AJO

ONE FUTURE, TWO VIEWS OF GROWTH[1]

By Laurence B. Siegel
July 15, 2014

Economic growth in the developed world has been notably slower than in the 20th century. In the last few years, that slowing has spread to emerging markets. Is this the end of a 200-year trend of rapid human development, or is it a short-term fluctuation that we should not worry about?

Growth may slow, as Robert Gordon contends, as least when measured by GDP — if only because population growth is slowing. But per-capita GDP, not overall GDP, is what counts for measuring the standard of living. And even if per-capita GDP growth were to slow, it doesn't mean that growth in the global standard of living would slow commensurately, because per-capita GDP misses some improvements in the quality of life that come with advanced technology.

Most economic historians expect continued robust growth propelled by technological progress, but some economists, including Northwestern University's Gordon, are not so sure. I examined this question in Advisor Perspectives last year in "The Prospects for Long-Term Growth: A Critique of Grantham and Gordon."[2] Now, in the light of a friendly feud between Gordon and his campus colleague Joel Mokyr, publicized in *The Wall Street Journal* on June 15, 2014,[3] I take another look. Gordon, a macroeconomist, believes that six headwinds make further economic growth much more difficult, while Mokyr, a highly respected economic historian who also teaches at Northwestern, thinks that the best years of the human race are yet to come.

Before getting into the details, it's worth pointing out that no growth rate can continue forever. Jeremy Grantham of GMO is fond of noting that if an ancient Egyptian consumed one cubic yard of physical materials (a reasonable amount by today's standards) per year in 1000 B.C. and his consumption grew at only 2% per year (roughly the rate of per-capita consumption growth in the developed world in the last 200 years), the Egyptian would be consuming more than the volume of the planet each year by the present time. Such expansion can only continue for a finite amount of time, if consumption of physical materials is what we are talking about. (Mokyr asserts that it is not. Economic growth means a reduction in the effort needed to produce a unit of utility, he says, not necessarily an increase in the consumption of physical materials.)

---

[1] This article appeared under the title "Two Top Experts Debate the Outlook for Growth" in Advisor Perspectives, July 15, 2014.

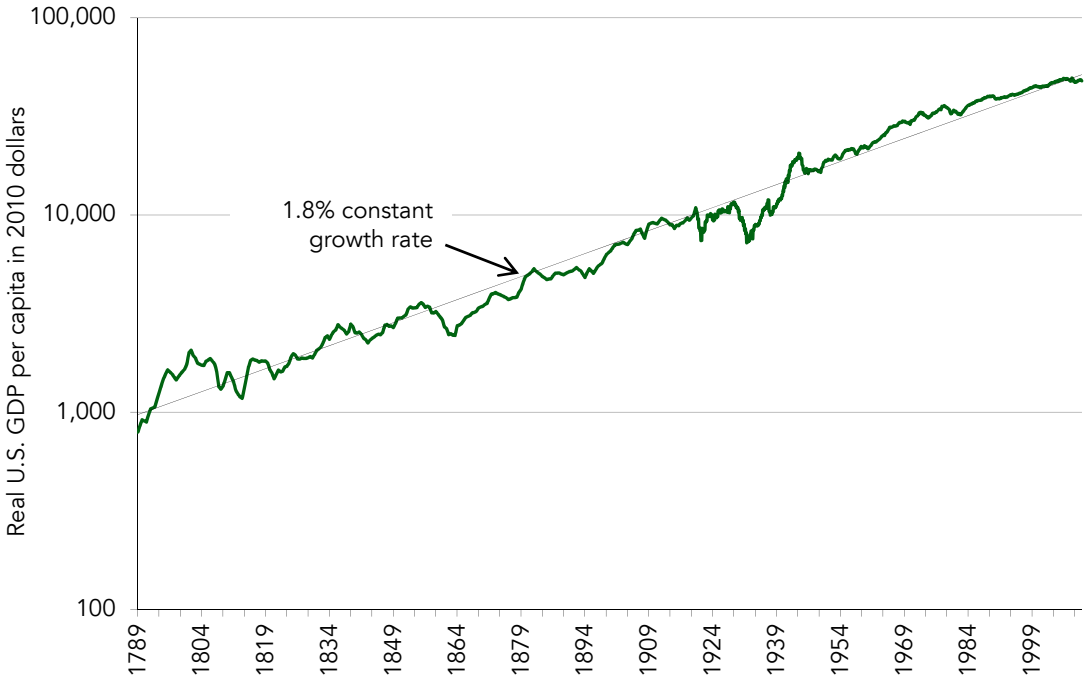
[2] Siegel, Laurence B. 2012. "The Prospects for Long-Term Growth: A Critique of Grantham and Gordon." *Advisor Perspectives* (November 27), http://www.advisorperspectives.com/newsletters12/A_Critique_of_Grantham_and_Gordon.php

