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# The Growth Paradox

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If our technology is so smart, why aren't we all getting richer?

By Paul Starr

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Americans are seeing no gains in their standard of living. The problem is not that new technologies are so expensive that they are available only to large organizations and the rich. On the contrary, they have become so cheap that they are pervasive and now enable ordinary people and the smallest of enterprises to do things that were once the stuff of science fiction. As a result, a yawning disparity has opened up between the subjective experience of innovation and the objective measures of its economic impact. Subjectively, the technological revolution of our time seems far bigger and more consequential than the economic data indicate.

This disparity between the sense of change and the measured impact of change also shows up in sharply differing long-term economic forecasts. Some economists, extrapolating from recent data and skeptical about the payoff of new technologies, believe that we need to dial down our expectations of economic growth. Other analysts, skeptical about the data and convinced of the promise of innovation, believe that the big economic gains from the digital revolution are still to come.

The controversy over inequality triggered by Thomas Piketty's *Capital in the Twenty-First Century* is directly related to this disagreement about growth. When the rate of growth is lower than the rate of return (after taxes and consumption), Piketty argues, capital inexorably gains an increased share of national income—and that is where he says we are headed. In his view, the high growth and relatively low inequality in the technologically advanced economies during the three decades after World War II were a historical anomaly. Since the 1970s, the advanced economies, instead of growing 3 or 4 percent a year, have reverted to an earlier and more sluggish pattern that, in Piketty's view, is a more realistic basis for

forecasts. The "return to a historic regime of low growth" implies "the return of capital." As he puts it, somewhat overstating his own position, "In stagnant societies, wealth accumulated in the past naturally takes on considerable importance."

In fact, rather than stagnation, Piketty assumes that output per capita in the advanced societies will grow at 1.2 percent a year, which is still far greater than in the centuries preceding the industrial revolution. A more dismal forecast comes from Robert Gordon, an influential economist at Northwestern University, who in two papers published by the National Bureau of Economic Research projects a long-term growth rate for the United States of less than 1 percent. Gordon suggests that it is not just the exceptionally high growth in the mid-twentieth century that may prove anomalous: "the rapid progress made over the past 250 years could well turn out to be a unique episode in human history."

Gordon's pessimism is extreme. Now in his seventies, he has been disparaging the economic gains from new technology for years, and he sees no evidence to change his views. In one of the more remarkable claims ever made in the social sciences, he declares that "future advances in medicine related to the genome have already proved to be disappointing." *The future has already been a disappointment*: in a nutshell that sums up a strain of disillusionment in contemporary thought with what many regard as the unfulfilled promise of technology to make us all more prosperous. But that promise still has its believers, and they have a case.

BOOKS BY BUSINESS SCHOOL PROFESSORS can usually be counted on to give a cheerful view of technological innovation, and Erik Brynjolfsson and Andrew McAfee's book mostly conforms to that

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THE DIGITAL REVOLUTION HAS TRANSFORMED our way of life, but according to official statistics, economic growth in the United States has lagged behind earlier periods and the vast majority of



stereotype until it turns in its later chapters to the uncomfortable fact of rising inequality. Brynjolfsson is a professor at the MIT Sloan School of Management, and McAfee is associate director of Sloan's Center for Digital Business. Just by its title, *The Second Machine Age* draws an analogy to the industrial revolution which implicitly suggests that the digital revolution will be comparable in its effects on long-run economic growth. The book's subtitle, *Work, Progress, and Prosperity in a Time of Brilliant Technologies*, makes that general optimism explicit.

Yet it is not an easy case to make, because the technological advances of recent decades have not yet resulted in sustained gains in economic productivity. In 1987, Robert Solow famously remarked that "we see the computer age everywhere except in the productivity statistics." (Solow is the founder of modern growth accounting, the method for estimating the various factors in economic growth, including capital and labor, which are estimated directly, and a residual commonly regarded as a measure of productivity.) Beginning in 1995, productivity growth did accelerate significantly—indeed, it especially accelerated in the service industries, historically the least progressive sector of the economy—but the gains trailed off after 2004.

