

Part A: Themes

-II. Wealth-

A. Increasing wealth

This twentieth century has been above all the century of increasing material wealth.

The growth in wealth—the productivity of workers and the standards of living of consumers, especially of those who live in the industrialized democracies that make up the core of today’s world economy—over the twentieth century has been unprecedented. No previous era and no previous economy has seen material wealth and productive potential grow at such a pace. The bulk of America’s population today achieves standards of material comfort and capabilities that were beyond the reach of even the richest of previous centuries.¹ Even lower middle-class households in relatively poor countries have material standards of living that would make them, in some respects at least, the envy of the powerful and lordly of past centuries.

Rates of increase in material wealth and productive potential that would have struck all other centuries as miraculously fast are today taken so much for granted that they seem barely worthy of mention. If in the eighteenth century people began to think of the idea of progress, and in the nineteenth there actually began to *be* visible progress,² in the twentieth century we *expect* progress: we take it very much for granted that each generation will live between half again and twice as well in material terms as its parent generation.

¹ Could the Emperor Tiberius have eaten fresh grapes in January? Could the Emperor Napoleon have crossed the Atlantic in a night, or gotten from Paris to London in two hours? Could Thomas Aquinas have written a 2000-word letter in two hours—and then dispatched it off to 1,000 recipients with the touch of a key, and begun to receive replies within the hour?

² Although not clearly so until after the so-called “Hungry [Eighteen-]Forties.” John Stuart Mill could write that it was doubtful that progress had lightened the burden of toil on humanity; Thomas Carlyle could christen economics the “dismal science” for its predictions that progress would not lighten the burden of toil on humanity. See George Boyer (1998), “The Historical Background of the Communist Manifesto,” *Journal of Economic Perspectives* ; Thomas Carlyle (), *Latter-Day Pamphlets* (); John Stuart Mill (1848), *Principles of Political Economy, with Some Applications to Social Philosophy* ().

This ratcheting-up—by many notches—of the pace of economic growth and change is the most important characteristic of twentieth century economic history.

Computers, automobiles, airplanes, VCR's, washing machines, vacuum cleaners, telephones, and other technologies—combined with mass production—give middle-class citizens of the United States degrees of material wealth—control over commodities, and the ability to consume services—that previous generations could barely imagine.

In fact, the gulf is so large it is even hard for even *us* to imagine how large a gulf there is in styles of life and capabilities of action.³

³ One attempt to capture the difference is made by the science-fiction writer Walter John Williams in his novel *Aristoi*. His viewpoint characters come across a planet of humans that has deliberately been kept in ignorance of industrial and post-industrial technology as part of a grand—and immoral—metaphilosophical experiment, and they react with horror:

..population estimates stabilized at around 1.3 billion, the final number depending on how many people were actually living under the vast tropical canopies...

Windmills, wind-powered ships, oxcarts, and flatboats, but most work seemed to be done by brute human muscle power alone Primitive firearms existed in large numbers--cannons were picked out on the ramparts of castles and star-forts, and musketeers were seen drilling next to other soldiers carrying swords and pikes. Apparently Saigo's creations slaughtered each other with great frequency.

Clancy's report on public health: open sewers down the middle of every street and open cesspits everywhere, some in alarming proximity to wells and cisterns. A few of the larger urban areas had some proper sewers, but only in a few neighborhoods and in any case inadequate for the observed population. A few aqueducts existed here and there to guarantee good water, but most water was acquired from river, streams, or public wells. The public health situation, in short, was horrifying. If Saigo had provided his people with as many microbes as he had firearms, disease and plague were bound to flourish....

The broadcast images showed that existence, even for the better-off, more than justified Thomas Hobbes's remarks on life being nasty, brutish, and short. Heads were observed stuck on pikes above city gates; bodies that showed signs of pitiless torture swung in cages over city streets. Filthy children slept in gutters while disinterested oligarchs in their finery were carried in chairs over the starving bodies. Diseases were various, unimpeded by rational treatment, and often fatal. Disfigurement was even more prevalent: seemingly healthy individuals were often revoltingly ugly, a fact that disturbed the Cressida's cultured, gene-enhanced observers almost as much as anything else.

In the country, wandering families of laborers and gleaner slept under haystacks while those with property largely slept with their animals. Famine seemed fairly commonplace—banditry, much of it under the guise of warfare, even more so...

1. Montgomery Ward's prices

One place to begin is with the 1895 Montgomery Ward catalog. At the turn of the century Montgomery Ward was the largest mail-order business in the United States. It supplied rural and small-town households around the country with goods produced in America's factories. It was one of *the* ways that the forty percent or so of America's households that still lived in small towns or isolated farmsteads could purchase the products of industrial civilization. The shops and stores of the big cities were much less convenient than the regular arrival of the mail-order catalogues. Shipping by mail order from centralized warehouses, companies like Montgomery Ward were willing to supply goods ranging from sterling silver teaspoons to sets of the *Encyclopedia Britannica* to drill presses.

Table 1: Multiplication of Productivity 1895-1997
Time Needed for an Average Worker to Earn the Purchase Price of Various Commodities

Commodity	Time-to-Earn in 1895 (Hours)	Time-to-Earn in 1997 (Hours)	Productivity Multiple
Horatio Alger (6 vols.)	21	0.6	35.0
One-speed bicycle	260	7.2	36.1
Cushioned office chair	24	2.0	12.0
100-piece dinner set	44	3.6	12.2
Hair brush	16	2.0	8.0
Cane rocking chair	8	1.6	5.0
Solid gold locket	28	6.0	4.7
<i>Encyclopedia Britannica</i>	140	33.8	4.1
Steinway piano	2400	1107.6	2.2
Sterling silver teaspoon	26	34.0	0.8

The cumulative impact of the probes' images staggered the Cressida's crew. Rubens and Yaritomo took to spending several hours each day in tranquil meditation; others buried themselves in work or sport; Clancy took refuge in unremitting fury.

"Sadist, did I say?" she said. "De Sade was a piker by comparison! Hitler was a trifle maladjusted, Stalin a blunderer, and Chingiz Khan a mere amateur!"

See Walter John Williams (1992), *Aristoi* (New York: Tor: 0812514092).

