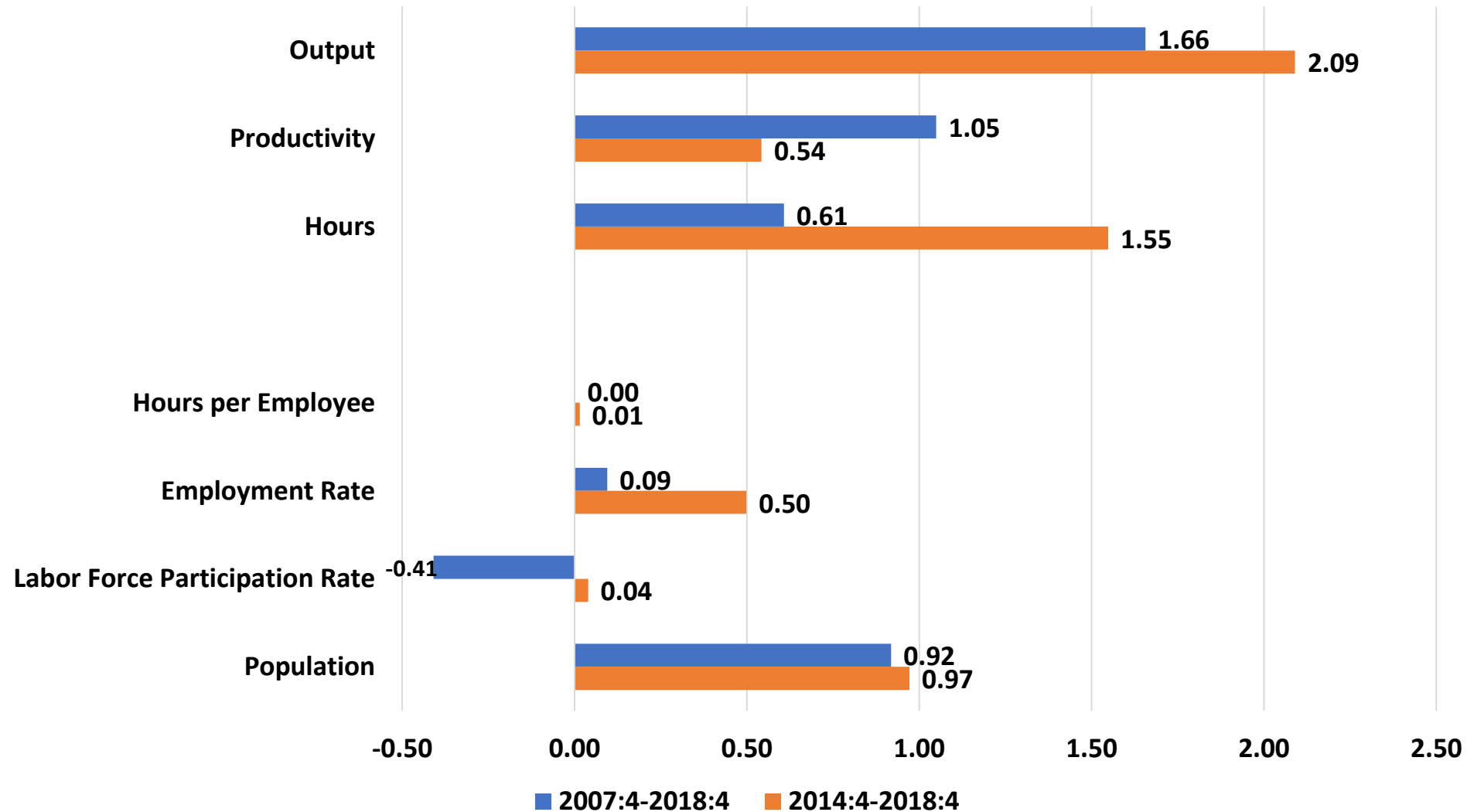
Output Trend Divided between Trends in Productivity and Hours



