

Is U. S. Economic Growth Over? Lessons from the Long 20th Century

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What is “The Long 20th Century”?

- Commonplace term in European History: The long 19th century is from the French Revolution of 1789 to the start of WW I in 1914
- In parallel, the long 20th century for the U.S. is from the end of the Civil War (1870) to the previous business cycle peak (2007)
- **This talk is *NOT* about the great recession, the global economic crisis, or anything that has happened since 2007. The US economy had plenty of problems already in 2007.**
- Three industrial revolutions (IR) propelled growth. IR #1 (1760-1830), IR #2 (1875-1900), and IR #3 (after 1980 until when?).

What Are You Talking About???

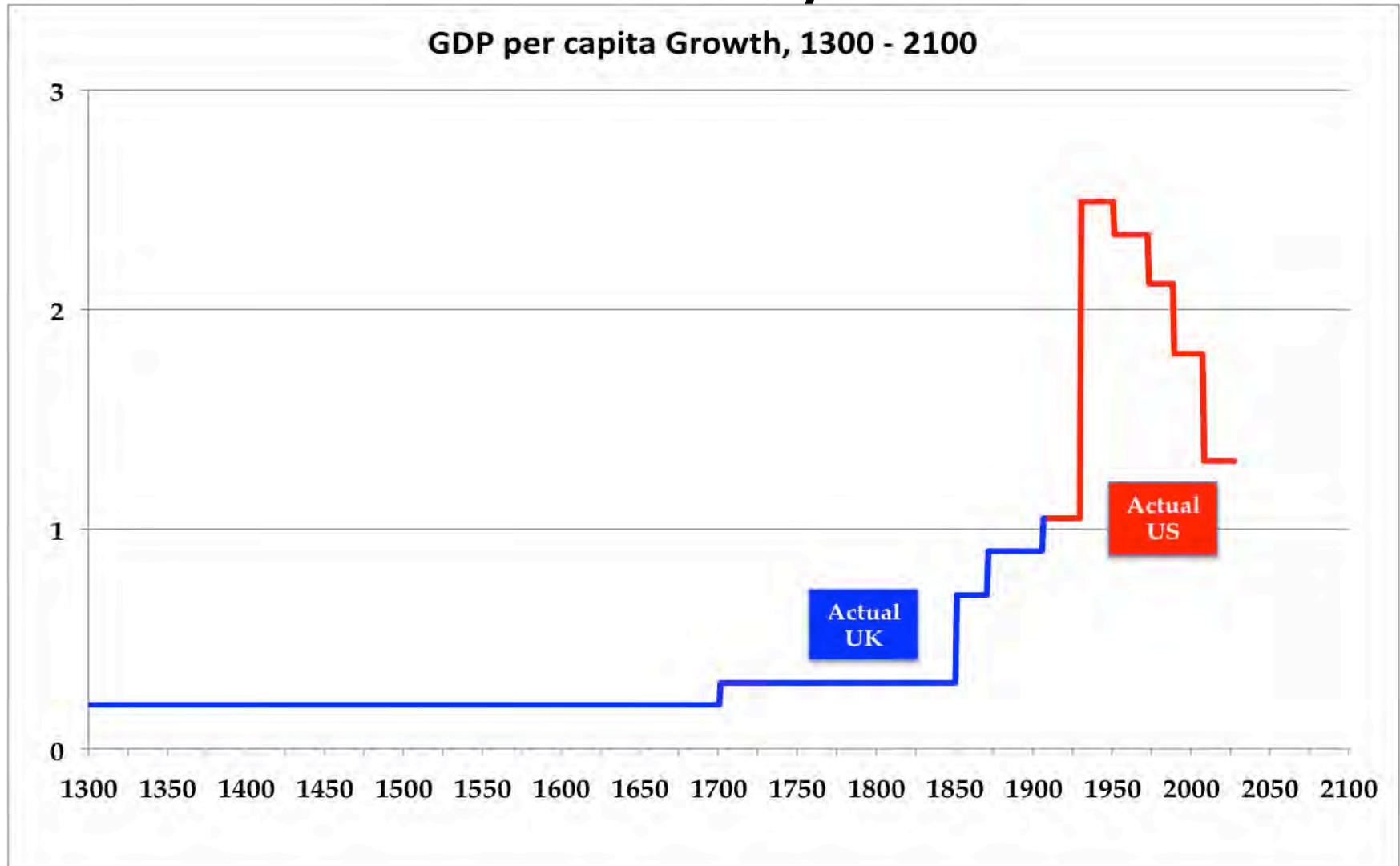
The End of Economic Growth?

- Explanation and Qualifications
 - This is just about the U. S., which established the frontier of productivity and the standard of living from 1900 until now.
- The central theme: technological change is not continuous. The Great Inventions involved a **one-time-only** set of changes.
- One-time-only changes included horses to trucks, outhouses to indoor plumbing, buckets to running water, and many more
- Maybe this seems obvious about horses and outhouses, but once you accept that, you've been drawn into my central thesis.
Economic growth is not a continuous long-run process but an artifact of a unique three-century period of human history.