Source: 1895 Montgomery Ward Catalogue⁴

The table above presents a sample of consumer goods available through Montgomery Ward at the start of the twentieth century. Near the top of the table is a one-speed bicycle, costing \$65 if ordered from Montgomery Ward in 1895. The price of a bicycle measured in “nominal” dollars has more than doubled over the past century (as a result of inflation). But the bicycle today is much less expensive in terms of the only measure that truly counts, its “real” price: the work and sweat needed to earn its cost. It took perhaps 260 hours’ worth of the average American worker’s production in 1895 to mount up to enough money to buy a one-speed bicycle.

[Picture: commodities in the table above]

Today an average American worker can buy a one-speed bicycle—of higher quality—for a little less than one day’s worth of value added.

In terms of labor power bicycles have become 36 times cheaper over the near-century from 1895 to 1990. On the bicycle standard—measuring wealth by counting up how many bicycles it can buy—the average American worker today is some 36 times richer than his or her counterpart was back in 1895. Other commodities would tell a different story. A cushioned office chair has become only 12 1/2 times cheaper, in terms of the time the average worker requires to produce enough to pay for it. A Steinway piano or an accordion is only twice as cheap. A sterling-silver teaspoon is 25 percent more expensive.⁵

Thus the answer to the question “how much wealthier are we today than our counterparts of a century ago?” depends on which set of commodities

⁴ *1895 Montgomery Ward Catalogue*, intro. By Boris Emmett (New York: Dover Books, 1969 facsimile edition: 0486223779). I was made aware of the *Montgomery Ward Catalogue* as a source by William Baumol, Sue Anne Batey Blackman, and Edward Wolff (1989) *Productivity and American Leadership: The Long View* (Cambridge: MIT Press: 0262521636), which contains a nice discussion of productivity growth through this particular lens. Boris Emmett’s introduction to the facsimile edition of the *Catalogue* is very well done. Also very well done is W. Michael Cox and Richard Alm (1997), *Time Well Spent* (Dallas: Federal Reserve Bank of Dallas).

⁵ But is the important characteristic of a late nineteenth-century teaspoon that it is *silver* (and thus made out of a rare and precious metal traditionally used for jewelry and coinage) or that it is a spoon that *does not rust*? For those who think that the important characteristic is that it is made up of silver, it is indeed 25 percent more expensive now than it was back then when you could pick the silver up off of the ground in Nevada. But for those who think that the important characteristics is that it does not rust, a teaspoon today costs only one-fiftieth as much in terms of labor time as it did a century ago.

you view as central and important. If you care only about personal services—having a butler around to answer the door and polish your silver spoons—then you would find little difference in national average wealth between 1895 and 1990: an hour of a butler's time then cost about an hour's worth of the time of an average worker; an hour of a butler's time today costs about the same; on the butler-hiring standard we are no richer off than a century ago. But suppose you care a lot, instead, about your ability to buy mass-produced manufactured goods—like bicycles. Then the multiple is 36.

This divergence is the index-number problem.⁶ It is ultimately unresolvable: there is no single, unique, correct index that will tell you how much higher wealth of productivity is: it all depends on what you value, and what set of weights you choose to evaluate the different production possibilities of different eras.

2. Long-run estimates of GDP per worker

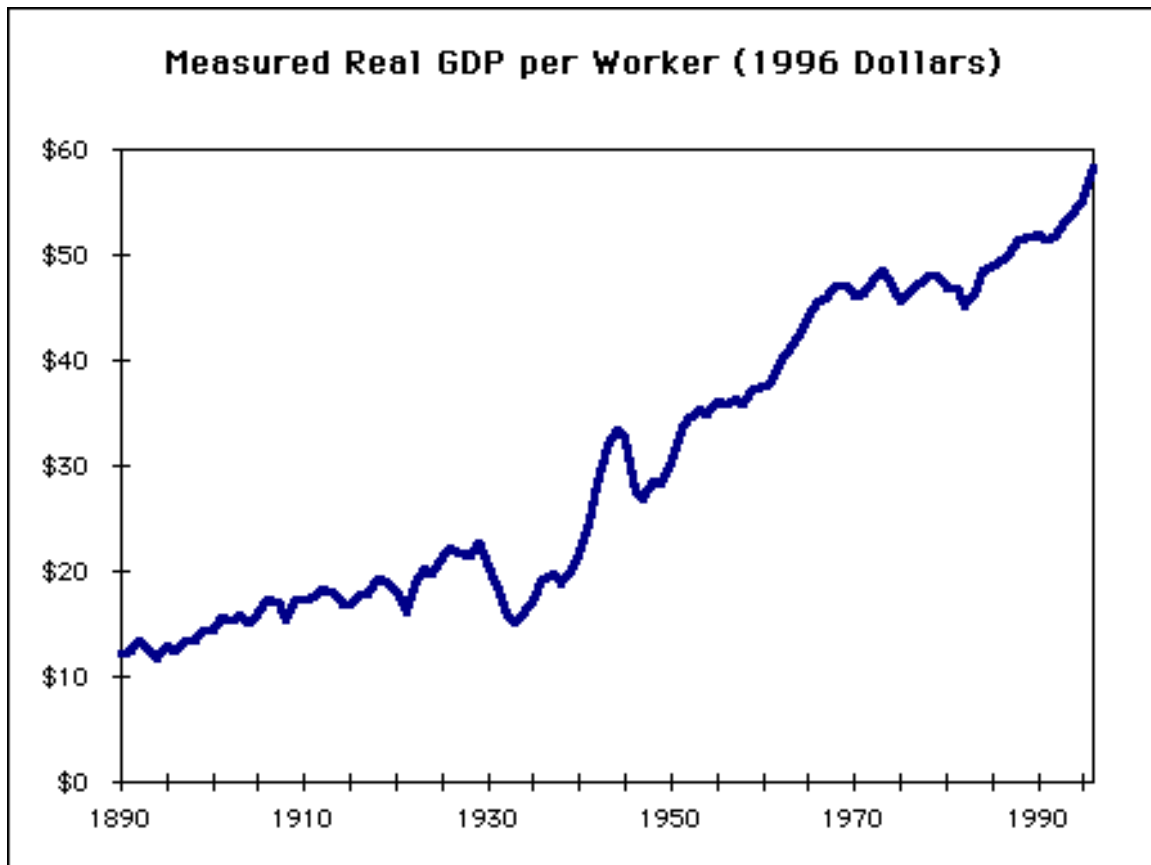
How, then, can you arrive at a single number? There are single, semi-official numbers. Pull *Historical Statistics of the United States*⁷ down off of the library shelf, perform a few calculations, discover that GDP per worker in the United States today is some \$57,000 dollars per year—measured at 1996's prices—and that what *Historical Statistics* tells us of GDP per worker in the United States in the past is as plotted in the figure below, which shows *measured* GDP per worker in tens of thousands of today's dollars: a little over a century ago—back in 1890—GDP per worker (at 1996s prices) was some \$12,000 a year.