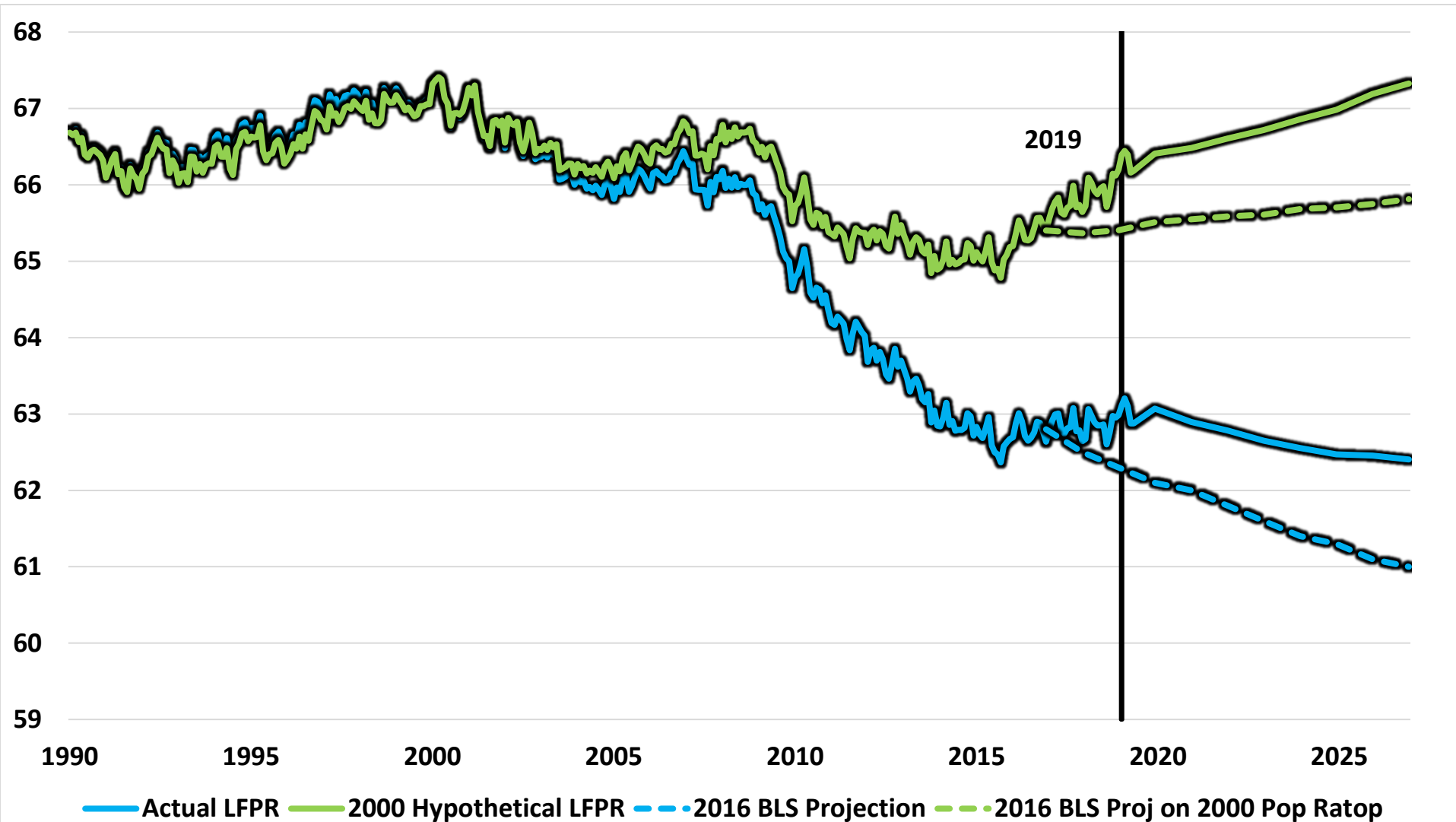
Decomposing Potential Output Growth

- **Output Growth Equals Productivity Growth plus Hours Growth**
- **Hours Growth Consists of**
 - **Hours per Employee**
 - **Employment Rate (Zero for Potential Output)**
 - **Labor Force Participation Rate**
 - **Population Growth**
- **CBO to 2028: 0.5 Hours, 1.4 Productivity**

The Anatomy of Output Growth, 2007-2018 and 2014-2018



How Baby-boom Retirement Has Changed the LFPR, 1990-2026



My Optimistic Adjustments to BLS Projections

- **Four age groups (16-24, 25-54, 55-64, 65+)**
- **My adjustments**
 - **End of declining LFPR for 16-24**
 - **Continued recovery of 25-54 halfway back from now to 2000 peak**
- **Result?**
 - **BLS 2019-2026 -0.48 percent**
 - **My alternative -0.16 percent**

Implications for Potential Output

- CBO has 0.5% hours and 1.4% productivity growth.
- Their 0.5% hours growth combines 0.9% population growth and -0.4% LFPR change
- My alternative, 0.75% hours growth with the same 0.9 % population growth and -0.15% LFPR change
- Ignores any change in hours / employee, since there was zero change 2007-2018
- And by definition of potential output, zero change is assumed for the employment rate

