

**Secular Stagnation
on the Supply Side:
U.S. Productivity Growth in the
Short and Long Run**

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**Bank of Canada and European Central Bank,
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Growth Performance**

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Secular Stagnation: Applies Not Just to US but Canada, EU-15, Japan

- **Secular Stagnation: slow growth not no growth**
- **Most of my talk is about the U.S.**
- **But almost everything here applies to Canada and the EU-15**
- **At the end: charts comparing Canada, the U.S., and the EU-15 for output per hour, output per capita, and hours per capita**

Secular Stagnation

1938 and 2015 As the Mirror Image

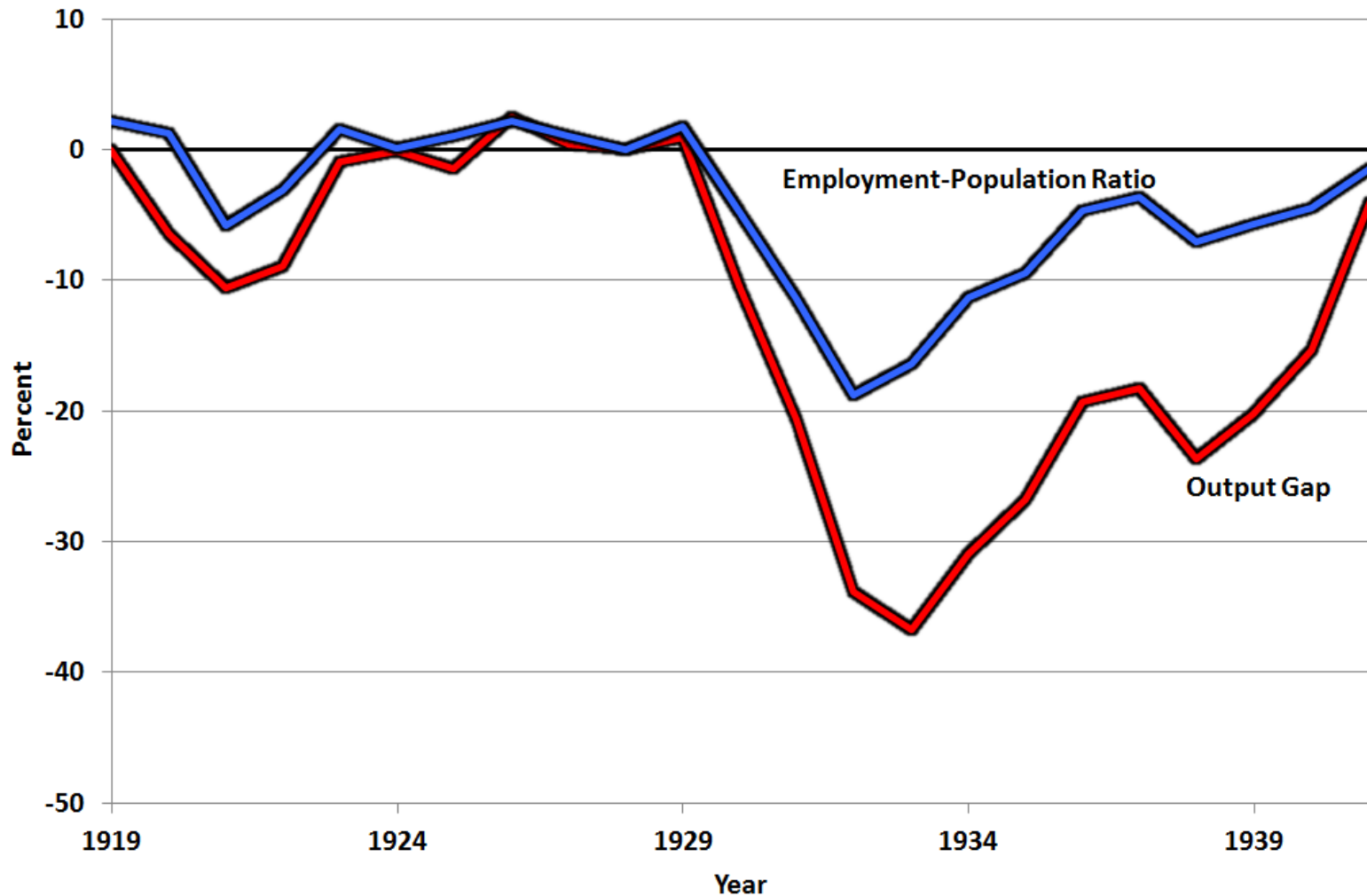
- Sources emanate from supply side:
 - Hansen in 1938: slowing population growth and end of territorial expansion
 - “the whole new outfit of capital formerly needed by the added population is now no longer needed”
 - Today 2015: slowing potential GDP growth
 - Potential Output per Hour
 - Potential Hours of Work
 - Working-age Population
 - Falling Labor-force Participation Rate (LFPR) reduces Hours per capita
 - Actual real GDP growth: 1974-2004 3.12, 2004-14 1.55
 - “the whole new outfit of capital formerly needed by the added population is now no longer needed”
- Mirror-image Interpretation, Hansen 1938 vs. U.S. now

Chains of Causation

- **AS Effects directly reduce output per capita growth:**
 - Declining LFPR
 - Declining productivity growth
- **For any given rate of output per capita growth**
 - Slower population growth reduces potential GDP growth
- **Implies Lower Net Investment**
 - Basic idea: long-run steady state with fixed capital-output ratio
 - Slower output growth means slower growth in capital to maintain fixed capital-output ratio
- **Lower net investment: reduces aggregate demand and feeds back to lower productivity growth**

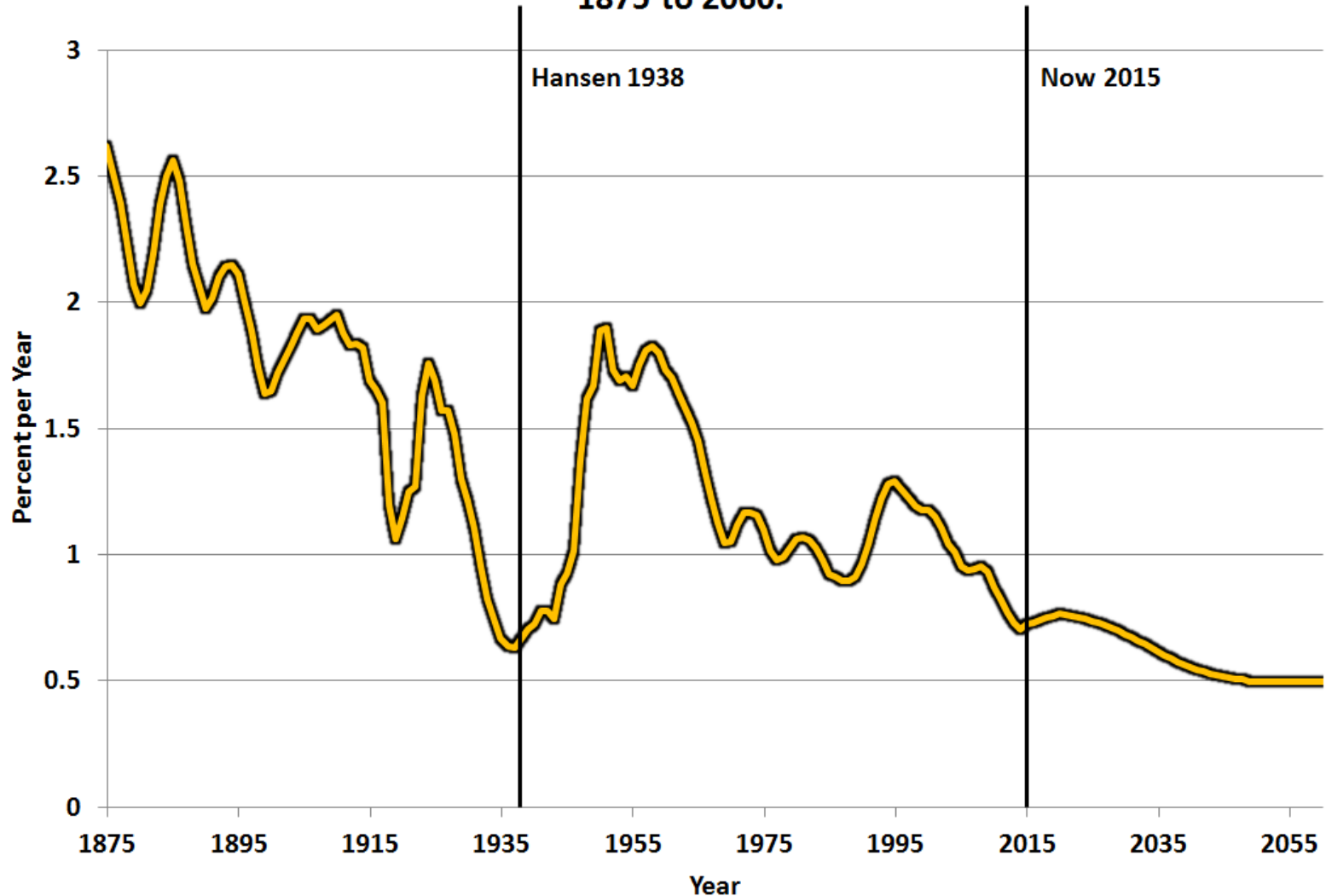
Employment-Population Ratio and GDP Gap, 1919-1941

Figure 1. Output Gap vs. Log Employment-Population Ratio, 1919 to 1941, 1928=0.



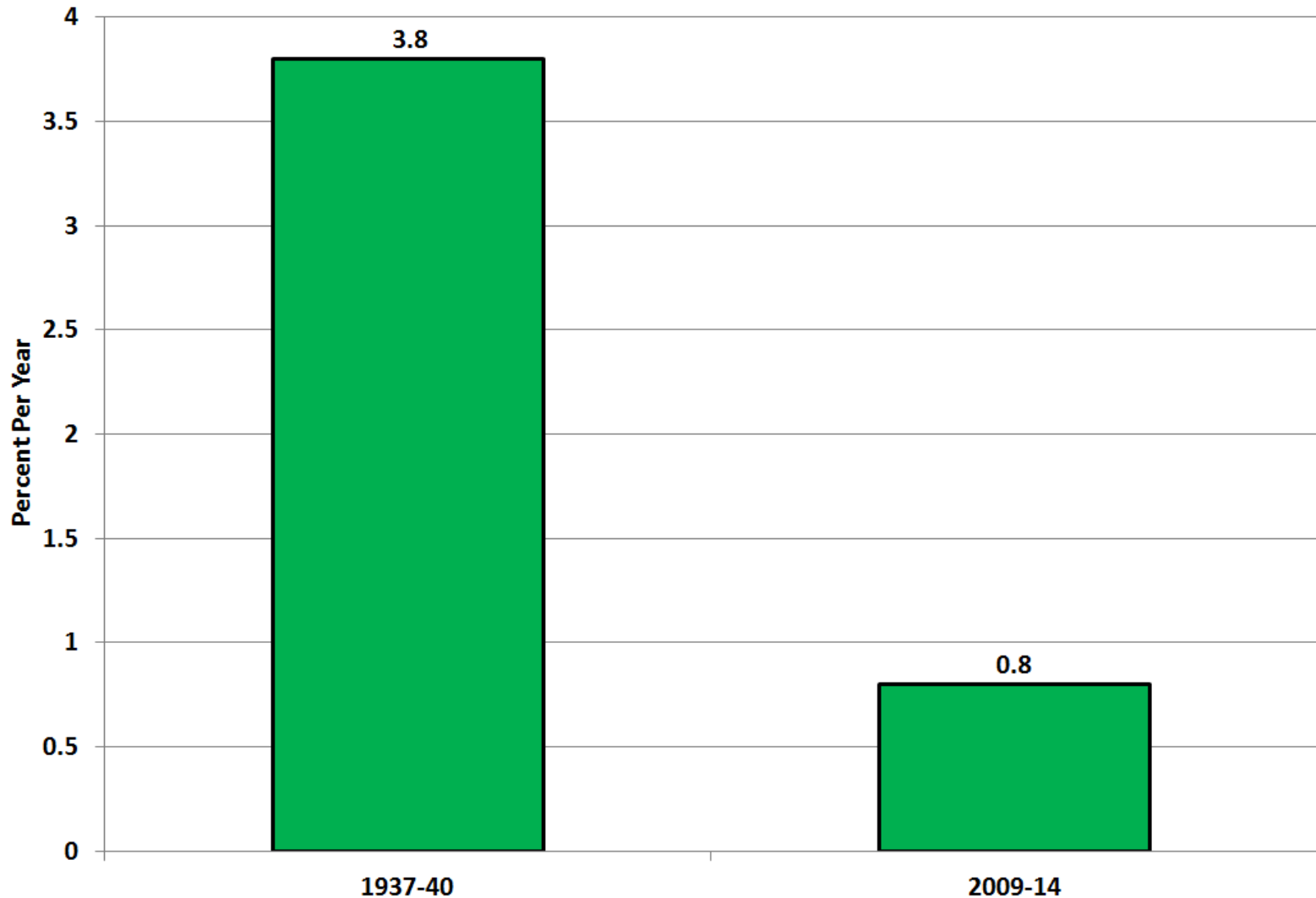
Decline in Population Growth As Seen From 1938 and 2015

Figure 2. Annualized Five-Year Growth Rate of U. S. Population,
1875 to 2060.



