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OPINION

What Today's Economic Gloomersayers Are Missing

Science is enabling invention like never before and in ways that will improve life but isn't captured by GDP statistics.

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By JOEL MOKYR

Updated Aug. 8, 2014 6:22 p.m. ET

There is nothing like a recession to throw economists into a despondent mood. Much as happened in the late 1930s—when there was a fear of so-called secular stagnation, or the absence of growth due to a dearth of investment opportunities—many of my colleagues these days seem to believe that "sad days are here again." The economic growth experienced through much of the 20th century, they tell us, was fleeting. Our children will be no richer than we are. The entry of millions of married women into the workforce and the huge increase in college graduates that drove post-1945 growth were one-off boons. Slow growth is here to stay.

What is wrong with this story? The one-word answer is "technology." The responsibility of economic historians is to remind the world what things were like before 1800. Growth was imperceptibly slow, and the vast bulk of the population was so poor that a harvest failure would kill millions. Almost half the babies born died before reaching age 5, and those who made it to adulthood were often stunted, ill and illiterate.

What changed this world was technological progress. Starting in the late 18th century, innovations and advances in what was then called "the useful arts" began improving life, first in Britain, then in the rest of Europe, and then in much of the rest of the world.



A sample of graphene Corbis

Why did it happen? In brief: Science advanced. One reason science advanced so rapidly is that technology provided the tools and instruments that allowed "natural philosophers" (as they were known then) to study the physical world. An example is the barometer. Invented by a student of Galileo's named Torricelli in 1643, it showed the existence of atmospheric pressure. That scientific insight spurred the development of the

first steam engines (known as atmospheric engines).

In 1800 another Italian, Alessandro Volta, invented the "pile"—the first battery. It served primarily as a tool for chemical research, allowing chemists to map out the newly discovered world of elements and compounds that unleashed the chemical industries of the 19th century.

In that fashion technology pulled itself up by its bootstraps: An invention in one area stimulated progress in another. The germ theory of disease and the subsequent revolution in medical technology might never have occurred without improved microscopes.



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- 1** 

Compared with the tools we have today for scientific research, Galileo's look like stone axes. We have far better microscopes and telescopes and barometers today, and the digital codification of information has penetrated every aspect of science. It has led to the reinvention of invention. Words like "IT" or "communications" don't begin to express the scope of the change. Huge searchable databanks, quantum chemistry simulation and highly complex statistical analysis are only some of the tools that the digital age places at science's disposal.

The consequences are everywhere, from molecular genetics to nanoscience to research in Medieval poetry. Quantum computers, though still experimental, promise to increase this power by orders of magnitude. As science moves into new areas and solves problems that were not even imagined, inventors, engineers and entrepreneurs are waiting in the wings to design new gizmos and processes based on the new discoveries that will continue to improve our lives.

In the speculation on what the new technologies will look like and do, robots and artificial intelligence remain front and center, at once wished for (who likes making beds?) and feared as job-killers. We haven't seen a fraction of what is possible in information and communication technology. But the most unexpected advances may come from less glamorous corners, such as material science.

Materials are the core of our production. The terms Bronze and Iron Ages signify their importance; the great era of technological progress between 1870 and 1914 was wholly dependent on cheap and ever-better steel. But what is happening to materials now is a leap far beyond any of the past, with new resins, ceramics and entirely new solids designed in silico, (that is, on a computer) developed at the nanotechnological level. These promise materials that nature never dreamed of and that deliver custom-ordered properties in hardness, resilience, elasticity and so on.

One example is graphene, a sheet of very thin carbon whose molecules can be arranged to make it either the strongest or the most flexible material on earth. It conducts electricity and heat better than any material ever discovered. In the future graphene is likely to replace silicon in transistors, solar cells and other applications we cannot yet imagine.

Genetic modification is another area of expanding frontiers. Plants will be designed to fix nitrates in the soil or to absorb more carbon dioxide from the atmosphere and that can adapt to more extreme temperatures and rainfall. These could be our best defense against environmental degradation, climate change and other nasty side effects of earlier, cruder agricultural techniques. "Nanobombs" that physically penetrate bacterial membranes are the next weapon in mankind's never-ending war on microbes.

The breakthroughs are not "on the horizon." They are here. The economy may be facing some headwinds, but the technological tailwind is more like a tornado. Fasten your seat belts.