The Big Puzzle: Productivity Growth

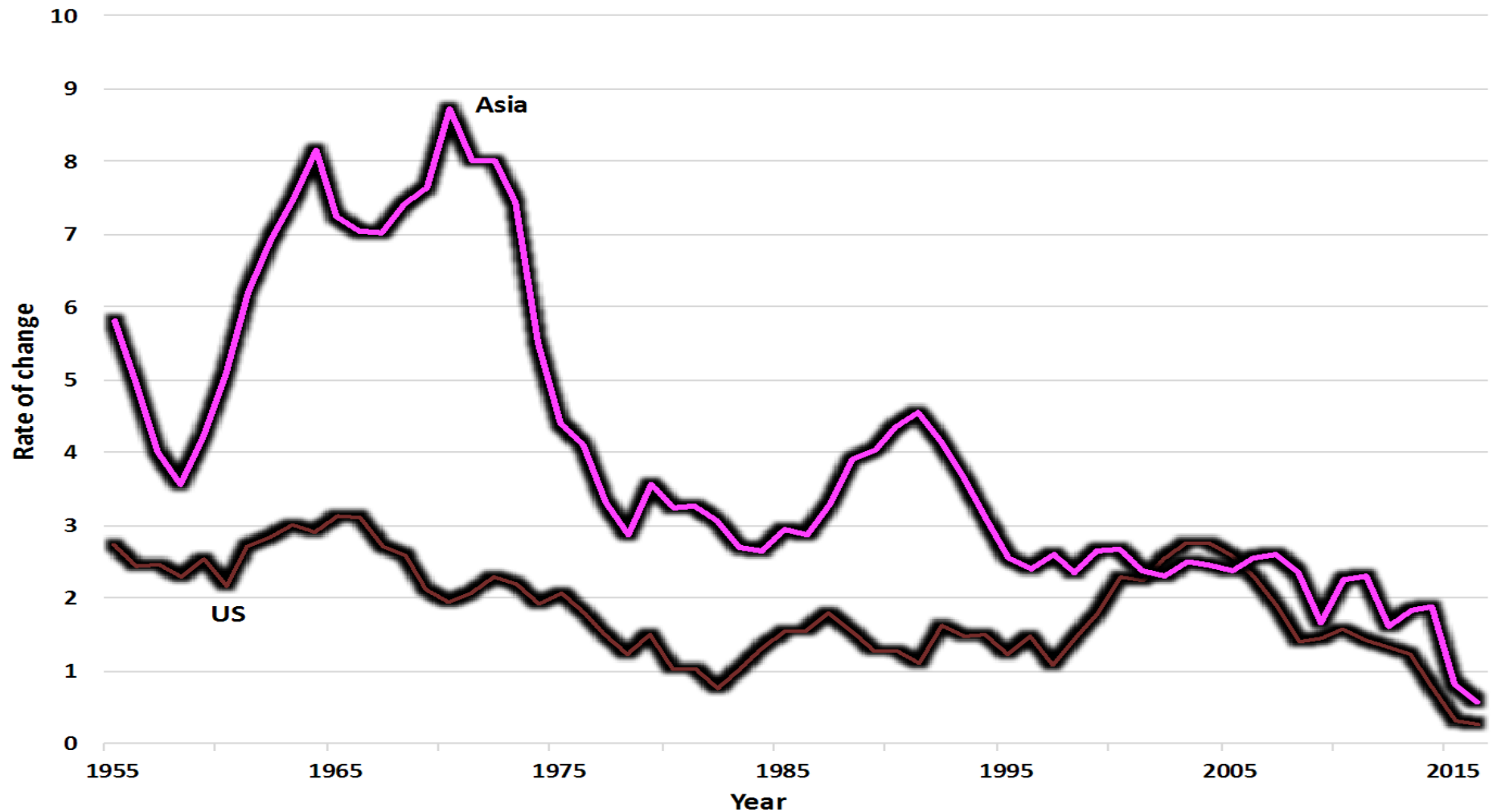
- **Actual data, not trend estimate: Total economy 0.48% 2010:Q4 – 2017:Q4**
- **Which Hypotheses are Convincing?**
- **Will Investment Come to the Rescue?**
- **Interpretation of 2018 Revival: Just procyclical or a revival of trend?**
- **Prospects for a turnaround of innovation**

Assessing Alternative Explanations of Slow Productivity Growth 2011-17

- To be convincing, an explanation must explain why productivity growth was fast 1995-2004, slow after 2010**
- Explanations relying on gradual change cannot explain this timing – e.g., rising concentration**
- To be convincing, an explanation must explain why slowdown was worldwide among developed countries**
- A US-centric explanation like increased regulation under Obama doesn't explain others**