Why Hansen Wasn't Worried About Productivity Growth

Figure 3A. Annual Growth Rate of Output per Hour, 1937-40 vs. 2009-14



Preview: Primary Source of Secular Stagnation is Slowing Productivity Growth

- **Since Solow 1957: The history of TFP growth is the best guide to the importance of innovation**
- **The best organizing principle to think about innovation is to distinguish among the industrial revolutions (IR #1, IR #2, IR #3).**
- **IR #2 was without compare in its impact in creating rapid TFP growth for a full half century**
- **IR #3 has changed our lives but has raised TFP growth less, for only a decade instead of a half-century.**

To Understand TFP History, We Need Definitions of the Three IR's

- *The 1st IR occurred 1770-1840, continued impact through 1900*
 - Steam engine, railroad, steamships, wood=>steel
- *The 2nd IR occurred 1870-1920, continued impact through 1970 along at least 6 dimensions*
 - Electricity, light, elevators, machines, air conditioning
 - Internal combustion engine, vehicles, air transport
 - EICT: Telephone, phonograph, movies, radio, TV
 - Running water, sewer pipes, and the conquest of infant mortality
 - Chemicals, plastics, antibiotics, modern medicine
 - Utter change in working conditions, job & home

Third Industrial Revolution

- Since 1960 the “EICT” Revolution (one dimension compared to the six dimensions of IR #2)
- *Everything on this list has already happened; to continue TFP growth of 1970-2014 there must be a steady stream of innovations that are of similar importance*
 - Entertainment: TV – color, cable, time shifting, HDTV, streaming
 - Information Tech – mainframes, minis, PCs, web browsers, e-commerce
 - Communications: mobile phones, smart phones
 - Productivity enhancers: ATM, bar-code scanning, lightning-fast credit card authorization
 - Search tools provide free information, both public and proprietary inside the firm

The Standard of Living Is Not the Same as Productivity Growth

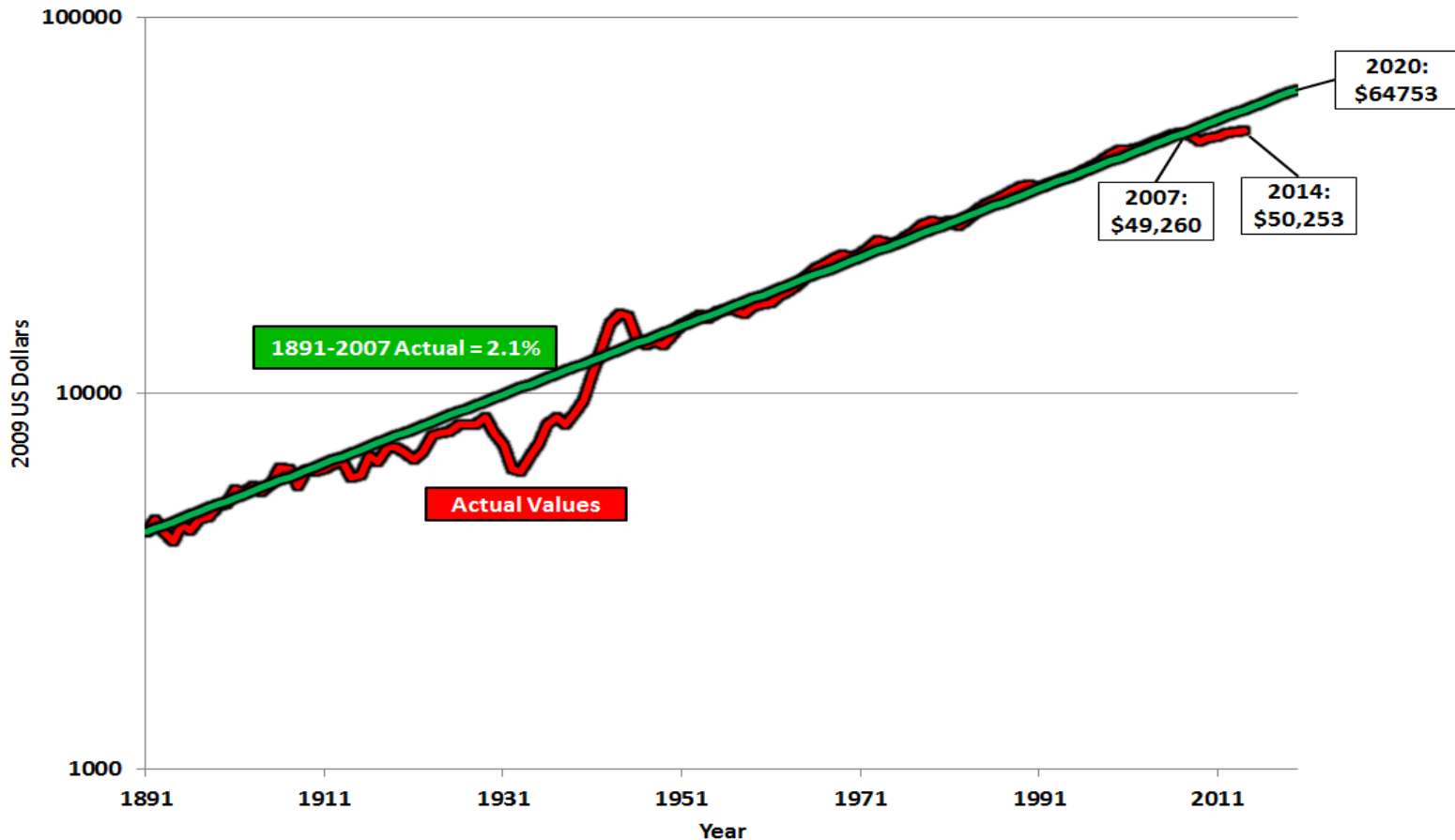
- Total Output or GDP (Y).
- Total Hours of Work (H).
- Total Population (N).

- The Output Identity

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

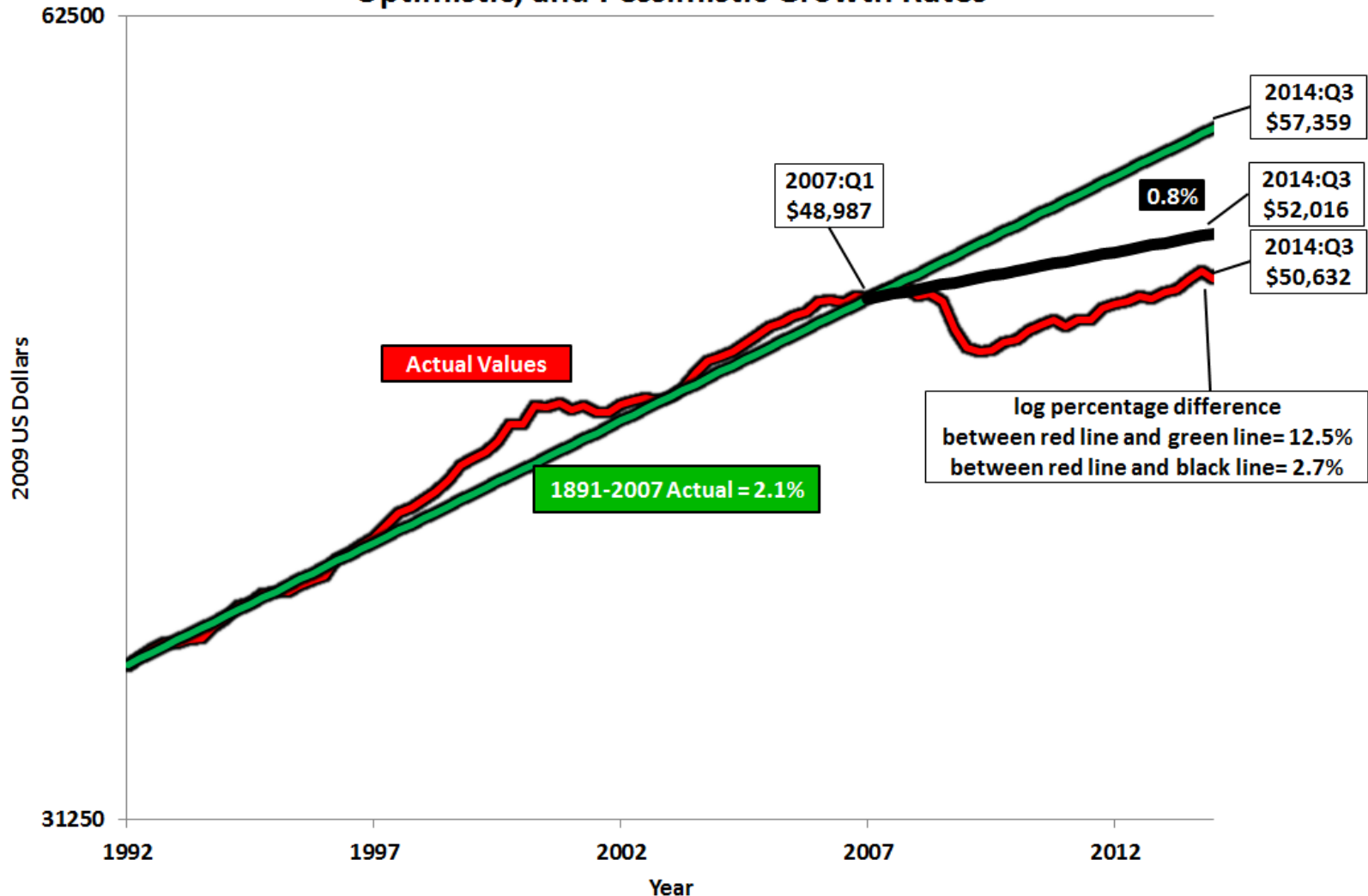
Real GDP Per Capita Is Not the Same As TFP And Does Not Measure Innovation

Figure 1. Prospective Level of 2020 Real GDP per Capita



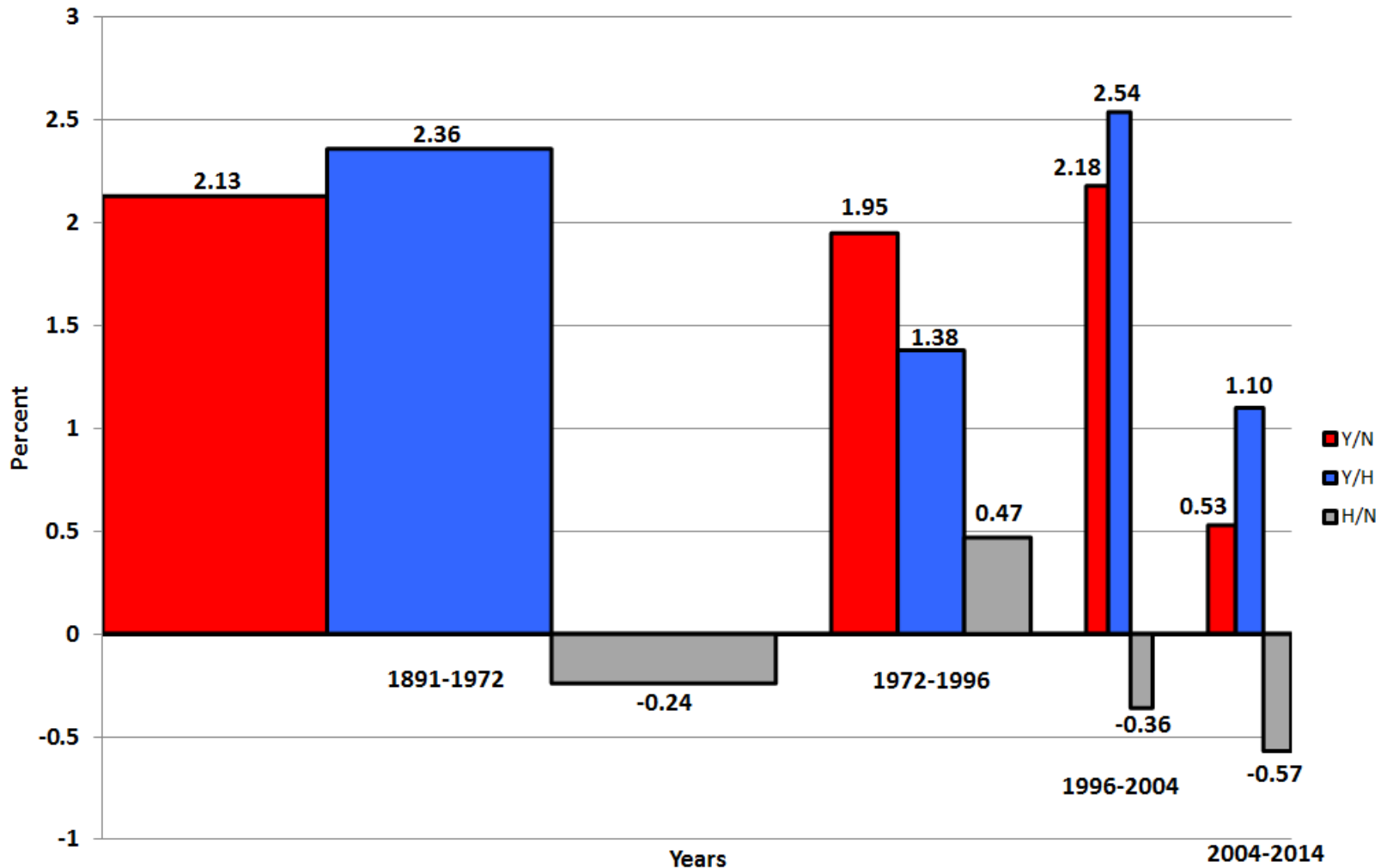
Per-capita Real GDP Growth Now Is Below Pessimistic Trend

Figure 4. Level of Real GDP per Capita through 2014:Q3, Actual, Optimistic, and Pessimistic Growth Rates



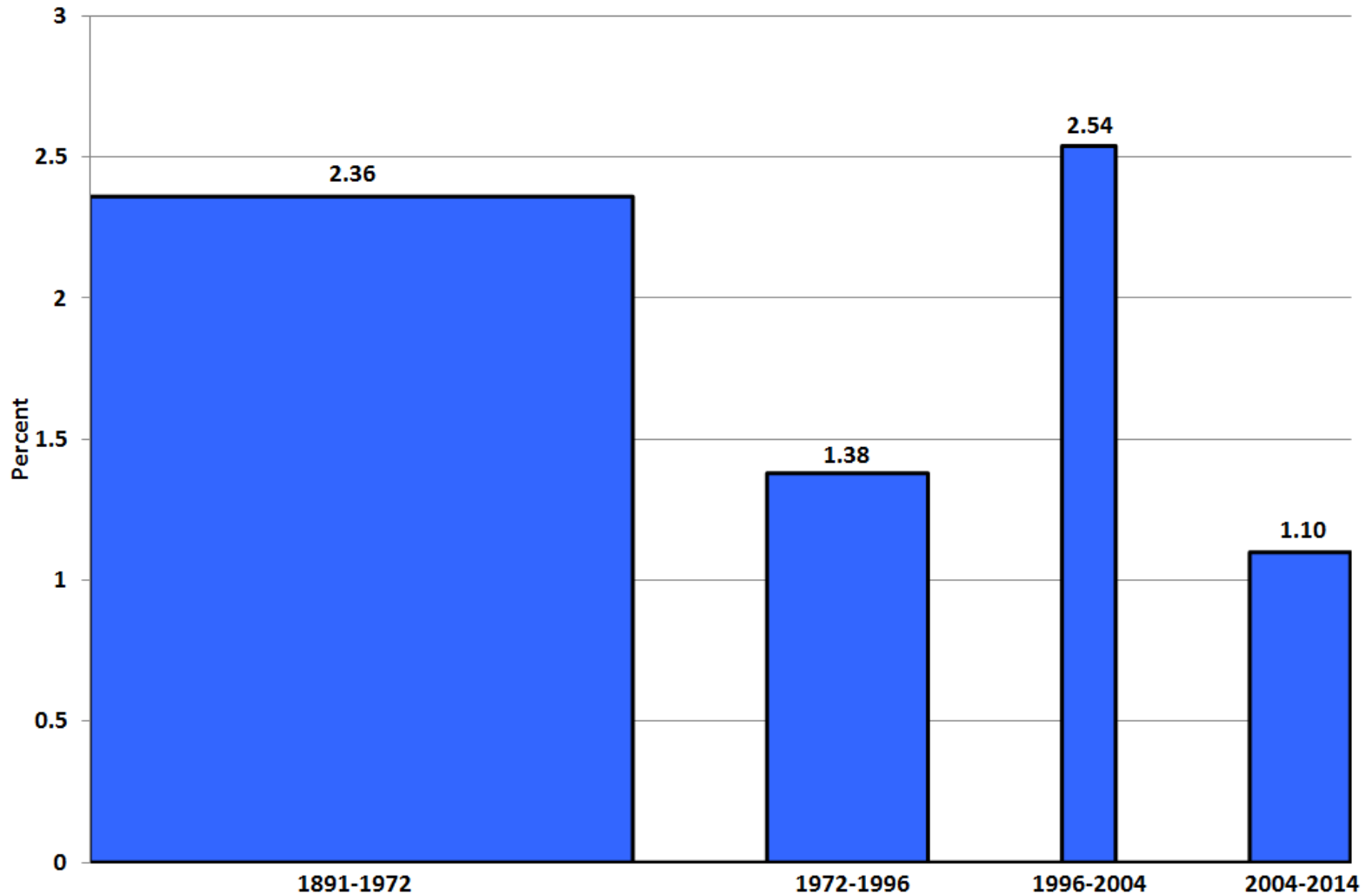
Per-Capita Income Growth Does Not Equal Productivity Growth