[3] Aeppel, Timothy. 2014. "Economists Debate: Has All the Important Stuff Already Been Invented?" *The Wall Street Journal* (June 15), http://online.wsj.com/articles/economists-duel-over-idea-that-technology-will-save-the-world-1402886301

For reference, Exhibit 1 shows U.S. real per-capita GDP (the best available measure of economic productivity) from 1789 to 2012. The long-term growth rate is 1.8% per year, and growth has recently been slower.

EXHIBIT 1

U.S. REAL GDP PER CAPITA, 1789-2012



Source: William F. Sharpe, P. Brett Hammond, Martin L. Leibowitz, and Laurence B. Siegel. "The Equity Risk Premium." Presentation at the Q Group, Dana Point, CA, October 16, 2012.

HEADWINDS AND TAILWINDS

Mokyr summarizes Gordon's views as follows: "The low-hanging fruit has been picked, because we won't invent indoor plumbing again." Nor will we again invent the railroad, the telephone, the electrical grid, the automobile, the airplane or the computer, emphasizes Gordon.

Gordon echoes, "The rapid progress made over the past 250 years could well turn out to be a unique episode in human history."[4]

Well, sure. Nothing like it has ever happened before, and now that the basic tools of modern life have been invented, it does not have to and cannot happen again. The first take-off into sustained economic development is, by definition, unique in history. But what is next?

[4] From the June 15, 2014 *Wall Street Journal* article linked above.

Gordon argues that improvements will be successively smaller as we refine our knowledge and skill but fail to make fantastic new breakthroughs. He has also written about the six headwinds that make it difficult, in the U.S. especially, to make further rapid economic progress:[5] demography, educational shortcomings, inequality, globalization, energy and environmental constraints and the overhang of consumer and government debt. Gordon concludes that consumption per capita is likely to grow at a rate as slow as 0.5% per year "for an extended period of decades."[6]

I believe some of the headwinds are a real concern. The aging of the population will make labor (and tax dollars extracted from it) scarcer. The root causes of aging, however, are longevity and a low birth rate, which, in my 2012 essay, "Fewer, Richer, Greener,"[7] I argued are huge positives for the economy and environment. I am concerned that entitlement spending is crowding out valuable infrastructure projects. We need to educate and train low- and middle-skilled workers.

But Mokyr, in an extensive interview with Russ Roberts, host of the web site econtalk.org,[8] counters that "there are also tailwinds." Mokyr notes that we faced headwinds in the 20th century as well — communism, fascism, the possibility of nuclear war, and a population explosion — and had the most economically successful century in history. He attributes this success to basic discoveries in the natural sciences, a view that sets Mokyr apart from many colleagues, who credit engineering, entrepreneurship, and capital accumulation.