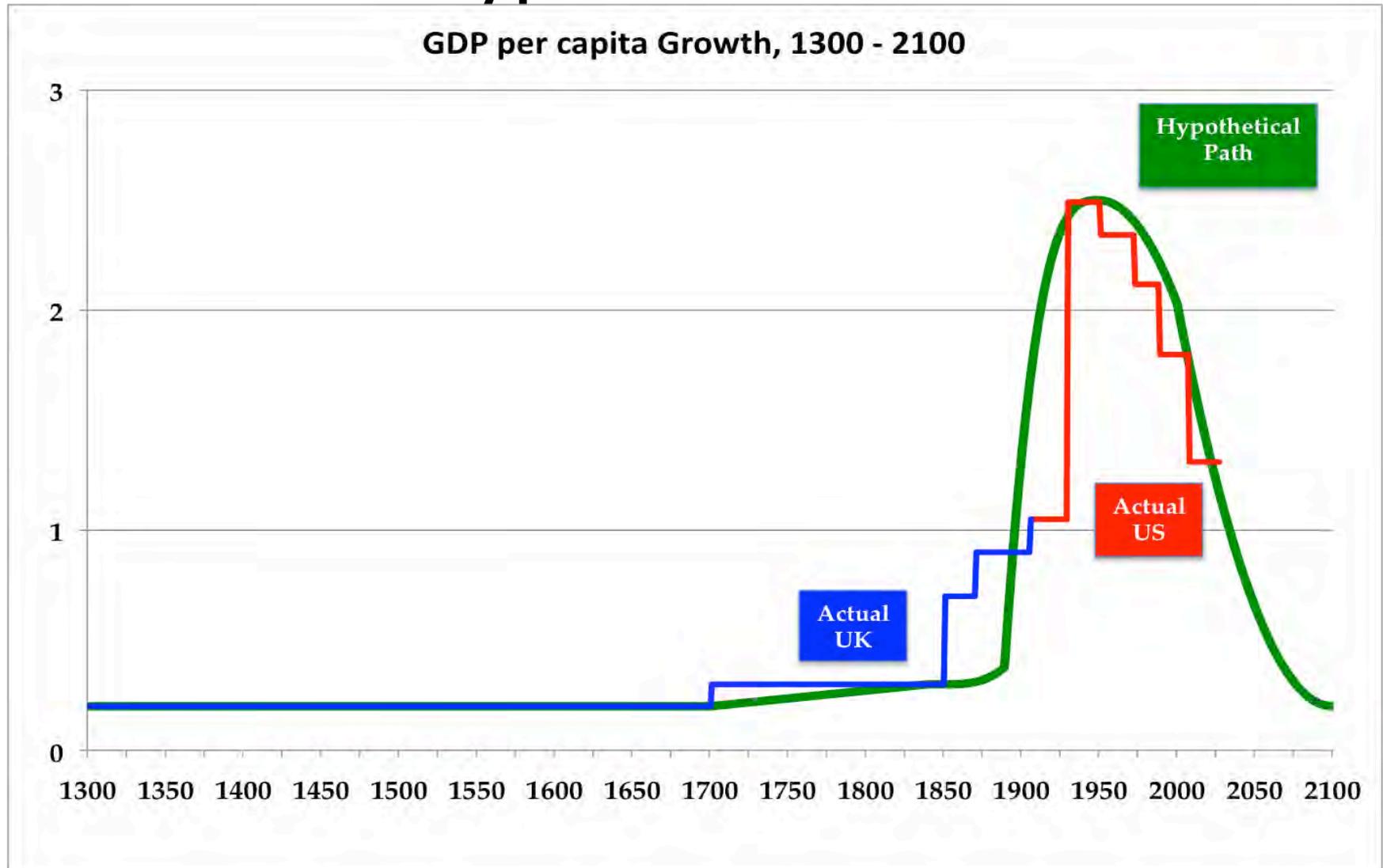
Further Qualifications to the Title

- This talk does not predict the end of economic growth in general -- It is specifically limited to the U. S.
- China, India, and everybody else can catch up and even move ahead
- The central themes of the talk are
 - The one-time-only nature of the Great Inventions of IR#1 and IR#2 that accounted for most of the economic growth from 1800 to about 1970.
 - The possibility of a smaller cumulative effect of IR#3
 - Folly of predicting future technical change (with examples)
 - Future innovation will happen but will be cancelled out by 5 “headwinds” for the US economy
 - Some of the headwinds are universal, others are U. S. specific

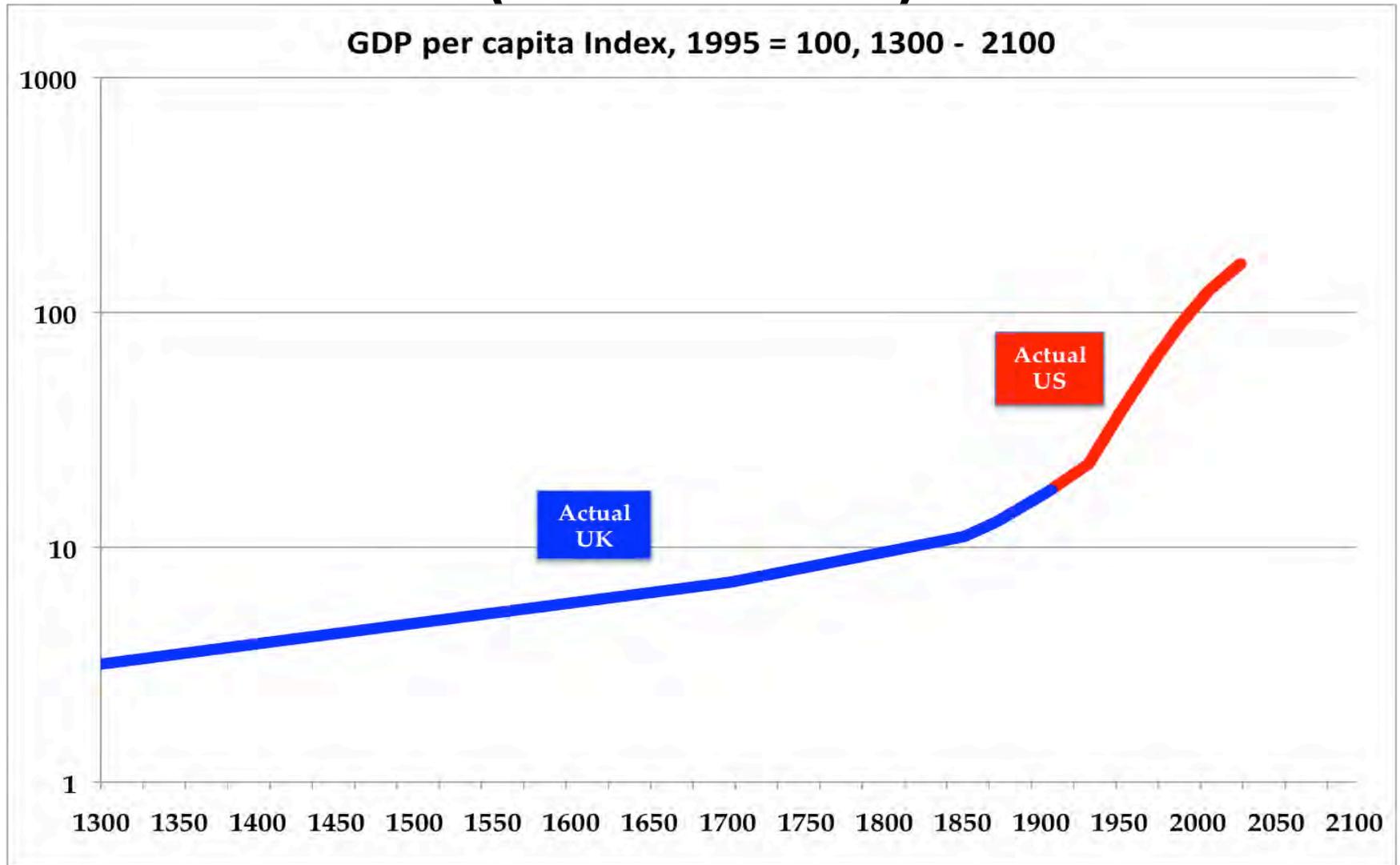
The Remarkable Three Centuries: Growth of the UK/US Frontier