Figure 2. Annualized Growth Rates of Output per Hour, Output per Capita, and Hours per Capita, 1891-2014



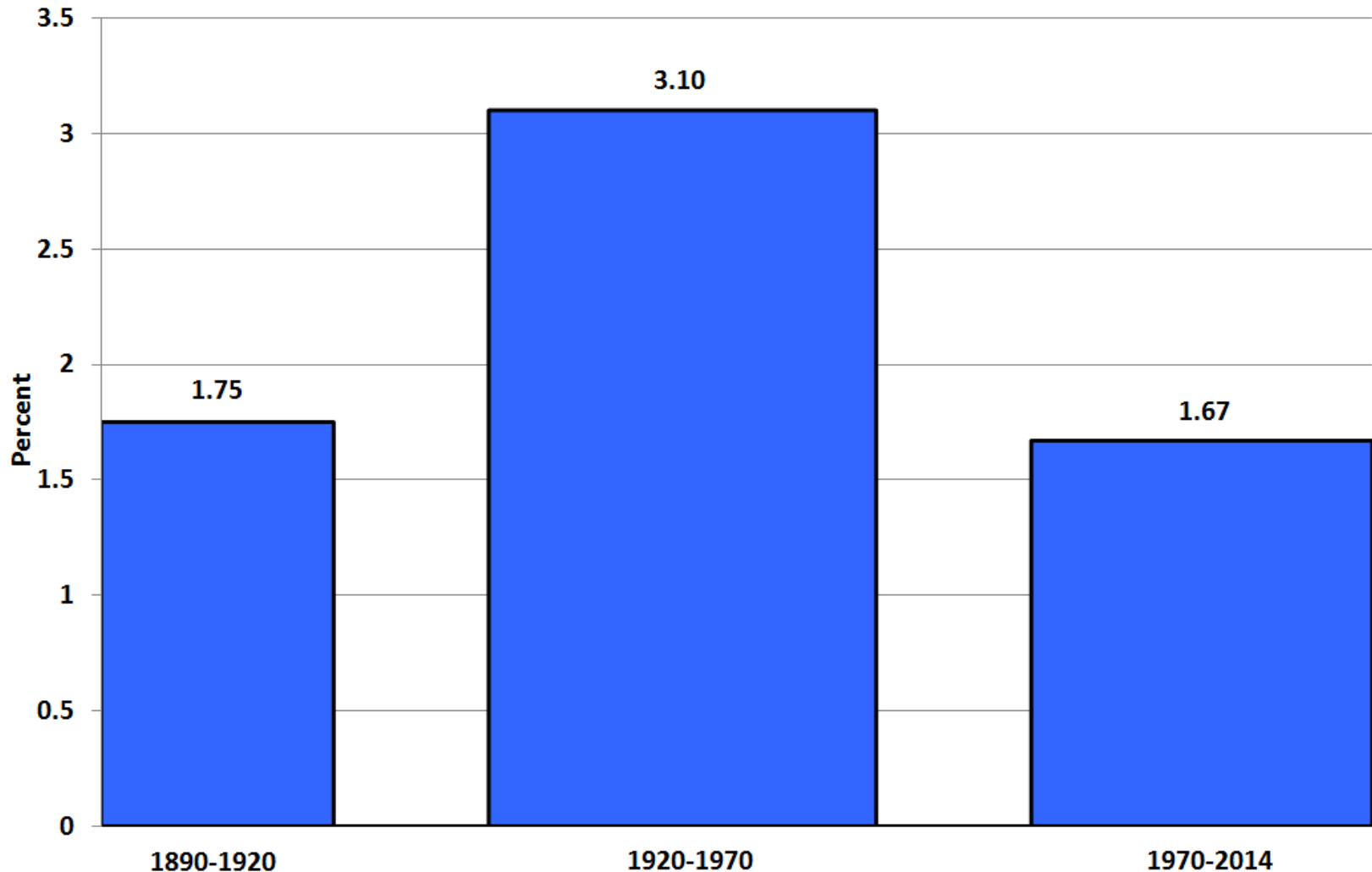
The Same History, Just for Productivity (Y/H) Growth

Figure 5. Annualized Growth Rates of Output per Hour, 1891-2013



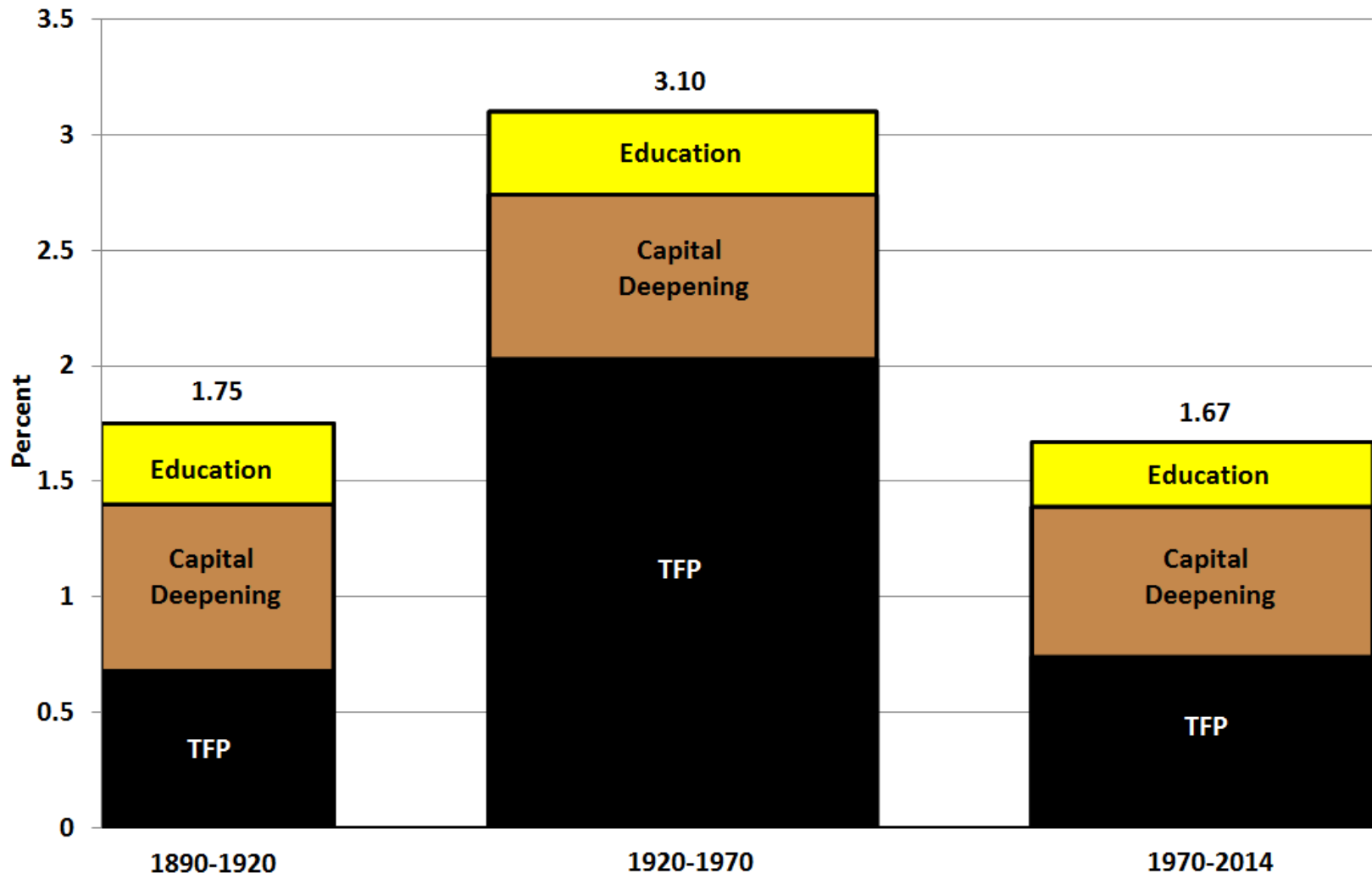
Growth in Labor Productivity Over Three Eras

Figure 1-2. Average Annual Growth Rate of Output per Hour,
Selected Intervals, 1890-2014



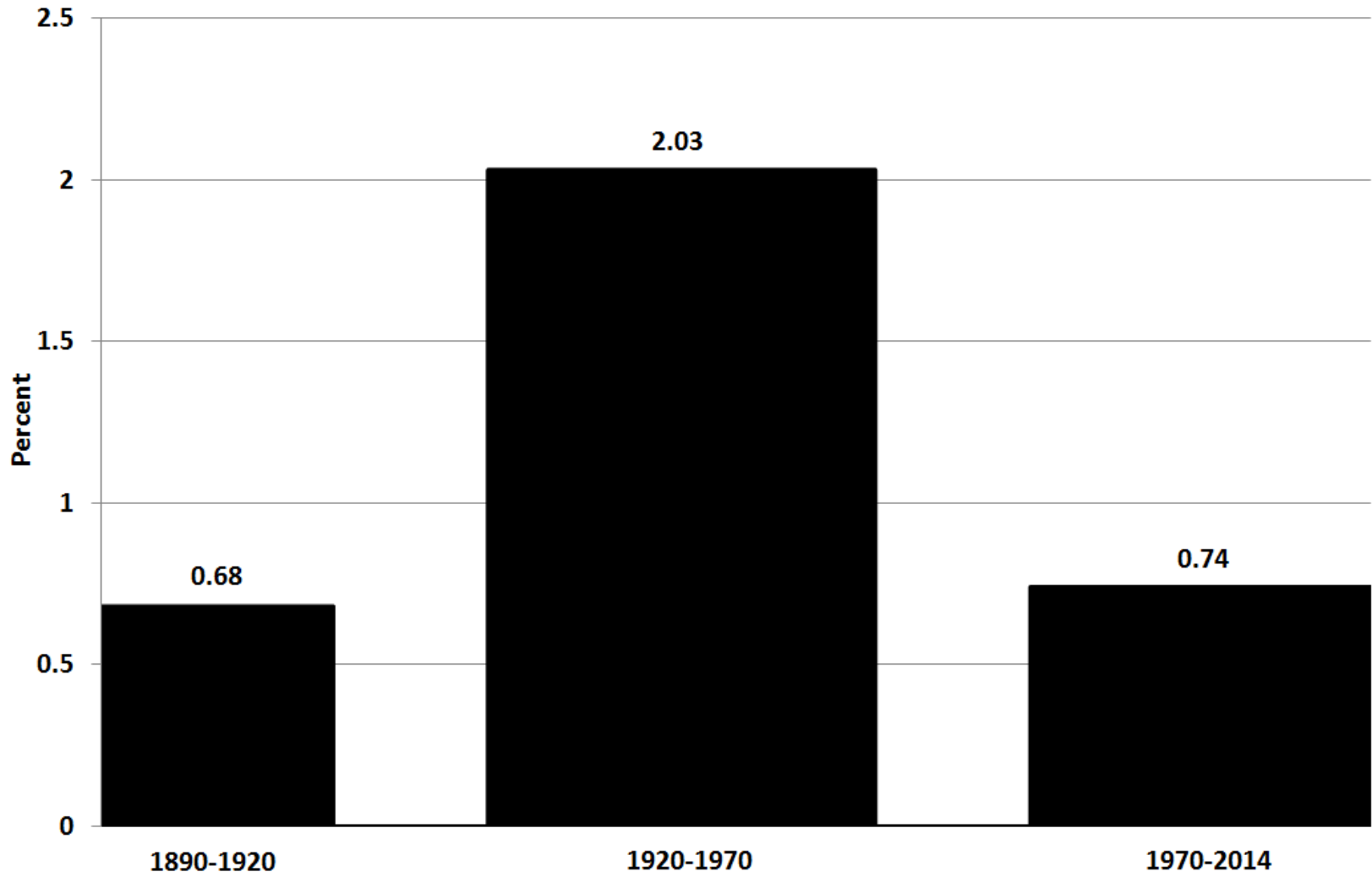
The Effect of Education and Capital Deepening

Figure 1-2. Average Annual Growth Rates of Output per Hour and Its
Components, Selected Intervals, 1890-2014



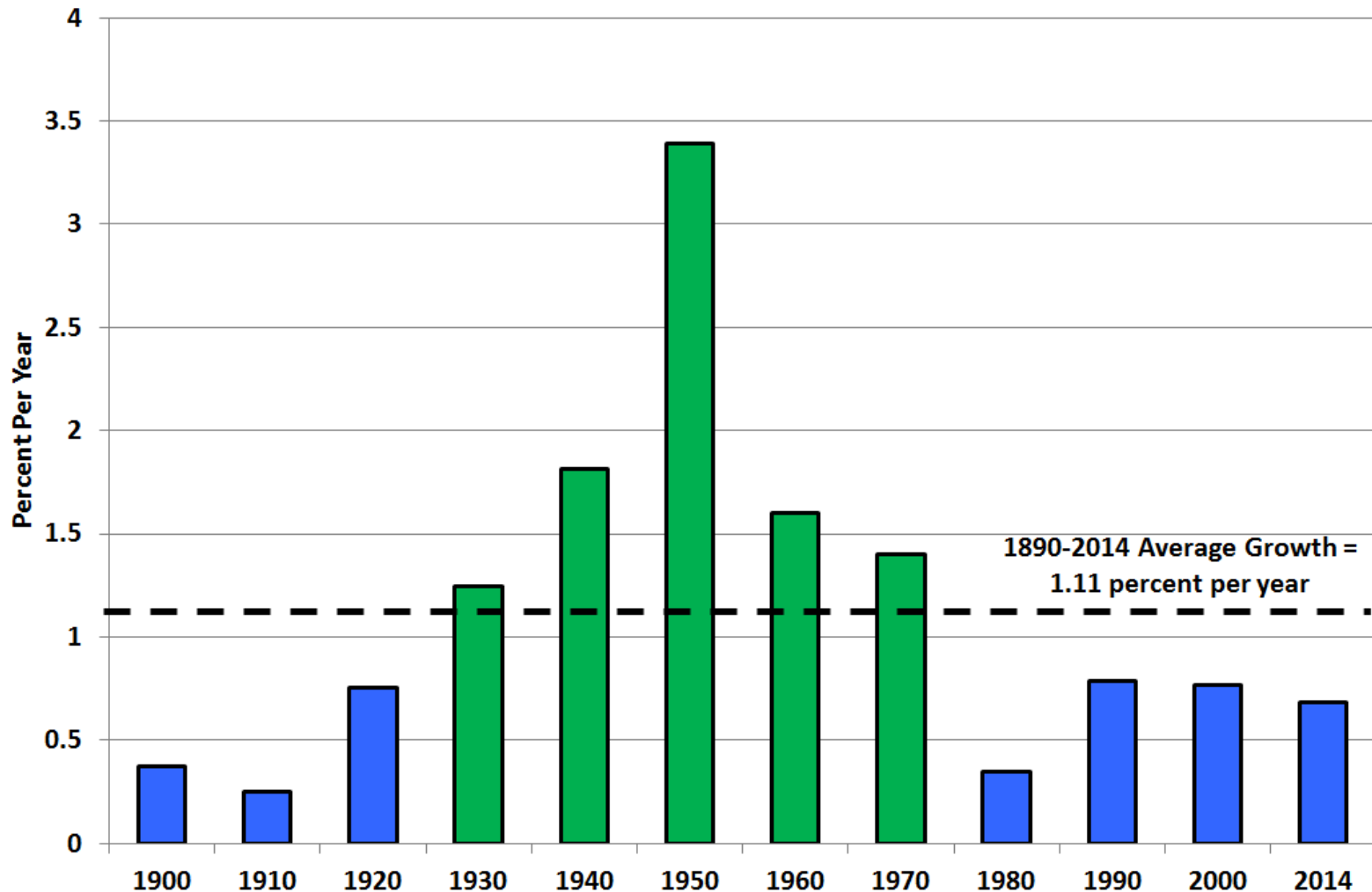
The Second Industrial Revolution vs. the Third Industrial Revolution