The case for resumed growth made by Brynjolfsson and McAfee begins with claims about the nature and the rate of technological change. Digital innovation is comparable to the advent of steam power and electrification because all three are examples of general-purpose technologies, that is, technologies with broad application across an economy. Moreover, Moore's law, the doubling of integrated circuit computing power roughly every eighteen months, has counterparts in other elements of computational technology: "many of the critical building blocks of computing—microchip density, processing speed, storage capacity, energy efficiency, download speed, and so on—have been improving at exponential rates for a long time."

Thanks to this continuous doubling, Brynjolfsson and McAfee argue, we are now reaching a point of "inflection," where dramatic new capacities are in reach. As an example, they cite the increasing

ability to do "simultaneous localization and mapping" (SLAM), the real-time mapping of objects in changing environments that is required for such innovations as self-driving vehicles. In 2004, in *The New Division of Labor*, the economists Frank Levy and Richard Murnane cited driving in traffic as an example of a task that computers could not perform because it requires pattern recognition—but now Google's self-driving car has disproved that assumption. As a result, organizations are likely to find even wider use than previously expected for robotic devices, raising productivity and displacing whole categories of workers from whose standpoint SLAM may turn out to be a peculiarly apt acronym.

A closely related aspect of contemporary technological change is the proliferation of low-cost sensors and the resulting growth of machine-to-machine communication, allowing devices to interact with each other and respond to new conditions without human intervention. And with the digitization of "just about everything" come streams of data making possible a ubiquitous "Internet of things" and providing the necessary information for continuing improvement and new discoveries about complex processes.

The spectacular decline in the cost of computational power and communications opens up innovation more widely.

posted its data on one such public clearinghouse, Innocentive, where a retired radio-frequency engineer in New Hampshire with no background in astrophysics proposed the winning solution. The development of technologies such as 3-D printing should continue the trend toward lower capital costs and reduced barriers to economic creativity. Crowdfunding platforms such as Indiegogo and Kickstarter also provide inexpensive ways of raising start-up capital.

SO WHY DON'T WE SEE THE RESULTS in the productivity data? According to Brynjolfsson and McAfee, the answer has two parts: institutional lag and statistical mismeasurement.

The lag stems from the time it takes to reshape institutions in line with new possibilities. General-purpose technologies need "complementary innovations" involving the design of organizations and countless other changes in both material structures and social relations. Here Brynjolfsson and McAfee draw on work by the economic historian Paul David and others on the delay during the late nineteenth and early twentieth century in realizing the benefits of electrification. It took decades for industrialists to redesign factories that had been set up for the use of steam power. Today the mere use of computers is not enough; organizations have to redesign their internal processes as well

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Much of the creative work in today's economy takes place in distributed networks of small firms instead of being undertaken primarily in large industrial laboratories. As examples of a new form of "open innovation," Brynjolfsson and McAfee point to online clearinghouses for science challenges. Unable to solve a long-standing puzzle—how to predict solar-particle events—NASA

as connections to suppliers and consumers. According to Brynjolfsson's research, business investment in information technology is correlated with productivity gains, but businesses need to spend \$9 in software, retraining, and organizational process redesign for every \$1 in computer hardware, and it takes five to seven years for companies to see the gains.



Changing the basic routines of organizations is difficult. The inertial forces are often so great that businesses cannot adapt. Change then happens only when new organizations emerge to seize the opportunities that technology affords. Moreover, the digital revolution has been a continuing upheaval. Piecemeal changes adopted in the early stages of computerization have often stood in the way of more comprehensive enterprise-wide systems. But realizing the promise of the digital revolution requires systemic reorganization on a continuing basis.

