Economic Growth in the West: Can Innovation Save Us from the Six Headwinds?

Robert J. Gordon, Northwestern University, NBER,and CEPR

Keynote Speech,

TUSIAD CEO Forum Meeting

Istanbul, October 5, 2013

The End of Growth?
What's He Talking About?

- **The Great Controversy**
  - **My forecast is that U. S. economic growth is almost over**
  - **Stark contrast with the optimists: surging innovation**
    - **Majority of TED audience: innovation is accelerating**
    - **Economist debate, I lost 71-29**
    - **Ben Bernanke's commencement speech, faith in the future**
- **Two problems for the optimists**
  - **U. S. economy is buffeted by ominous headwinds that will offset much of the benefit of current and future innovation**
  - **I don't predict the end of innovation. I merely state a fact, that the effect of innovation on productivity in the past 40 years is about 2/3 the pace of the previous 80 years.**

The End of Growth?
Why Is This Relevant for Europe?

- **The U. S. Has Created the Technological Frontier Since 1875**
  - **Electricity, Motor Vehicle, Mass Production**
  - **Europe Fell Behind 1900-1945 due to preparation for WW I, interwar chaos, and WW II.**
  - **Productivity and output per capita in Europe in 1950 were half or less of the US level**
  - **Europe's made progress in catching up but did not move ahead or take over the frontier.**
- **Is U. S. Growth "Almost Over"?**
  - **My pessimism is based more on "headwinds" than on lack of innovation.**
  - **Will Europe be saved by having fewer and weaker headwinds?**

End of Growth? Compared to What?

- This is *only* about the U. S. (not about China)
- The criterion of "growth" is the percentage annual change of real GDP per capita
  - The high hurdle: 1891-2007 growth of 2.0 %
- The criterion of doubling
  - Growth at 2.0 percent doubles every 35 years
  - Growth at 0.2 percent doubles every 350 years
- Americans got used to their standard of living doubling from that of their parents. No more.

We Care About the Standard of Living, Not the Same as Productivity Growth

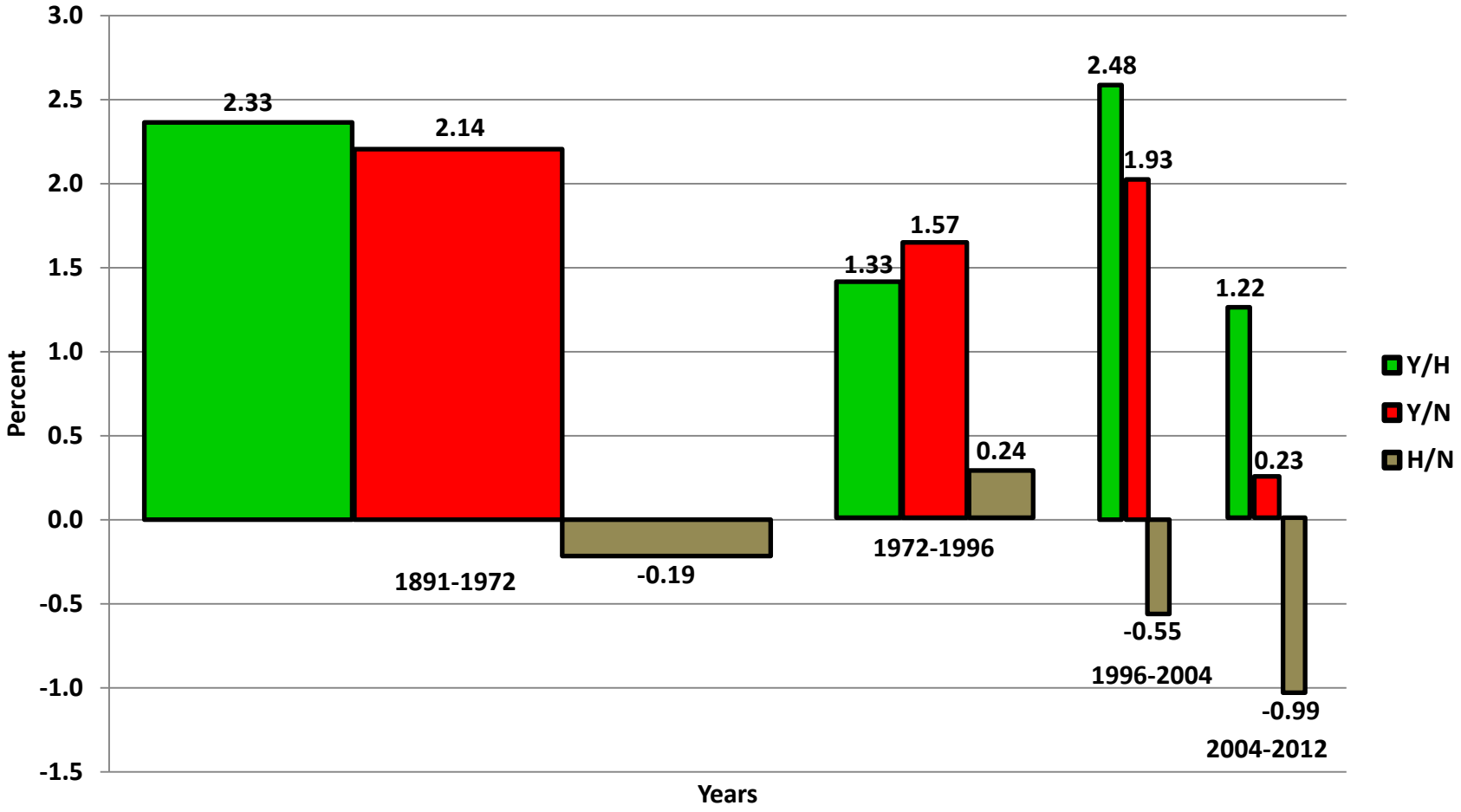
- **Total Output or GDP (Y).**
- **Total Hours of Work (H).**
- **Total Population (N).**

- **Productivity (Y/H).**
- **Standard of Living (Y/N).**
- **Hours per Capita (H/N).**
- **The Magic Equation**

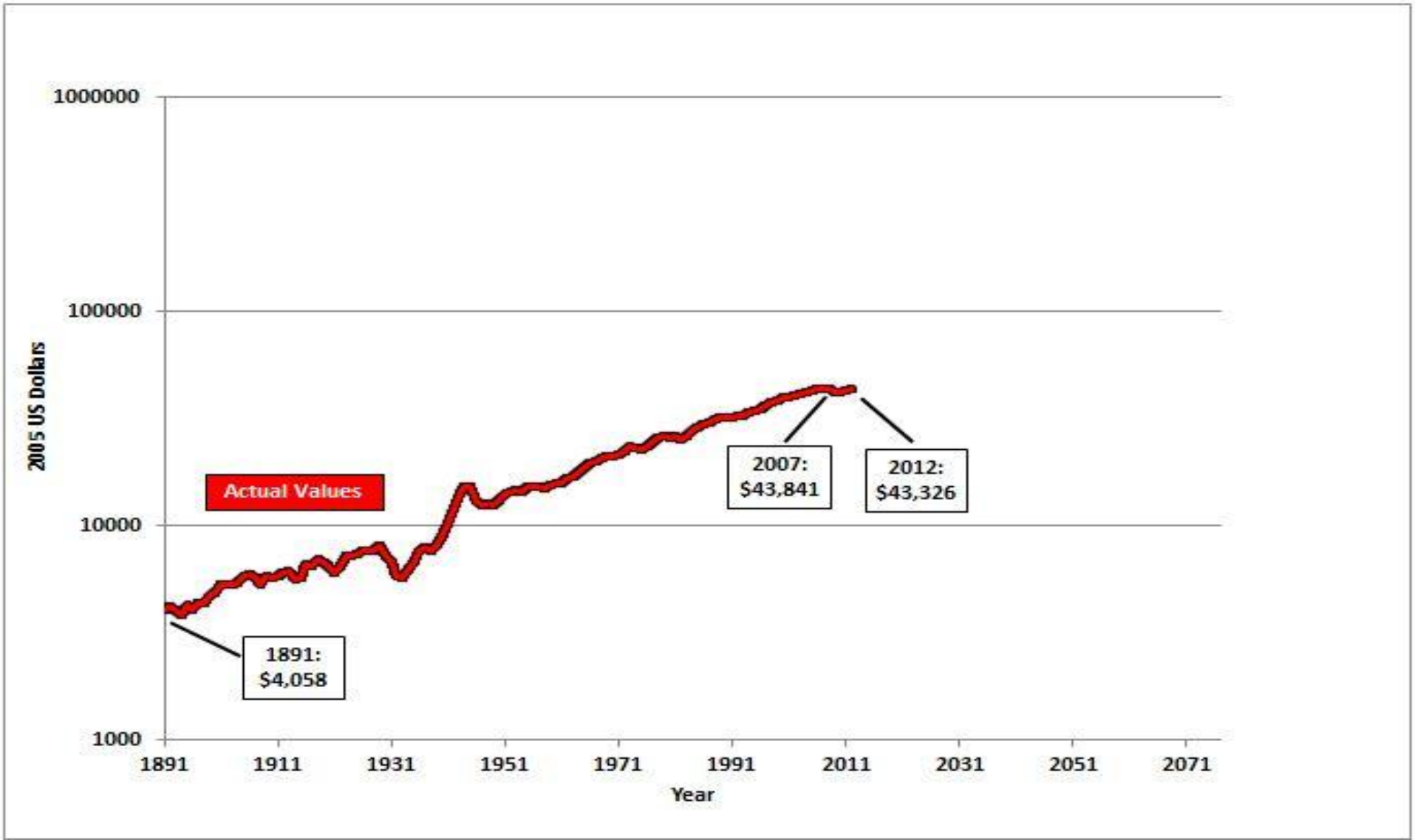
$$Y/N \equiv Y/H * H/N$$

The Magic Equation in Action, 1891-2012

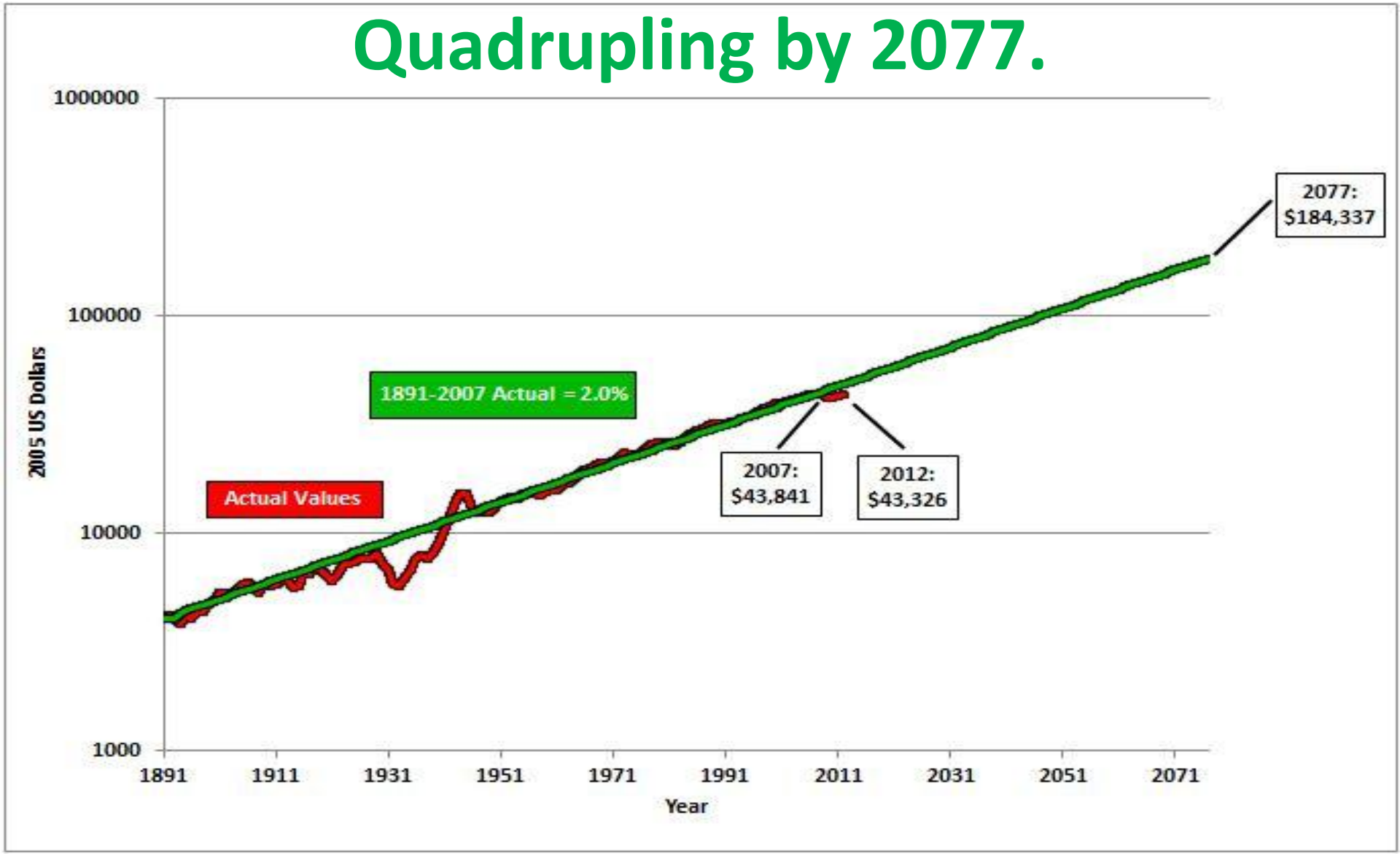
Figure 1: Annualized Growth Rates of Output per Hour, Output per Capita, and Hours per Capita, 1891-2012



Skeptics Sometimes Show This Chart. We Still Seem to be Growing



The Green Line Extends 1891-2007 to 2077. Growth of 2.0 Forever Implies Quadrupling by 2077.