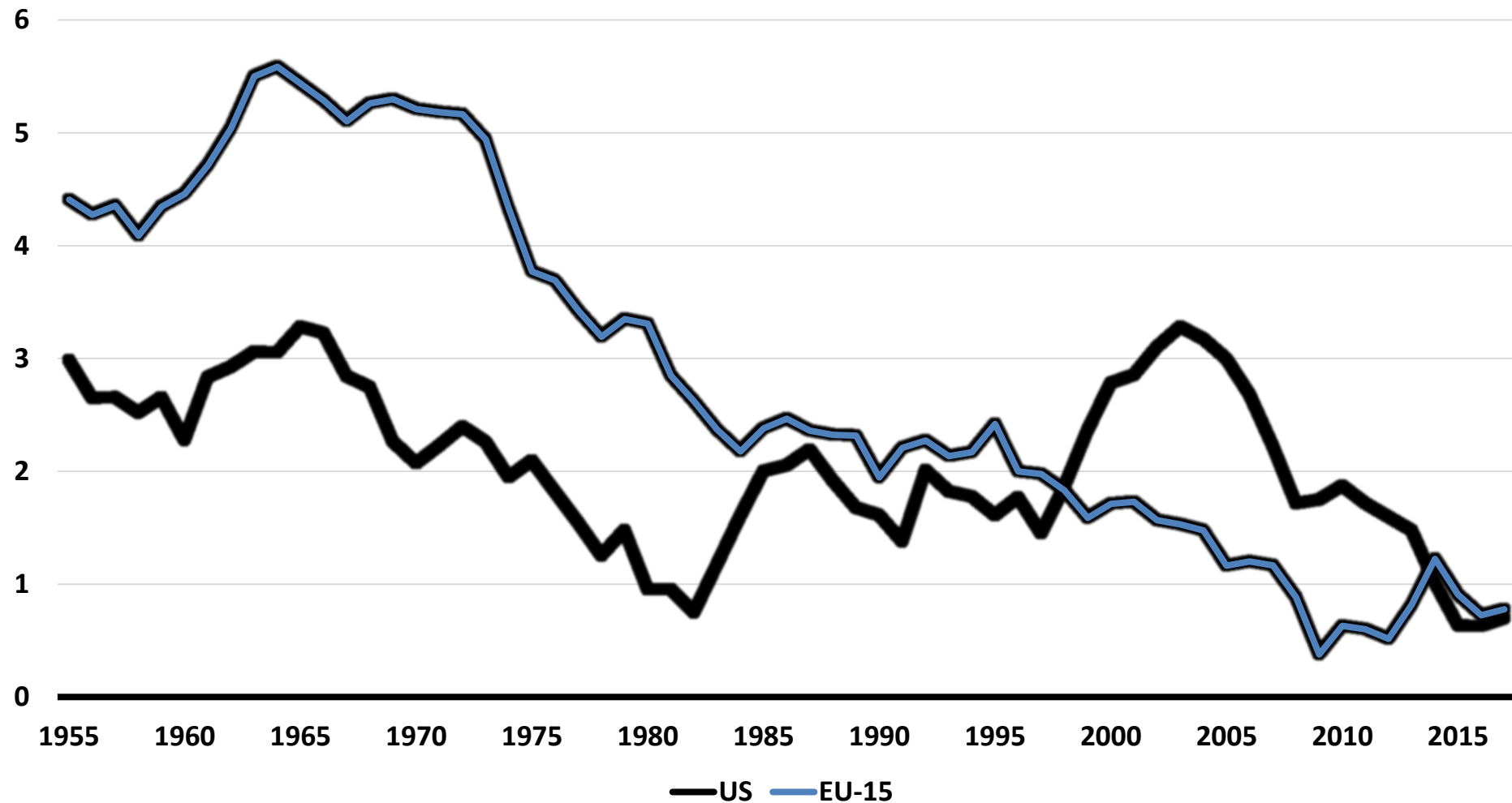
Productivity Growth, US vs Developed East Asia, 1955-2017

Output / Hours, 5-year moving rate of change (US, Asia)



Productivity Growth, US vs. W. Europe (EU-15), 1955-2017

US vs. EU-15 Labor Productivity Growth, 1955-2017



The Leading Hypothesis: Diminished Impact of Innovation

- **U.S. Productivity Growth nearly 3% for five straight decades, 1920-1970, then slowdown to 1.3%. Influence of “Great Inventions”**
- **Digital revolution boosted growth back to 3% for only 8 years, 1996-2004**
- **By 2005 the transformation of office work from paper, typewriters, and file cabinets to flat screens and the internet had been completed**
- **The retail revolution based on big box stores, bar-code scanning, and computerized inventory management was largely finished**

Has Innovation Declined Since 2005?