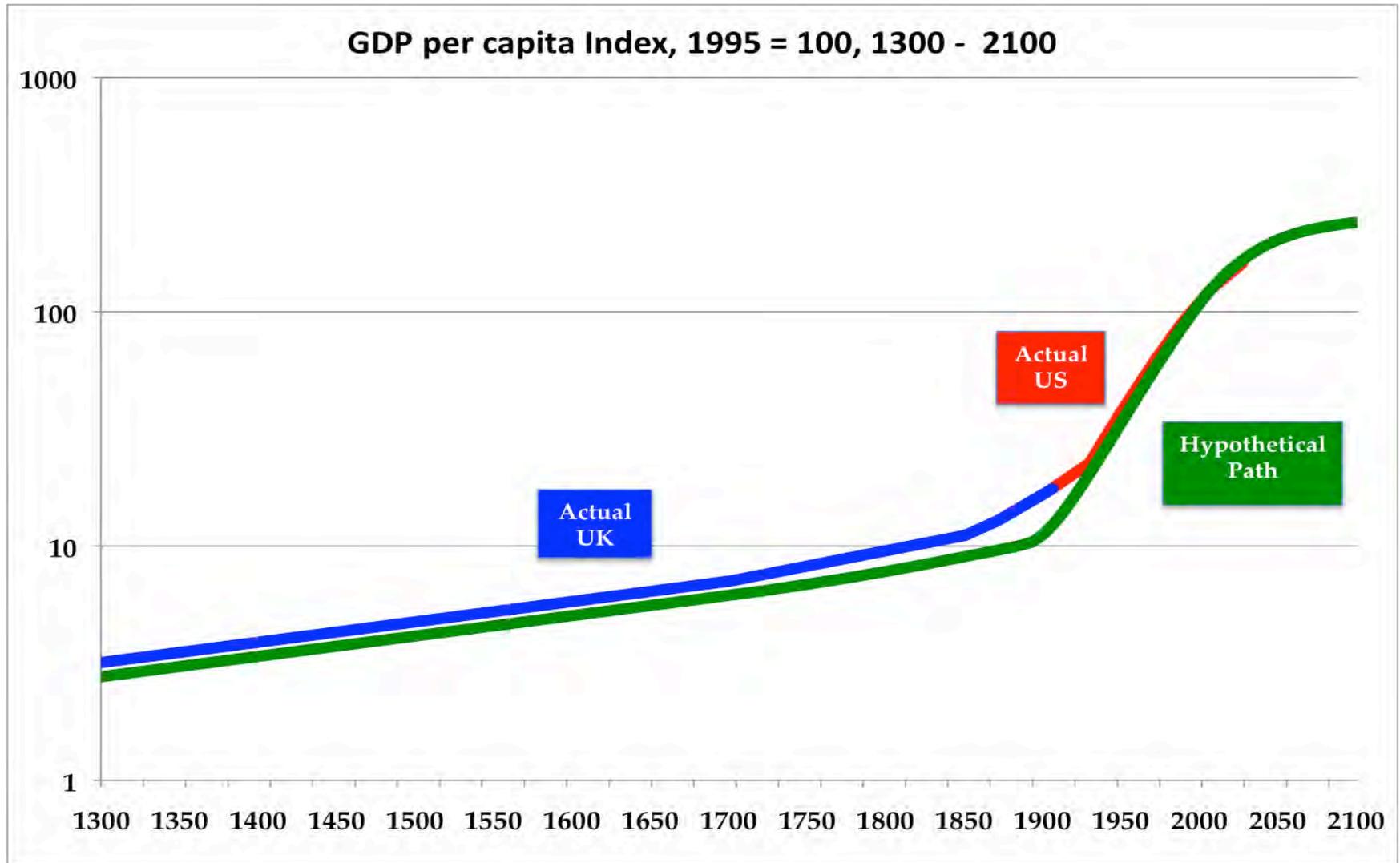
Capturing the Actual Growth Rate in a Hypothetical Curve