What are the tailwinds? Mokyr doesn't enumerate them, but I can think of a half dozen:

- Relatively free markets and free trade
- Patent protection, which allows rewards for innovation to be captured
- Instantaneous and nearly free communication
- Cheap, safe air transportation that enables innovators to socialize, collaborate and sell
- Widespread use of a common language (English)
- A worldwide network of outstanding universities that can become the basis for an internet-based educational system

---

[5] Gordon, Robert J. 2012. "Is U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds." NBER Working Paper #18315, http://www.cfa-sf.org/files/SSRN-id2133145%20-%20Is%20US%20Economic%20Growth%20Over%20-%20Gordon.pdf

[6] This forecast is for the U.S. and excludes the richest citizens, who, Gordon argues, can expect faster consumption growth.

[7] Siegel, Laurence B. 2012. "Fewer, Richer, Greener: The End of the Population Explosion and the Future for Investors." *Financial Analysts Journal* (November/December), pp. 20-37. http://larrysiegeldotorg.files.wordpress.com/2013/12/fewer-richer-greener_siegel_2012.pdf

[8] All Joel Mokyr quotes are from an interview with Russ Roberts of econtalk.org on November 25, 2013, accessible at http://www.econtalk.org/archives/2013/11/joel_mokyr_on_g.html. For further reading, see also Mokyr, Joel. 2013. "Technopessimism Is Bunk," http://www.pbs.org/newshour/making-sense/technopessimism-is-bunk/ (July 26).

Most of these have barely begun to be exploited.

The Interplay of Technology and Science

Mokyr's thesis is that human advancement, and thus economic growth, comes from the interplay of two quite separate aspects of technology. The first is technique, or "a set of recipes… how you bake a cake…make an ingot of steel…build a nuclear reactor." Behind that is the second aspect:

> A set of natural laws and regularities that … you could call … science, but there is more to it than science [in that the knowledge is about our environment and is directly usable].
>
> These two types of technology interact with one another. … It's not just that we discover laws of science, [say] quantum mechanics ... and then we build a nuclear reactor. It's much more complex than that. By building a nuclear reactor or … television sets or smart phones … we learn more about science. [Thus, technology and science] … reinforce one another in a very subtle way.

Many people misunderstand this process, and believe that the dance between technology and science takes place only in one direction: abstract scientific discoveries make later technological advances possible. But, Mokyr persuasively argues, that's not always or even usually the case. After describing the interplay of the practical and theoretical aspects of technology in the Age of Reason, when advances in practical optics (attributed to Lippershey) made possible astronomical discoveries (Galileo) and eventually abstract physics (Newton), Mokyr applies this principle to the age of the computer:

> We have added a tool that no one [has] dreamed about before, namely, high-powered computing. … In any kind of research, not just natural sciences, it's unimaginable to do [it] without computers. This is the most powerful research tool that humans have ever invented. And we [have] just started to scratch the surface. [If] you think about the chemistry and the physics and the nanotechnology that these machines will develop and you [think about] what … further instruments [will be developed], you will see [a] mutually reinforcing process that's … going to launch us into an orbit that we today … cannot imagine. That's why I'm an optimist.

Should We Worry About Diminishing Returns?

Without new fundamental discoveries, Mokyr argues, innovation tends to be incremental and faces diminishing returns. "A lot of innovation is happening in very small increments by entrepreneurs," he says. "But, basically, if there is no further expansion of our understanding of nature, and of physics, chemistry, biology, then at some point [innovations] are going to run into diminishing returns."

Diminishing returns, also one of Gordon's prime concerns, are, of course, a basic economic principle. When you add a variable factor to a fixed factor, the incremental benefit levels off pretty quickly. A textbook example is farmers (the fixed factor) and tractors (the variable factor). A farmer can grow more food if he can buy a bigger, faster, or better tractor, but he cannot drive two tractors. For that you need two farmers.

But with profound changes in our understanding of nature, the number of farmers and tractors does not determine how much food we can grow. The Green Revolution and genetic engineering changed that equation utterly. For the first time in human history, and possibly in the history of any species, our problem is too much food, not too little.[9]

The Sluggish Airliner

To show what he means by the slowing of innovation, Gordon uses the example of today's sluggish airliners. By the 1950s, it was possible to fly large numbers of people at just under the speed of sound. Today we can fly passengers at a much lower real cost, and the flights are only a little slower (!). Doesn't that mean that progress in air transportation has come to a virtual halt?