The second part of Brynjolfsson and McAfee's explanation for disappointing measured growth is that the official statistics fail to capture the full gains being realized. "There's a huge layer of the economy unseen in the official data and, for that matter, unaccounted for on the

income statements and balance sheets of most companies." Music provides a readily understood example. From 2004 to 2008, sales of music on physical media dropped from 800 million units to 400 million units, and total revenue (including digital) dropped by 30 percent. But as Brynjolfsson and McAfee argue, it was price that fell, not value. The official data measure the size of the information sector by the total sales of "software, publishing, motion pictures, sound recording, broadcasting, telecommunications, and information and data processing services." During the past quarter of a century, those sales have continued to represent just 4 percent of the economy, but this is clearly understating the real value being created.

A peculiar aspect of information goods is that most of the cost of production

goes into the first copy. For digital products, the first copy represents nearly the entire cost, and partly as a result the price of some digital goods has not only fallen but disappeared. When people post freely available videos, photos, and other content, neither their labor nor most of the resulting goods and services are the subject of market transactions. As far as the measured economy is concerned, the rise of social media has been of negligible significance. User-generated content, Brynjolfsson and McAfee write, "involves unmeasured labor creating an unmeasured asset that is consumed in unmeasured ways to create unmeasured consumer surplus."

"Consumer surplus" refers to the additional value of goods that consumers receive above the price they pay. Any effort to estimate consumer surplus for free

goods is necessarily speculative, since it requires asking what people would pay if they had to. In research with Joo Hee Oh, Brynjolfsson made an estimate of the value created by the Internet on the assumption that, even for free goods, people give up something of value to them: their time. They must “pay” attention. On that basis, Brynjolfsson and Hee estimated that between 2000 and 2011 the Internet created about \$2,600 of value per user each year, which if it had been included in GDP would have raised annual productivity growth from 1.2 percent to 1.5 percent. Brynjolfsson and McAfee also cite other attempts to value free online services such as Google searches in an effort to show how much the official data are missing because of the peculiar properties of the digital economy.

The shift toward a post-industrial economy has also aggravated long-standing problems with economic data, such as the measurement of productivity in services. Medical care is a notorious case: when gains in productivity take the form of new and more effective treatment, they generally fail to show up in the productivity data. The digital revolution has yielded a spectacular increase in the number and the variety of goods and services available to consumers in both large retail stores and online marketplaces. Brynjolfsson and McAfee suggest adjusting economic data by imagining that a new product had always existed “but only at such a high price that no one could buy it. Making it available is like lowering the price to a more reasonable level.” If such adjustments were made to the official data, inflation would be lower and productivity growth would be higher. But changes of this kind would inevitably be controversial, in part because the measures themselves have real-world effects such as cost-of-living adjustments in Social Security benefits. The general problem is that some economic statistics that are useful for measuring short-term change become increasingly suspect over longer periods when the economy undergoes fundamental change.

In short, the disparity between the sense of change and the measured

impact of change may be partly, if not entirely, the result of statistical illusions. Arguing that “new metrics” are needed, Brynjolfsson and McAfee write that “if we are looking at the wrong gauges, we will make the wrong decisions.” And those errors in policy may begin with underestimates of gains from innovation.

GORDON IS UNIMPRESSED BY ARGUMENTS that unmeasured consumer surplus or other problems are obscuring real gains. The industrial revolution produced consumer surplus, he says, citing the disappearance of manure from the streets when automobiles replaced horses. But if streets cleared of manure go on one side of the ledger, industrial pollution must go on the other side, and it seems implausible that industry’s net environmental impact in that era made consumers better off. The case for consumer surplus substantially raising welfare in the digital age seems a lot stronger.

But Gordon’s analysis has more force in another respect, unrelated to technology. In the second of his two recent papers, he starts from a baseline of 2.0 percent growth in real GDP per capita (U.S. performance from 1891 to 2007) and

percent. None of this, Gordon emphasizes, requires an assumption that technological innovation will decline to a level lower than in the past forty years.

We could balance Gordon’s exercises in subtraction with Brynjolfsson and McAfee’s more optimistic exercises in addition and raise projected growth back up toward 2 percent. But Gordon’s forecast should serve as a provocation. Unless we change our policies in such areas as education, health care, and taxation, the bottom 99 percent will not see much improvement in living standards. For the great majority of Americans, the problem is that productivity growth, whatever its real level, is not translating into higher incomes. The gains from growth are going to the top—and on this point Brynjolfsson and McAfee have no disagreement with Gordon.