Figure 1-2. Average Annual Growth Rates of Total Factor Productivity,
Selected Intervals, 1890-2014



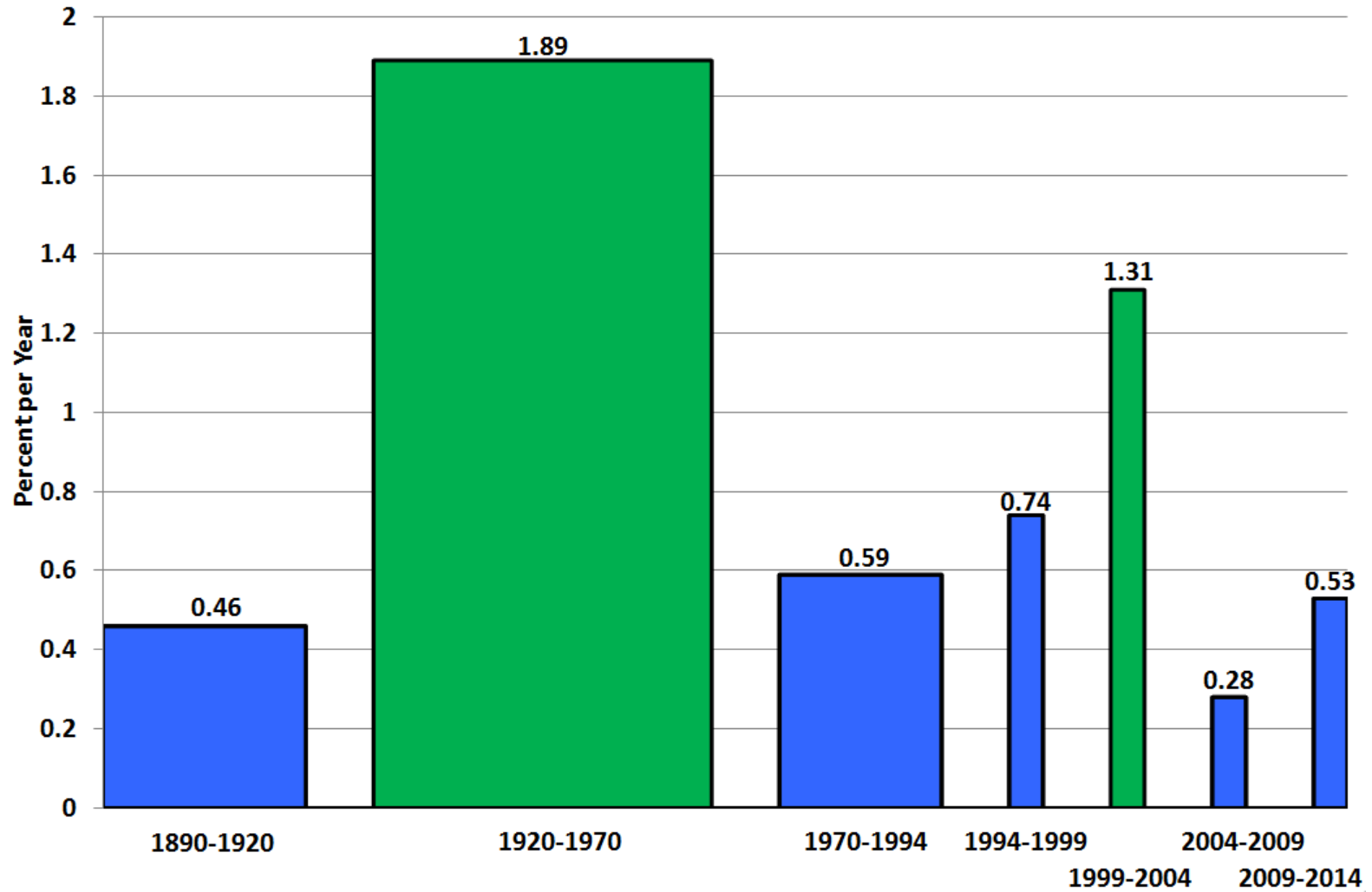
The Powerful But Delayed Effect of IR #2 on TFP Growth

Figure 3. Annual Growth Rate of Total Factor Productivity for Ten Years
Preceding Years Shown, Years Ending in 1900 to 2014



IR #2 Created “Big Green” TFP; IR #3 Created “Little Green” TFP

Figure 6. Average Annual Growth Rate of Total Factor Productivity,
Selected Intervals, 1890-2014



IR #3 Has Failed the TFP Test

- **Failure #1: TFP growth post-1970 barely 1/3 of 1920-70**
- **Failure #2: IR #3 boosted TFP growth only briefly 1996-2004**
- **Brynjolfsson and McAfee: “We’re at a point of inflection of accelerating productivity growth”**
- **My response: “Could the productivity benefits of IR #3 be almost over?”**

The IR #3 Changed Business Practices Completely 1970-2005

- **Transformation in offices completed by 2005.**
 - 1970 mechanical calculators, repetitive retyping, file cards, filing cabinets
 - 1970s and 1980s. Memory typewriters, electronic calculators, PCs with word processing and spreadsheets. E-mail.
 - 1990s. T-1 lines, in-house software. The web, search engines, e-commerce
 - 2000-05 flat screens, revolution in business practices was over
- **Transformation in retailing completed by 2005**
 - 1980s and 1990s Wal-Mart led big box revolution with innovations in supply chain and inventory management
 - Check-out revolution: bar-code scanners, credit/debit card authorization technology

More Achievements Completed by 2005

- **Finance and Banking**
 - 1970s and 1980s, ATM machines
 - 1980s and 1990s. Transition from multi-million share trading days to multi-billion share days
- **How Long Ago Were the Creations:**
 - Amazon 1994, Google 1998, Wiki and i-tunes 2001, Facebook 2004, iphone 2007

Summary: Stasis Everywhere You Look

- **Offices use desktop computers and proprietary information as they did 10-15 years ago**
 - The Northwestern econ department staff, 1998 vs. 2015
- **Retail stasis. Shelves stocked by humans, meat sliced at service counters, checkout bar-code scanning. Maybe card authorization a bit faster**
- **Medicine: electronic medical records largely rolled out,**
 - little or no change in what nurses and doctors do
- **Higher Education: cost inflation comes from rising ratio of administrative staff to instructional staff**

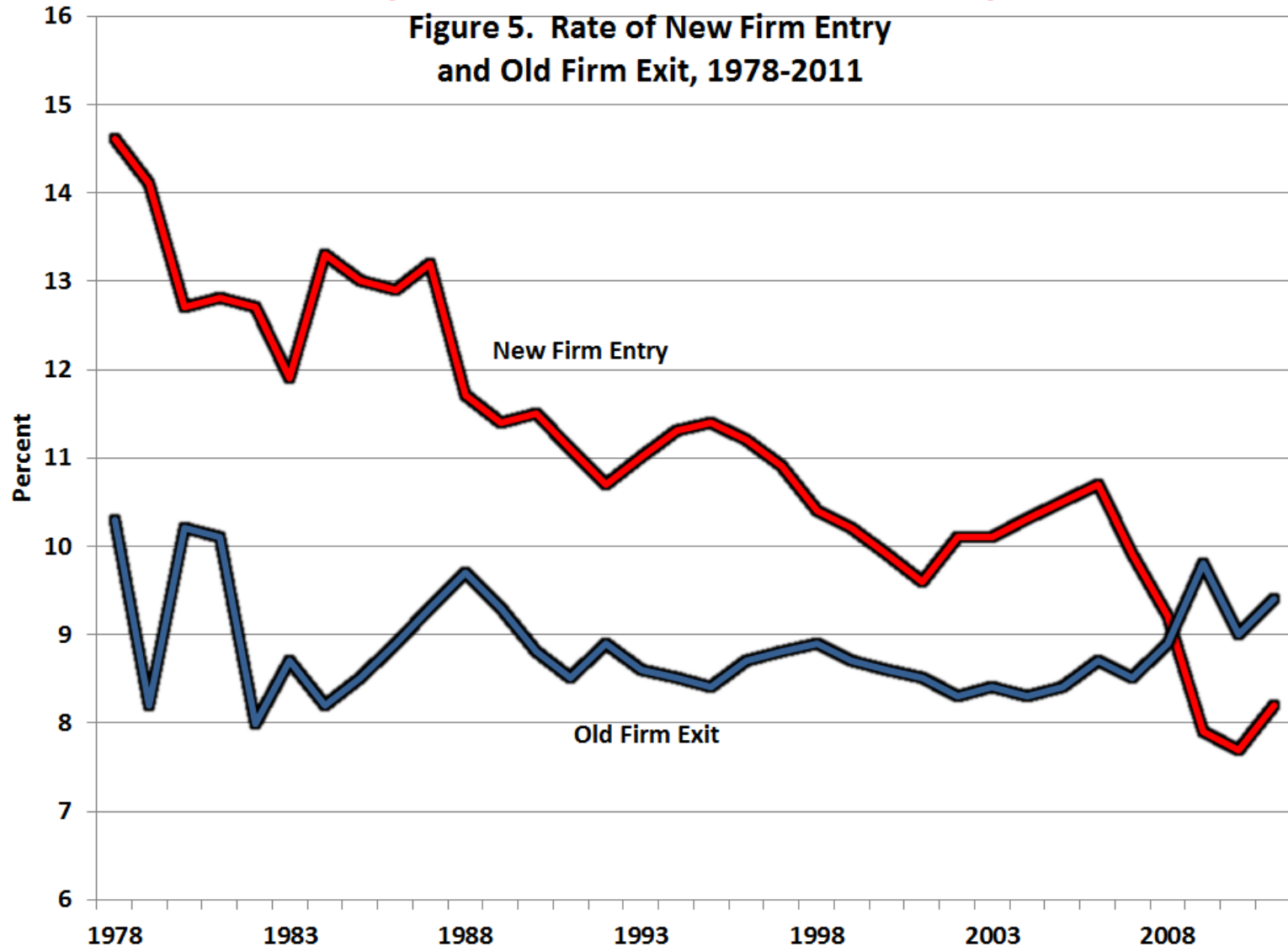
Stasis in Consumer Electronics

- **NYT on Consumer Electronics Show, January 2014**
- ***This show was a far cry from the shows of old . . . Over the years it has been the place to spot some real innovations (VCR 1970, CD 1981, HDTV 1998)***
- ***This year's crop of products seemed a bit underwhelming by comparison***
- ***Editor of gadget website: "This industry that employs all of these engineers . . . Needs you to throw out your old stuff and buy new stuff – even if that new stuff is only slightly upgraded.***

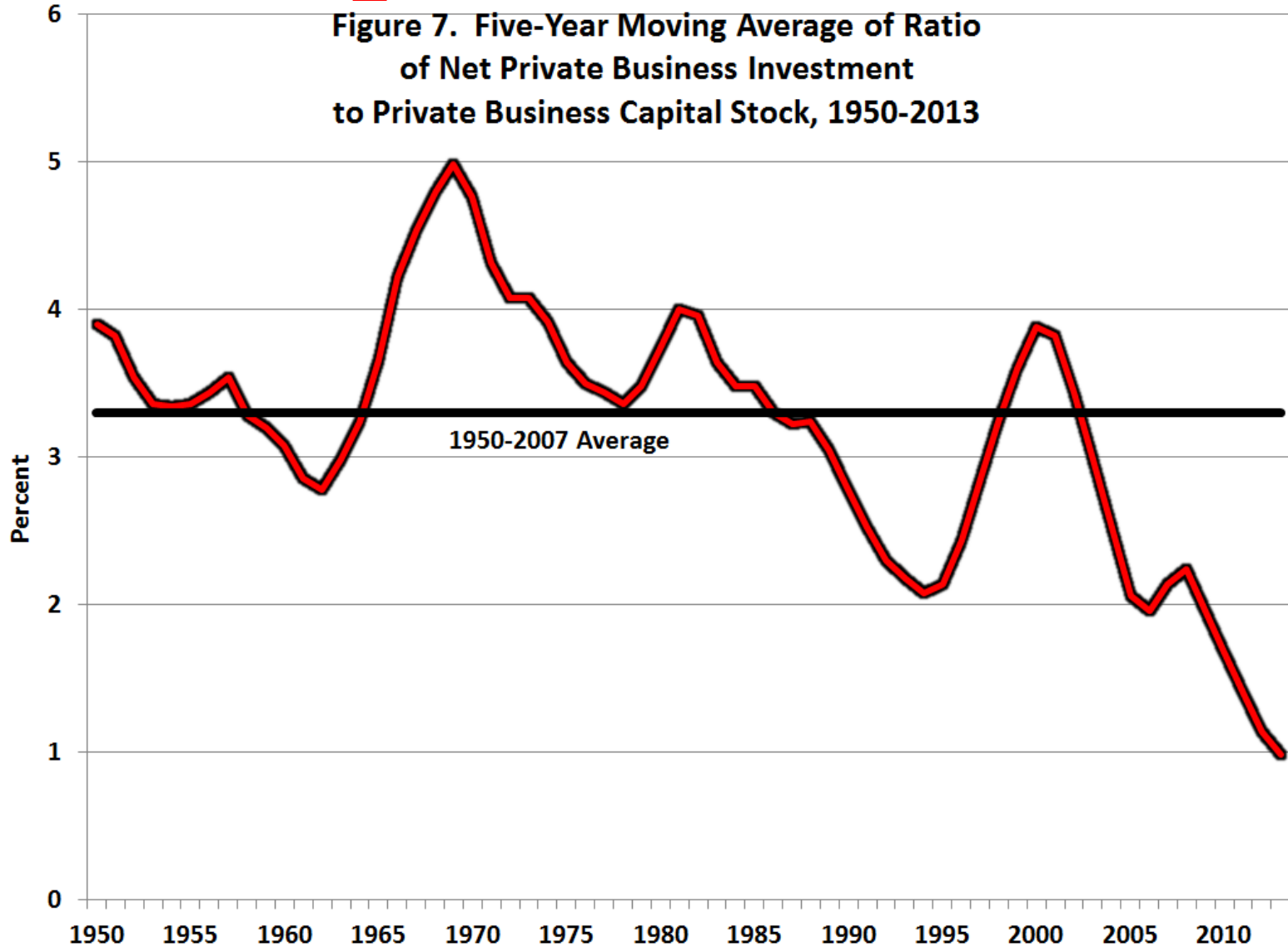
Additional Evidence of Diminishing Returns