Even if the Pace of Innovation Equals 1870-2012, We Face Four Headwinds

- ***The headwinds are separate from the debate over innovation. They are less controversial.***
- **Demographics** ***(Reduction in H/N)***
- **Education** ***(Reduction in Y/N and Y/H)***
- **Inequality** ***(Y/N for Bottom 99% falls short of average Y/N)***
- **Debt** ***(Disposable income grows slower than output)***

Components of the Demographic Headwind

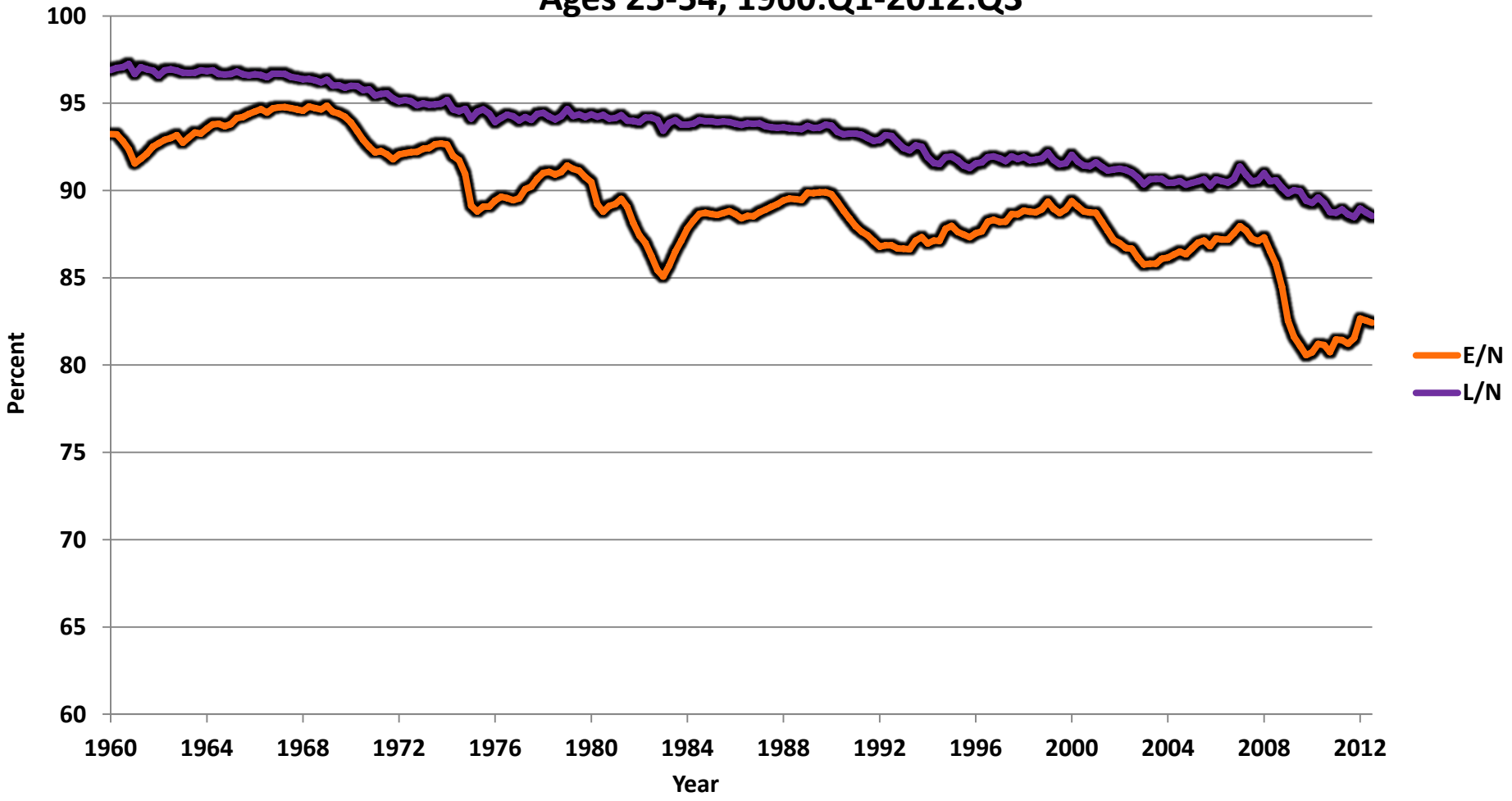
- **Baby Boomers**
  - **Their hours go to zero when they retire but they are still part of N**

The Decline in Hours per Capita is Not Just About Baby-boom Retirement

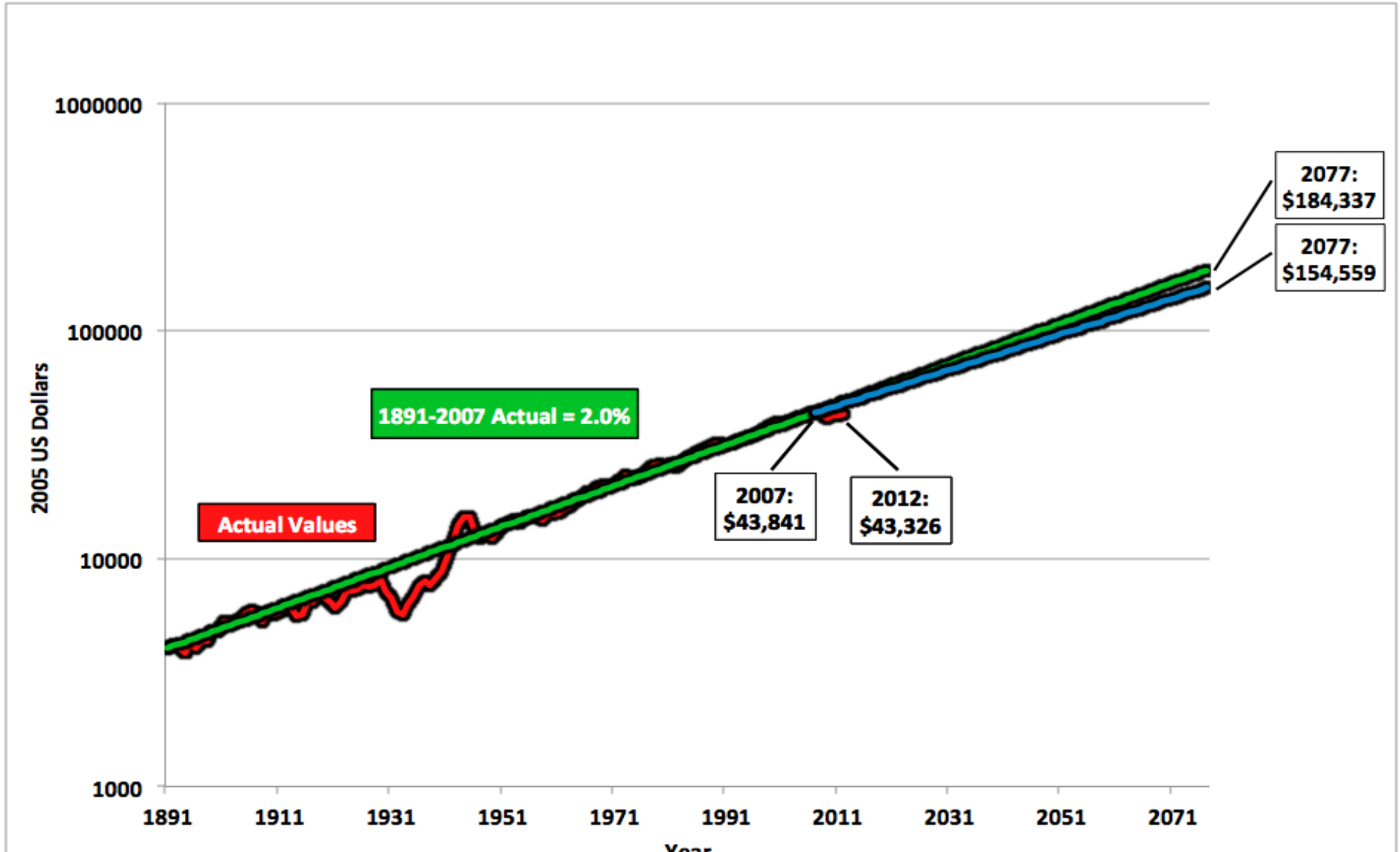
- **Prime-Age Males**
  - **Employment/Population Ratio 95% in 1968 to 83% in 2012**
- **Youth**
  - **Employment/Population Ratio 65% in 1988 to 46% in 2012**
- **Females 20 and Over**
  - **Labor Force Participation Rate rose 35% in 1968 to 58% in 2000, then fell back to 55% in 2012**

Prime-Age Male Participation Is Part of the Demographic Headwind

Figure 20: Employment per Capita and Labor Force Participation Rate, Males Ages 25-54, 1960:Q1-2012:Q3



The Demographic Headwind Takes the Growth Rate from 2.0 to 1.8



Components of the Education Headwind

- **Rising educational attainment has contributed to long-term economic growth. For 25-29 age group**
  - **High school or above: 38% 1940, 84% 1975, now 87%**
  - **BA or higher: 6% 1940, 23% 1990, now 32%**
- **But HS 87% includes GED**
  - **Should be 77% in 1975 to 74% in 2011**

Problems Throughout All Levels of American Education

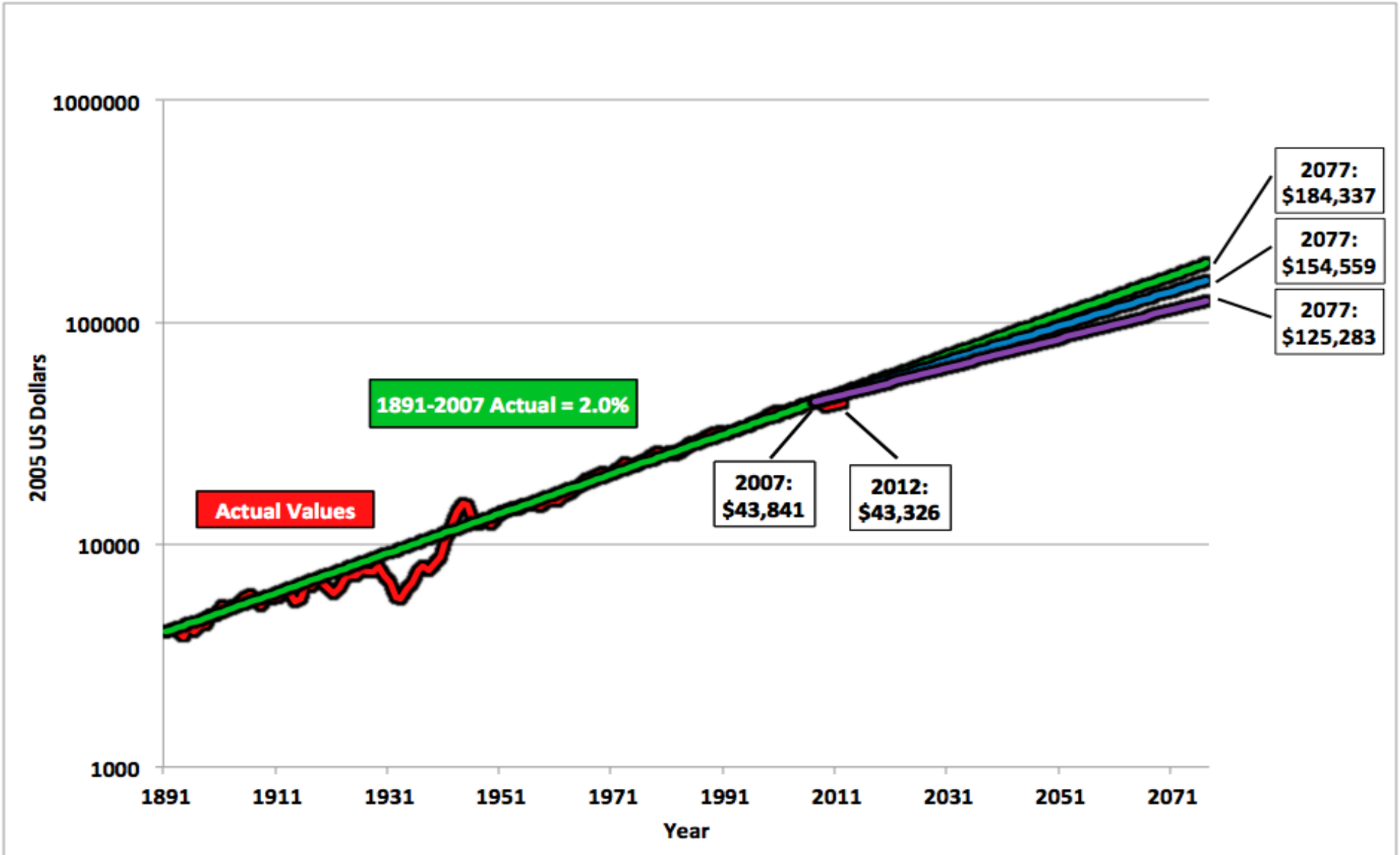
- College tuition cost inflation since 1972

  (National Accounts data)

  - Adjusted for overall inflation, HE price up 3.7 times
- $1 Trillion in college debt
- PISA International Rankings of secondary schools:

  US is #17 in reading #17, #31 in math, #23 in science

Slower Growth in Educational Attainment Takes us from 1.8 to 1.5



The Biggest Headwind of All: Growing Inequality

- **1993-2008:**
  - **Average Real Income Growth = 1.30%**
  - **Average Real Income Growth for Bottom 99% of distribution = 0.75% That's a gap of 0.55%**
  - **Top 1% of distribution received 52% of all income gains**

Causes of Growth of Inequality at the Top and the Middle

- **Why? Start with the Top 1%**
  - At the top, Economics of Super-Stars
  - Unregulated explosion of finance industry
  - Outsized CEO compensation related to greater importance of stock options
- **Why wage stagnation in the Bottom 99%?**
  - Decline in the Real Minimum Wage
  - Decline of labor unions in private sector
  - Globalization: imports, outsourcing
  - Small role for unskilled immigration