Just as they see the digital revolution as a powerful stimulus to growth, so Brynjolfsson and McAfee see it as the primary source of rising inequality. Curiously, they do not make much of their own analysis of unmeasured consumer surplus resulting from free online goods, which implies that economic inequalities are somewhat less than the

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subtracts what he expects to be the negative impact of a series of “headwinds”: demographic change (declining hours of work per capita), declining educational quality, inequality, and fiscal corrections. This “exercise in subtraction” leaves a long-term growth rate of 0.9 percent in output per capita and 0.2 percent in disposable income for the bottom 99

standard data on income and consumption indicate. They share the prevailing view that the primary effect of technology is to widen inequality. Technological change eliminates routine labor, whether physical or cognitive, and it increases demand for non-routine work typically requiring more education. It also creates winner-take-all markets, often on a

global basis, allowing those with exceptional talent (or luck) to obtain far greater rewards than in the past. "Superstars" thrive, while even the second-best lose out. And in line with Piketty's analysis, they count capital among the winners: the division of national income between capital and labor has shifted significantly toward capital in just the past decade.

Brynjolfsson and McAfee do not view technological innovation as correcting these disparities; in fact, such developments as SLAM and artificial intelligence are likely to threaten workers in an increased range of jobs previously thought to be safe from technological displacement. Although the historical record suggests that demand for new goods and services will be sufficiently elastic to make up for jobs lost as a result of innovation, no economic law guarantees employment for all willing workers at a wage sufficient to live on. In their concluding chapters, Brynjolfsson and McAfee do not offer a program to deal with inequality so much as a menu of options, including substantially more progressive taxes. Their openness to redistributive alternatives in a book primarily aimed at a business and tech audience testifies to the shift of elite opinion on inequality that is now taking place.

The question is ultimately what kind of society we are creating. If Gordon and Piketty are right and we are headed toward low growth and high inequality, the consequences are likely to be ugly for a wide range of human concerns. As Benjamin M. Friedman argued in *The Moral Consequences of Economic Growth*, growth brings out more tolerant and generous social and political impulses. We ought to heed Gordon's and Piketty's warnings by making the most of the possibilities that Brynjolfsson and McAfee highlight. The slow recovery from the financial crisis of 2008 has left us with a nagging anxiety that our economic problems have no answer. We will find a way forward only when we can put growth and equality back together. The next phases of the digital revolution have to be part of that solution. ●

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## [Things the realtor will not tell the new owner]

By Leslie Harrison

When she left she left so many ghosts the whole place is  
poisoned with them their stray sadnesses untraceable scents  
those cold holes in the very air so when you wake your throat  
choked with tears having dreamt some strange some other  
beloved you never knew and know is gone and this morning  
desperately miss don't panic please please rise instead into  
the groundmist walk out among her patient anchored trees  
her ghostbear is there but will offer no harm will pace hungry  
way and finally away there too the ghost coyotes who filled  
her nights with difficult with strange music you'll hear her  
ghostbirds the hawk as a tiny falling wind the owls of winter  
dying like prayers the morning flight of songbirds who carve  
her shape into the yard with their swerving whose young  
are born into the feel and smell of her hair rise and walk  
through all of it to the lake next door you'll find her spot  
on shore you'll let those borrowed those inherited tears  
join hers the ones she shed so long ago you'll let small fish  
rise to the drops salted and falling it will all feel familiar  
to them and like she's come home so go about your days  
in phantom pain as if your own life had been badly amputated  
then badly sewn back but when you weary of it slip  
into that room ease down on the bed the one she left  
and left and left again when you lie down you chose the other  
side you sleep in sleep your arm reaches to where her back  
once curved you pull her impossibly toward you and you  
nest you rest like that but wherever it is she is she and  
all her creatures sleep on uncomforted and alone