- **Decline in Business “Dynamism”**
 - Decline over last 30 years in creation of new firms
 - In recent years more exiting firms than entering firms
- **Decline in labor market “Fluidity”**
 - Decline in job and worker reallocation rates

Business “Dynamism” Represented by New Firm Entry

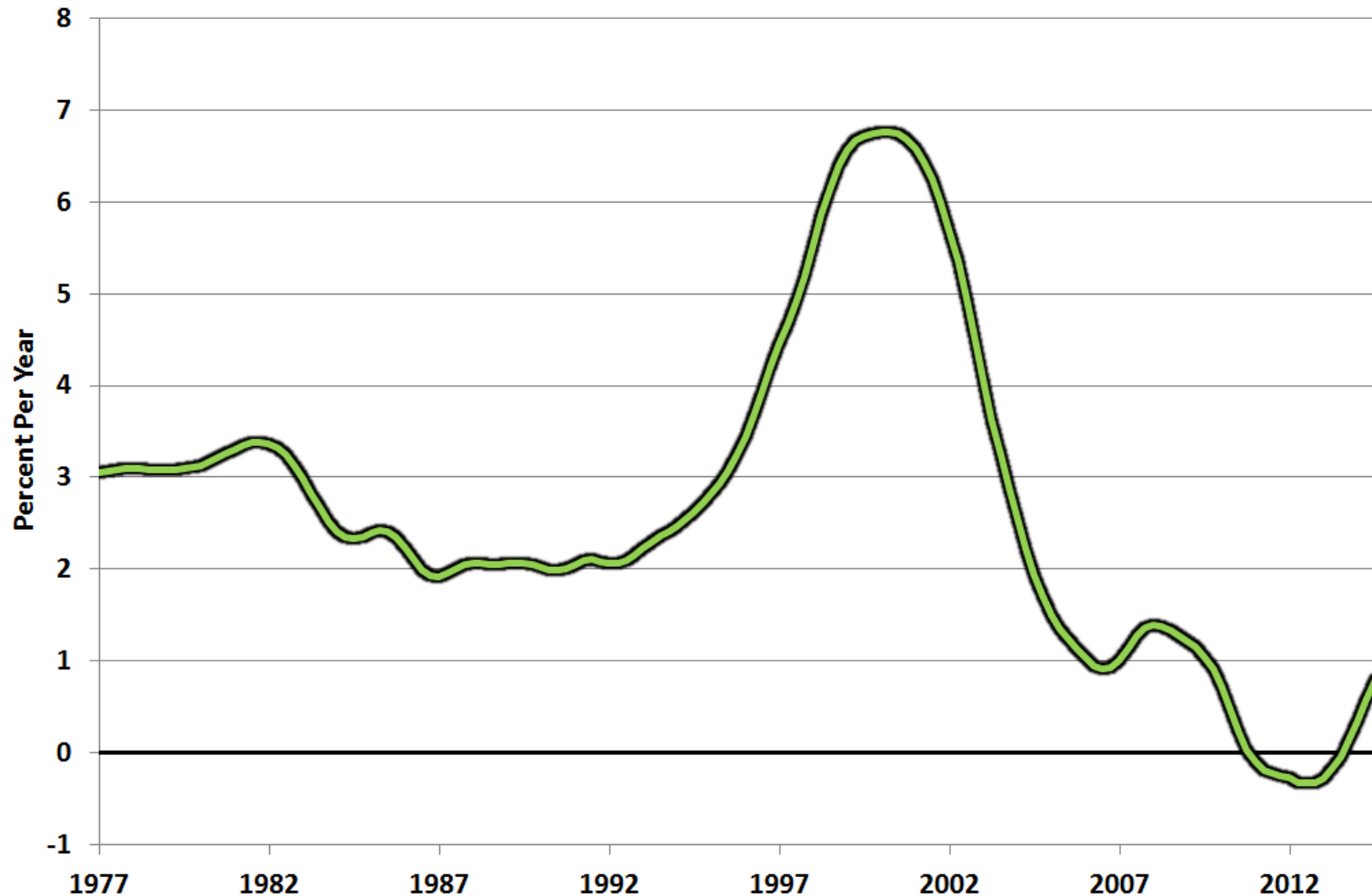


Stagnation Symptom #2: Declining Rate of Net Investment

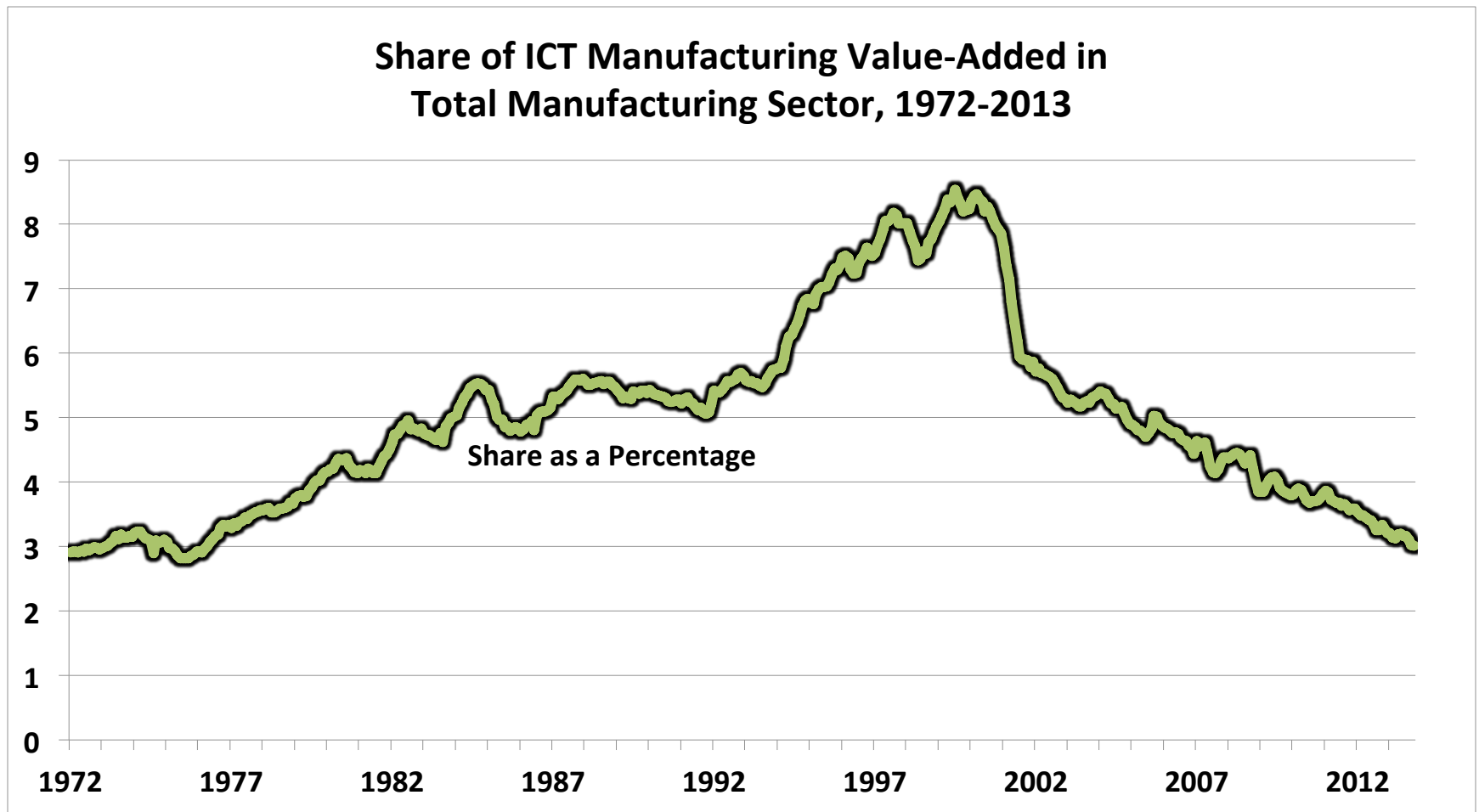


Stagnation Symptom #3: Growth in Manufacturing Capacity

Figure 8. Annualized Five-Year Change in Manufacturing Capacity,
1977-2014

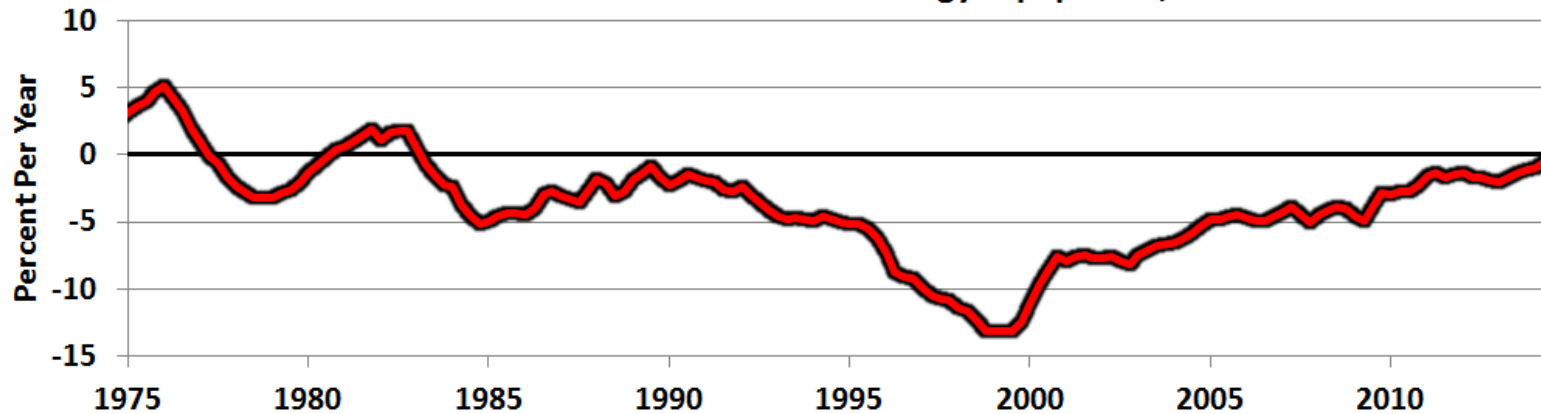


Stagnation Symptom # 4: The Most Dynamic Part of Manufacturing Has Disappeared



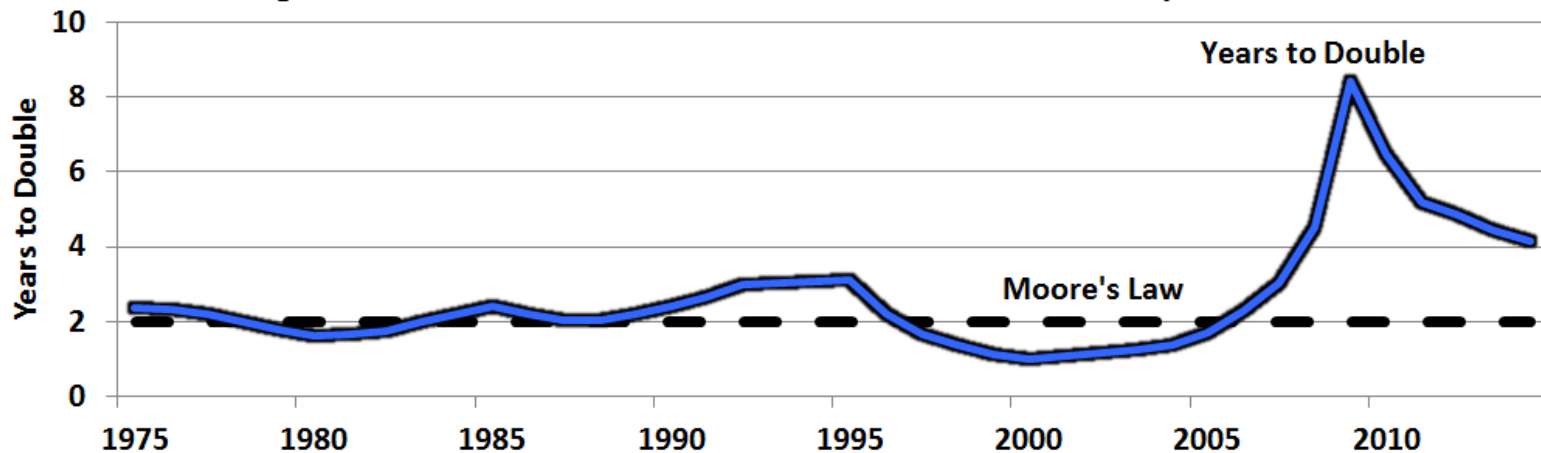
#5 and #6: Computer Prices and the Demise of “Moore’s Law”

Figure 9a. Rate of Change of Deflator for Information and Communications Technology Equipment, 1975-2014



Source: NIPA Table 5.3.4

Figure 9b. Years Taken for Number of Transistors on a Chip to Double



Source: Intel Corporation website

Innovations Continue But How Important Are They?

- **Medical and Pharmaceutical**
 - Continuous slow but steady progress in advancing life expectancy (but US vs. Canada)
 - Coming collision between physical wellness and mental illness (Alzheimers)
 - Increasing costs of drug development, fewer important new drugs
- **Small Robots and 3-D Printing**
 - Robots date back to 1961, continued development is evolutionary not revolutionary
 - Amazon robots are not as smart as you might think
 - 3-D printing useful for development prototypes, not mass production

Innovations Continue But How Important Are They?