So: If everything is so good, why is everything so bad? Why the gloominess of so many of my colleagues? Part of the story is that economists are trained to look at aggregate statistics like GDP per capita and measure for things like "factor productivity." These measures were designed for a steel-and-wheat economy, not one in which information and data are the most dynamic sectors. They mismeasure the contributions of innovation to the economy.

Many new goods and services are expensive to design, but once they work, they can be copied at very low or zero cost. That means they tend to contribute little to measured output even if their impact on consumer welfare is very large. Economic assessment based on aggregates such as gross domestic product will become increasingly misleading, as innovation accelerates. Dealing with altogether new goods and services was not what these numbers were designed for, despite heroic efforts by Bureau of Labor Statistics statisticians.

The aggregate statistics miss most of what is interesting. Here is one example: If telecommuting or driverless cars were to cut the average time Americans spend commuting in half, it would not show up in the national income accounts—but it would make millions of Americans substantially better off. Technology is not our enemy. It is

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our best hope. If you think rapid technological change is undesirable, try secular stagnation.

Mr. Mokyr is professor of economics and history at Northwestern University. His most recent book is "The Enlightened Economy: An Economic History of Britain 1700-1850" (Yale, 2012)."

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Wellbethere Cruise

mostly material have been developed by many organizations except water and tree. water by mean i know is the subject which go around, go through and go further under the ambient temperature, gravity force, etc. tree by mean i know is the subject which doing bridge for water connect weather and ground. i do not know what the irrigation is. i also do not know what the tree farm is. i do not know how deeply they relate each other. King Bhumibol and Queen Sirikit are fostering stages together.

Aug 13, 2014



CJ Sousa

I don't buy the argument that GDP is somehow "missing" innovation.

The truth is that any and every "new" product is an "innovation" in and of itself. The automobile, for instance, was an innovation that replaced the horse-drawn carriage. Did GDP "miss" the effects of the change to autos?

Innovation is, or should be, an everyday endeavor.

The real GDP "problem" in America is that innovation has never come from management, but rather from the front-line employees, rebels and dreamers who management types are always trying to keep out of the executive wash room.

America is drowning in an ocean of college-educated prima donnas. The dismal results speak for themselves.

Aug 13, 2014



JAY ROBBINS

[@CJ Sousa](#) respectfully, and just my interpretation of the article, in answering your question, "Did GDP 'miss' the effects of the change to auto's": the answer is no, it did not miss it because each auto had to be built for significant cost and purchased by consumers. While the production line helped to reduce costs of building auto's, they were still costly. The difference between your example of auto's and technology today, quoting from the article, "Many new goods and services are expensive to design, but once they work, they can be copied at very low or zero cost." It is also my opinion that too many college-educated people are not a problem for America. Education is the key to the future. Assembly lines and some manufacturing activities can be done cheaper in developing nations. The U.S. should focus on 1) providing education to those who are ambitious and 2) a free market where good ideas and hard work can prevail without too much regulation or government oversight.

Aug 15, 2014



Richard Tauchar

[@JAY ROBBINS](#)

Hi Jay, you responded to my comment "Isn't it intuitively clear that things are going to get worse in America, given the maker/taker prospects?" I received an email with your reply, but do not see it below, so I will respond here. You asked whether I was referring to capitalism. No, actually I was referring to the demographic trend of having fewer and fewer contributors to economic growth, and more and more people who are a drain on the economy. At some point we will reach an unsustainable threshold, unless the course can somehow be reversed. But for reasons mentioned in my prior comment, I'm not sure that will happen.

Aug 15, 2014



JAY ROBBINS

[@Richard Tauchar](#)

Thank you for clarifying, it was my mistake.

And I agree with the remainder of your reply. Too many people in the cart, not enough pulling.

Aug 15, 2014



oliver carmichael

[@Lee Zehrer](#) - My argument is not that God exists. My argument is that the America was founded on the notion that God exists and that we "the are endowed by our Creator with certain unalienable rights". There are countless references to "God", "Lord", "Providence" in our founding documents. And, if God exists and grants us unalienable rights, then each of us has the God given right to the fruits of

their labor and their fruits of their creativity. Dictators, Socialists, and Tyrants covet what others create. At America's founding that was considered so wrong that it led to rebellion and the founding of a new nation under.....

Aug 12, 2014

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