Not in the slightest! As I wrote a few years ago, we know perfectly well how to fly at three times the speed of sound — the military does it every day.[10] We just choose not to. We fly slowly to save on fuel costs and to avoid subjecting non-flyers to annoying sonic booms. These are legitimate reasons to fly slowly, but they have nothing to do with technological limitations. The current speed of airplanes represents a social decision.

Technology Diffusion, Satiation and the Alleviation of Poverty

Now that the basic tools of a technological society have been invented, we have another task at hand: using the tools effectively. Technology diffusion is just as critical to progress as invention. Which produces a greater improvement in human life and in global GDP, an African or Indian buying his first car or an American trading an iPhone 5 for an iPhone 6?

The car. It produces an improvement in total utility many times larger than the iPhone trade.

---

[9] Yes, even in less developed countries. Of course, because of unequal distribution, some people are still hungry. I discuss food abundance more in a later section.

[10] "Why 'Fewer, Richer Greener': Investment Thinker Larry Siegel Dares To Be Contrarily Optimistic," *Welling on Wall St.,* Volume 2, issue 1, January 11, 2013. Since that time, an aircraft has been flown at five times the speed of sound.

The quality of life of the global middle to upper-middle class is pretty good. If it could be expanded to include almost everyone in the world (pathological cases aside), and if such a way of life could be maintained indefinitely into the future, it would represent a stunning achievement by the human species. But such an outcome would not look impressive if measured by developed-country GDP growth rates, because these countries are already most of the way there. Emerging countries, continuing the "great convergence" that has persisted since around 1950, would grow rapidly for a number of decades as they catch up. Then, global growth would slow to a crawl.

Would this satiation scenario be a bad thing? Not at all, but we can do better. At today's GDP per capita of approximately $50,000, many — perhaps most — Americans fall short of participating in the global middle to upper-middle class. How would they fare at the $108,191 GDP per capita projected by Goldman Sachs for the United States in 2050?[11]

While poverty would not be eliminated, any more than it has been eliminated at today's historically high level of per-capita GDP, the poor would live more like the middle class of today. According to the Heritage Foundation, "the average poor American [already] has more living space than the *average* individual living in Paris, London, [or] Vienna."[12] This fact is at least partly a consequence of the great housing boom of the last generation,[13] and the improvement will continue if future overall economic growth is strong. Of course, the social pathologies of poverty, some of which seem as intractable as ever, may be due to relative rather than absolute deprivation, and to cultural factors. These may not improve as physical living conditions improve. But economic growth cannot be expected to solve every human problem.

Biteback: Why We Need More Technological Progress

If diffusion of existing technology is enough to bring the fruits of modern life to the world's people, why bother trying to develop new technologies?

According to Mokyr, one reason is that the technology we need and want creates new problems that require technological solutions, and so on, ad infinitum:

> I don't want to come across as … a technology-*über-alles* guy. I don't think technology is an undivided good. You get the bad with the good, and for every opportunity that technology creates there are costs and what Edward Tenner has called "biteback."

[11] $91,683 in 2006 dollars, inflated to 2014 dollars. This forecast was before the Great Recession, from which it took about 6 years to recover in per capita GDP terms, so the forecast is more likely to be realized around 2056.

[12] Rector, Robert. 2007. "How Poor Are America's Poor? Examining the 'Plague' of Poverty in America." Heritage Foundation (August 27), http://www.heritage.org/research/reports/2007/08/how-poor-are-americas-poor-examining-the-plague-of-poverty-in-america

[13] Government transfers are also a factor, as is general economic growth.

> What happen[s] is [that] you come up with a new invention or … form of technology and you realize it improves life in some dimension. But, somewhat unexpectedly, there are some side effects, some … biteback that happens. You have to find a solution to that, and … technology often solves these issues. The solution [itself may] create biteback. You have to find a solution to that. And so it goes on forever.