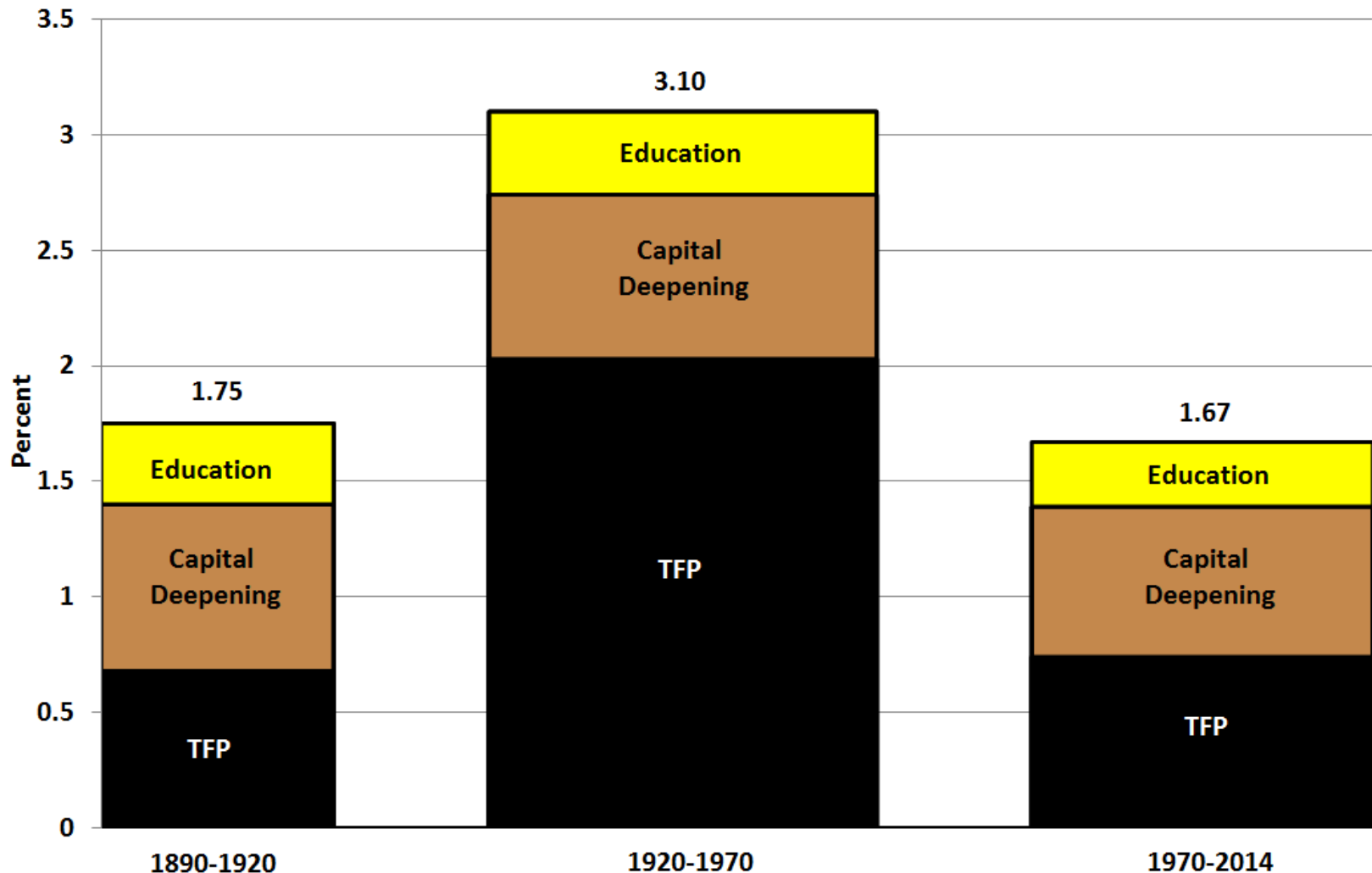
- **Big Data and Artificial Intelligence**
 - Predominant uses of big data are in marketing, zero-sum game
 - Application to legal searches, radiology reading evolutionary, not revolutionary
 - Next wave of replacement of humans: personal financial services (“Robo-advice”) and insurance agents
- **Driverless Cars and Trucks**
 - Truck drivers don’t just drive trucks, they unload them and stock the shelves
 - Wholesale trade isn’t just gee-whiz Amazon warehouses. Most of it involves delivering bread, coke, and beer

Slower Growth Goes Beyond Innovation

- **The educational plateau -- Increase in educational attainment coming to an end**
 - Goldin and Katz 0.35 percent contribution of education
 - Jorgenson -0.30 downward adjustment to education's contribution, i.e., close to zero
- **U.S. steady decline in league tables of high-school completion, four-year college completion**
 - Poor preparation for college. International PISA test scores rank out of 34 OECD countries: US #17 in reading, 20th in science, 27th in math
- **New issues of college affordability and \$1.2 trillion of student debt**

The Effect of Education and Capital Deepening

Figure 1-2. Average Annual Growth Rates of Output per Hour and Its
Components, Selected Intervals, 1890-2014



Socioeconomic Changes with Adverse Future Implications

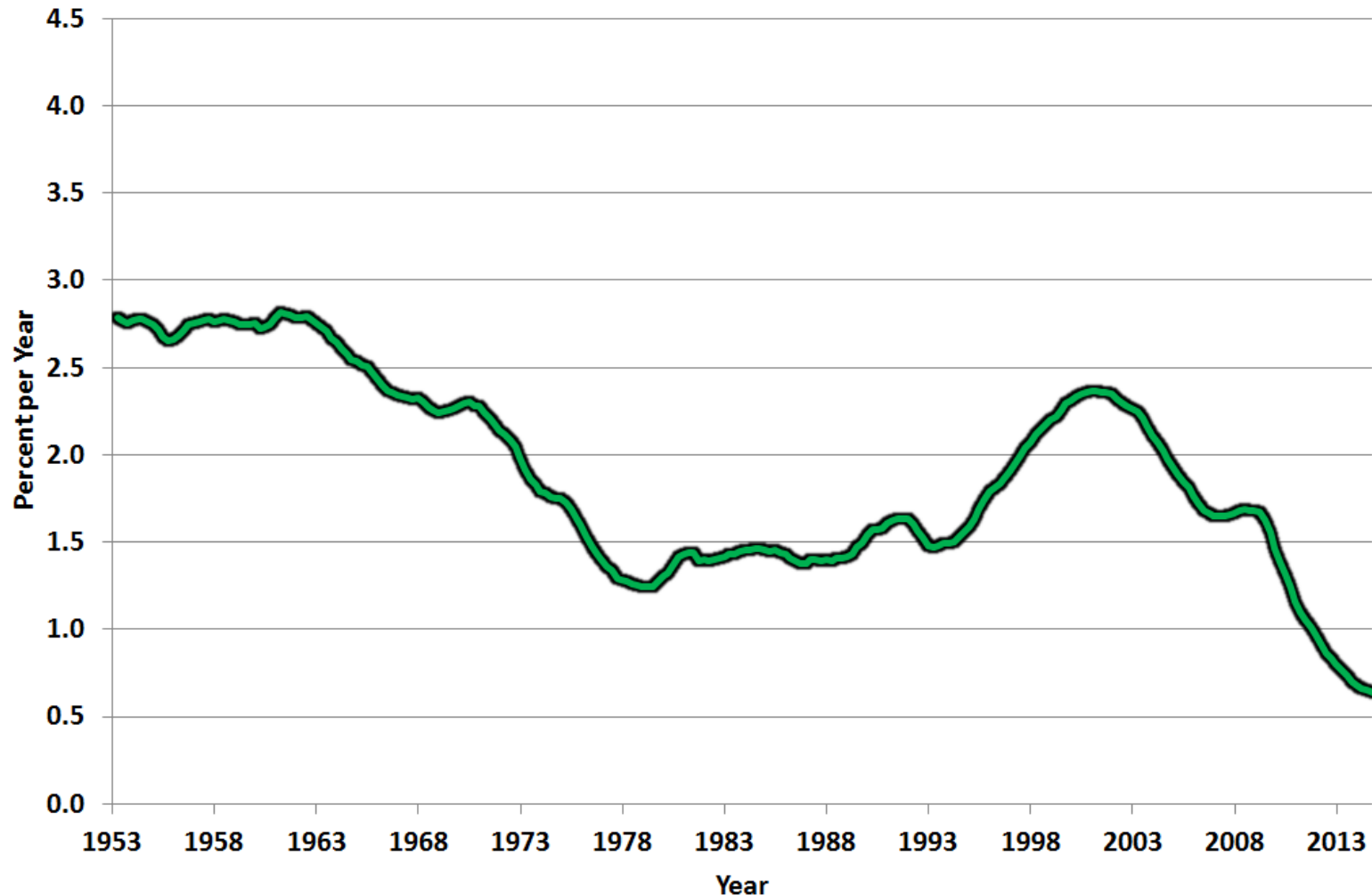
- **Changes 1982 to 2008, children born out of wedlock**
 - White high school grads 4 to 34 percent
 - White high school dropouts 21 to 42 percent
 - Black high school grads 48 to 74 percent
 - Black high school dropouts 76 to 96 percent
- **Change 1960-2010, bottom 1/3 of white population**
 - For 40-year-old women percent of children living with both biological parents declined from 95 to 34 percent

Socioeconomic Changes with Adverse Future Implications

- **Future consequences of single-parent households**
 - More children growing up in poverty
 - Greater likelihood of future high-school dropping out
 - Greater likelihood of criminal activity
- **Additional adverse effects: 1979-2009**
 - percent with prison records
 - white high school dropouts with prison records 4 to 28 percent
 - blacks 15 to 68 percent**

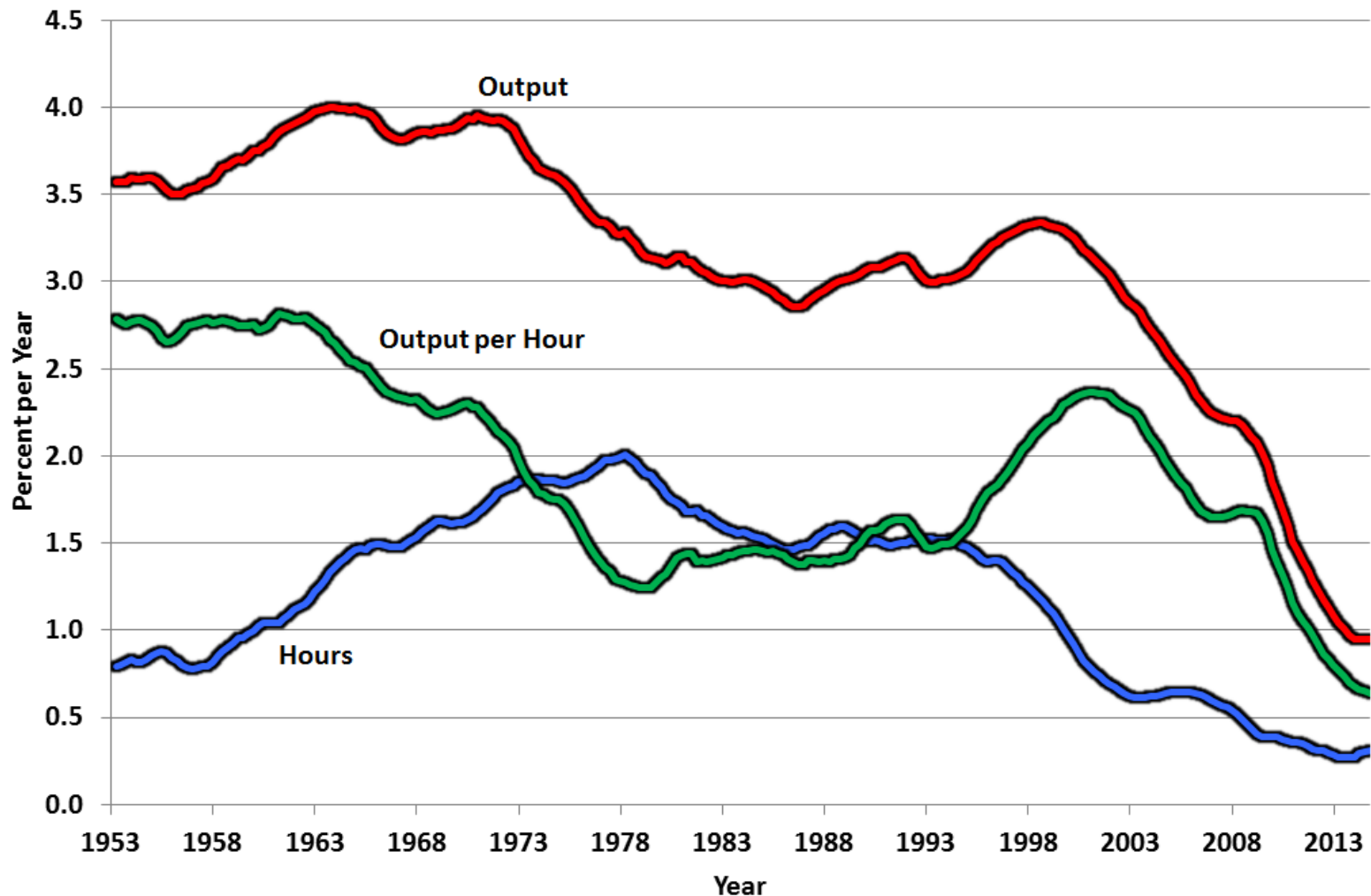
Trend in Labor Productivity Growth When Unemployment Rate is Fixed

Figure 10. Kalman Growth Trend of Output per Hour,
1953:Q1 to 2014:Q4



Potential Output Growth (at a Constant Unemployment Rate)

Figure 10. Kalman Growth Trends of Output, Hours, and Output per Hour, 1953:Q1 to 2014:Q4



Productivity Growth in the Short Run: Implications for the Future

Table 1			
Annual Growth Rates, Selected Intervals, 2004-14			
	Real GDP	Aggregate Hours	Real GDP per Hour
2004:Q4 - 2009:Q4	0.83	-0.82	1.65
2009:Q4 - 2014:Q4	2.28	1.73	0.55
2004:Q4 - 2014:Q4	1.55	0.45	1.10
Future Trend	1.50	0.40	1.10
Memo: 1974-2004	3.12	1.40	1.72

Figure 11. Actual GDP vs. Potential GDP, CBO vs. Alternative Measures, 2004:Q1 to 2024:Q4