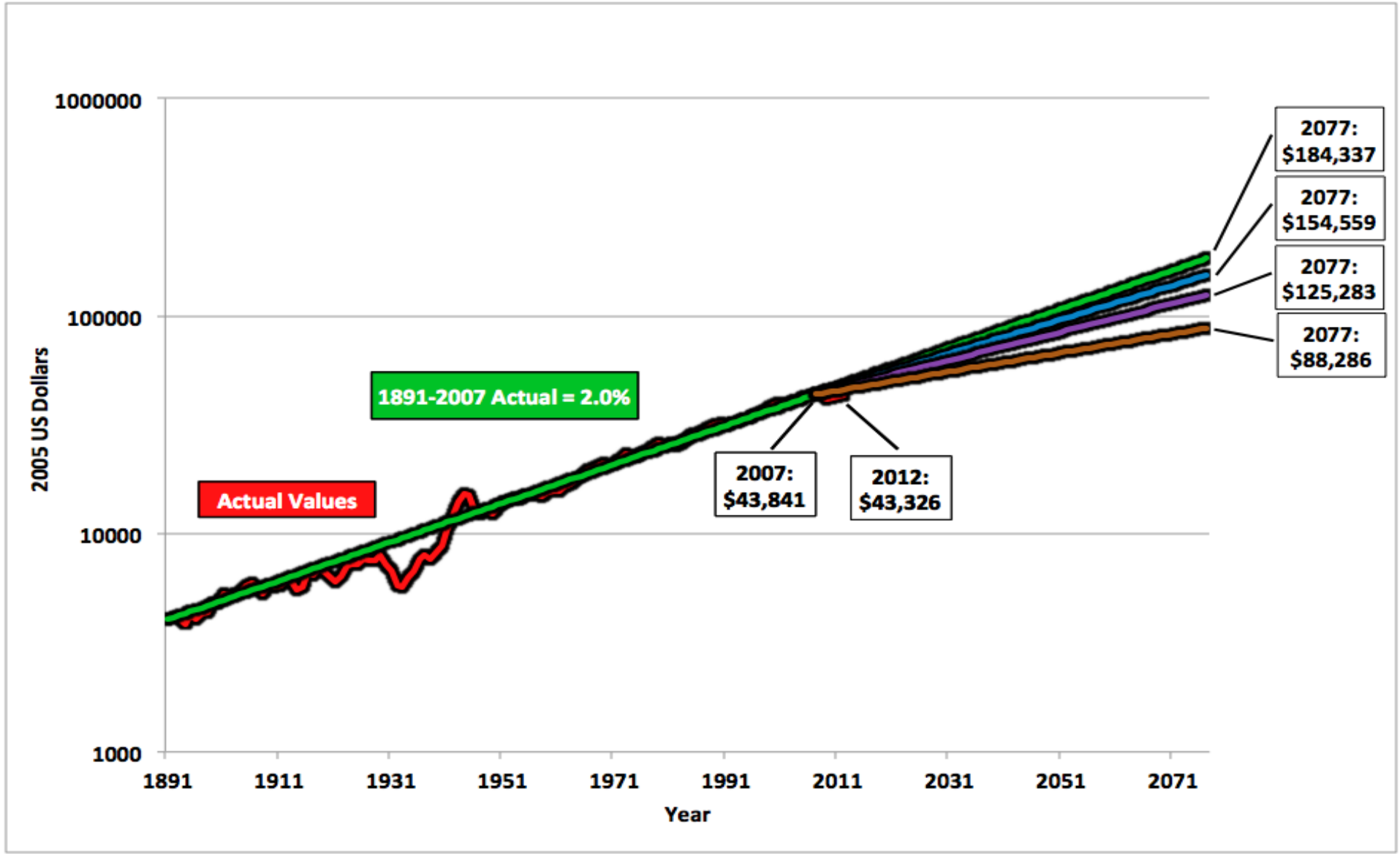
The Termites in the Bottom 1/3 of the White Population

- **The New Causes of Declining Incomes at the bottom 1/3 of the white population, with the meticulous statistical documentation of Charles Murray's Coming Apart (Belmont vs. Fishtown).**
- **All data compare Fishtown 1960 to 2010. Sociological facts**
  - **Fishtown aged 30-49 married, 85% in 1960 to 48% in 2010**
  - **Fishtown never married aged 30-49, 8% in 1960 to 25% in 2010**
  - **Divorce rate aged 30-49, 5% in 1960, 33% in 2010**

More on the Termites in Fishtown

- **This is a sociological decline, not just an economic decline. But the two interact**
  - **Most stunning: % of children living with both biological parents when mother is age 40, 95% in 1960 to 34% in 2010**
  - **Dire consequences for the future educational attainment of these children**
  - **Shortage of eligible men for more highly educated women**
- **Decline in hours per person**
  - **Families in which the head of household or spouse worked 40 or more hours in the preceding week: 84% in 1960, 58% in 2010**

Income Inequality Takes Growth from 1.5 to 1.0 for the Bottom 99%



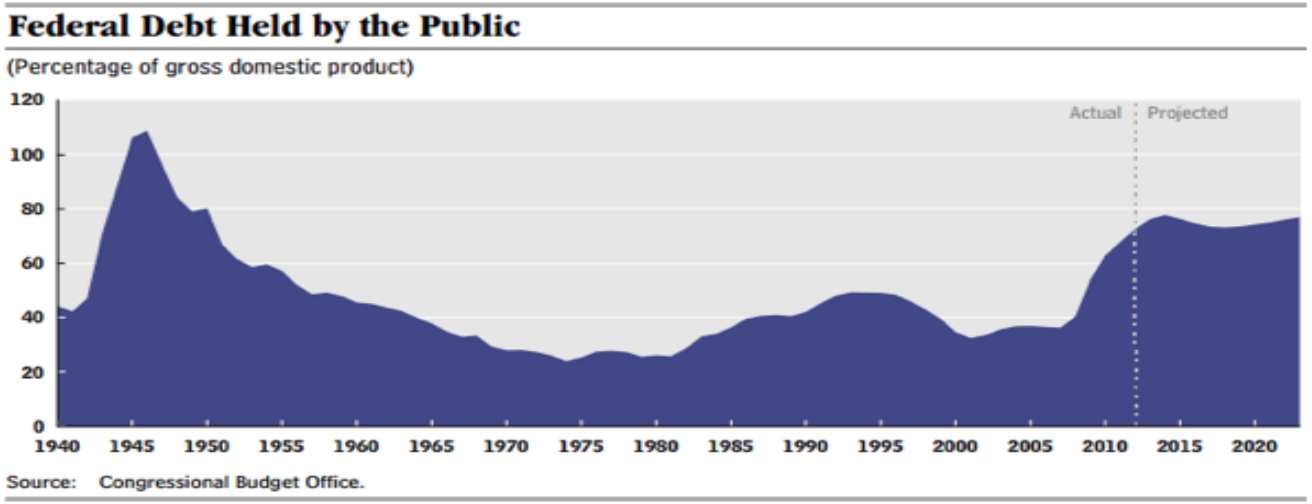
The Final Headwind: Stabilizing the Ratio of Debt to GDP

- **Households**
  - **Ratio of liabilities to disposable income grew from 90% in 1995 to 133% in 2007. Now back down to 114%, largely through defaults.**
  - **Repaying debts and slower growth of credit a big reason why the economic recovery is so slow**

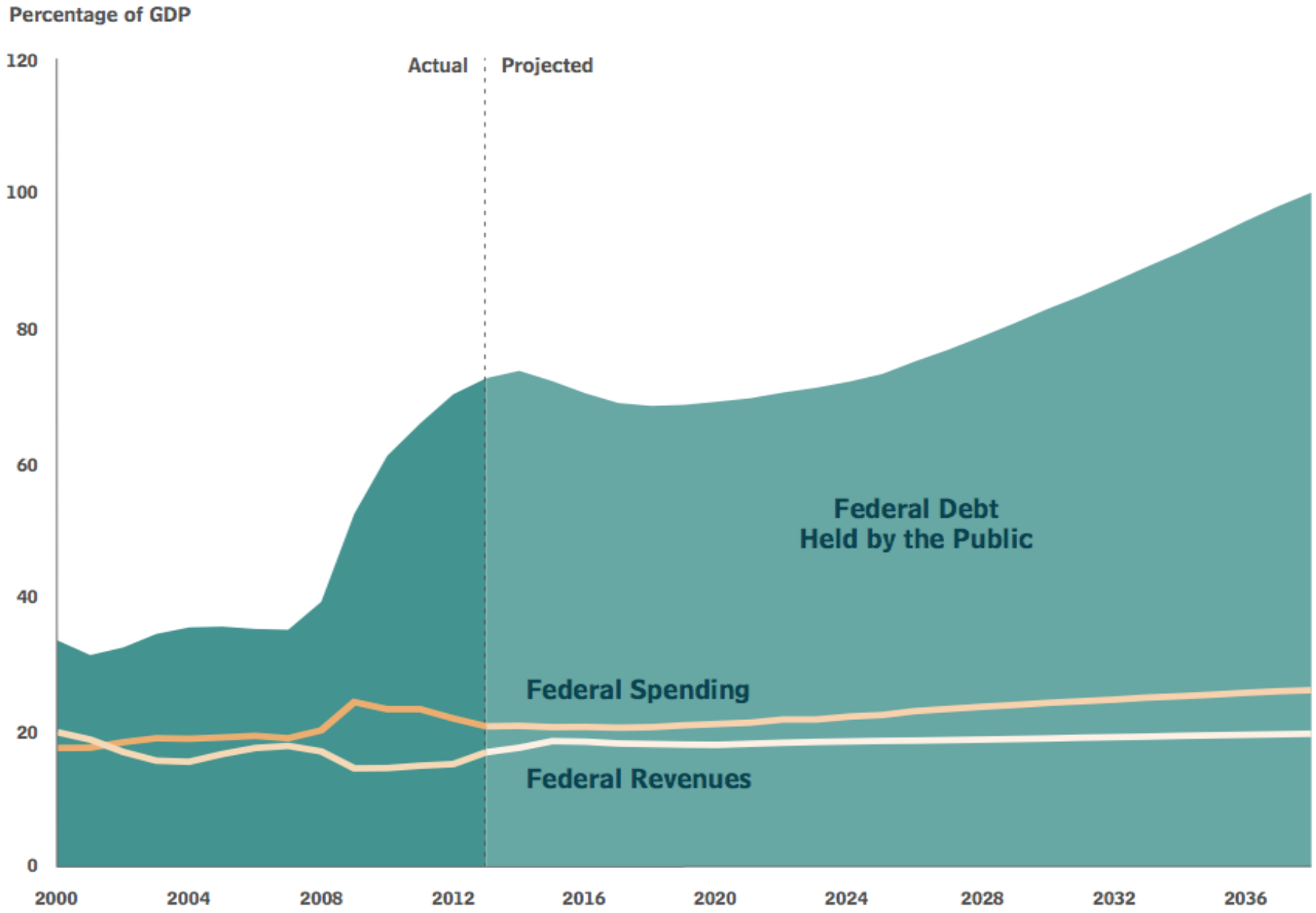
- **Students**
  - **$1 Trillion in debt, delays marriage, children, compromises occupational choice.**

Stabilize Ratio of Government Debt to GDP

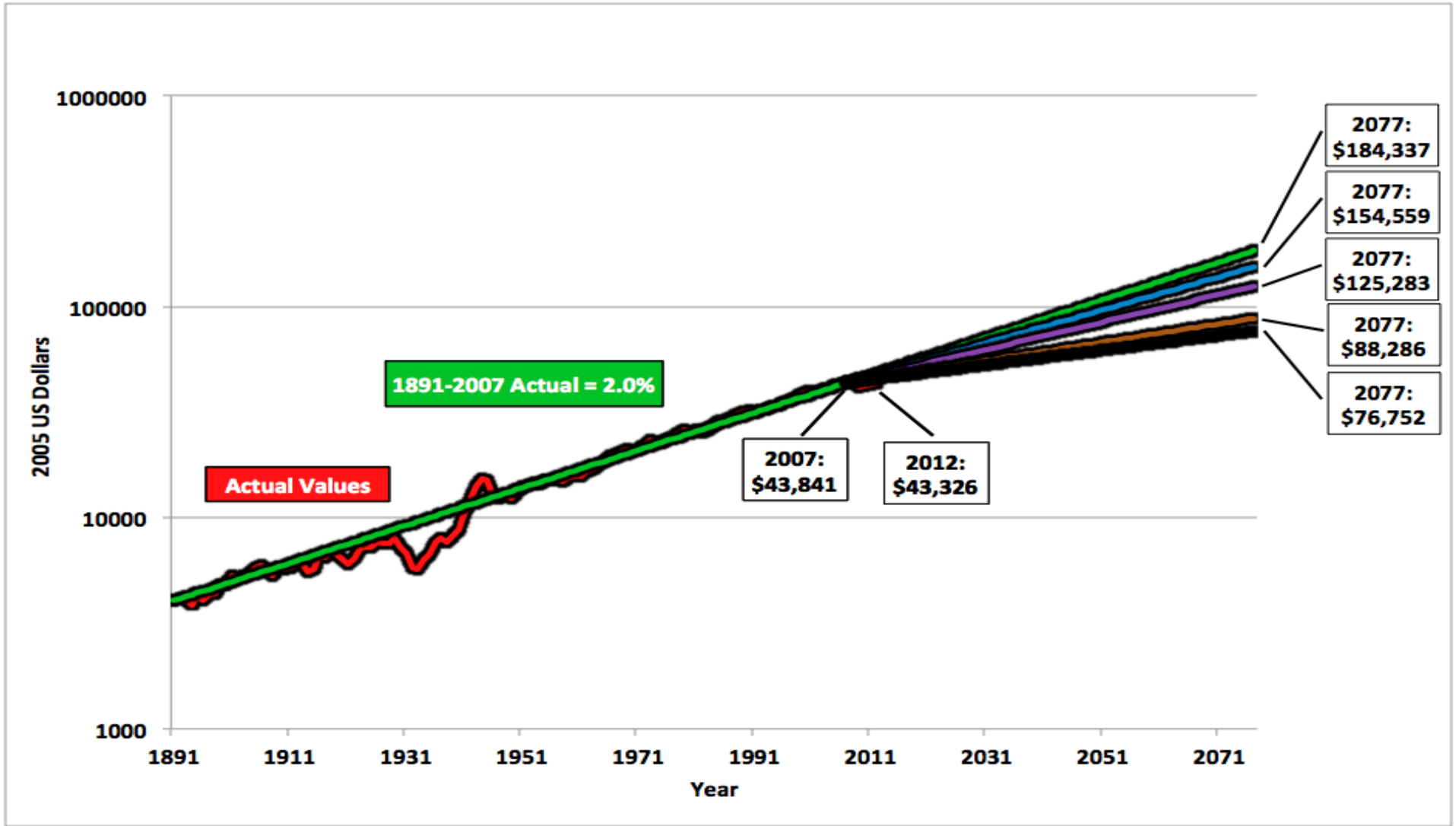
- **Federal, State, and Local Debt**
  - Deficits don't have to go to zero, but the ratio of debt to GDP must be stabilized
  - Medicare runs out of money in 2026, Soc Security in 2033
  - Stabilizing debt/GDP means faster growth in taxes and/or slower growth in spending on entitlement programs