An example of biteback is obesity. For almost all of human history, famine was an ever-present threat. Now, in much of the world, we have too much food. An unintended consequence of having efficient agriculture and avoiding starvation is that people get fat. Having fought hunger and won, we have to fight fatness.

Fighting fatness is biologically harder than fighting hunger. We are conditioned by billions of years of evolution (not just our own species, but our ancient ancestors) to know how to look for food and to know that gathering and storing extra food is a good defense against hungry times.

Combating obesity is, in contrast, a profound technological challenge involving diets, exercise regimens and medications that work against everything our bodies are telling us to do. We are just beginning to get a grip on these technologies. They will be an important component of the global economy in the future.

The Earth Bites Back

Some of the biteback is environmental. Massive consumption of fossil fuels has raised justified concern about warming caused by greenhouse gases, primarily carbon dioxide (CO_2). As Robert Litterman, the editor of the *Financial Analysts Journal*, has suggested, this risk should be priced like any other.[14]

So far, the price of global-warming risk has been zero (because CO_2 emissions have not been regulated or taxed). The price should be set at a level that balances the cost of reducing emissions against the cost of not reducing them. There are only so many resources in the world, and risk cannot be eliminated. But if the prices of all risks are set fairly, the market will allocate the right amount of resources to alleviating each risk.

[14] Litterman, Robert. 2011. "Pricing Climate Change Risk Appropriately." *Financial Analysts Journal,* Vol. 67, No. 5 (September/October), pp. 4–10.

If the cost of reducing emissions is set sufficiently high, it will stimulate technological advancement and the cost will come down, resolving the problem over time (although at a higher atmospheric CO_2 concentration than before the industrial era started). Some would set the cost of emissions high enough to collapse the global standard of living, including the food supply. But there is no reason to believe that such a high cost is needed to spur the required technological advances, and it would probably make such advances unachievable.[15]

Surgery without Anesthesia: Measuring Utility

Gordon and Mokyr also find themselves on opposite sides of an economic measurement problem. Without saying so, Gordon appears to believe that GDP measures economic activity with enough accuracy that more GDP can be presumed to be better than less.

This is not necessarily the case. The concepts of gross domestic product (GDP) and gross national product (GNP) were first developed by Simon Kuznets in the 1930s to measure economic output in that era. They did a pretty good job at the time, at least for comparing periods that are not too widely separated in time. However, it is no longer clear that GDP captures the output of a service- and information-dominated economy, and it has never been right for measuring the progress of an economy over very long time periods. (Kuznets himself advised against using it to measure "the welfare of a nation."[16])

What's wrong with GDP? Unlike industrial output, which is fairly easy to measure, the output of service jobs is hard to measure, so economists measure inputs (effort) instead. Basically the contribution of services to GDP is considered equal to what was paid for the service. But the productivity of service workers, especially highly paid professionals, fluctuates wildly from one day to the next. GDP doesn't capture that variation.

Innovations that are primarily cost-saving cause GDP to decline while utility increases. Ride sharing (Uber and Lyft), residence sharing (Airbnb and VRBO) and free advertising (Craigslist) not only reduce costs but also take transactions out of the measured economy. Even if everyone involved in this new "sharing economy" fully reported income and paid taxes on it, the cost saving would mostly accrue to the consumer and not be counted in GDP. The same can be said of improvements in computing, telephony, and fuel-efficient driving.

---

[15] I also worry about global cooling, but I seem to be alone in that concern. (A few decades ago, I would not have been alone, even though a widely circulated image appearing to be a *Time* cover with the title, "How to Survive the Coming Ice Age," is a fake. The *Newsweek* article, "The Cooling World," April 28, 1975, is not a fake and describes meteorologists' predictions of an ice age.) The next few hundred years may be kind of hot, but ice ages come fairly regularly — the last one ended only 12,000 years ago — and involved a two-mile-thick ice sheet over much of the world's agricultural land. The next ice age will be a technological challenge *par excellence* for future agronomists and geoengineers.