No, But Lower Impact on Business

- **Diminished Impact of Innovation**
 - The past decade: smartphones and tablets
 - Large unmeasured reductions in costs of photography, communication, information
- **Changed consumers lives without changing business methods of production**
- **Phones are imported, which limits the effect of price index bias on GDP**
 - Import share of IT equipment has increased from 30% in late 1990s to 90% now

Bloom *et al.*: Ideas Are More Costly to Find

- **Moore's Law, computer chips, research productivity has fallen by a factor of 18 since 1971**
- **Research productivity in agriculture has declined by 4 to 6% per year since 1960**
- **Research productivity in curing diseases has declined by between 5 and 10% per year since 1970**
- **"It takes 15 times more researchers as 30 years ago to produce same rate of firm revenue growth"**

Slower Growth of Educational Attainment

- **Timing and Across Countries**
- **Higher educational attainment raises labor quality, a contribution to productivity growth**
- **From 1900 to 2005, increased labor quality boosted productivity by 0.3-0.4% annually**
- **Since 2012, closer to 0.0-0.1%**
 - **End of improvement in HS completion**
 - **Slower rise of college completion**
 - **40% of college graduates can't find jobs requiring a college education**

Concentration and Business Dynamism

- **Rising Concentration**
 - Record high profit share, high markups
 - Top 1% firms share of patents 35 to 50%
 - Less pressure on top firms to compete by raising productivity
- **Declining Business Dynamism**
 - Falling share of business startups
 - Declining contribution of reallocation to growth
- **Problem: these changes are gradual trends and don't account for the 1996-2004 revival**

The Measurement Explanation

- **Everyone agrees price index bias forever, but it was roughly constant over decades**
- **Didn't disappear 1996-2004, then balloon after 2004**
- **Consensus View**
 - **Byrne, Fernald, Reinsdorf (2016)**
 - **Syverson (2017)**
- **For GDP (as contrasted to consumer welfare)**
 - **End of Moore's Law, slower price decline**
 - **Smaller share of domestic IT manufacture**
 - **Upward biased import price indexes mean greater growth in real imports**

Other Unconvincing Explanations

- **Burdensome regulations**
 - Requires shift from no regs 1996-2004 to burdensome regulations 2011-17
 - Not that much contrast Clinton vs. Obama
 - Occupational licensing and land-use regulations at state and local level
- **High taxes replaced by Trump tax cuts**
 - Clinton raised taxes in 1997 yet economy achieved its dot.com investment and productivity boom
 - Corporate reaction to Trump tax cuts has been largely to raise dividends and stock buybacks, little response so far of investment

Future Potential Growth Depends on Productivity Growth

- **Range of possibilities for total economy**
 - **2011-2017 0.48%**
 - **Kalman trend 2018:Q4 0.61%**
 - **CBO projection 1.4%**
- **Reasons for outcome above 2011-17**
 - **2018 outcome 4-qtr average 0.9%**
 - **Possible investment boom**
 - **Future influence of AI, robots, autonomous vehicles**
 - **Productivity trend has unexplained ups and downs, adjustment lags**

Interpreting the Revival in 2018

- **Productivity growth rose from 2011-17 0.5% to 0.9% in 4 quarters ending 2018:Q4**
- **Two classes of explanations**
 - Increased gap due to procyclical response to faster demand growth
 - Faster trend
- **Determine mix of the two via regression of gaps**
 - Regression indicates normal procyclical response explains all but 0.1% of 2018 rise
 - Resulting error implies trend increased 0.6 to 0.7%