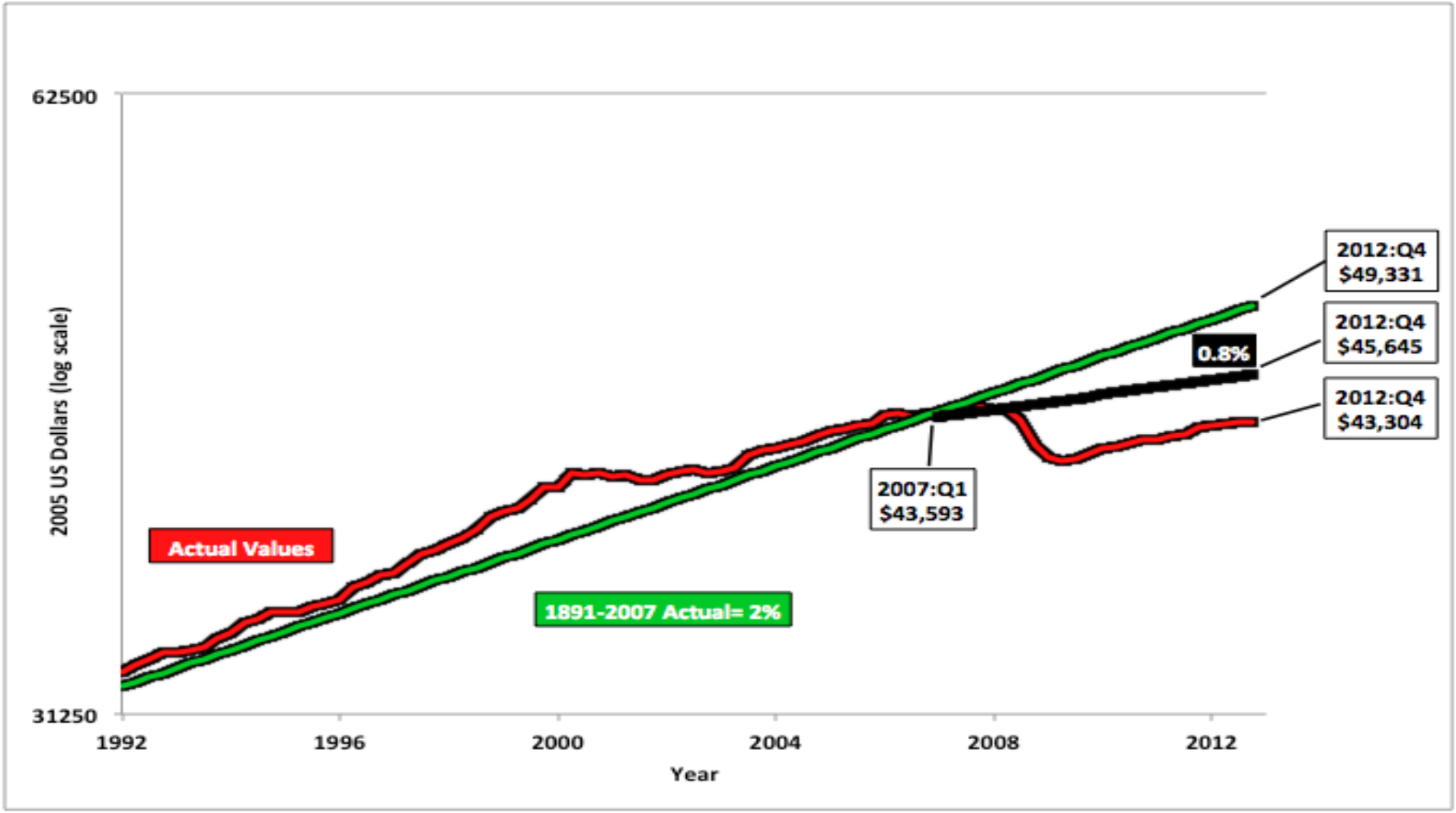
Federal Debt/GDP Ratio, 2000 to 2038



Subtract 0.2%. Reducing Household Debt to Income and Government Debt to GDP (Not to Mention Student Debt Burden)



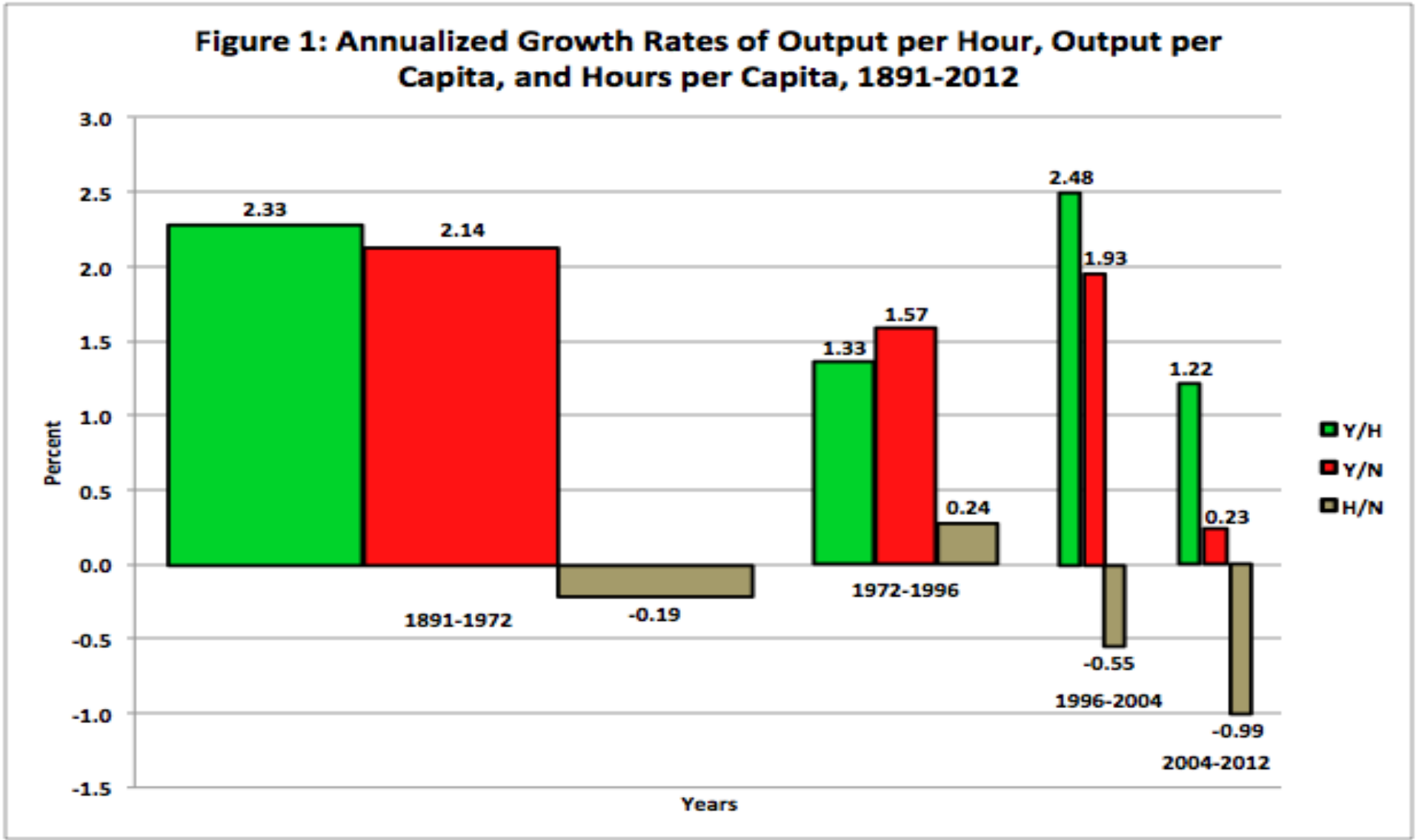
Actual U.S. Economy is 13% Below the Historic Trend and 5% Below the Pessmistic Trend



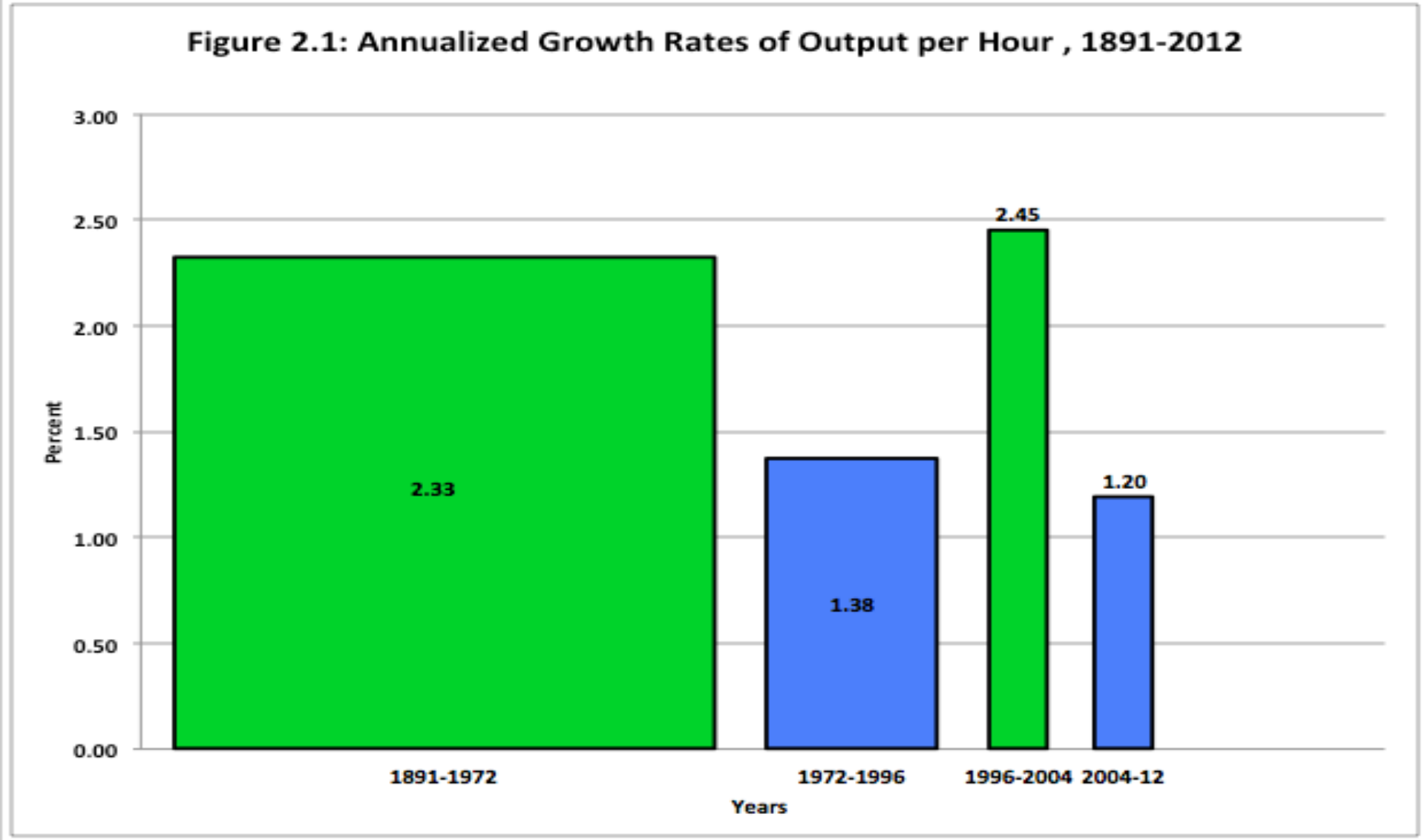
Move from Headwinds to Innovation

- **Until now, we've subtracted the headwinds from the actual growth performance of 1891-2007, which assumes that the role of innovation in growth in the future will be the same as 1891-2007.**
- **Now we reverse the exercise in subtraction. *Now we pretend that there are no headwinds and look just at innovations.***
- **First, let's look at history.**

Review: How Is Growth in GDP per Person Related to Productivity?



Productivity Growth by Itself Over the Same Four Intervals



The Three Industrial Revolution: Definitions

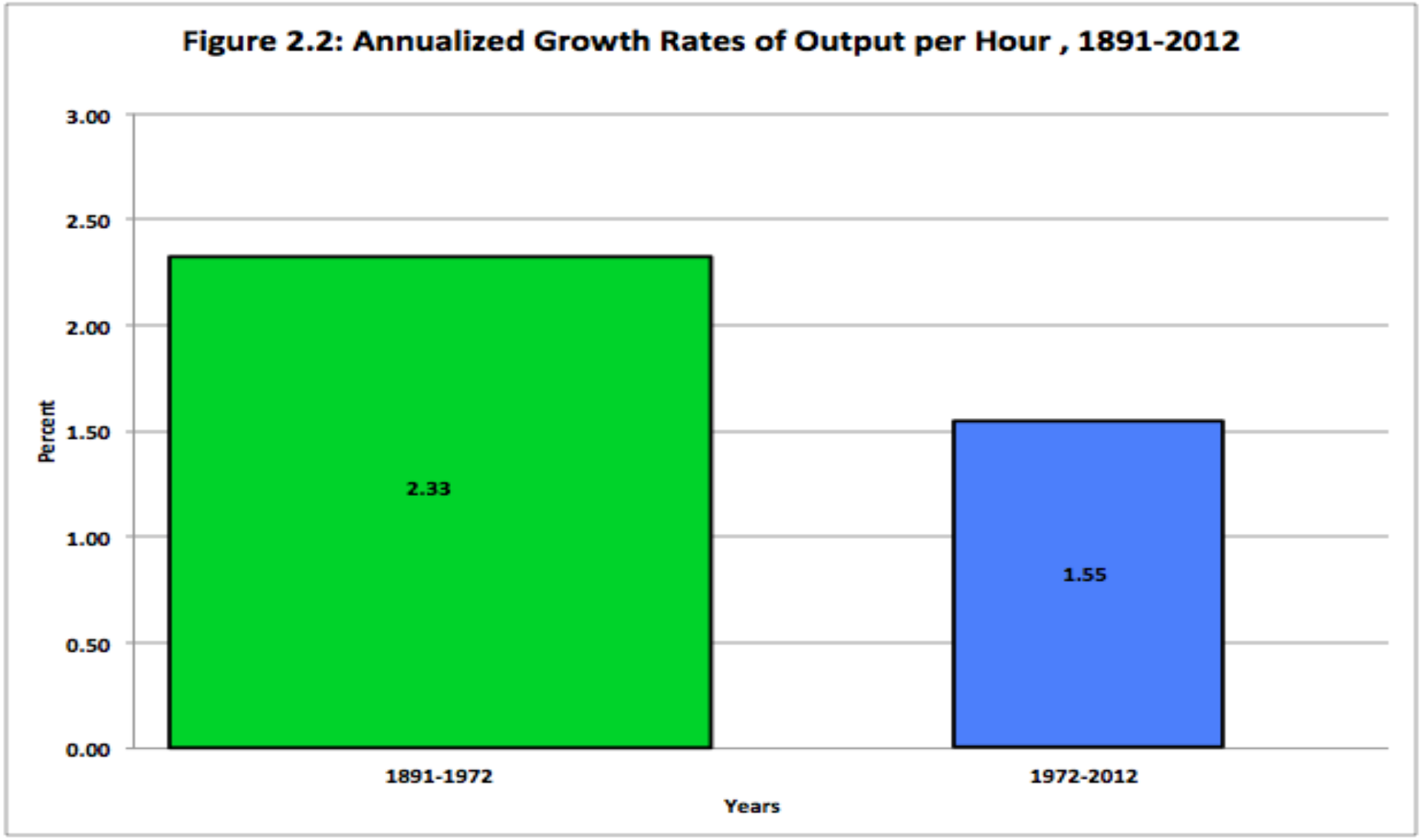
- ***The 1st IR occurred 1770-1850, continued impact through 1900***
  - **Steam engine, cotton spinning and weaving**
  - **Railroad, steam-powered ships, shift from wood to iron and steel**
- ***The 2nd IR occurred 1870-1920, continued impact through 1970 (at least 5 dimensions)***
- ***The 3rd IR 1960-now, one dimension, the ICT revolution***

What Happened to Make Productivity Growth So Rapid 1891-1972?