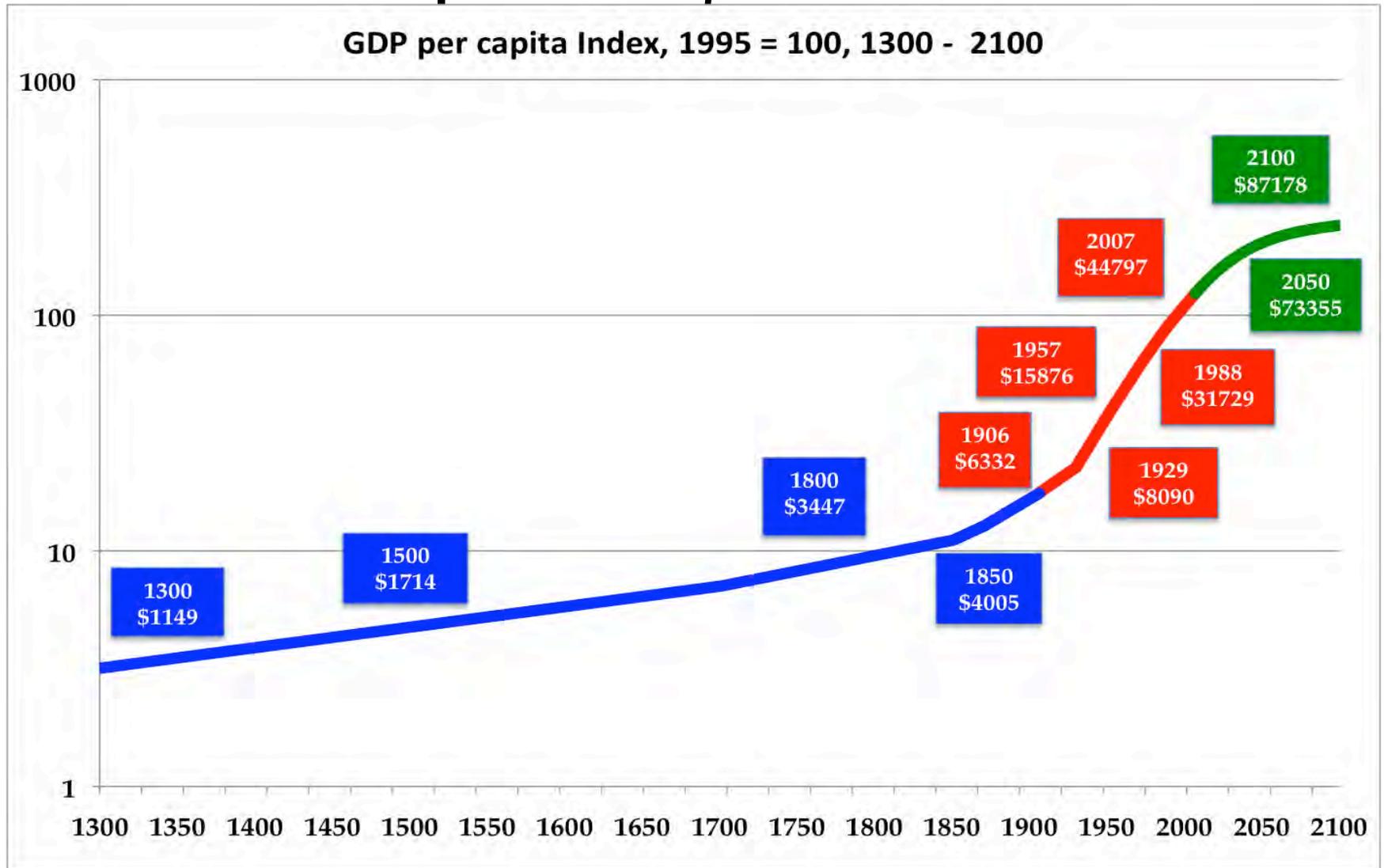
Converting the Actual to Levels (1995=100)



Add the Level of the Hypothetical



Some Examples of Income per Capita in \$US 2010



The Excitement of Discovery: Writing a Book

- Many of my examples tonight come from the process of writing a book.
- ***Beyond the Rainbow: The American Standard of Living Since the Civil War***
- You'll learn a lot tonight about the standard of living in 1870
- Most of economic growth in the 20th century consisted of eliminating the worst aspects of late 19th century life. **This can't happen every century, it could only happen once.**

Where Does Growth Come From?

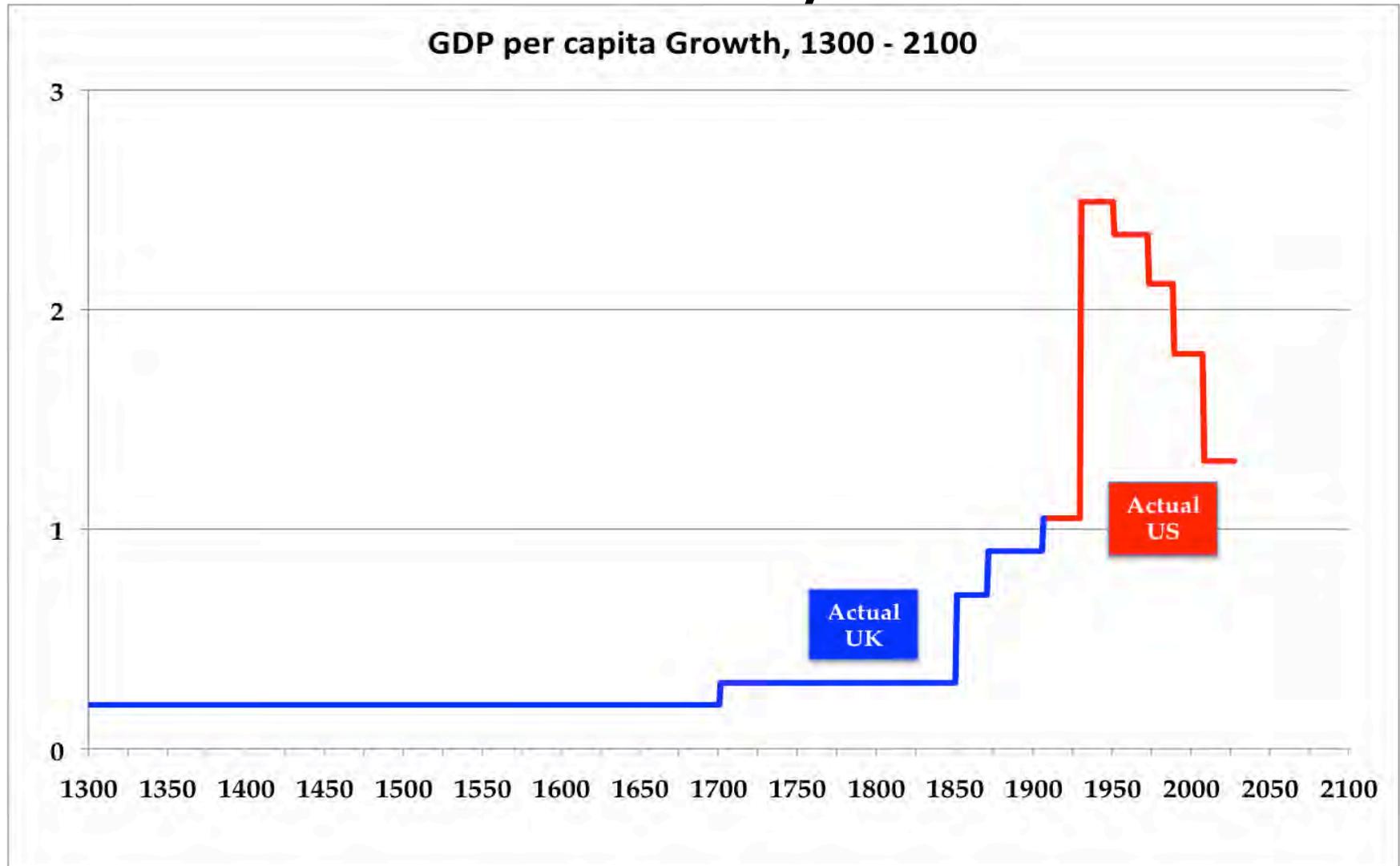
Solow vs. Jorgenson vs. Domar

- Robert Solow in 1957 concluded that 90% of economic growth was due to technical change.
- Jorgenson-Griliches 1967, attacking Solow and others, concluded that it was the opposite, 90% of growth was due to inputs
- J-G was an intellectual fraud. Labor and capital inputs grew only because of technological change.
- Domar 1961: For capital accumulation to continue without technological change would amount to “piling wooden plows on top of wooden plows.”
- Economic growth = the history of technological change, and not all technological change is equally important