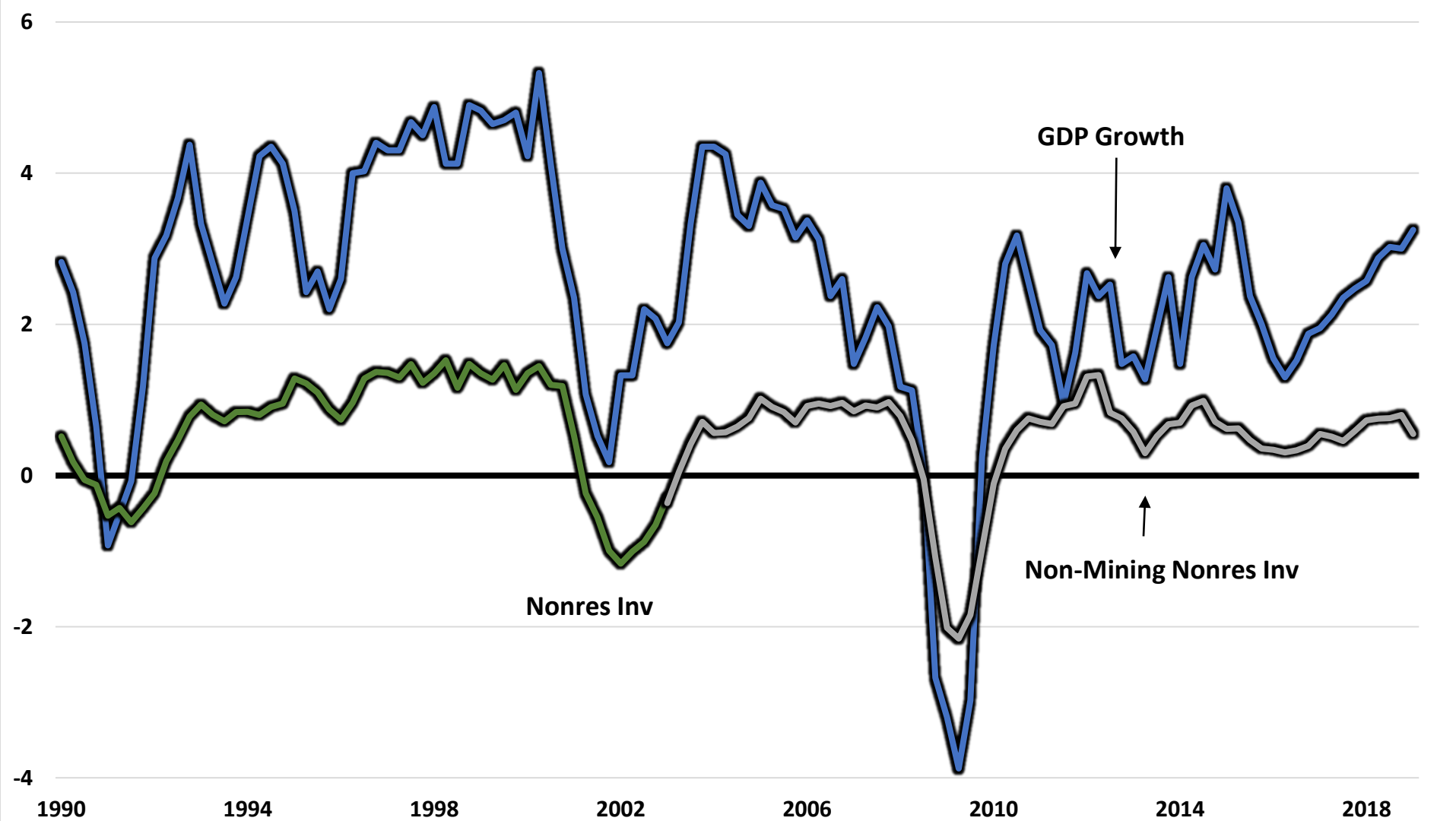
Role of Investment

- Productivity growth equals TFP growth plus contribution of capital deepening
- More of slowdown associated with TFP than with investment (**business sector not total economy**)

	1996-2004	2011-2017	Diff
Productivity	3.3	0.7	2.6
TFP	1.8	0.3	1.5
Cap deepening	1.5	0.4	1.1