Why the “per worker”? Because GDP is a measure only of economic activity that passes through the market. As the share of the American adult population in the paid labor force has risen, so measured GDP has risen, even though part of what has been going on has been the shifting boundary between categories of work that used to be outside, but are now inside the market. So divide real GDP by the size of the American *labor force* (not

⁶ See, for example, R.G.D. Allen (1975), *Index Numbers in Theory and Practice* (Chicago: Aldine Publishing Company: 0202060713). The classic remains Irving Fisher (1922), *The Making of Index Numbers* (Boston: Houghton-Mifflin: 1851962328).

⁷ (1997) *Historical Statistics of the United States* (Cambridge: Cambridge University Press: 0521585414). How created. Forthcoming millennial revision. Carter and Sutch.

by the population) to attempt to control for the shifting boundary between market and non-market work, and still arrive at a measure of material well-being and prosperity.⁸



Note, first, that on this scale the business cycle-centered concerns of newspaper financial pages are barely visible.⁹ Almost all of the business cycles—the recessions and depressions—experienced in the past century appear as insignificant ripples that do not materially affect the pace of productivity growth or the level of production. The key feature is the upward trend, not the irregular cycle.

⁸ GDP. What it includes and excludes. How the line between inclusion and exclusion is highly arbitrary—driven much more by what Simon Kuznets thought that he could estimate reliably than by correspondence with the quantities we would really like to measure. How the line between GDP and not-GDP has been crossed by people and activities over the past century. What we think a better measure than GDP would show.

⁹ Save for the Great Depression, which alone is of large enough scale to be clearly visible as a major feature of the record of twentieth century GDP per worker growth. Caution that the welfare costs of business cycles are (perhaps) at least an order of magnitude larger than their costs in terms of output per worker. Cite to David Romer (), *Advanced Macroeconomics* (). Cite to Rebecca Blank and Alan Blinder.

Recessions are in fact *not* feared because they significantly reduce the volume of production. They are feared because of the distribution of the losses that they create. Most people are unaffected, but some of the people lose their jobs and a few of the rich lose their wealth.

There is one exception: the Great Depression of 1929-1941, which temporarily annihilated a generation's growth in riches, saw unemployment peak at a quarter of the labor force and remain above ten percent until the beginnings of World War II, and provoked fears that the run of economic growth that had commenced with the industrial revolution had played itself out. But the Great Depression was unique, a watershed that has not been repeated.¹⁰

Thus *Historical Statistics* seems to say that the average American worker today—with a 1996-price GDP per worker of some \$57,000—is some five times as well off in a material wealth or an economic productivity sense as his or her counterpart in 1890. Adjusting for the declining length of the work-year over the past century, as the eight- or the seven-and-a-half hour day has become the norm and as vacations have grown, and find that the multiplication of *measured* wealth is more like eightfold.

The upward jump of productivity and wealth has not been confined to the industrial core of the world economy. In 1987, 97 percent of households in Greece—not usually considered one of the world's industrial leaders—owned a television set. In Mexico in that same year there was one automobile for every sixteen people, one television for every eight, one telephone for every ten.¹¹

Thus *Historical Statistics* produces the same estimated eight-fold multiplication over the past century as did the calculations based on comparing prices and incomes today to incomes a century ago and prices in a century-old Montgomery Ward *Catalogue*.

The equality of the calculations from *Historical Statistics* and those from the Montgomery Ward *Catalogue* should come as no surprise. The calculations are at bottom very similar conceptual experiments. They are,

¹⁰ At least it has not yet been repeated. But the economic stagnation of Japan in the wake of the late-1980s collapse of its "bubble economy" is rapidly approaching Depression size in terms of lost production and foregone economic growth. The current majority opinion is that the Great Depression required that uniquely large shocks hit the global economy at a time of uniquely great structural vulnerability. Hence many people are willing to bet real money that the Great Depression will not be repeated. See Peter Temin (), *Lessons from the Great Depression* (Cambridge: MIT Press); Barry Eichengreen (1997), *Globalizing Capital* (); Christina Romer (), "??," *Journal of Economic Perspectives* ().

¹¹ (1990), *The Economist Book of Vital World Statistics* (New York: Times Books: 0812918770).

very roughly, the following: we could take everything produced in some past year, stuff it into a time machine, move it forward to today, and sell it; how much would it be worth? That is what the “1996 prices” in the statement “GDP per worker in 1890 was some \$12,000 a year at 1996 prices” means.

3. The index-number problem

But alternative calculations produce different answers—and different answers that are just as valid as the calculation in *Historical Statistics*. This divergence is the index-number problem. It is unresolvable: there is no single, unique, correct index that will tell you how much higher wealth of productivity is: it all depends on what you value, and what set of weights you choose to evaluate the different production possibilities of different eras.

If you take the basket of goods and services that were produced a century ago as your set of weights for constructing your index of productivity—if you average changes in prices over all the commodities they made then and that we made now—you will find that your index of productivity today is about eight times what it was a century ago: an average worker today could buy with one hour's work the average bundle of things that an average worker of a century ago took eight hours to earn.

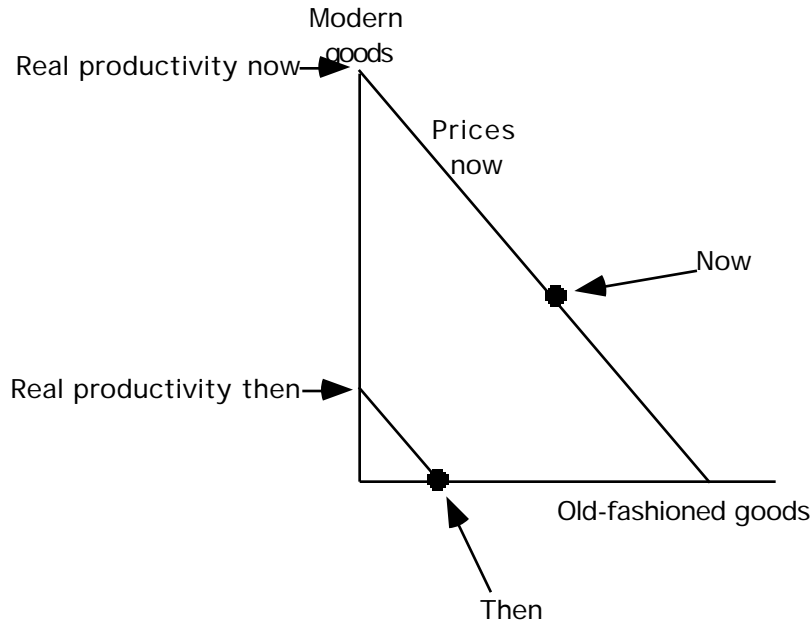
The top panel of the figure below shows one of the standard diagrams of introductory economics. The slope of the lines drawn through the points representing production of “new goods” and old goods shows the relative price today of the two kinds of goods. Because the two lines are parallel, the ratio of their relative distances from the bottom-left corner shows the ratio of the today's-dollar value of production “now” to production “then” this is how you use the metric provided by today's prices to make a *single* numerical comparison between the value of goods produced “now” and the value of goods produced “then.”