- ***The 2nd IR consisted of at least five dimensions of Great Inventions***
  - **Each invention had spinoffs developed over 1890-1972**
  - **Those fundamental inventions of 2nd IR kept productivity growing at 2.33% 1891-1972**
  - **Many benefits of 2nd IR have produced benefits that have never been measured**

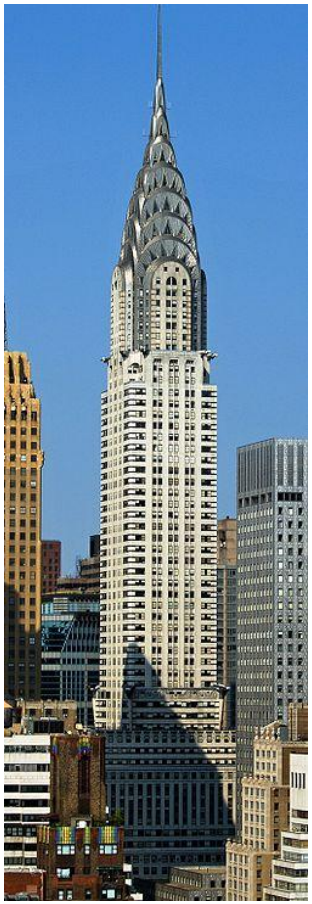
The 3nd IR has so far produced about 1/3 as much cumulative productivity gain as the 2nd IR

The Second Industrial Revolution vs. the Third Industrial Revolution



Light and Power

- Before 1879 reading at night required lamps fueled by kerosene or gas.
  - Odors, pollution, dim light, and hard to control
- By 1929 in urban America
  - Electric light everywhere indoors and out
  - Elevators created skyscrapers and urban density
  - Electric hand tools and machine tools replaced hand work
  - Electric streetcars, the Chicago El, the NYC Subway

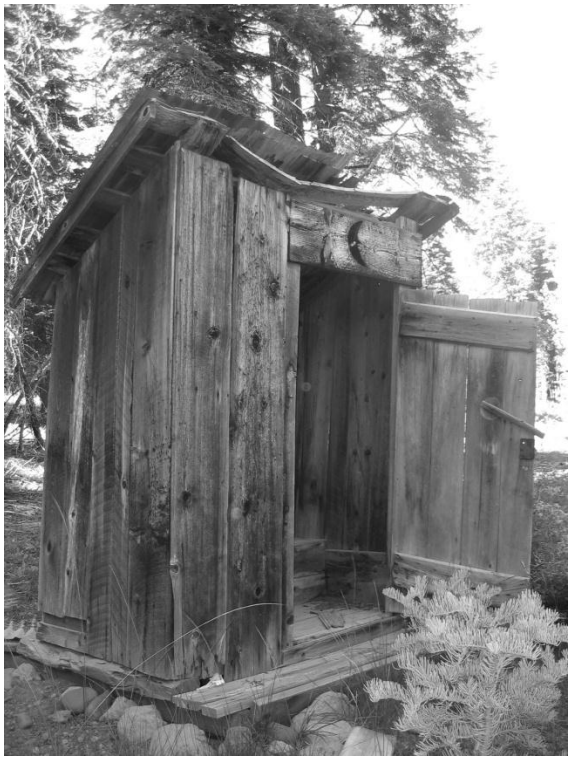


Internal Combustion Engine

- Before 1900 horses carried cargo and people
- The average horse produced 20 to 50 pounds of manure and a gallon of urine daily
- The daily amount of manure worked out to between 5 and 10 tons per square mile
- Carcasses of dead horses often lay in the streets for days, creating a public health menace
- American roads were described in 1903 as “simply two deep ruts, with a stony ridge in the middle on which the car bottom will drag”

The Most Important Event in Women's Liberation? Running Water

- In 1885 the average NC housewife walked 148 miles per year carrying 35 tons of water
- Clean water was carried in for cooking, laundry, washing dishes, and commodes.



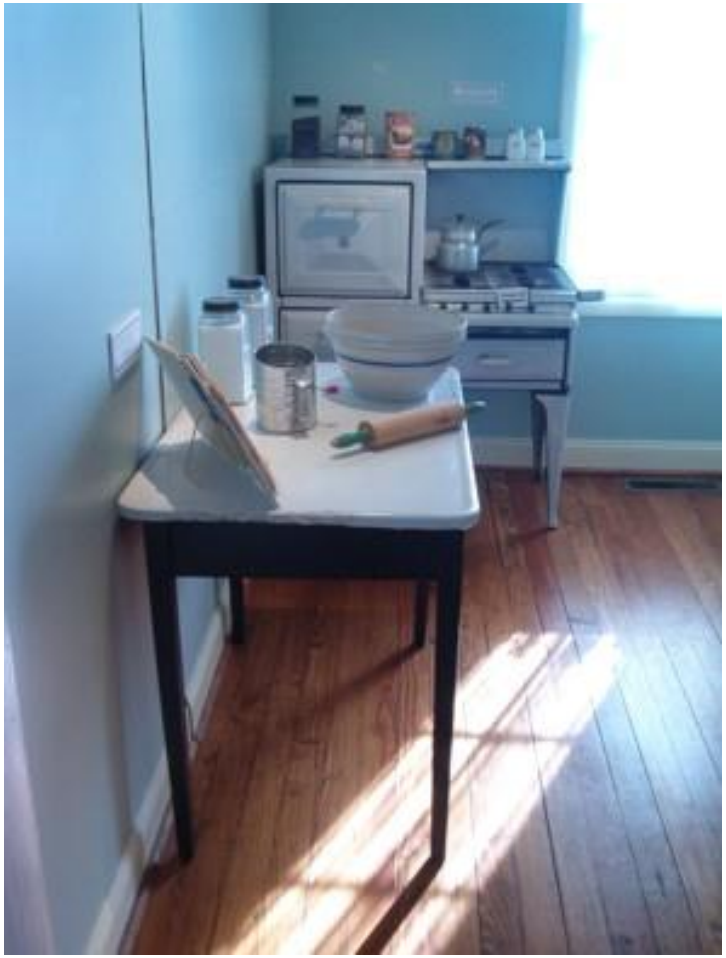
- And the same amount of dirty water had to be carried out.
- The American home became connected to water pipes and sewers between 1870 and 1929
- Outhouses were replaced by indoor bathrooms with toilets, bathtubs, and showers at the same time

Completing Female Liberation

- No more need to carry water in and water out
- The slavery of laundry was eliminated by the electric washing machine (1920-1950)
- The slavery of daily shopping was eliminated by the electric refrigerator (1920-1950)
- The slavery of hauling in coal or wood to the kitchen hearth was eliminated by central heat (coal, oil, or gas) in the same time period
- By 1929 almost all urban homes were totally “networked”

The Kitchen in 1870: Where is the Sink, the Refrigerator, the Range?

A Well-Equipped Kitchen of the 1920s



A Well Equipped Kitchen of the 1950s

100%

Something Cannot Be More Than 100% of Itself

- Electrification from 0 to 100% (1880-1930)
- Motor vehicle ownership 0 to 80% (1900-1929)
- Travel as a % of speed of sound, 1% to 80% (1830-1958)
- Running water, sewers, indoor bathrooms 0 to 100% (1870-1929)
- Urbanization 25% to 75% (1870-1929)
- Postwar: Female Labor Force Participation 20% to 60%

0%

Other Great Inventions: Something Can't Be Reduced Below Zero Percent

- **The Greatest Improvement of All? Infant mortality decreased from 22% to 1% between 1890 and 1950.**
- **Between 1870 and 1920 the American hospital had been transformed from a "cesspool for the indigent" to a life-saver for all social classes.**
- **Life expectancy increased 3x as fast in the first half of the 20th century as the last half.**
- **Central heating and air conditioning reduced the variance of indoor temperature**

How Important Were Innovations During 2002 – 2012?

- A thought experiment
- Choice A: You get 2002 electronic technology and get to keep running water and indoor toilets. But you cant use any electronic invention introduced since 2002. (You can keep Wikipedia & Amazon & Google)
- Choice B: You get everything invented in the past decade, right up to Facebook, Twitter, and the iPad, but you have to give up running water and indoor toilets. You have to take your iPad to the outhouse. If you want a bath, put down your ipad and go out and carry water inside in a pail. And 22% of your newborns will die, since you face 1890 levels of infant mortality.
- Which do you choose?

Tribute to the Toilet

- But it wasn't just the toilet
- Carrying water in for cooking, laundry, and hygiene
- Carrying all that water back out

Storm Sandy: Historical Rewind

- **For those most impacted by Sandy, including several elite professors in Princeton, NJ, they temporarily lost the 20th century**
  - **No electricity**
  - **No running water**
  - **No cooking, no hot water, no hot showers**
  - **No heat because electric thermostats didn't work**
  - **No gasoline available because the pumps didn't work**
  - **Modern gadgets including iPhones could not be recharged**

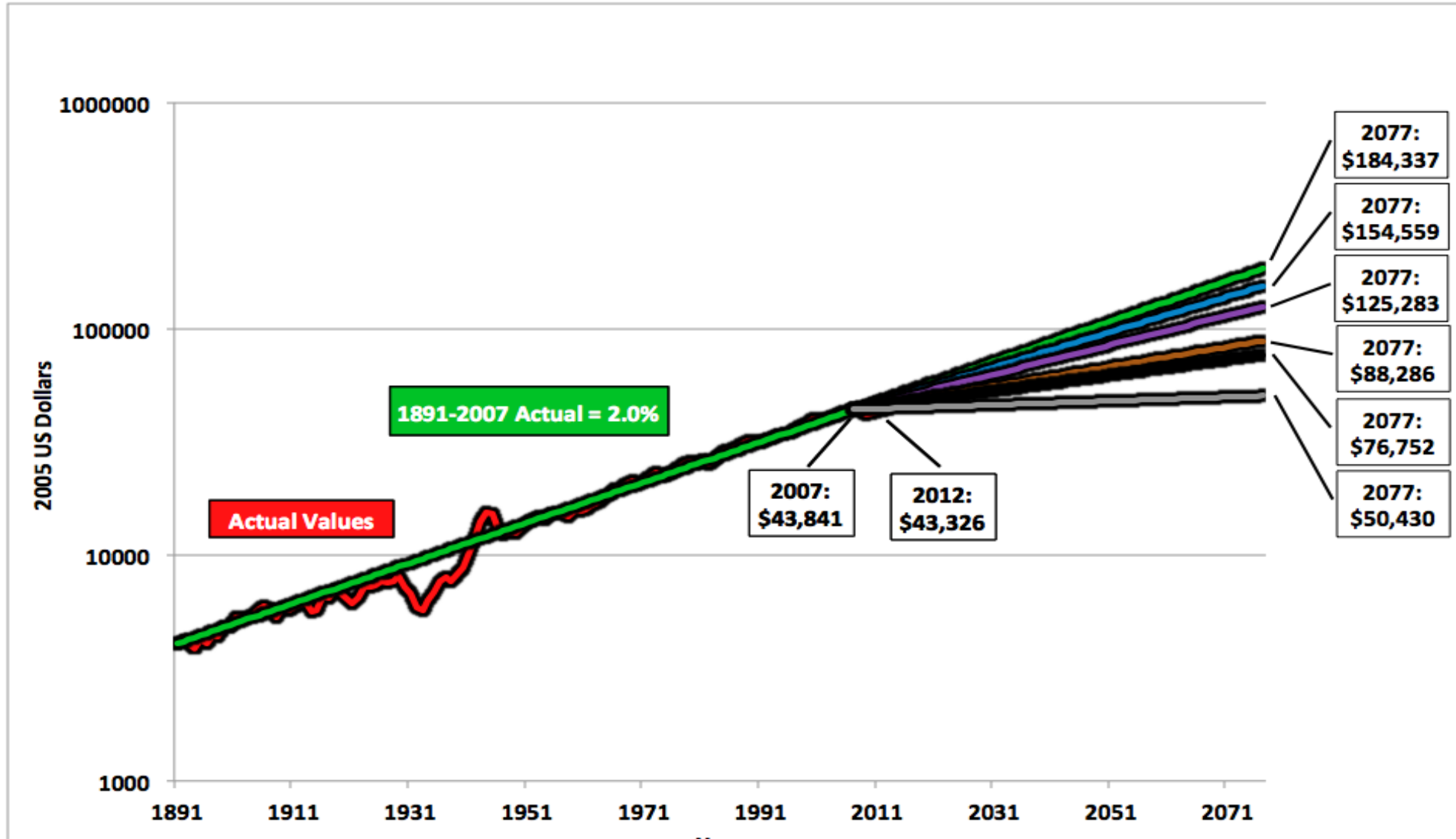
Summing Up: How Much to Subtract from 2.0 Historic Growth in Y/N?