A Brief Word on IR #1 (1760-1830)

- The Great Inventions were:
 - Steam Engine
 - Set on its side, the SE created the railroad
 - And the steam ship
 - Cotton gin
 - Power-operated machines (power spindle and loom)
- Remarkably Little Response of MFP Growth
 - Consensus estimate UK income per capita 1700-1850, 0.3 percent per year
- **Brad de Long: “Compared to the 20th Century growth, all earlier centuries were standing still.”**

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



Pre-1844:

Slowness of Communications

- Communication speed limited by the horse and the sail
- The famous example: January 8, 1815 Battle of New Orleans fought after the December 24, 1814 Ghent peace treaty
- The difference was made by the telegraph (1844) and undersea cable (1858, 1866)
 - 1850 30 days from NY to SF
 - 1860-61 10 days by short-lived Pony Express
 - Then instantaneous
- You who think that the internet was the greatest invention, be humble. 1844 was the greatest leap in speed of the entire history of communications.

Why is 1870 the Pivotal Year for This Talk?

- End of Civil War, U. S. economic growth really took off
- The basic data series for the U. S. economy begin in 1869
- The epochal event: May 1869, the joining of the transcontinental railway, the golden spike, silver hammer
- The instantaneous telegraph transmission of the one-word message **DONE!** not just to US and Canada but also to UK created the biggest spontaneous celebration in the U. S. until V-J day in 1945.

Demography and Spending in 1870

- Over 80 percent of adults were married couples, almost always with children, in contrast to less than 50 percent married couples today.
- The population was roughly 80 percent working class, with the remaining 20 percent middle class and a few that qualified for the upper class. Our description of life in 1870 and afterwards refers to the working class majority.
- The three necessities are food, clothing, and shelter
 - *Working class households spent 50% of their income on food*
 - Virtually nothing spent on durable goods or on services besides housing rent. **Most working class men walked home from work because they could not afford the fares on horse-drawn streetcars..**

What Was Different About Food and Clothing in 1870?

- U. S. 75% rural, 60% lived on farms
- Most food home-produced on farms
- Monotonous diet of hogs 'n' hominy supplemented by home-grown vegetables in summer on farms and in urban gardens
- Clothing: most women made their own clothing
 - Purchased clothing in 1870, 20 times greater for men than women. By 1929 1-to-1.
 - Huge switch in consumption from fabrics and notions in 1870 to purchased clothing in 1929.

Housing: Much Progress 1870 to 1930

- Urban tenements. “In most large cities, and in many smaller ones, the more poorly recompensed laborers inhabit tenements.”
- High rents, dark or dingy rooms, no toilet or bathrooms. Families crowding 5 family members into three small rooms were forced to accommodate boarders and lodgers, just to make ends meet.
 - In NYC in 1907, 1/3 of the rooms in tenements were “dark,” i.e. had no windows.
- Farm houses, less crowded but still primitive

Common Features of 1870 Housing, Rural and Urban: Smoke and darkness

- First was the lack of enclosed iron stoves that could control heat, invented after 1870. Housewives in 1870 had the open hearth, with all its energy inefficiency that would curl the hair of the modern Sierra Club.
- Second, there was no electricity. Light for working and reading at night consisted of lamps fueled by kerosene or whale oil.
 - Town gas was still a rarity.
 - Polluted air inside the house
 - One candle produced light equal to about 1/100th of a simple incandescent light bulb.

THE BIGGEST DEAL OF ALL: LACK OF RUNNING WATER

- Third, and most important, there was no running water. Every drop of water for laundry, cooking, and indoor chamber pots had to be hauled in by the housewife, and the waste water hauled out.
- One source claims that the average North Carolina housewife in 1885 had to walk 148 miles per year while carrying 35 tons of water.
- Water in, water out. The water taken out was dirty and/or disgusting. Coal or wood in for fires, ashes out.
- We all talked about “women’s lib” in our youth; nothing has liberated women more than running water in the period 1890-1930*

Were summers better than winters in 1870?

- Perhaps a trivial item was the lack of window screens, which were invented in the 1870s and 1880s.
- The typical farm family in the summer had open windows, through which flies passed in between the animal waste in the yard to the food prepared for humans on the table.
- No wonder the house fly was once declared as the “American bird” of the 19th century.

Horses (and Pigs)

- Urban America during 1870-1900 was utterly dependent on the horse (1872 horse flu)
- Horses required expenditures each year for food and maintenance equal to their capital cost
 - Imagine if your \$30,000 car required every year \$30,000 additional for fuel and maintenance
- The average horse produced 20 to 50 pounds of manure and a gallon of urine daily, applied without restraint to stables and streets. The daily amount of manure worked out to between 5 and 10 tons per urban square mile, all of which required gruesome human labor to remove.
- We'll return to this: the standard of living is not just about consumption, but the quality of work

British Travelers in the 1880s

- Horses, pigs, and unpaved roads
- The urban streets of the 1870s were full not just of horses but pigs, which were tolerated because they ate garbage.
- Oscar Wilde on Kansas City
- Rudyard Kipling on Chicago
- Kipling on New York City

Unpaved Urban Streets

- I was quite surprised at the extent to which streets were unpaved in the 1890s.
- An eminent urban historian claims that the development of the autonomous “corporate” city after 1870 decided to pave the streets and this made possible the adoption of the automobile
- Rather than vice versa
- Very different than the reality of 1890 Paris and London