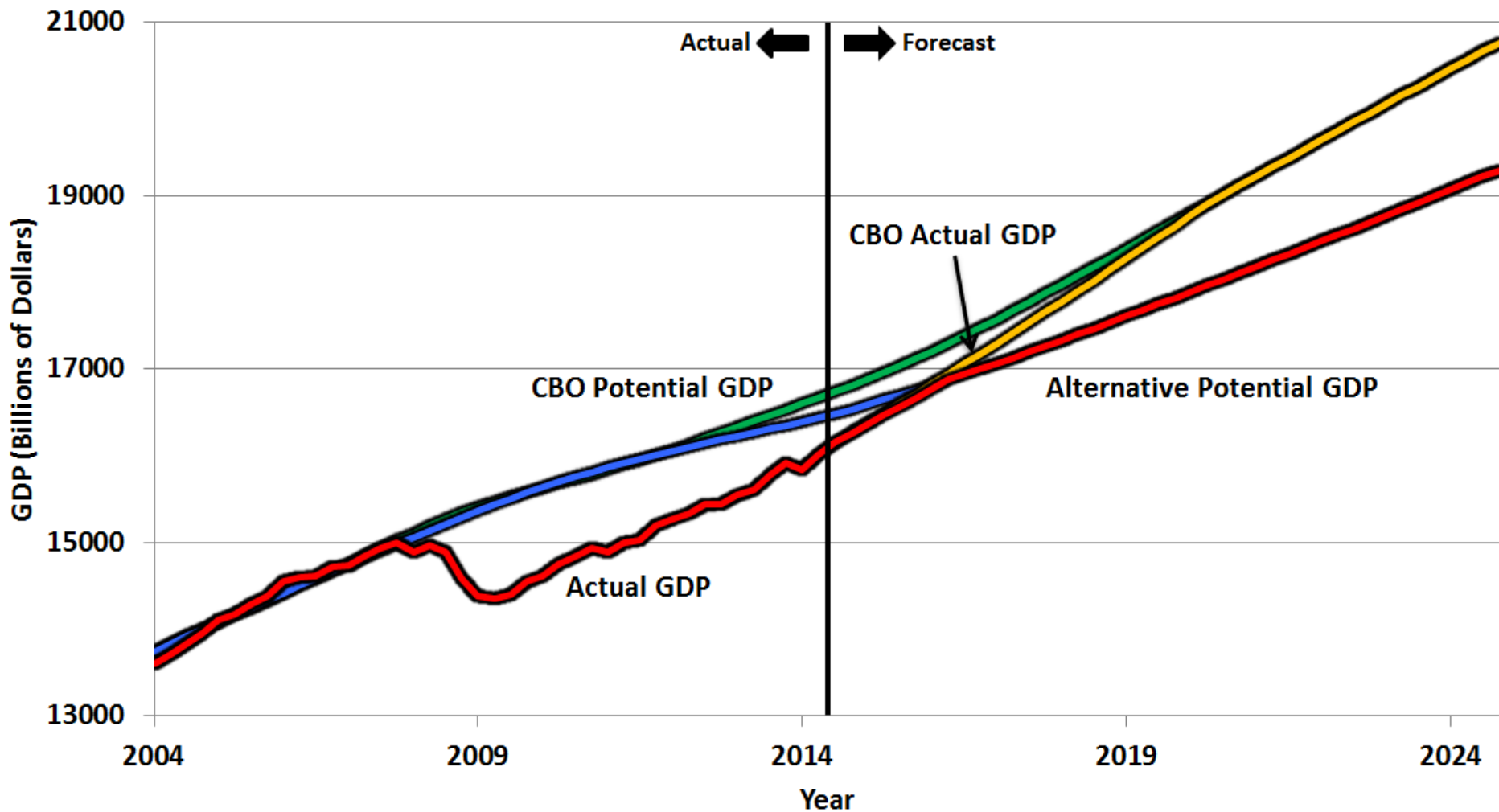
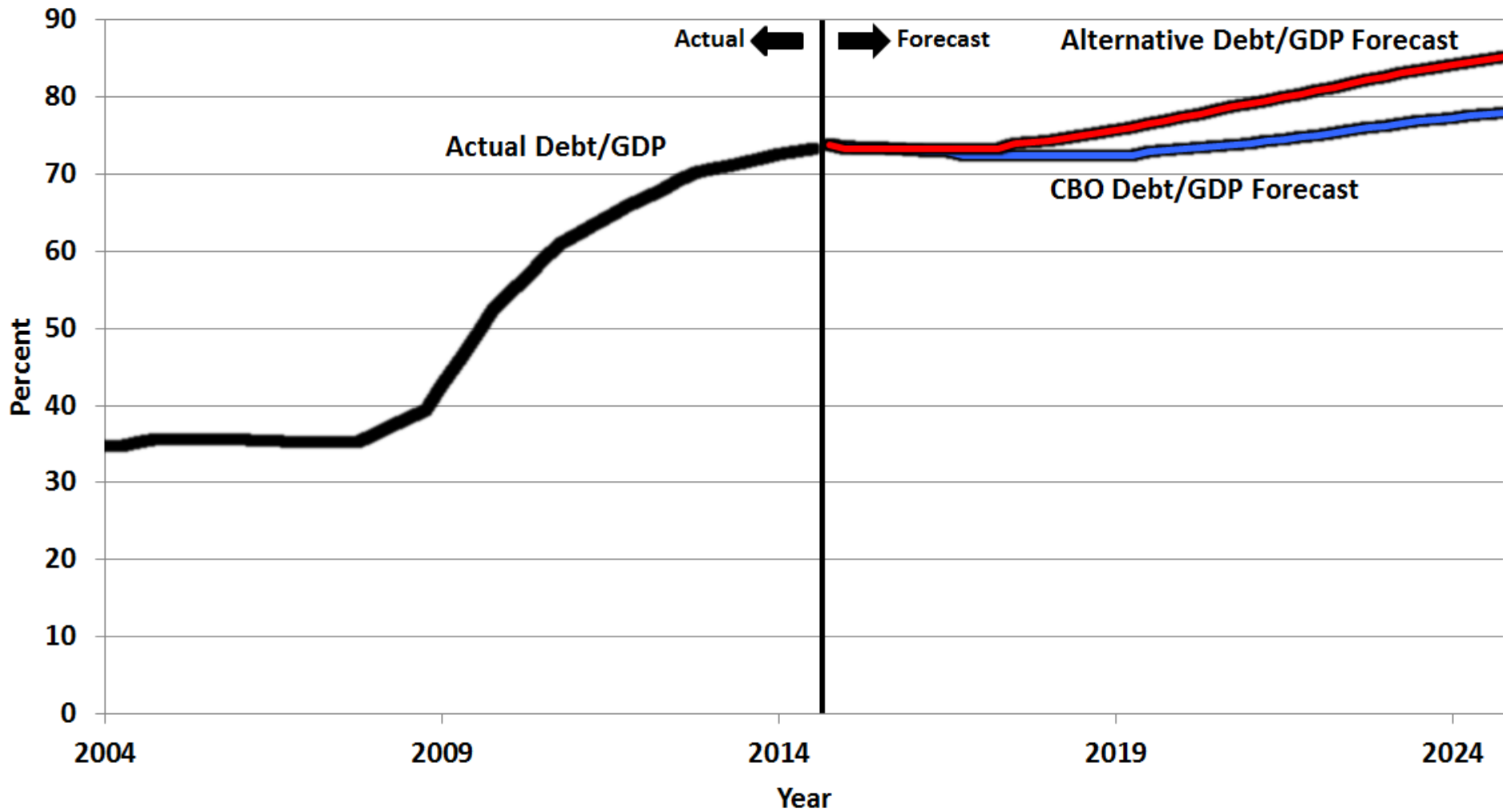


Figure 12. Debt/GDP, Actual and Forecast, CBO and Alternative Projections, 2004:Q1 to 2024:Q4



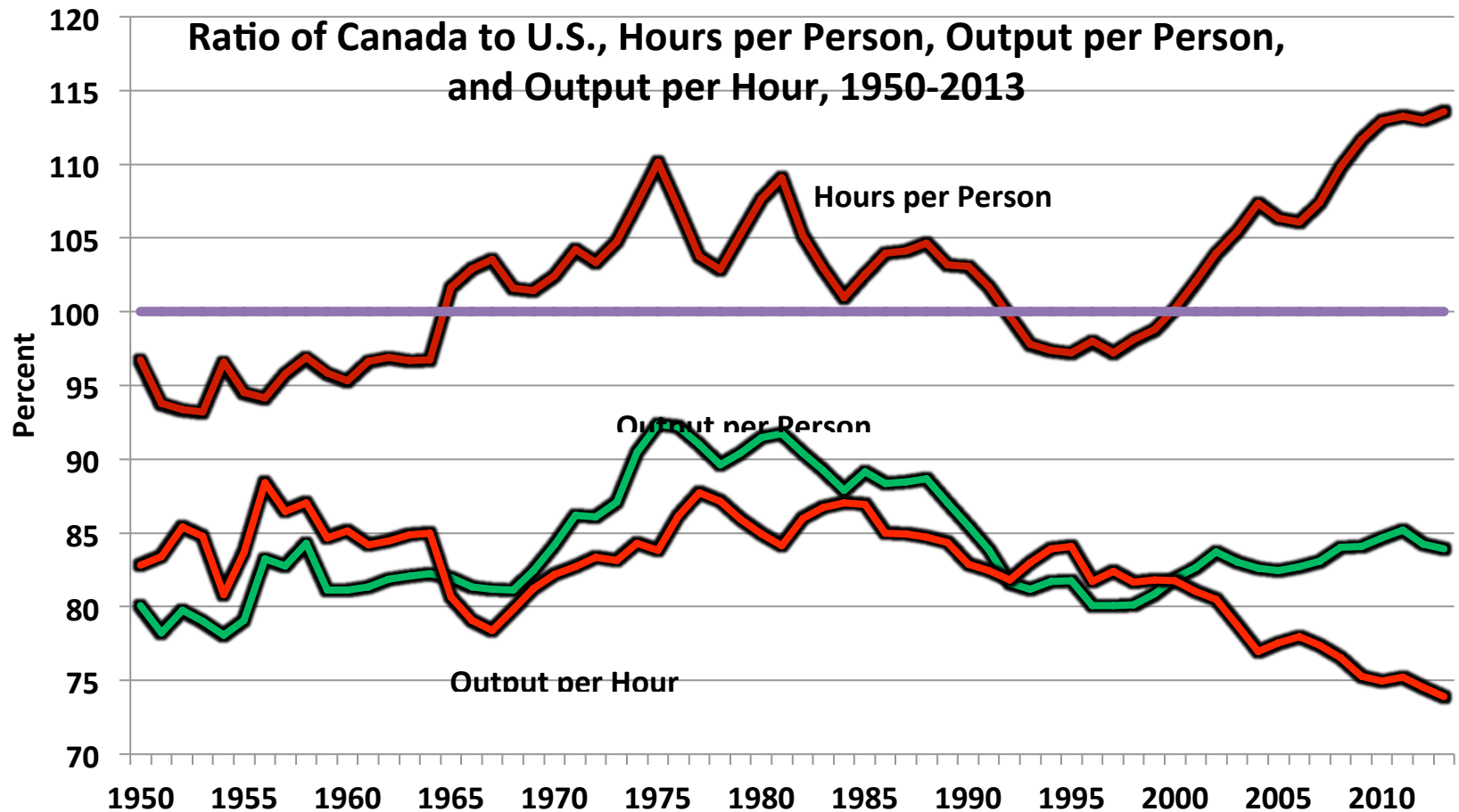
Conclusions

- **70 percent of all TFP growth since 1890 occurred 1920-70**
- **The big impacts on TFP of IR #3 were largely completed by 2005**
 - **Innovation continues but is less important in its impact on labor productivity and TFP than in 1996-2004**
- **Educational plateau and socioeconomic decay subtract from future productivity growth**
- **Even if productivity growth returns to its 2004-14 average of 1.1, adding 0.4 points for hours yields potential output growth is only 1.5**
- **Implications of slow growth for fiscal solvency, debt-GDP ratio**

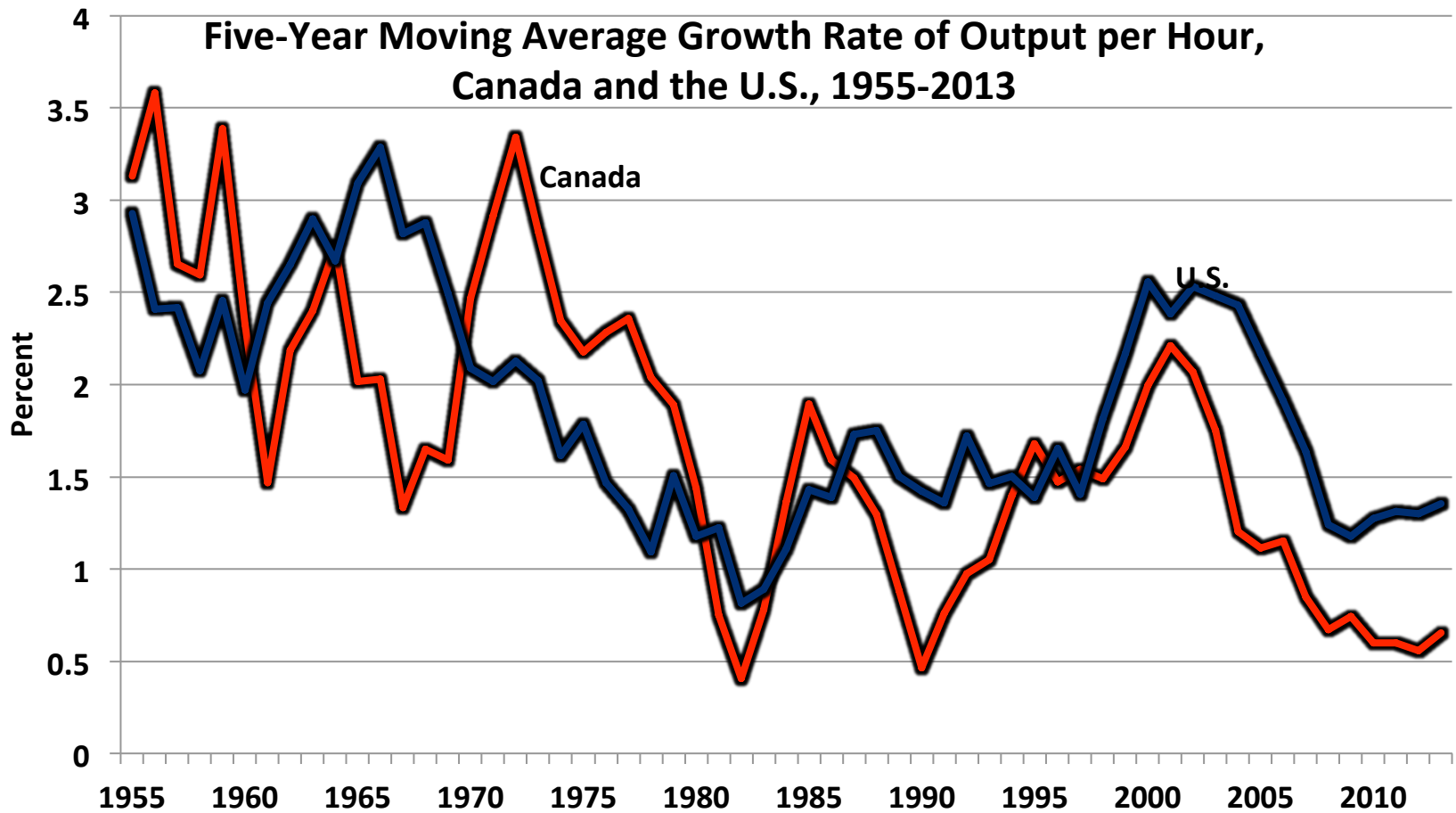
Comparing Canada and the US: The Output Identity Again

- Total Output or GDP (Y).
 - Total Hours of Work (H).
 - Total Population (N).
- Y&H refer to **total economy**
- The Productivity Identity
- $$Y/N \equiv Y/H * H/N$$