But what if we took some other set of prices? The standard current-price calculation corresponds to a particular thought experiment: take everything produced at some year in the past, stuff it into a time machine, bring it forward to today, and sell it.¹² What if we took everything produced today,

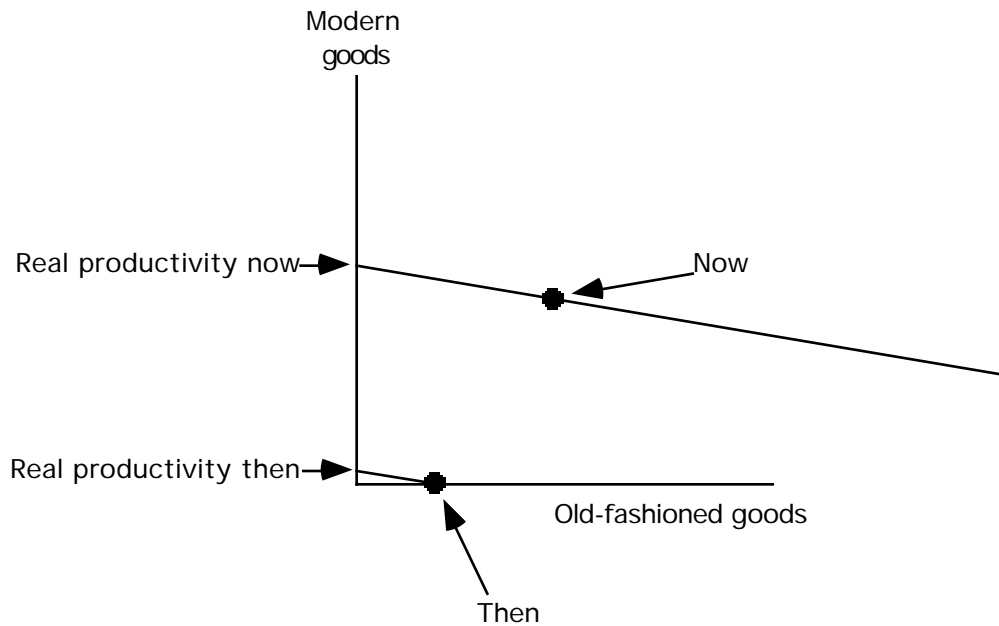
¹² Not quite the thought experiment. Historical GDP series made of Laspeyres indices chained together. Major point, however, still holds. Likely to massively *underestimate* economic growth for well-known

took it back to the past, and sold it at the prices that then prevailed for goods and services?

Relative Real Productivity Levels: Using Today's Prices



Relative Real Productivity Levels: Using Past Prices



reasons: the Laspeyres index is not an estimate of growth, it is the *lowest possible* estimate of growth, the lower bound to estimates of growth.

Then we would have a different answer, as is shown in the bottom panel of the figure above. Because many of the goods and services we produce today could only have been produced—or analogues could only have been produced—at astronomical prices then, the price in the past of our “new goods” in terms of “old goods” is nearly infinite.

So when we draw our lines through the points representing production “now” and “then,” we find that the ratio of the distance of these two lines from the origin is very, very large.

We thus conclude that, measured in the metric provided by prices in the past, that economic growth over the past hundred years has been nearly infinite: even all of the resources of the economy of the past would have been unable to produce even an infinitesimal fraction of some of the goods we make today. We are nearly infinitely better at producing the floating-point arithmetic operations, or airplane flights, and antibiotics that we take for granted—because they are so cheap—today.

This is the first rule of calculating index numbers: calculations using the prices of the later year understate “true” economic growth, and calculations using the prices of the earlier year overstate “true” economic growth.

And neither answer is the one that we would prefer, that we would really believe.

The answer that we would really believe would presumably have one of the two following forms:

- Take a household with income per capita today equal to the economy-wide average. What multiple of average income per capita a century ago would be required for that household to feel equally well-off in a material sense, if transported back in time?
- Take a household with income per capita a century ago equal to the economy-wide average then. What fraction of average income per capita today would be required for that household to feel equally well-off in a material sense, if transported forward in time?

But even these two questions will not have identical—or even close—answers. Only if consumption patterns are what economists call *homothetic*—only if a proportional increase in income leads to a proportional increase in the purchase of *all* commodities—will the answers

to these two thought-experiments be the same. There is no good reason to believe in such homotheticity.¹³

So do we shrug our shoulders and accept the *Historical Statistics* answer that we today are eight times as rich as our counterparts of a century ago? (And that the gulf is larger if we care about manufactured goods; and smaller if we care about personal services, and some kinds of luxuries?)

No, I do not think that we accept this answer, because the *Historical Statistics* answer is the *least* of the possible answers we could arrive at: we know that it provides a lower bound to “true” growth. It provides a lower bound because the calculations that underlie it are flawed in that they semi-deliberately leave out entire dimensions of economic growth.

The sets of calculations made above—comparing the change in labor-standard prices of commodities that existed then and exist now, or valuing the total amount of production just before the turn of the century at today’s prices—are flawed because our material wealth today has more dimensions than just the one of our increased capability to produce the goods that were made a century ago. They are flawed because there are many things we make today that were not made back in 1895: much of our wealth today lies in our ability to make a broader range of commodities than used to be possible. That broader range is not factored into the calculations.