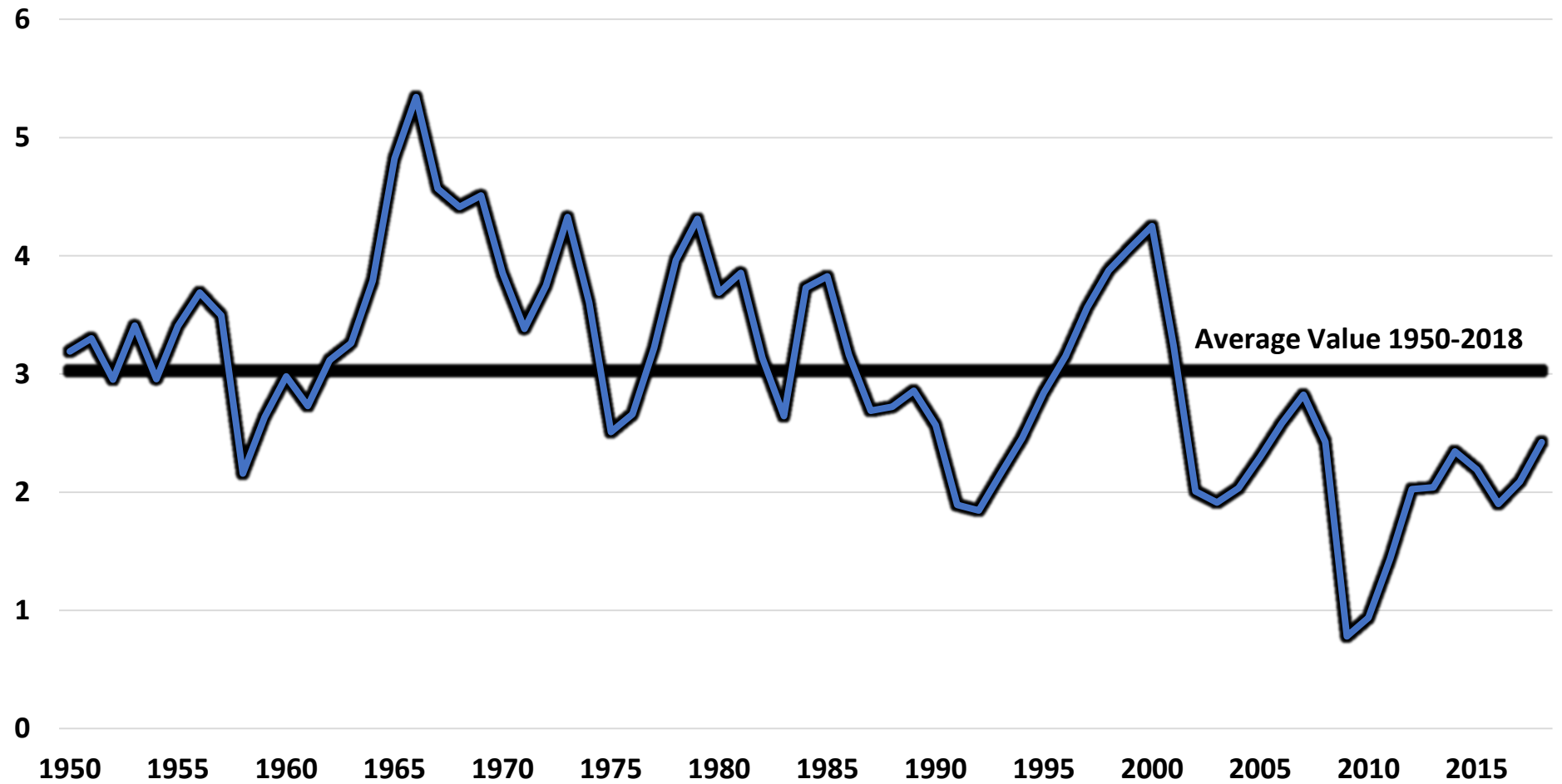
- It would take a return of investment to late 1990s levels to boost productivity growth by 1%