Ratios, PPP-Adjusted, Canada to US, Y/N, Y/H, and H/N, 1950-2013

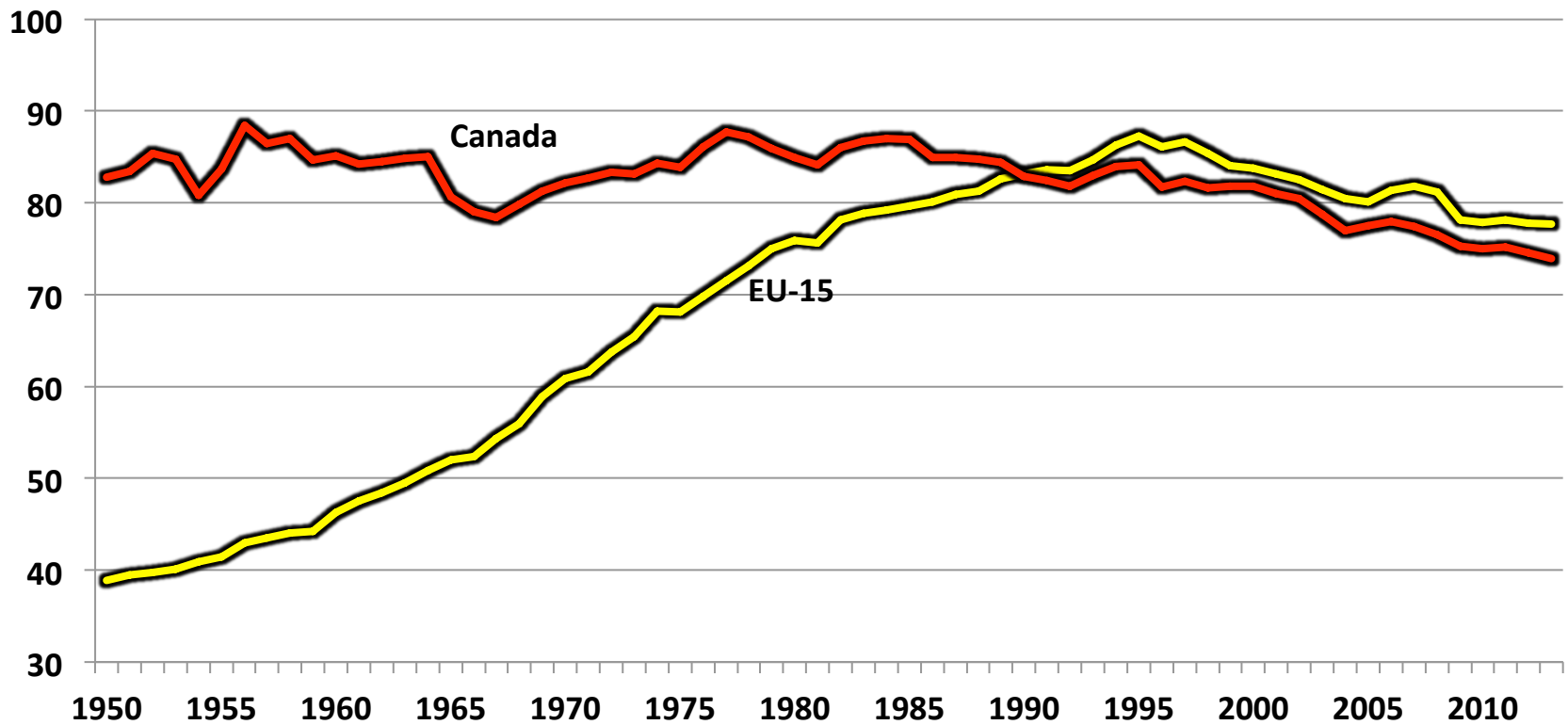


Productivity Growth Rates, 5-YR MA, Canada and the US, 1955-2013



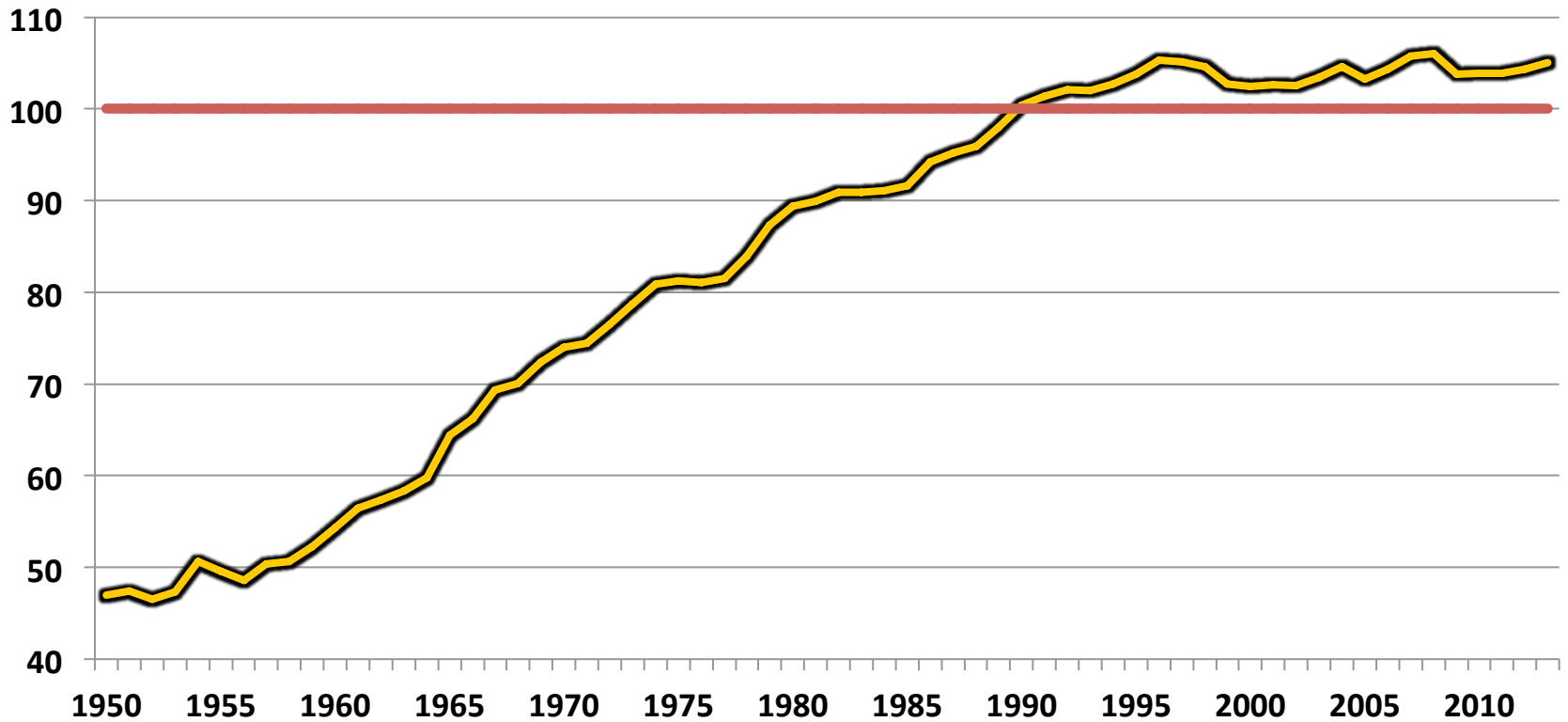
Canada and the EU-15 Output per Hour Relative to the U.S., 1950-2013

Ratio of Canada and EU15 to U.S., Output per Hour, 1950-2013

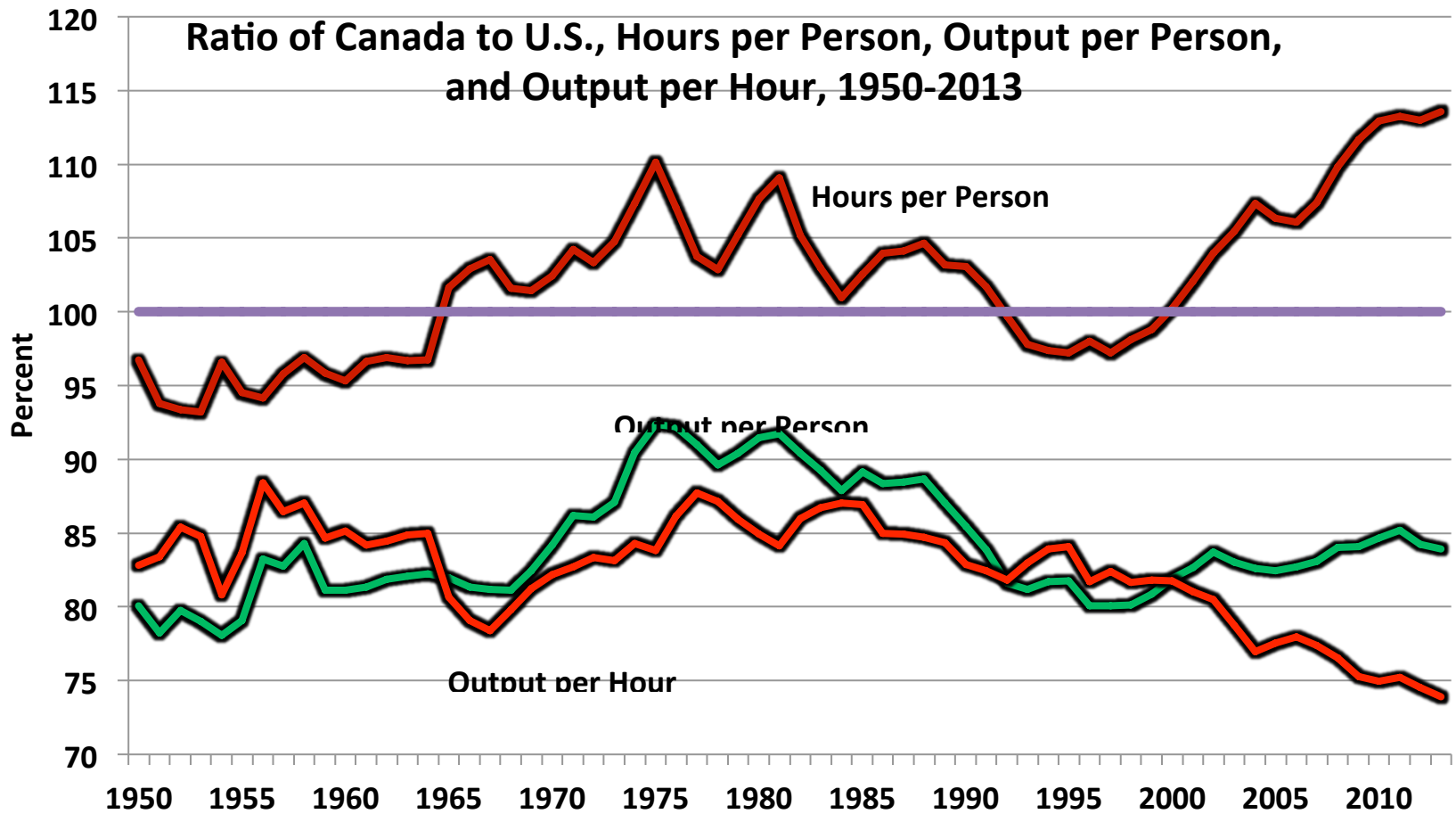


Output per Hour, Ratio of the EU-15 to Canada, 1950-2013

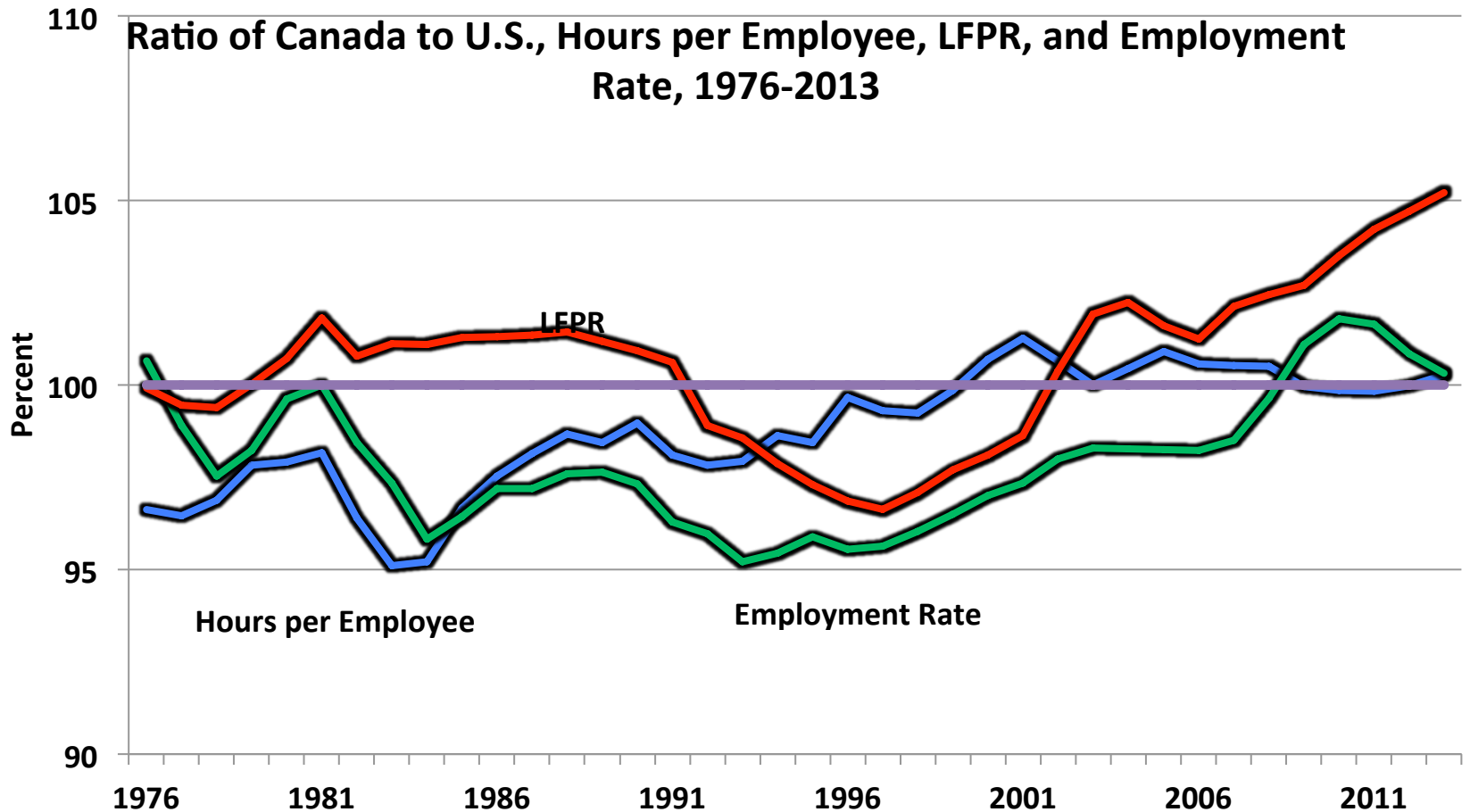
Ratio of EU15 to Canada, Output per Hour, 1950-2013



Ratios, Canada to US, Y/N, Y/H, and H/N



Ratios Canada to U.S., Components of H/N, 1976-2013



Five Dimensions of Superiority of Canada to the U.S.

- **A Labor Market That Has Escaped a Precipitous Decline in Labor-Force Participation**
- **Medical Care as a Right of Citizenship**
- **A University System without Exorbitant Tuition or Mountains of Student Debt**
- **An Immigration System Based on Skills**
- **A Well-Regulated and Stable Financial System**