4. The limit of human felicity

We can see the magnitude of the contribution that the changing set of commodities we can produce makes to our wealth by reading *Looking Backward*, Edward Bellamy’s turn of the last century utopian novel.¹⁴ In *Looking Backward* the narrator—thrown forward in time from 1895 to 2000—hears the question, “Would you like to hear some music?”

He expects his host to play the piano—a social accomplishment of upper-class women around 1900. To listen to music on demand then, you had to

¹³ And even if we could assume homotheticity, this still would not carry us to a measurement of social welfare.

How economists approach the social welfare function: Bentham plus a “veil of ignorance” and risk aversion. Advantages of economists’ approach. Disadvantages. Rawlsian approaches. “Communitarian” approaches.

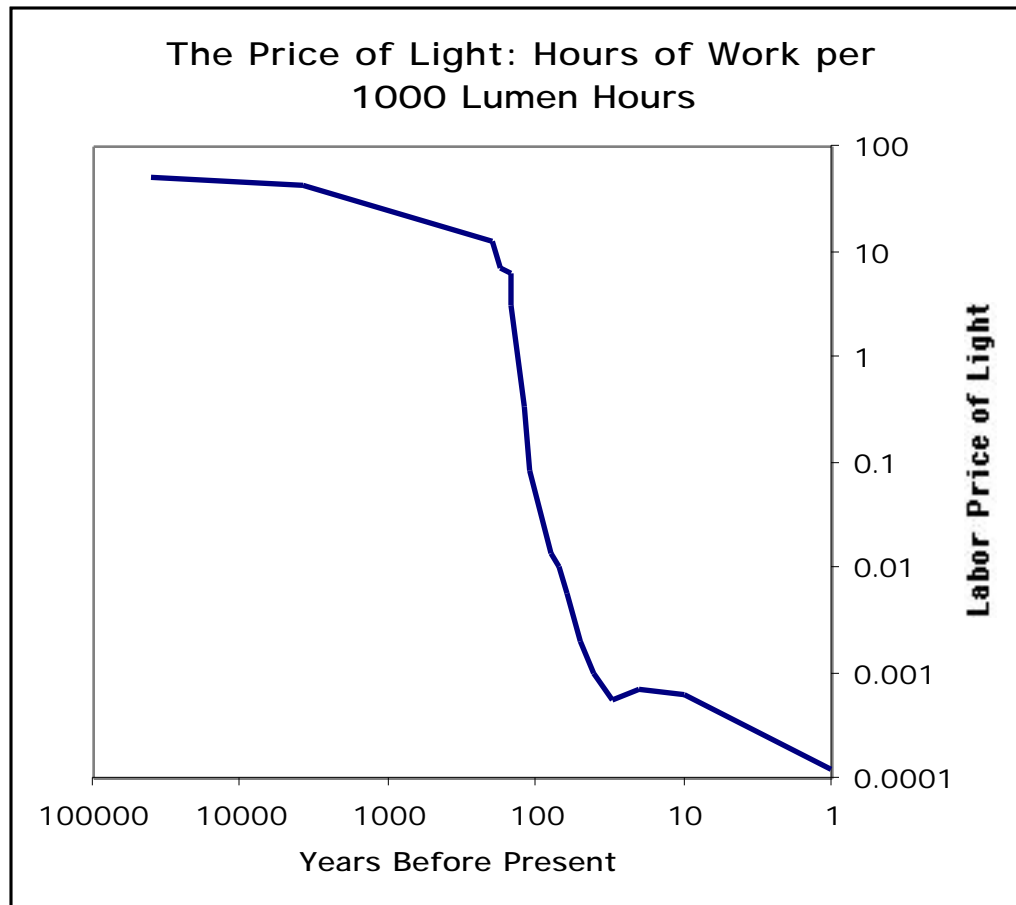
¹⁴ Edward Bellamy (1887), *Looking Backward* (New York: New American Library: 0451524128). Paragraph on the importance of *Looking Backward* viewed in its context.

have—in your house or nearby—an instrument, and someone trained to play it. It would have cost the average worker some 2400 hours, roughly a year at a 50-hour workweek, to earn the money to buy a high-quality piano, and then there would be the expense and the time committed to piano lessons.

But today, to listen to music-on-demand in your home, all you need is a CD or a tape player—or in a pinch, if you are willing to let others choose your music for you, a radio.

The labor-time value of a Steinway piano has fallen in price from 2400 average worker-hours a century ago to 1100 average worker-hours today. But if what you value is not the piano itself but the capability of listening to music at home, the cost has fallen from 2400 average worker-hours a century ago to 10 hours today (240 dollars for the boom-box plus 10 dollars for the CD).

So when we calculate the increase in material wealth, do we count the halving of the labor-time price of the *commodity* (which is what *Historical Statistics* does); or do we count the 240-fold decrease in the real labor-time price of the *capability* of listening to piano music? The experiences of live and recorded music are different in kind. But are they different enough to put a serious dent in the fact that a household today can acquire the capability of listening to piano music for only 1/240 the labor time cost a household of a century ago? And whose piano playing do you *really* want to listen to?



The argument that our commodity-focused price indices miss most of the real action—that price indices focusing on the *services* provided would produce vastly greater estimates of long-run economic growth—is made most powerfully by William Nordhaus in his study of the economic cost of light.¹⁵ Nordhaus attempts to construct a consistent series of the real labor-time cost of illumination from the dawn of civilization until today. He concludes that the past hundred years have seen a ten thousand-fold decline in the real price of illumination. Yet commodity-based price indices have only captured a ten-fold decline in this real price.

Nordhaus guesses that the *Historical Statistics* estimates of economic growth have understated true economic growth since 1800 by between 0.5% and

¹⁵ William Nordhaus (1997) “Do Real Output and Real Wage Measures Capture Reality?: the History of Lighting Suggests Not,” in Timothy Bresnahan and Daniel Raff, eds., *The Economics of New Goods* (Chicago: University of Chicago), pp. 29-66. Also worth reading is the insightful comment by Charles Hulten, pp. 66-70. For a somewhat different methodology—an attempt to calculate the total consumer surplus generated from a single innovation, the CAT scanner—see Manuel Trajtenberg (1990), *Economic Analysis of Product Innovation: The Case of CT Scanners* (Cambridge: Harvard University Press: 0674225406).

1.4% per year—an amount that cumulates to a multiplicative factor of between 3 and 15 over the past two centuries, and to a conclusion that real wages since 1900 have multiplied by a factor between 20 and 100.

Is this credible?