- Four headwinds took us from 2.0 to 0.8, ignoring the issue of innovation and inventions.
- Let's assume that productivity growth continues at the same rate as the last 40 years
  - 1.6 percent, minus 0.3 for the education headwind, implying future productivity growth of 1.3.
- This compares to 2.3 before 1972.
- We subtract 1.0 to get from 2.3 to 1.3
  - 0.3 is education
  - 0.7 is slower innovation after 1972 compared to pre-1972

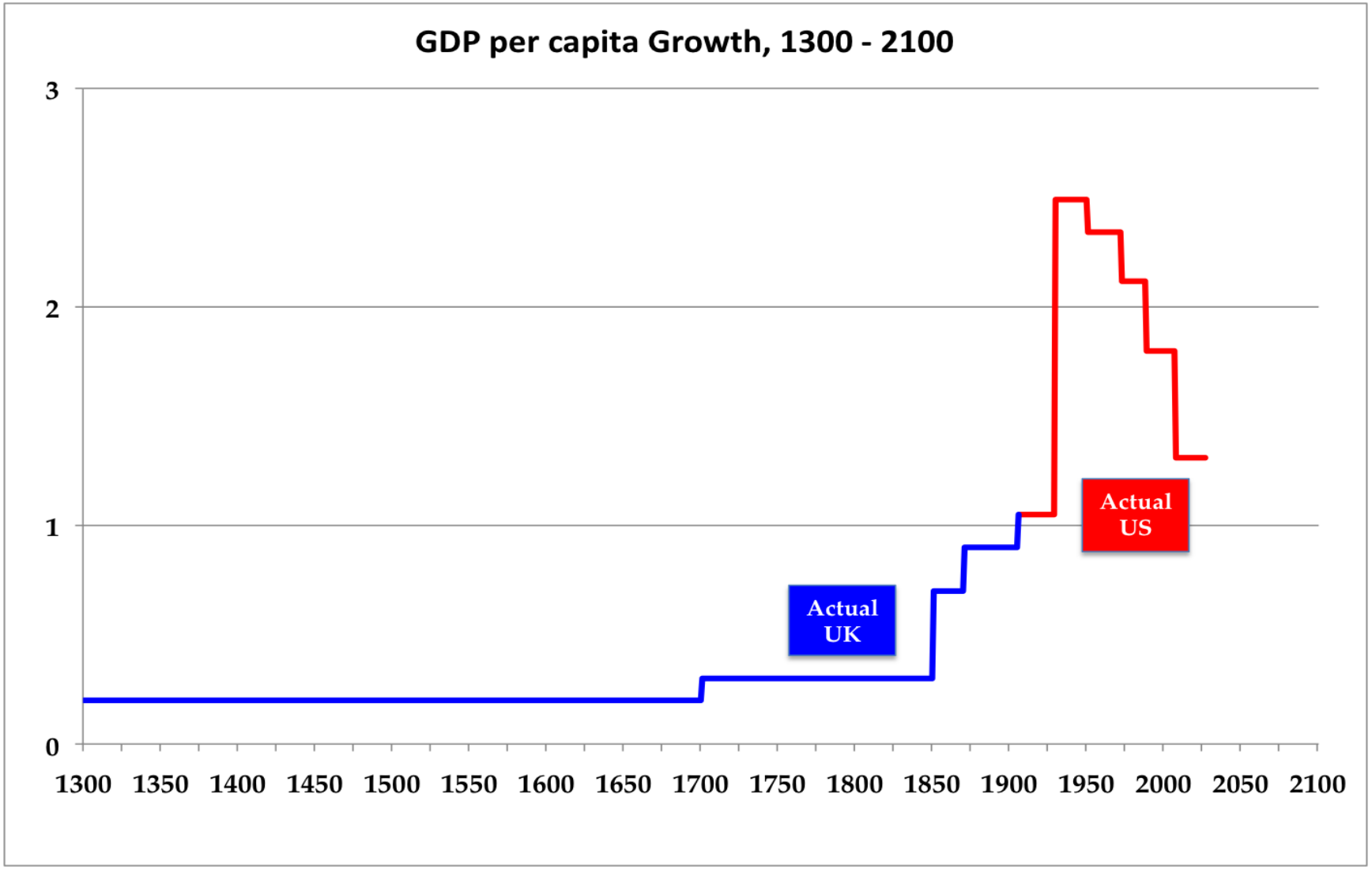
What a Stunningly Optimistic Outlook!

- **Think what it means to assume that innovation in the next 40 years will match the last 40.**
- **The next 40 years must bring us innovations as important as**
  - **The PC, the internet, web browsing, e-commerce**
  - **Mobile phones, digital music, smart phones & pads**
  - **Digitilization of library catalogues and parts catalogues**
  - **Bar-code scanning, the ATM machine, i-tunes, cable TV, CDs, DVDs, movie streaming**

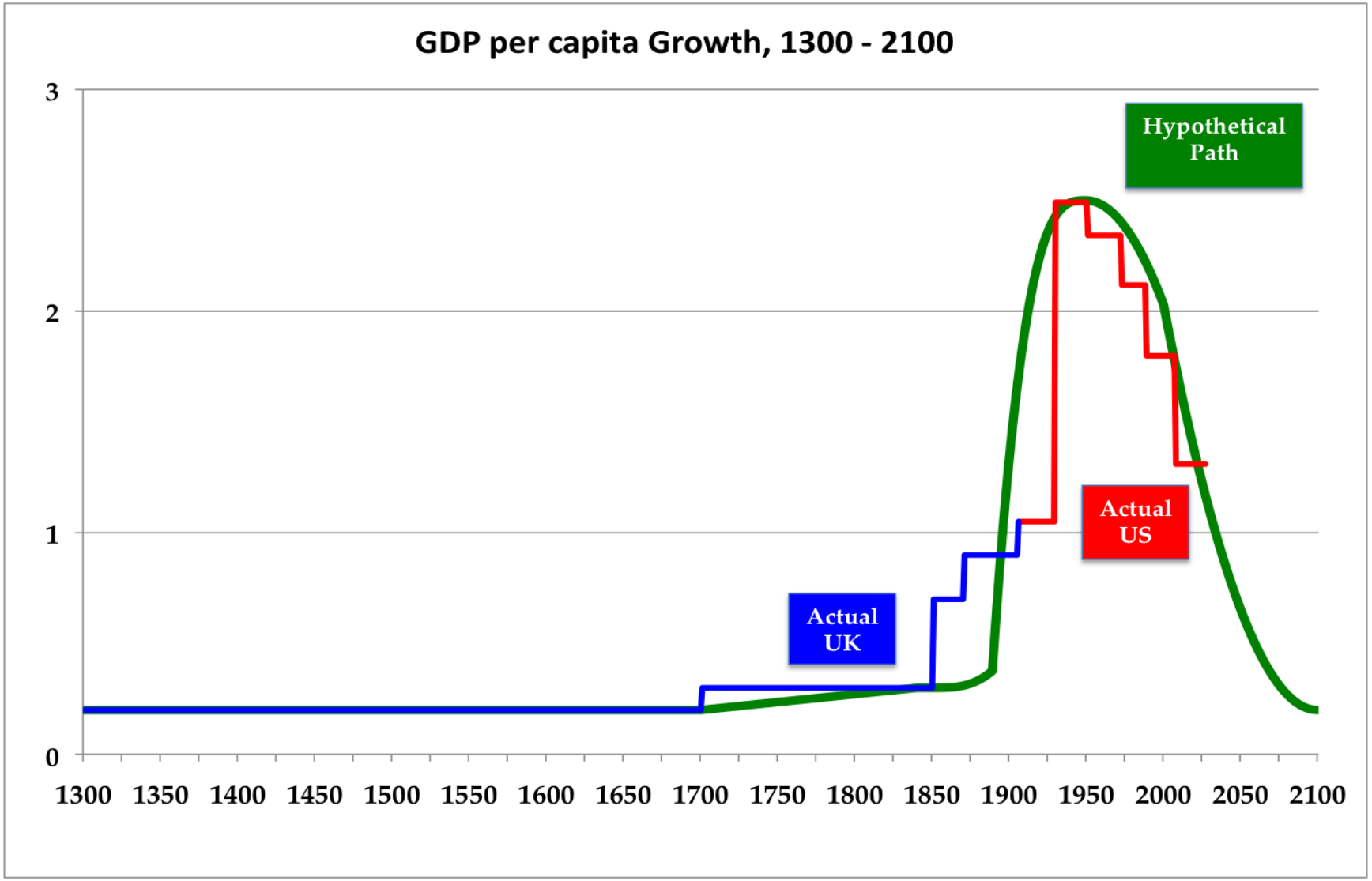
If Innovation's Impact on Economic Growth Declines by 0.6, Future Growth in Per-Capita Income Goes from 0.8 to 0.2



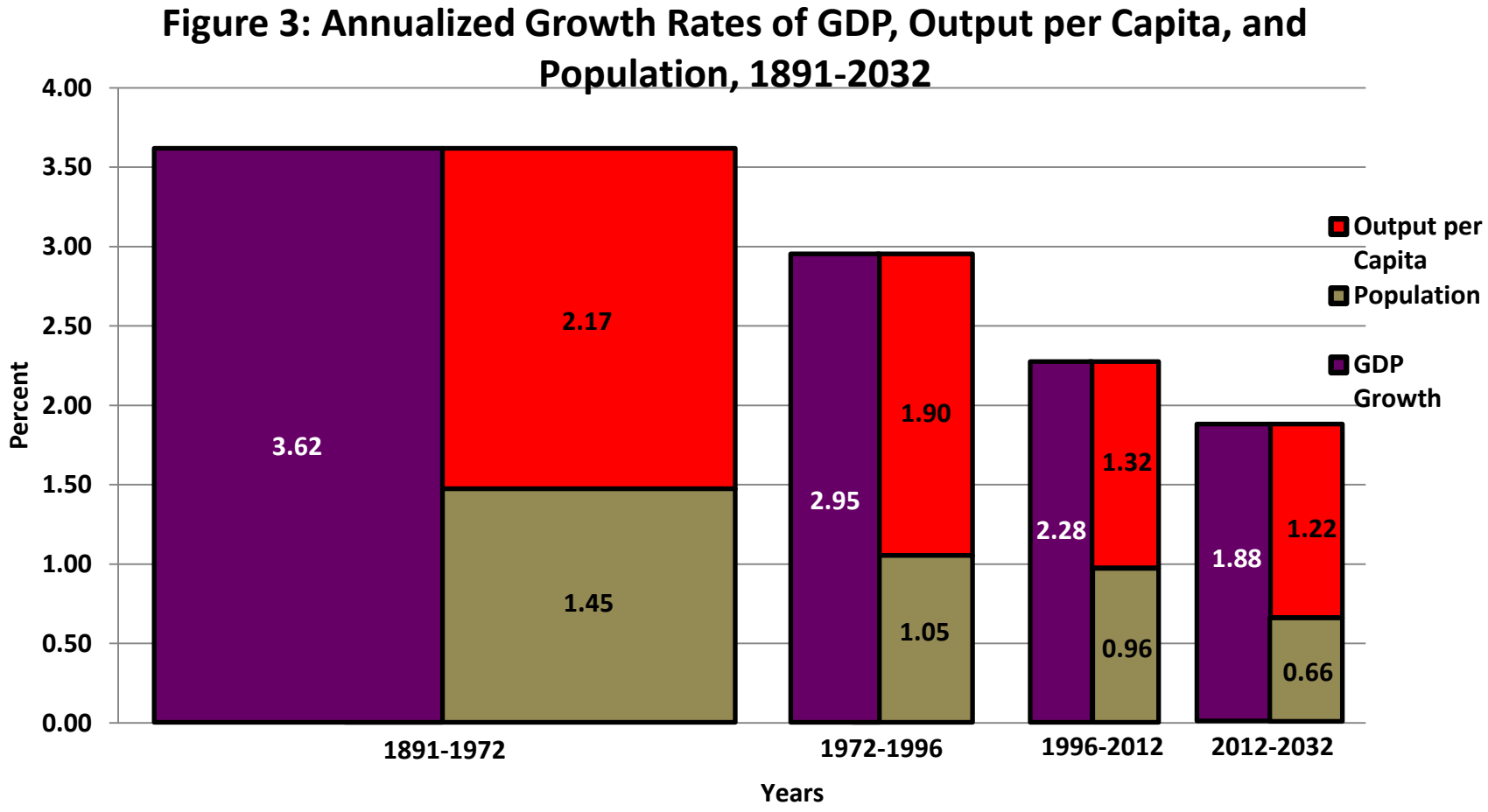
The Remarkable Three Centuries: Growth of the UK/US Frontier



Capturing the Actual Growth Rate in a Hypothetical Curve



Bottom Line: The Big Slowdown in GDP and GDP per Capita



Comparing Europe to the U.S.