Why Life Expectancy Was So Low in 1870

- At birth life expectancy was only 45 years in 1870 compared to 79 years recently.
 - Causes in 1870: infant mortality resulting from poor sanitation, water-transmitted diseases, and contaminated milk.
 - The first attempts at urban sanitation infrastructure emptied waste not into cesspools but into nearby rivers with no filtration. The theory at the time was that “the rivers cleaned themselves.”
- Further causes: hard physical labor, injuries, RR deaths, polluted indoor air, violence, lynchings
- ***A surprising fact about life expectancy***

The Standard of Living Involves Not Just the Quality of Consumption but the Quality of Work

- We can rate the “quality of work” as “pleasant” and others as “unpleasant.”
- If we describe farming, blue-collar work, and domestic servants as unpleasant jobs, and the rest as pleasant then 87 percent of jobs in 1870 were unpleasant.
 - By 2010 this percentage had declined to 22 percent.
- Most of this transition from unpleasant to relatively pleasant work was completed by 1970.
- All of this transition should be credited as an achievement of IR #2
 - As one example, think of farm machinery that allowed an enormous decline in the share of the work force in farming, hard outdoor work exposed to the elements

The Quality of Work for Women

- Already described: hauling those tons of water in and out, plus the coal and wood
- Most bread was home-baked, so Sunday was baking day
- Monday was laundry day
- Tuesday was the day to dry and fold the clothes
- Wednesday was the day for sewing and making clothes for mothers and daughters
- Virtually no working-class women worked outside the home.

Another Great Change: The “Quality of Youth”

- Young people below the age of 25 made up 60 percent of the population of 1870.
 - Few children extended their education beyond the age of 12.
 - Male teenagers worked, they were not at school, and the labor force participation rate for males aged 16-19 was 76 percent.
 - Female teenagers shared the household chores of their mothers.
- Think of the leisurely life of today’s video game-obsessed male teenagers and facebook-obsessed female teenagers compared to their hard-working counterparts of 1870, exposed to outdoor elements on farms or trapped in underground coal mines.

How Did the Great IR #2 Inventions Change 1870 Living Conditions?

- The great inventions of IR #2 can be clustered into five groups. Each had a primary breakthrough invention that occurred between 1860 and 1900.
- The first was electricity, including both electric light and electric motors.
 - In the early decades of the 20th century electric motors revolutionized manufacturing by decentralizing the source of power.
 - After a lag electric motors embodied in consumer appliances eliminated the greatest source of drudgery of all, manual laundry.
 - Refrigerators eliminated food spoilage more effectively icebox
 - Still to come: air conditioning.

The 2nd and 3rd Group of Great Inventions of IR #2

- Second, the internal combustion engine made possible personal autos, motor transport, motor trucks, and air transport.
 - Derivative inventions include the suburb, superhighway, and supermarket.
 - Gradually eliminated were many of the ills of 1870, from manure to unplowed snow to rural isolation to the horses themselves.
- Third, the rapid spread after 1880 of running water, indoor plumbing, and urban sanitation infrastructure.
 - To be useful the indoor toilet required running water going in and out to a sanitary disposal facility
 - Urban sanitation infrastructure was the single biggest contributor to improved health between 1870 and 1929.

The 4th and 5th Group of Great Inventions of IR #2

- The fourth set includes petroleum, natural gas, and processes which “rearrange molecules,” including chemicals, plastics, and pharmaceuticals.
 - Sulfa-based drugs were invented in the 1930s, penicillin during World War II.
 - Plastics were mainly developed after World War II.
- The fifth group consists of the complex of innovations related to entertainment, communication, and information.
 - We have already hailed the 1844 invention of the telegraph.
 - Also in this group and qualifying as part of IR #2 are the telephone (1876), phonograph (1877), popular photography (1880s, 1890s), radio (1899), motion pictures (1881 to 1888), and television (1924-31).
- How far we had come by 1942. 4/10 of AFI’s greatest-ever films were made in 1939-42
 - Can you name them?

How Much Had Happened by 1929!

- Most of the benefits had already occurred by 1929.
 - Urban America by then was electrified with running water
 - Electricity brought light to city streets and to every dwelling, had made possible washing machines and refrigerators
 - It made skyscrapers possible through electric elevators, and revolutionized manufacturing by decentralizing the source of power.
 - Urban streets were paved, inter-city highways were being built, horses and manure were gone from the cities
- Much of the progress came as a result of urbanization, a one-time-only change. Percent of American population living in urban areas (>2,500 population).
 - 1870 25% 1930 56% 1970 74% 1990 75%

Amazing 1929 factoids about U. S. Motor Vehicles

- 6 million cars, trucks, busses produced in 1929
- 80 percent of the world's auto production
- 90 percent of the world's auto registrations
- Is it any wonder how the “Arsenal of Democracy” helped to win World War II, the “war of motors”?
- Full credit to the Soviets for beating the Germans, but they rode to victory on 400,000 Dodge trucks given to them by American Lend-Lease. While the German supplies were still carried by horse-driven wagons.

The Benign Role of Government as a Backdrop to IR #2

- Civil War Legislation
 - Homestead Act, free land
 - Morrill Act for land-grant state universities
- Teddy Roosevelt, Progressive Era
 - Food and Drug Act 1906 (Upton Sinclair *Jungle*)
 - Broke up Standard Oil monopoly
 - Free, open immigration until 1922
- American standard of living propelled by fast population growth, no internal customs barriers
 - As symbolized by the Sears catalog, buying & selling

Economic Growth as Created by IR #2, Continued 1929-70

- Television, first shown 1939, big cities 1946-51
- Interstate highways 1958-72
- Air travel
 - We've never gone faster than the 1958 Boeing 707
 - Reversal of speed, end of US space shuttle
- Spread of air conditioning, opening the south
- GI Bill, golden age of higher education, the example of Pat Brown's and Clark Kerr's California

How Does IR #3 Measure Up?