I have no problem at all with the conclusion that *Historical Statistics* significantly understates growth. My family's income today is roughly \$110,000 a year—about twice average GDP per worker. Suppose that you stuffed me and my family into a time machine, sent us back a century to 1890, and then gave us an income equal to twelve times that of 1890 average GDP per worker—an income that would put us at the same place in the relative income distribution then as some \$350,000 a year would today. We would not be among the 1,000 or so richest families in the country that might be invited to the most exclusive parties in the mansions of Newport Rhode Island; but we would be among the next outer circle of 10,000 or so.

Would we be happy—or at least not unhappy—with the switch? Our power to purchase some commodities would be vastly increased: we would have at least three live-in servants, a fifteen-room house (plus a summer place), if we lived in San Francisco we would live on Russian Hill, if we lived in Boston we would live on Beacon Hill, if we lived in New York we would live on Park or Fifth Avenue.

The answer is surely that we would *not* be happy. I would want, first, health insurance: the ability to go to the doctor and be treated with late-twentieth-century medicines. Franklin Delano Roosevelt was crippled by polio. Nathan Meyer Rothschild—the richest man in the world in the first half of the nineteenth century—died of an infected abscess.¹⁶ Without antibiotic and adrenaline shots I would now be dead of childhood pneumonia. The second thing I would want would be utility hookups: electricity and gas, central heating, and consumer appliances. The third thing I want to buy is access to information: audio and video broadcasts, recorded music, computing power, and access to databases.

None of these were available *at any price* back in 1890.

I could substitute other purchases for some. I could not buy a washing machine, but I could (and would) hire a live-in laundress to do the

¹⁶ See David S. Landes (1998), *The Wealth and Poverty of Nations: Why Some Are So Rich and Some So Poor* (New York: W.W. Norton: 0393040178), citing Derek Wilson (1994), *Rothschild: A Story of Wealth and Power* (London: Mandarin).

household's washing. I could not buy airplane tickets; I could make sure that when I did travel by long distance train and boat I could do so first class, so that even though travel churned up enormous amounts of time it would be time spent relatively pleasantly. But I could do nothing for medical care. And I could do nothing for access to information, communications, and entertainment technology save to leave the children home with the servants and go to the opera and the theater every other week. How much are the central heating, electric lights, fluoridated toothpaste, electric toaster ovens, clothes-washing machines, dishwashers, synthetic fiber-blend clothes, radios, intercontinental telephones, xerox machines, notebook computers, automobiles, and steel-framed skyscrapers that I have used so far today worth—and it is only 10 A.M.?

[Figure: collage of commodities invented in the twentieth century]

I would not be satisfied with my attempts to substitute using late nineteenth century technology. First of all, I would be dead. Second a very large chunk of my-high-material standard of living is the broad range of commodities newly-invented over the course of the past century that I can choose to purchase, and that I *do* use because they give me capabilities that were simply not possible a century ago.

Thus perhaps the most important component of the past century's economic growth is the new commodity component—the goods and services of which people alive in the 1890s could dream but not purchase. Whenever we hear a sentence like “average GDP per worker in 1890 was equal to some \$12,000 at 1995 prices,” we cannot help but think that the material standard of living *then* was about what we could obtain *now* if we had \$12,000 to spend. But it was not. The simple valuing of the past's production at the present's prices leaves out a very important part of the picture: the material standard of living *then* was about what we could obtain *now* if we had \$12,000 to spend, *but were required to spend it all on commodities that have been around for more than a century*: no modern entertainment or communications or transportation technologies; no modern appliances; buildings, roads, bridges, and other infrastructure built using century-old technologies. And an income of \$12,000 that must be spent exclusively on late nineteenth-century commodities is, for most of us, worth a lot less than \$12,000.

Return Edward Bellamy's utopia, *Looking Backward*. After answering “yes” to the question “would you like to hear some music?” Bellamy's

protagonist is stupefied to find his host “merely touched one or two screws,” and immediately the room was “filled with music; filled, not flooded, for, by some means, the volume of melody had been perfectly graduated to the size of the apartment. ‘Grand!’ I cried. ‘Bach must be at the keys of that organ; but where is the organ?’”

He learns that his host has called the orchestra on the telephone—for in Bellamy's utopia you can dial one of four orchestras, and then put it on the speakerphone. Bellamy's protagonist then says that:

if we [in the nineteenth century] could have devised an arrangement for providing everybody with music in their homes, perfect in quality, unlimited in quantity, suited to every mood, and beginning and ceasing at will, we should have considered the limit of human felicity already attained...

To Edward Bellamy—a self-described utopian visionary, a late-nineteenth century minister's son from western Massachusetts—a radio that could tune into any of four stations is “the limit of human felicity.”

What if someone were to take Edward Bellamy to Tower Records? Or Blockbuster Video? His heart would stop. Yet we do not think of our modern ability to cheaply listen to high-fidelity go-anywhere listen-to-anything music as a remarkable or even a notable part of our economy. We do not daily give thanks for our cassette players and genuflect in front of our CD collections. We do not reflect that they have brought us to the limit of human felicity.

Edward Bellamy dressed up to go to the symphony and the opera, and did so rarely. Professional-quality music was a big deal. Yet for us it is not a big deal. The technological inventions of the past century have transformed experiences that were rare and valued luxuries—available only to a rich few at great expense—into features of modern life that we take for granted. Bellamy's view of us might be somewhat analogous to our view of a civilization in which everyone had several boxes of gem-quality diamonds sitting in their basement because no one could find a use for them, and in which no one thought of these boxes as in any way interesting.

5. A bottom line

So how much has material wealth grown in the past century?

My own personal guess (and if you do not agree, your introspection-based assessment is certainly as valid as mine) is that, if confined to purchasing and consuming only those commodities that were in the set of items producible in 1890, I would be very, very unhappy indeed. I am not sure that *anyone* in 1890—not even Andrew Carnegie, John D. Rockefeller, or Queen Victoria—was as well-off then in a material-welfare sense as I am today.

[Figure: top row—photos of Andrew Carnegie, John D. Rockefeller, and Queen Victoria—bottom row—three pictures of non-famous late twentieth-century people]

So that perhaps the right answer is that we are so much wealthier than our counterparts of a century ago that the question has no meaning.