- Europe refers to pre-2004 EU-15.
- Charts illustrate the identity:

$$Y/N = Y/H * H/N$$

- Summary of History
  - Europe caught up to U.S. in output per capita until 1970
  - Europe caught up to U. S. in output per hour until 1995
  - This discrepancy is explained by falling EU/US hours per capita

Figure 1. Ratio of Europe-15 to the United States, Output per Capita and Output per Hour, 1960-2011

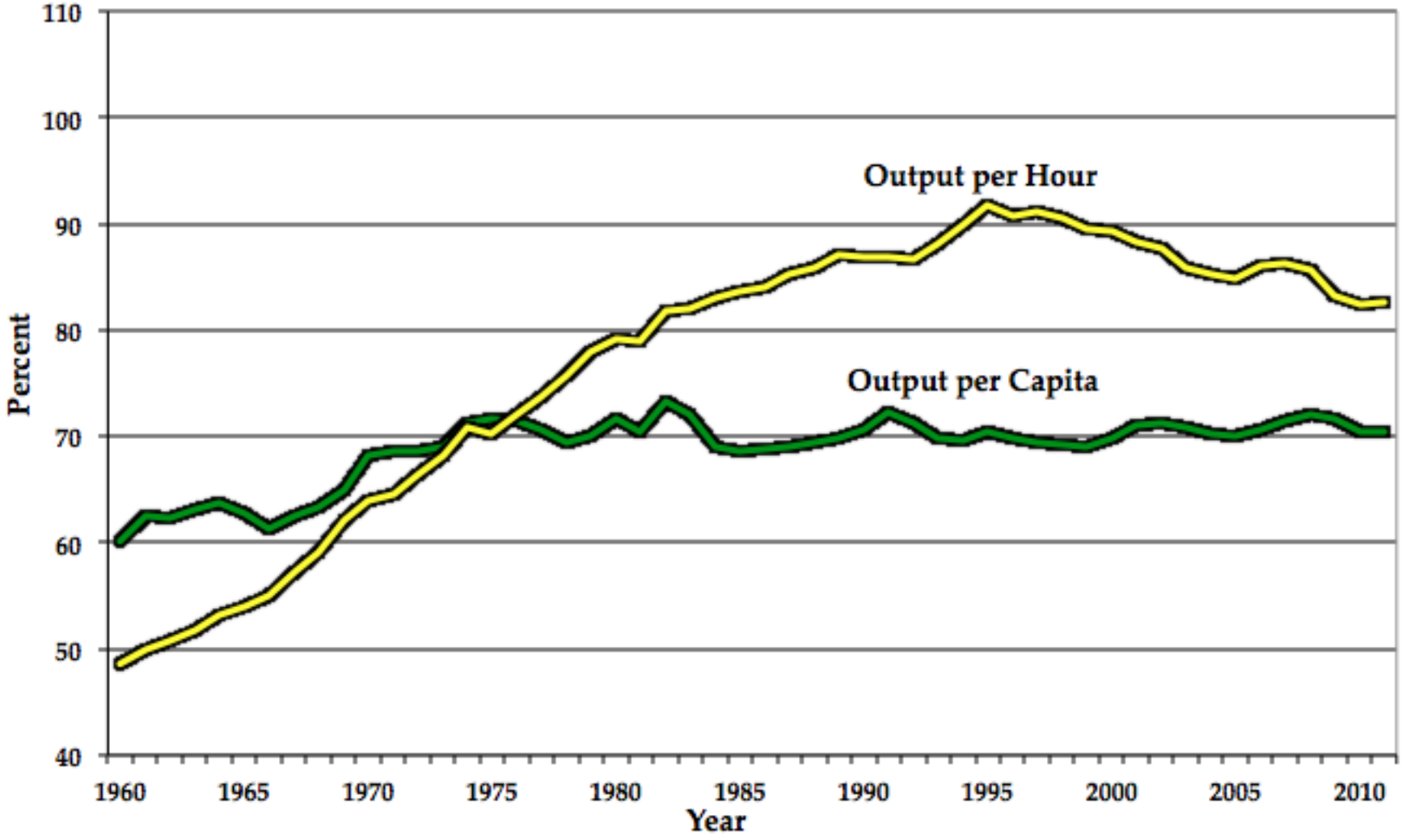


Figure 2. Ratio of Europe-15 to the United States, Hours per Capita, Hours per Employee, and Employees per Capita, 1960-2011

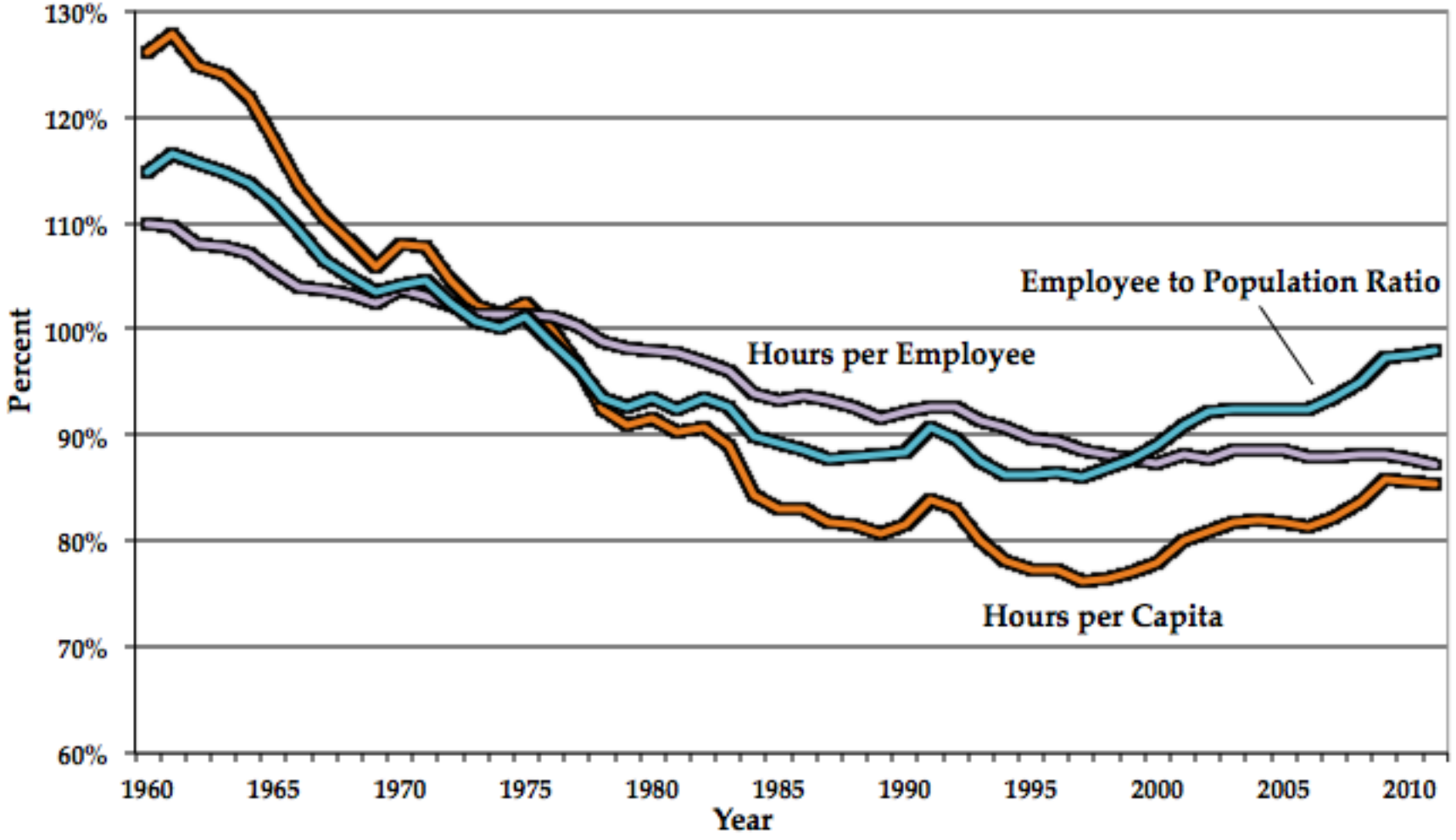


Figure 3. Hours per Employee, Europe-15 and United States, 1960-2011

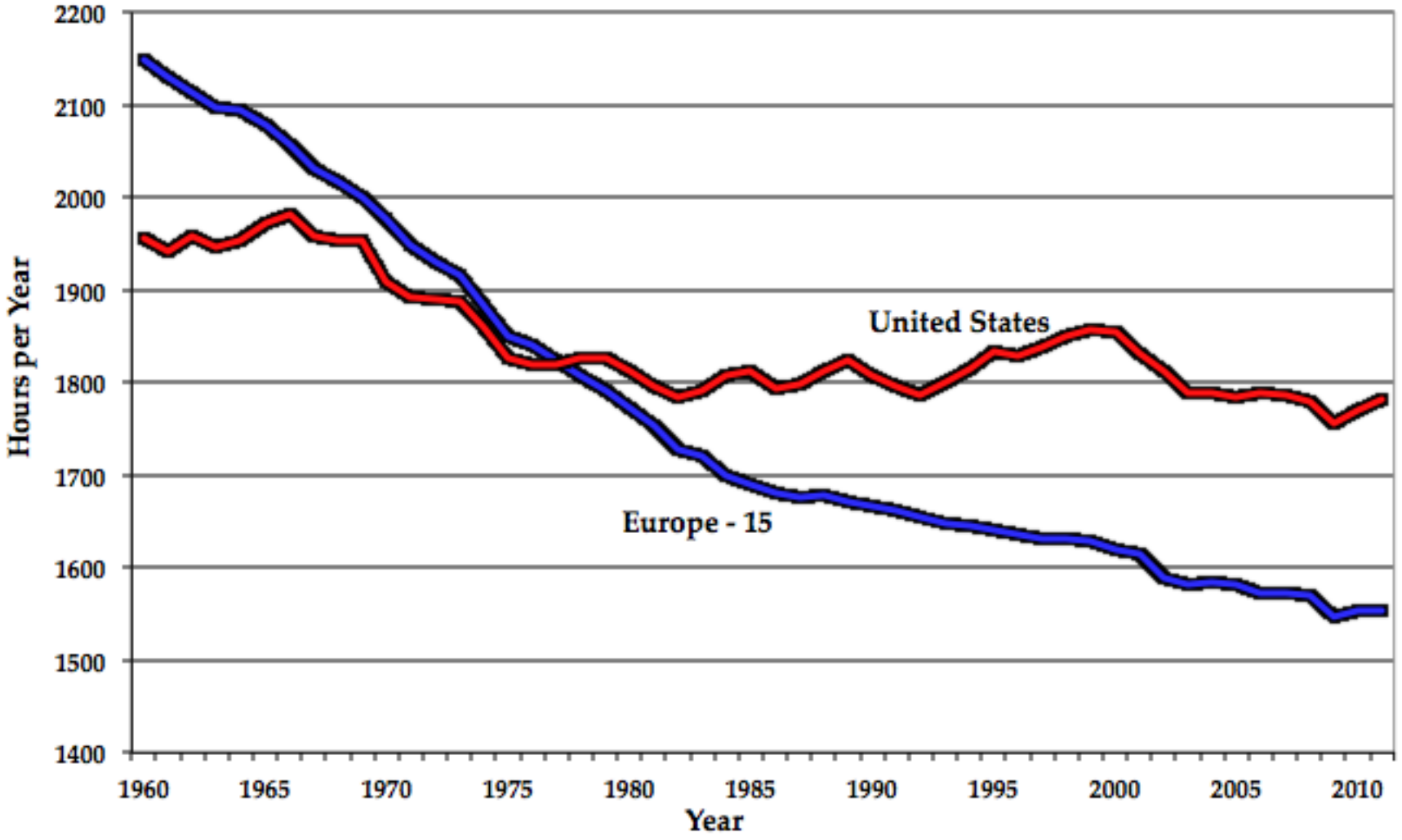
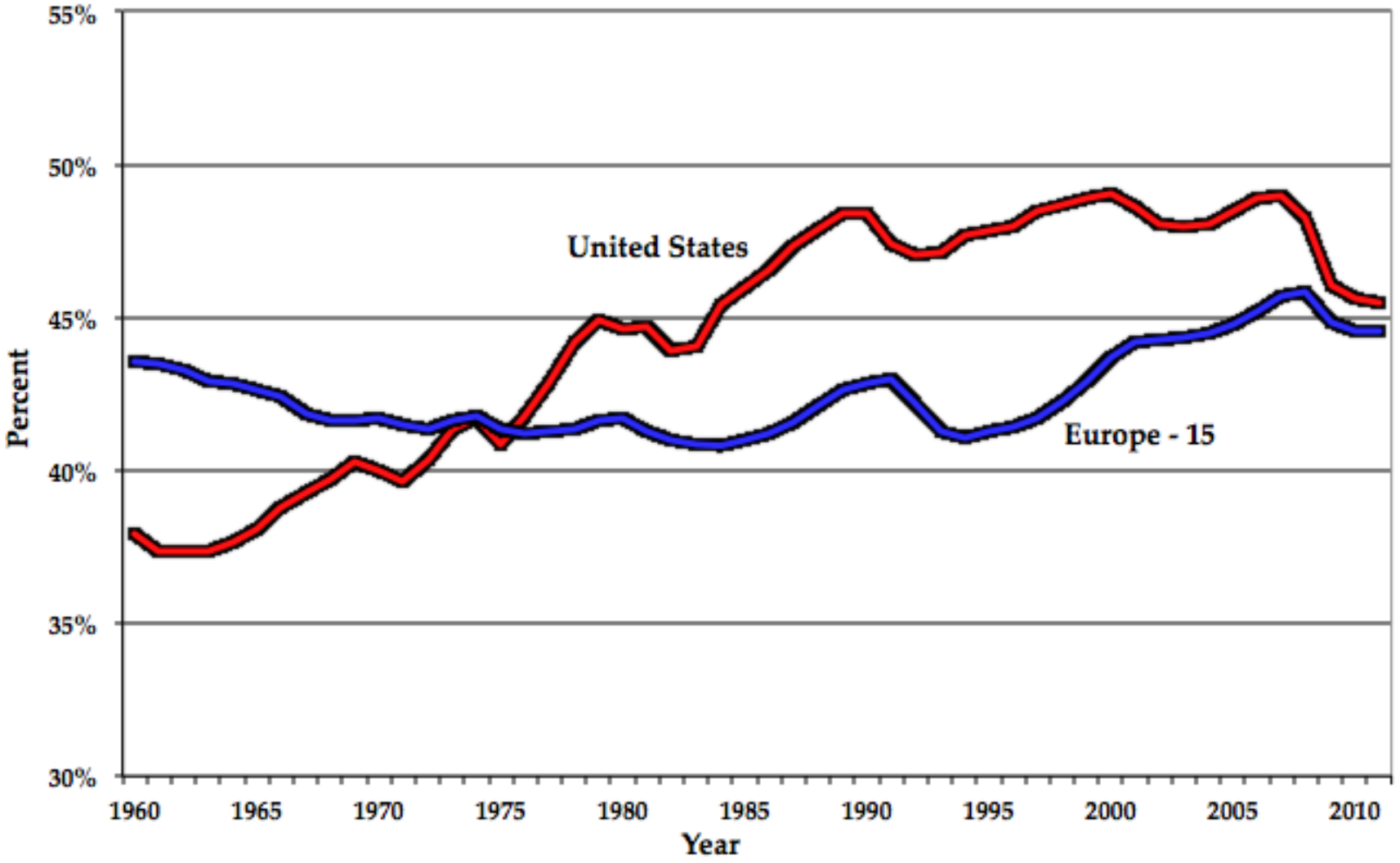
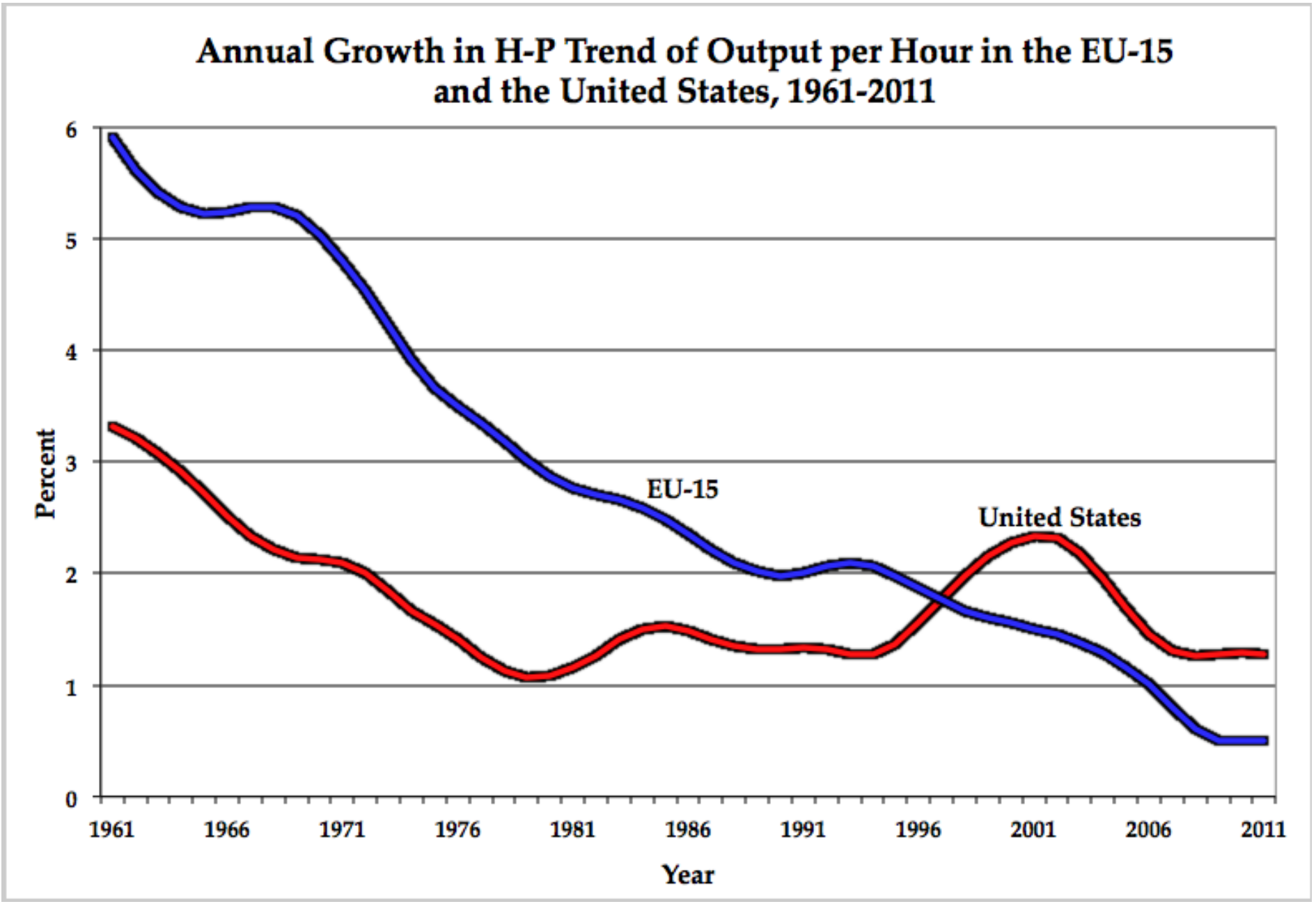