- Definition, let's be generous
 - It didn't start in 1995 with Windows 1995 & IE
 - It didn't start in 1982 with the IBM PC
 - It started in 1946 with the ENIAC mainframe
- The main point is that IR #3 gains for business productivity and human welfare started much earlier than most people recall.
- Progress was slow at the start because computers were mainframes that occupied entire buildings, used vacuum tubes rather than transistors, ran hot, required enormous air conditioning investment

The Progress of IR #3 Marked with Personal Memories

- 1978: My first acoustic coupler and dumb terminal in 1978
- 1983: My first personal computer with its two floppy drives
- 1992: The heaven of Wordperfect 6.0
- 1993: My first e-mail
- Moving from personal anecdotes to aggregate data, the one-shot nature of the late 1990s dot.com boom:
 - The share of total GDP taking the form of IT investment, including software and telecommunications, experienced a one-time increase from 3.6 to 4.8 percent between 1995 and 2000
 - But was just 3.8 percent in 2007 and 3.7 percent in 2010.
- This is part of the case that IR #3 is slowing down already

Contributions of IR #3 to Business Productivity

- It started before the internet, has the low-hanging fruit already been plucked?
 - 1980s: ATM machines and bar-code scanning was based on T-1 lines, not internet.
 - 1990s: Replacing paper library catalogs and paper parts catalogs at auto dealers and repair shops
 - Wal-Mart and its famous distribution efficiency
- Cell phone and internet were both the marriage of computers and communications
 - Cell phone for calls, not data, established by late 1990s
 - PCs in offices had T-1 lines, not dial-up, back in mid-1990s. Broadband arrived in homes 2002-2006 and created the e-commerce revolution

How Important Were IR #3 Innovations during 2001 – 2011?

- A thought experiment to value IR #2 vs. IR #3
- Choice A is that you get to enjoy your laptop with all the software that had already been invented in 2001, including windows, internet explorer, and Amazon, and you get to keep running water and indoor toilets. But you can't use any electronic invention introduced since 2001.
- Choice B is that you get everything invented in the past decade, right up to facebook, twitter, and the ipad 2, but you have to give up running water and indoor toilets, you have to go outside to an outhouse, and you have to carry your water for bathing and cooking in buckets and pails in from an outdoor well, and if you want hot water you have to heat it on an open-heart fireplace that you have to feed with wood or coal that you must carry inside in buckets and pails. And there's no cheating, you have to do it.
- Which do you choose?

Thinking About IR #2 vs. IR #3. Which Do You Value More?

- The introduction of GPS navigation screens on autos compared to the invention of the auto itself.
- The introduction of the cell phone compared to the invention of the phone itself and the telegraph.
- The invention of home-streaming of movies to the invention of the motion picture itself.
- The invention of the microwave oven to the replacement of cooking on the open hearth by the enclosed cast iron stove and later the kitchen range.
- Icemakers in refrigerators compared to the invention of the refrigerator

Summary of the Case Until Now

- The pace of economic growth has been propelled by the three IR's
- IR #2 is a much bigger deal than IR #3
- The expansion of the standard of living frontier is less under IR #3
- Most of the big benefits of IR #3 for business productivity happened early, before 2001, with ATM's, bar-code scanning and electronic catalogs
- The implication is that the scope for future productivity growth matching the rate from 1870 to 1970 is *relatively* limited

What About the Future of IR #3?

The Folly of Forecasting

- In 1876 an internal memo at Western Union, the telegraph monopolist, said that “the telephone has too many shortcomings to be considered as a serious means of communication.”
- In 1927, a year before the first talking motion picture, the head of Warner Brothers said “Who the hell wants to hear actors talk?”
- In 1943 Thomas Watson, president of IBM, said “I think there is a world market for maybe five computers.”
- In 1981 Bill Gates, defending the capacity of the first-generation floppy disk, claimed that “640 kilobytes out to be enough for anyone.”

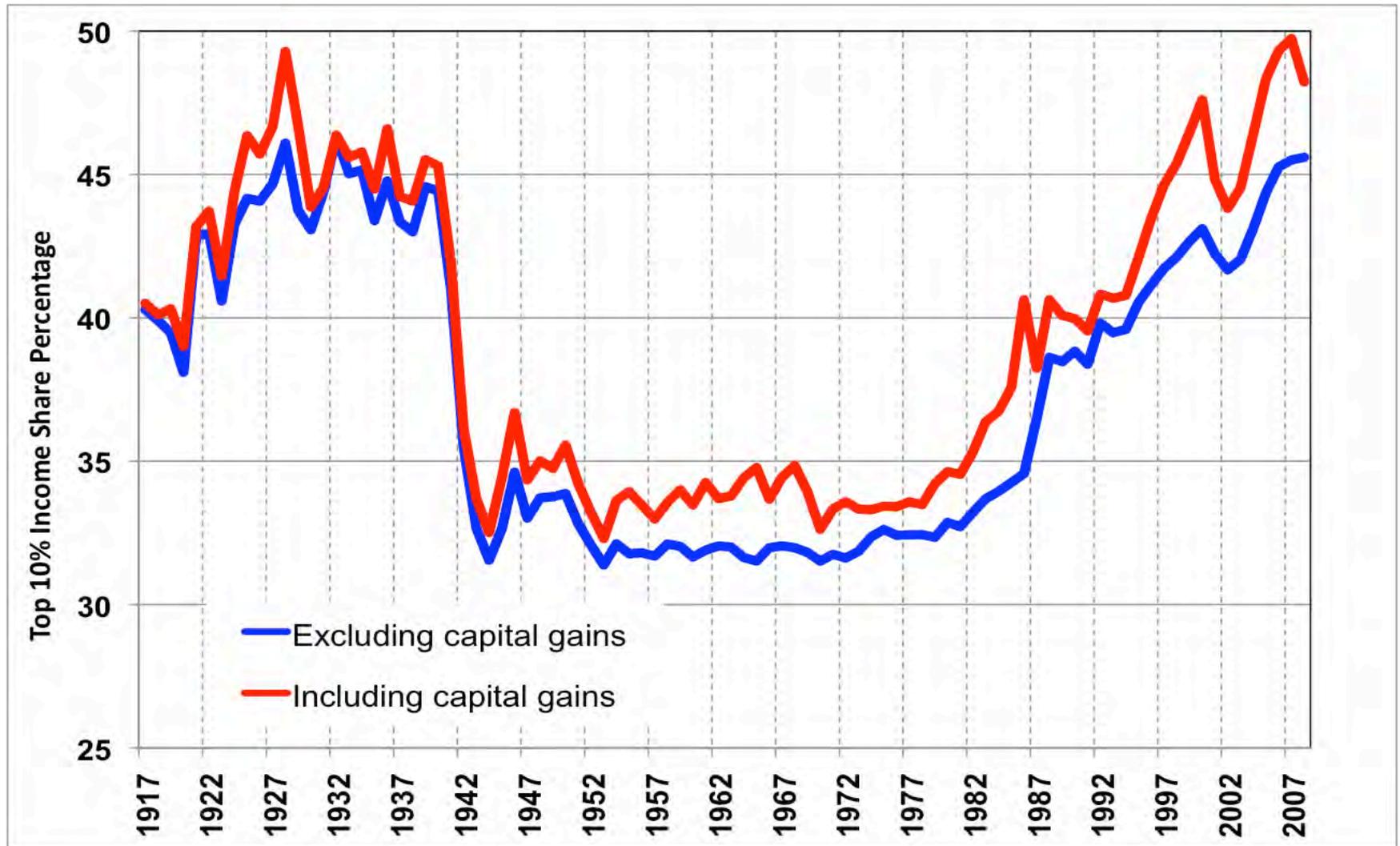
The Five Headwinds Fighting Innovation As a Source of Growth