And if it does have meaning, the answer is astronomical. William Nordhaus brackets the growth in real wages over the past century as somewhere between a 20-fold and a 100-fold increase. Alan Greenspan—Chairman of the Federal Reserve—has guessed that failure to take proper account of new goods and new types of goods has led us to overstate inflation and understate real income growth by 1.5 percent per year. Compounding this overstatement for a century and applying it to the numbers in *Historical Statistics* leads to an estimate of a thirty-fold increase in material wealth over the past century.¹⁷

That will do for a single number, if we must have one.

B. Growth in long-run perspective

1. Since and before the commercial revolution

¹⁷ The question of the distribution of material wealth—of what is done with this enormous productive potential—is a different one. At least in Edward Bellamy's mind, the society of his *Looking Backward* made much better use of its (vastly less than ours) productive potential than we do of ours: his society was a utopia, while ours is not.

The twentieth century appears is unique in its pace of economic growth. Such rapid growth in standards of living has never been seen before, anywhere. The nineteenth century saw perhaps a doubling of measured material standards of living in the United States—perhaps a tripling or quadrupling once proper account is taken of the impact of new technologies like the railroad and the telegraph, and the expanded range of technological capabilities.¹⁸ Nineteenth century growth was itself remarkably fast: people christened the nineteenth century the “industrial revolution” because it was remarkable compared to what had happened before. And before the nineteenth century growth was even slower. The standard of living in the Netherlands, probably the richest economy in the world at the end of the eighteenth century, might (or might not) have been some fifty percent higher than it had been three centuries before, at the time of the Renaissance.¹⁹

[Figure: the countryside: Roman Italy, circa 0; Netherlands, circa 1500; U.S. midwest, circa 1900; U.S. midwest, today]

And before that?

Between the invention of agriculture and the commercial revolution that marked the end of the middle ages, wealth and technology developed slowly indeed. Medieval historians speak of centuries and half-millennia when they speak of the pace at which key inventions like the watermill, or the heavy plow, or the horse collar diffused across the landscape. And improvements in technology relatively quickly led to increases in population, until the human population once again reached a new Malthusian steady state in which births were held in checks by death. For most of human history before the industrial revolution, increases in technological capability led to increases in the population that could be supported on a given natural resource base, with little if any appearing as an improvement in the median standard of living.²⁰

¹⁸ The standard source is—and by virtue of his industry and thoroughness will long remain—Angus Maddison (1995), *Monitoring the World Economy, 1820-1992* (Paris: OECD: 9264145494). See also his *19 Phases of Capitalist Development* (New York: Oxford: 0198284519), and Paul Bairoch’s speculative (but I have no better speculations) “Main Trends in National Economic Disparities since the Industrial Revolution,” in Paul Bairoch and Maurice Lévy-Leboyer, eds. (1981), *Disparities in Economic Development since the Industrial Revolution* (London: Macmillan).

¹⁹ Jan de Vries and Ad van der Woude (1997), *The First Modern Economy: Success, Failure, and Perseverance of the Dutch Economy, 1500-1815* (Cambridge: Cambridge University Press: 0521578256).

²⁰ Or so I read the history at least. See Abbott P. Usher (1922), *A History of Mechanical Inventions* (New York: Dover: 048625593X); Michael Kremer (1993), “Population Growth and Technological Change: One

So slow was the pace of change that people, or at least aristocratic intellectuals, could think of their predecessors of a thousand years before or more as effectively their contemporaries. And they were not far wrong. Marcus Tullius Cicero, a Roman aristocrat and politician of the generation before the Emperor Augustus, might have felt more or less at home in the company of Virginia planter Thomas Jefferson. The slaves outside grew different crops. The plows were better in Jefferson's time. Sailing ships were much improved. But these might have been insufficient to create a sense of a qualitative change in the order of life for the elite. And at the bottom being a slave of Thomas Jefferson was probably a lot like being a slave of Marcus Tullius Cicero.²¹

[Figure: Slaves at Monticello—Slaves working the fields of ancient Rome]

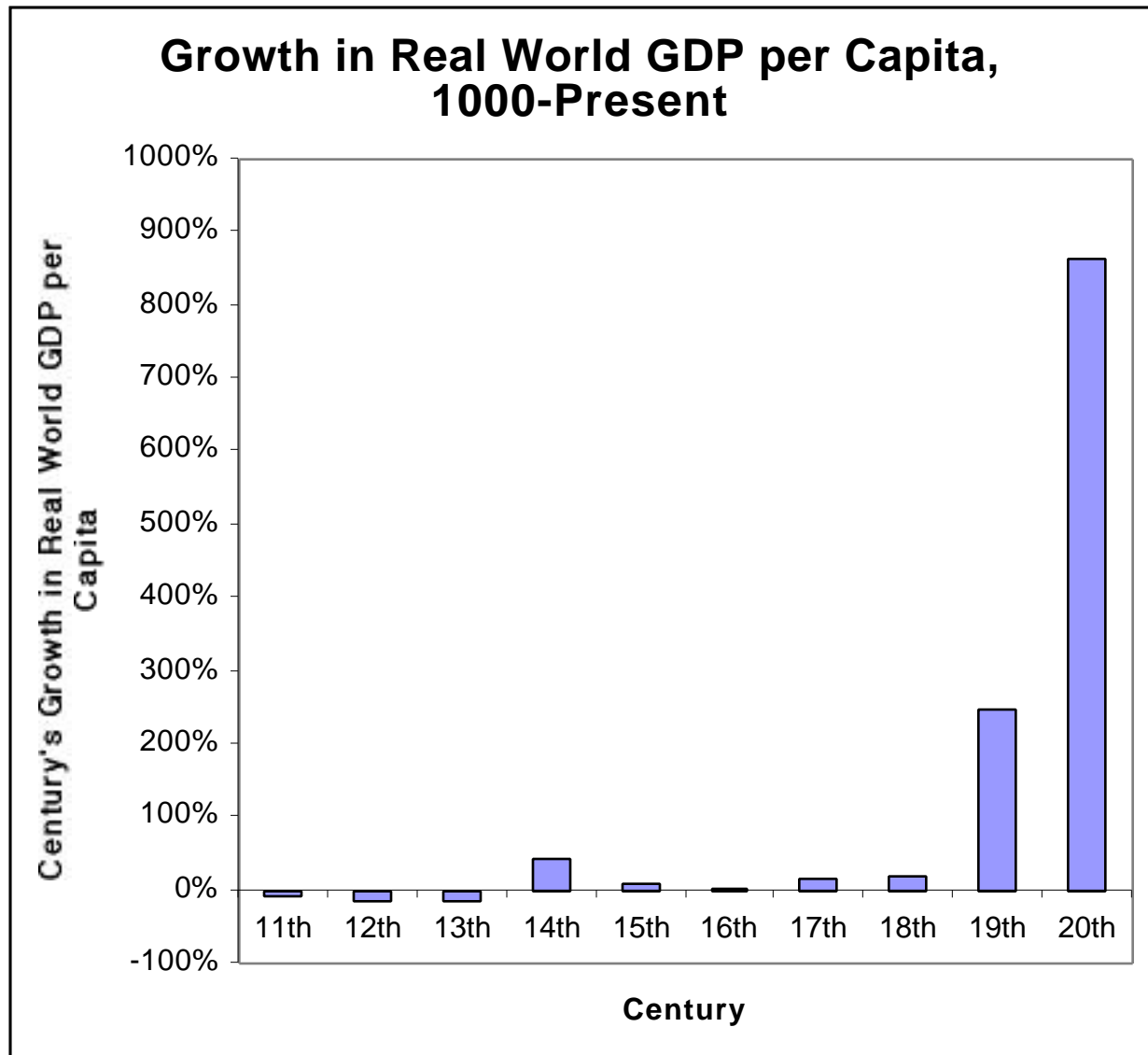
One change would probably have struck Cicero as amazing and wonderful: printing. Printing technology might have been enough to create a sense of a qualitative change in the order of life. For Cicero acquiring one copy of one book involved two months' worth of copying labor by a literate slave, an amount of labor that we would value at perhaps \$4,000 dollars compared to the \$10 price of a trade paperback book today; we today find the real price of books in terms of human labor to be 1/400 of what it was for Cicero, and even in Jefferson's day the real price of books had already fallen to perhaps 1/50 of what it had been at the beginning of the Roman Empire.²²