GDP Growth and Contribution of Fixed Nonresidential Investment. 1990-2019



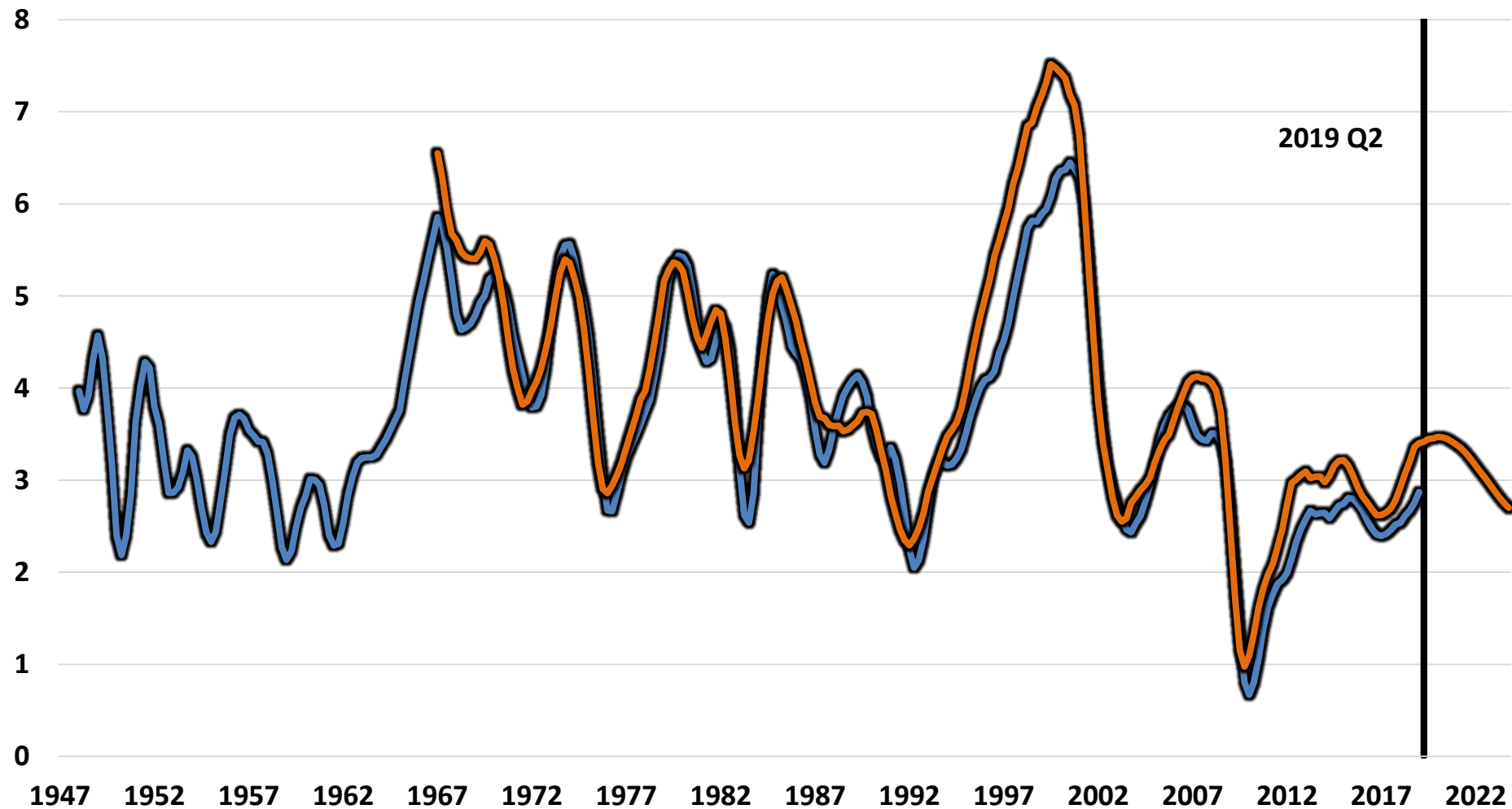
Net Business Investment as a Share of Capital Stock, 1950-2018

Annual Ratio of Nominal Net Private Business Investment to Private Business Capital Stock, 1950-2018



Growth of Capital Services, 1948-2023

Change in Capital Services, Actual versus Forecast



Prospective Return of Investment to Late 1990s?

- **Macro Advisers (charts) shows investment to decline from 2019 peak**
- **Monopoly power explanation of low investment, if true, won't turn around**
- **Shift of economy toward low capital-intensive services, declining price of capital goods, won't turn around**
- **Corporate tax cuts? Evidence so far of dividends and share buybacks, not increased investment**
- **Productivity growth and investment are co-determined, lagging innovation impact holds down investment**

Future Revival Created by Robots, AI, and Autonomous Vehicles

- **Growing use of robots didn't prevent precipitous decline in manufacturing productivity trend**
- **AI influence isn't suddenly jumping from no role to significant role**
 - **AI role long embedded in automated customer service phone responses**
 - **AI already exists: voice recognition, language translation, legal searches, robo financial services**
- **Autonomous vehicles still aren't ready for driverless use**
 - **Long, gradual replacement of existing 275m vehicles**

The Future Growth of U.S. Total-economy Productivity

- **Total economy productivity slower than private business sector (2018 0.9 vs. 1.4)**
- **Regression analysis suggests 2018 pulled trend up only from 0.6 to 0.7**
- **Brynjolfsson, Syverson delay argument**
 - **40 years for electricity to matter in mfg, 1880-1920**
 - **40 years for computer age to blossom 1996-2004**
- **We're still waiting for the impact of AI and robots**
- **No correlation of productivity growth between decades**

Conclusion:

Future Growth in Potential Output

- **Brynjolfsson, Syverson push me to raise productivity trend from 0.7 to 1.2**
- **But compelling evidence of a decline in the growth of labor quality (educational attainment) pushes back from 1.2 to 1.0**
- **Add future growth of hours: 0.75% in contrast to other forecasts of 0.5%**
- **Total for potential output, $1.0 + 0.75 = 1.75$**
- **Contrast to CBO, $1.4 + 0.5 = 1.9$**
- **So, we arrive at a similar conclusion by a different route**