- Inequality: growth in median income is much slower than in statistical averages for income and consumption per capita
- Globalization linked with IT: Hurts the leading nation more than others. Those radiologists in India.
- Environment: Payback for past growth, sacrifice for emerging market growth (is it fair?)
- Dysfunctional U.S. elementary and secondary educational system (ranked near the bottom in OECD PISA test scores)
- Twin deficits: consumer and government debt overhang. However slow is growth in production per capita, consumption per capita will grow slower.

Table 1. Real Annual Income Growth by Groups, 1993-2008

		Average Income Real Annual Growth	Top 1% Incomes Real Annual Growth	Bottom 99% Incomes Real Annual Growth	Fraction of total growth (or loss) captured by top 1%
		(1)	(2)	(3)	(4)
Full period	1993-				
2008		1.30%	3.94%	0.75%	52%
Clinton Expansion	1993-2000	4.0%	10.3%	2.7%	45%
2001 Recession	2000-				
2002	2002	-6.0%	-16.8%	-3.3%	57%
Bush Expansion	2002-				
2007	2007	3.0%	10.1%	1.3%	65%
Great Recession	2007-				
2008	2008	-9.9%	-19.7%	-6.9%	47%

The U. S. Top Decile Income Share, 1917-2008



Second Headwind: Globalization

- Explaining the Autor-Katz “polarization hypothesis.”
 - Upper level, creative, contact essential
 - Mid-level white collar. Not creative, easily outsourced
 - Bottom-level, contact essential. Waiters, bartenders, truck drivers, nurses
- Inventing the internet has worked against the US.
- Instant computer access from anywhere is carving out the mid-level white collar jobs
 - Replaced by machines (Brynjolfsson *NYT* 10/24/2011)
 - Replaced by outsourcing
- Implication for “the end of economic growth”, continued shortfall of median income growth below mean income growth

Third Headwind: Environment

- Like a massive debt hangover, global warming requires sacrifice of living standards
 - Carbon taxes
 - Constraints on which uses of energy are allowed
 - Household disposable income is diverted into spending on insulation and new energy-efficient cars and appliances which don't provide services any better than what they replace.
- Payback for 140 years of growth created by IR #2
- Advanced countries forced to sacrifice because of catch-up in the emerging fast-growing nations
- Controversial analysis about policy implications, uncontroversial that this will slow growth

Fourth Headwind: The Dismal U.S. Education Situation

- U.S. higher education is much admired, but the main achievement is in the past
 - U.S. has fallen from 1st to 8th in college completion
 - Cost inflation in higher education is as significant as in medical care
 - Many American students are being priced out of higher education
 - Who is attending in their place? The 500 Chinese applicants at tiny Grinnell college in Iowa
- Asian graduates increasingly are going back to Asia rather than their traditional practice of seeking high skilled employment in the U. S.
 - H1-B visa problem

Even More Dismal is American Primary and Secondary Education

- The OECD PISA tests in reading, math, and science
 - Ranks of US within OECD (37 countries)
 - Reading #17
 - Science #23
 - Math #31
- 75 percent of Army enlistees rejected because of poor test scores or previous criminal records
- Only 35 percent of American high school students are prepared for college
- Much of America's college participation is in 2-year community colleges which are glorified high schools, with most courses remedial, low graduation rates, and few transfers to 4-year colleges

Fifth Headwind: Consumer and Government Debt

- Household debt as % of disposable income went from 90% in 1995 to 133% in 2007, since then is back down only to 119%. Year after year of deleveraging will follow
- Federal government deficit the result of
 - Irresponsible Republicans, cut taxes while starting two wars with no revenues to pay for them
 - Then the deep revenue hole from the great recession
- Democrats equal blame: their role in state government deficits due to overly generous pensions and early retirement.

Implications of the Five Headwinds on Future Economic Growth

- Inequality will hold median income growth below average income growth
- Globalization will continue to hollow out the previous routine white and blue collar jobs in the former middle class
- Environment will either be ignored or will slow growth in consumption of non-energy-related products
- Poor education will lead to more outsourcing, more unemployed high-school dropouts, and increased movement of American firms to foreign locations
- Consumer debt means that consumption will grow slower than income; government debt means that more people will lose their jobs from expenditure cuts, and incomes after taxes and transfers will decrease relative to incomes before taxes and transfers.

An Exercise in Subtraction

- Growth of GDP per capita of 1.4% assumes technological change proceeds 2007-27 at the same rate as 1987-2007.
- Growth of consumption per capita of about 1.0%, as consumers pay down their overhang of debt
- For the bottom 99 percent of the income distribution, per capita consumption growth could be 0.5% or less.
- Consumption could also be held down by government debt reduction due to pension reform, slower growth in transfers, higher taxes on energy and incomes
- We'll be perilously close to zero growth in consumption per capita over the next 20 years, even starting from a 2007 base that ignores the destruction in human and physical capital that has occurred since 2007 as a result of the Great Recession

Conclusion: Now It's Your Turn

- You might ask, what are my solutions?
- I'd rather hear from you
- What can we learn from differences among countries. Are Canadians or Swedes as pessimistic? Why not?
- Do you accept the one-time-only interpretation of technical change?
- Which headwinds should we tackle?
- Your turn