[16] Kuznets, Simon. 1934. "National Income, 1929–1932." 73rd U.S. Congress, 2d session, Senate document no. 124, page 7.

Mokyr uses the vivid example of anesthesia to illustrate the idea that, with substantial technological change over time, utility rises faster than GDP:

> Consumer surplus measures how much better off you are as a result of a new good or a new service, by asking: How much would you demand to be paid if we took that good away from you and put you back in time to when that good didn't exist? If we took the global positioning system (GPS) out of your car, so that you have to buy maps and study them before driving, there's a loss of wealth … but it's probably not huge.
>
> So, my example of a very small invention for which we could ask this question is anesthesia. If you [ask] somebody who is about to have surgery, "How much would you demand to be paid if I took out your appendix without anesthetizing you?" … The sum would be infinite.

When anesthesia was introduced in the 1840s, Mokyr says, it had little effect on GDP. But the benefit of anesthesia was immeasurably huge.

GDP, then, doesn't have to grow as fast as in the past because the pile of stuff we use in our lives is reaching satiation. But progress in the sense of needing to exert less effort to achieve the same utility has no natural limit.

The Disappearing Need for Labor

This thought brings us to a transcendent question: What will the people now employed in low-skilled occupations do when machines can do the work better and more cheaply?

Neither Gordon nor Mokyr seems to know. Most readers are familiar with the Luddites, English textile artisans who were thrown out of work by the mechanical loom and who tried to save their jobs by destroying the machines. In the long run, the Luddites were wrong: The creative processes of capitalism would replace their jobs with something much better. But it would not have consoled the starving Luddites (there was no social safety net) to know that their grandchildren would be prosperous factory workers.

We face a similar dilemma today. Unskilled workers, and even the middle-skilled workers (whose jobs can be replaced with sophisticated robots, voice-recognition software and so forth), are in deep trouble. Mokyr retells the usual tale, that the Luddites' descendants, and even some of the Luddites themselves, would enjoy a level of prosperity of which they could only dream:

> The … problem is not that [technology] will not create new jobs, new occupations, new specializations, new challenges. The problem is people [whose] … skills become … valueless. [It is] typically … very difficult to retrain [them] in the new occupations.

> So … you may well observe … a whole generation of people who go through what the hand-loom weavers went through in the Industrial Revolution. They were too old, or for some other reason incapable of being retrained, and they died bitter and disappointed, and many of them poor.

The transition, then, will be difficult, expensive, and painful. We have already begun to pay that price. We can only hope that the eventual rewards are worth the pain.

Conclusion[17]

Mokyr and the techno-optimists (among whom he'd probably not wish to be counted) are right about technology itself. Economic growth due to technological advances will not slow down and may even accelerate. Not all innovation will show up in official productivity numbers, but the consumer surplus will grow and grow.

As a result, future generations will be much better off than we are. Global inequality will shrink dramatically as local inequalities expand somewhat. Investors will prosper, although probably not at the rate experienced in the 20th century in the U.S. (the most successful country in the most successful century in history). In a half-century, Gordon's headwinds will have long been forgotten.

The bad news, if you want to call it that, is satiation. There is only so much happiness you can experience. Most of the increase in it comes from removing adversity, and there is only so much adversity we can remove. A country with a per capita GDP of $100,000 is not twice as satisfied as one with $50,000. We will still experience sadness and loss, get sick and die. We will eat, sleep and make merry the way we always have.

Laurence B. Siegel is the Gary P. Brinson director of research at the CFA Institute Research Foundation in Charlottesville, VA. He lives in Wilmette, IL and can be reached at lbsiegel@uchicago.edu.

[17] Portions of this section are drawn from my speech, "Making Sense of the Markets' Madness," at the Morningstar Retirement Plan Conference in Chicago on June 26, 2000.