But overall the differences in standards of living and in technologies used to manipulate the world were small, or at least “small” relative to the pace of change in the nineteenth and twentieth centuries.

Million B.C. to 1990,” *Quarterly Journal of Economics* 108:3 (August), pp. 681-716; Massimo Livi-Bacci (1992), *The Concise History of World Population* (London: Blackwell: 0631204555).

²¹ See Moses Finley (1985), *The Ancient Economy* (Berkeley: University of California Press: 0520024362).

²² See Elizabeth Eisenstein (1993), *The Printing Revolution in Early Modern Europe* (Cambridge: Cambridge University Press: 0521447704). Printing made possible macrohistorical events like the Reformation and the Scientific Revolution. It also made it possible for a person to earn a living as an author: see Lisa Jardine (1995), *Erasmus, Man of Letters: The Construction of Charisma in Print* (Princeton: Princeton University Press: 069100157X). And it made it possible for individuals to own enough books to construct their own virtual reality chamber. See Niccolo Machiavelli to Francesco Vettori, December 10, 1515, in James Atkinson, ed. (1996), *Machiavelli and His Friends: Their Personal Correspondence* (David Sices, trans.) (Chicago: Northern Illinois University Press: 0875802109).



Even the first century of the industrial revolution produced more “improvements” than “revolutions” in standards of living. With the railroad and the spinning and weaving of textiles as very important exceptions, most innovations during the first century or so of the industrial revolution proper were innovations in transportation, in how goods were produced, and in new kinds of capital but not consumer goods. Standards of living improved because of these innovations in production processes and capital goods. But styles of life remained much the same. Improvements in productivity in the first half of the nineteenth century at

least were concentrated in a few relatively narrow sectors rather than spread throughout the economy.²³

So slow was the pace of improvement that literary intellectuals in the first half of the nineteenth century debated whether this industrial revolution was worthwhile. Was it an improvement or a degeneration in the standard of living? And opinions were genuinely divided, with as optimistic a liberal as John Stuart Mill coming down on the “pessimist” side as late as the end of the 1840s.²⁴

The figure above shows—approximately—the relative pace of economic growth in productivity levels and material wealth for the world as a whole over the past ten centuries. The estimates are rough and approximate only. But the figure does not do violence to the *qualitative* picture of relative rates of economic growth over the past ten centuries. And in the leading-edge economies of Europe (plus the European-settled North American economies) the acceleration of growth into the twentieth century was an order of magnitude faster still

3. Massive and colossal productive forces

In 1848, in the middle of the nineteenth century, before the industrial revolution proper had spread far from its original homes in Belgium and in the British midlands, a young German philosopher-turned-political activist marveled at the extraordinary pace of economic growth in his day. He saw it as a new historical epoch that was only a century old, and yet was opening wide the door to utopia. He saw the epoch as equivalent to that of Prometheus, the mythological Greek demigod who defied the chief god Zeus, brought knowledge of fire to humanity, and transformed humanity's condition.

[Figure: Young Karl Marx]

²³ So C. Knick Harley and N.F.R. Crafts have persuaded economic historians. See N.F.R. Crafts (1985), *British Economic Growth During the Industrial Revolution* (Oxford: Oxford University Press: 0198730675). Peter Temin, however, has cast some significant doubt on this conclusion. See Temin's 1997 “Two Views of the Industrial Revolution,” *Journal of Economic History* 57:1 (March), pp. 63-82.

²⁴ See George Boyer (1998), “The Communist Manifesto in Historical Perspective,” *Journal of Economic Perspectives*.

He wrote that the economically ruling class—the capitalist class, the entrepreneurial class, the business class, the *bourgeoisie*—of this epoch was:

...the first to show what man's activity can bring about. It has accomplished wonders far surpassing Egyptian pyramids, Roman aqueducts, and Gothic cathedrals; it has conducted expeditions that put in the shade all former Exoduses of nations and crusades....

[It has], during its rule of scarce one hundred years...created more massive and more colossal productive forces than have all preceding generations together. The subjection of nature's forces to man, machinery, the application of chemistry to industry and agriculture, steam-navigation, the railways, electric telegraphs, the clearing of entire continents for cultivation, the canalization of rivers, the conjuring of entire populations out of the ground—what earlier century had even a presentiment that such productive forces slumbered in the lap of social labor?

Karl Marx was dumbfounded at the pace of the economic transition he saw around him. Yet compared to the pace of economic growth in the twentieth century, all other centuries—even the nineteenth century that so impressed Karl Marx—were standing still.²⁵

²⁵ Karl Marx and Friedrich Engels (1848), *Manifesto of the Communist Party*, in Robert Tucker, ed., *The Marx-Engels Reader* (New York: W.W. Norton: 039309040X).