Figure 4. The Employment-Population Ratio, Europe-15 and United States, 1960-2011




Annual Growth in H-P Trend of Output per Hour in the EU-15 and the United States, 1961-2011
Percent
6
5
4
3
2
1
0
EU-15
United States
1961
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
Year

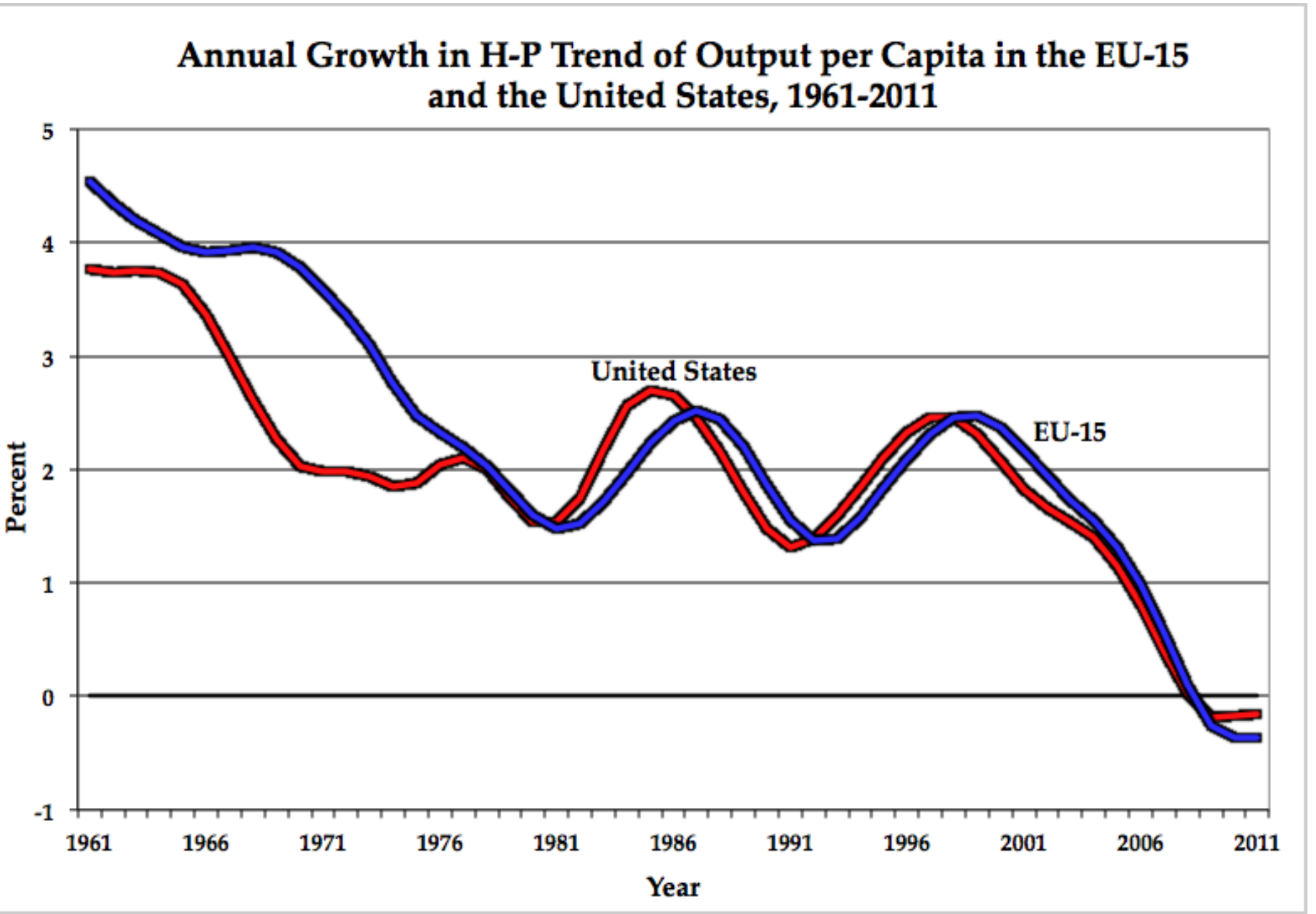
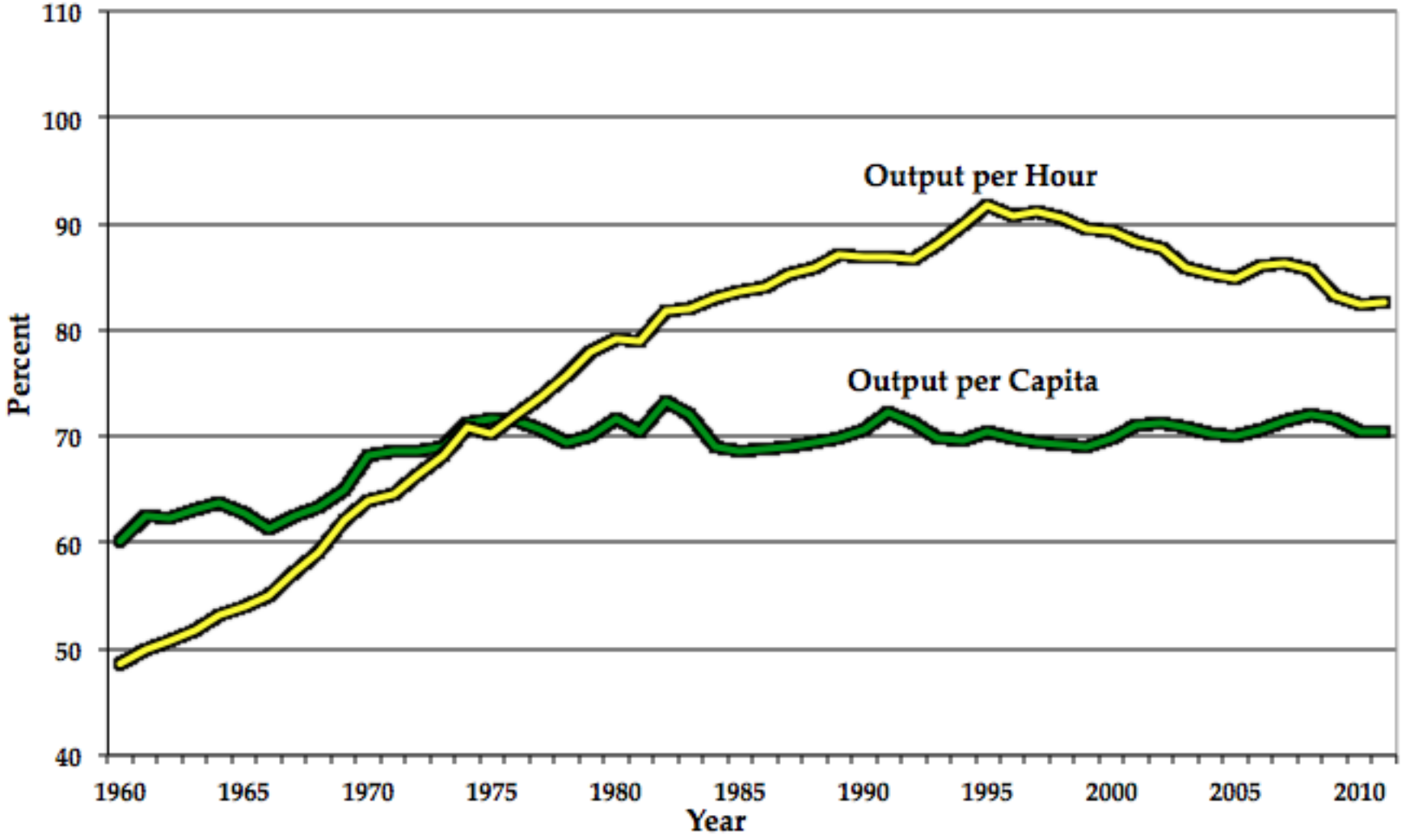

Annual Growth in H-P Trend of Output per Capita in the EU-15 and the United States, 1961-2011
5
4
3
2
1
0
-1
Percent
United States
EU-15
1961
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
Year

Figure 1. Ratio of Europe-15 to the United States, Output per Capita and Output per Hour, 1960-2011



Where Does Turkey Rank? Is It Immune to the European Productivity Malaise?

- **The can be found in Annex Table 12 in the May 1913 *OECD Economic Outlook***
- **Growth in Output per Hour Worked in the Total Economy, 1995-2012, annual growth rate**

U. S. = 1.47

Euro Area = 0.79

Turkey = 2.51

A Case Study: Retail Productivity in the EU-15 and the U. S.

- Timmer *et al. Economic Growth in Europe*
- 1995-2005 Labor productivity growth 3.0 in U.S. compared with 1.0 in EU-15
- Wholesale and Retail Trade contributed 0.8 of the 2.0 difference, fully 40 percent
- Superiority of U. S. trade productivity growth was not due to greater investment or more educated workers, but rather to efficiency
- By 2005 EU-15 labor productivity in market services had dropped to 70 percent of the U.S.
  - Sharp divergence between northern and southern EU-15

A Vast Literature Allows a Summary of Factors

- U. S. trucking deregulation in early 1980s meant any trucking firm could carry anything anywhere.
- All U. S. productivity gains occurred in new establishments, none in old establishments
- The “Big Box” format. Not just Wal-Mart but Target, Home Depot, Best Buy, with gigantic warehouse-sized stores.
- Designed for efficient delivery of supplies by large trucks, consumers pick up large quantities and drive them home in large cars

Handicaps in Europe Vary Across Countries

- **Regulations on:**
  - **Store opening hours**
  - **Land-use zoning**
  - **Labor market protections preventing the flexible labor force of U. S. workers that is non-union, employment is discretionary and often part-time**
  - **Many Europeans arrive at small stores by walking or public transit and purchase small quantities**
- **Efficiency driven by economies of scale**
- **Better treatment of employees in Europe vs. higher prices for consumers and lower productivity**

The Threat of Slower Growth: Implications for Europe:

- **Prediction: Innovation as Fast over next 40 years as last 40 years**
- **Subtraction for Headwinds:**
  - ***Demography. Europe's dependency ratio is higher***
  - ***But the socio-economic decline of the bottom third of the native-born population is not as serious***
  - ***In many countries education scores and higher and college much more affordable***
  - ***Inequality and poverty are less serious***
  - ***In northern Europe, debt problems don't exist in the same way***

Conclusion

- **I'm not predicting the end of innovation, just that innovation will be about 1/3 less important than 1891-1972 *and as fast as 1972-2012*.**
- **U.S. has been sliding down the league tables in higher educational attainment and life expectancy**
- **I fully expect the U.S. to be surpassed over the next 30 years in output per capita by one European nation after another**
- **Now it's time for skeptical questions about my U.S.-centric view.**