

The High-Tech Lever:

Examining Technology's Influence on the Economy

Highlights

1 Effects of technology

Technology is affecting people, businesses, and economies around the world. Those effects, sometimes unseen, are likely to influence investors in the coming years.

2 Mechanisms of influence

Technology pushes productivity by increasing the efficiency of capital allocation and creating new economically productive assets.

3 A broad influence

Technology is creating progress in decidedly non-tech industries and is a key for emerging market development.

4 Deflationary pressure

Lower prices and higher quality goods and services are a key effect of technological progress, and a factor in the global rise of the middle class.

5 Investment implications

Investors should look to U.S. companies, particularly those with strong domestic earnings, and niche sources of income in less efficient markets.

By Jim McCaughan, CEO, Principal Global Investors

The physical limitations of our strength, our endurance, and our finite life span have actually been a catalyst to the success of our species. Human beings have used their creativity and ingenuity to continually transcend those confines. Beginning with simple machines used to provide a mechanical advantage (e.g., the lever, the gear, the block-and-tackle pulley), humans were able to magnify their power and productivity. Archimedes, a Greek mathematician from the third century BC, was one of the first to understand the strength of mechanical advantage. Working with a simple lever (a movable bar attached to a fixed fulcrum), he mathematically proved the source of the lever's power. "Give me a place to stand and a lever long enough," Archimedes said, "and I will move the world."

In the modern era, humans have eclipsed mechanical advantage through the same creativity and ingenuity that provided that initial leap forward. This time, progress is in the form of a technological advantage: using technology to enhance human effort and to make work more productive. While the disciplines of mathematics and physics help us measure and explain mechanical advantage, technological advantage is harder to measure.

But it exists.

And its existence should lend us some optimism about the current state of the global economy and hopefulness about the possibilities for the future. In this paper, we will examine the problem of measuring the full impacts of technology on economic growth and productivity. We will explore a few ways that technology is affecting people, businesses, and economies around the world. And we will look at how those effects are likely to influence investors in the coming years.

Technology is like a lever made of silicon and semiconductors. It amplifies the efforts of human work, and as Archimedes suggested, it is moving the world.

› Technological change and the problem of measurement

For as long as technological advances have been a beneficial force for economic productivity and growth, they have also presented challenges for economists in judging their full impact. We examine two types of effects on economic growth and productivity: direct and indirect.

Direct effects are the easiest to identify and measure, areas where we have existing economic metrics to judge its influence. Gross domestic product (GDP) captures the value of goods and services produced in the economy. U.S. GDP reflected the sale of the new iPhone when it debuted in 2007. It also captured the data charges and accessories that sprang up with the new device. These are the direct effects, the easily measureable results that all economists are fluent in.

There are also indirect effects. They are harder to measure by current means, but still real. Some products and entire industries became obsolete or redundant when the iPhone appeared because the new technology combined so many new ideas into a single device. Indirect economic effects include the time, effort, and capital saved because the iPhone can replace dozens of other existing devices.

A technological advance like the iPhone is elegant because it solves so many drastically different challenges. Current economic measures, though, do not easily capture this elegance and efficiency. Intuitively, we know those indirect effects are there, though they do not reveal themselves to us fully until much time has passed and much effort has been expended.

This is not a new phenomenon. Major technological advances have typically puzzled economists intent on measuring their full effects. When the incandescent light bulb achieved widespread commercial viability, the direct effects were recognizable; stores sold light bulbs and lamps. The indirect effects were harder to see, but as reliability grew, the lever of technology began to exert its force. Electric light drove the creation of an electrical infrastructure and opened the floodgate of other electrical appliances. Building on gas lighting before it, electric light pushed factories to be safer and more productive. There were also economic benefits to the improved public health from reduced effects of carbon monoxide poisoning that had occurred with natural gas in indoor lighting.

Advancement can come at a cost though; what benefits the economy as a whole can often feel painful at the more granular level, with industries and careers falling by the wayside. That said, at the macro level, economies are creating new jobs every day. Search engine optimization specialists, sustainability managers, and data scientists are all jobs that did not exist even 10 years ago. These are the effects of technological advantage, but seeing them and measuring them at the time would have been difficult.

It is similar today. While we may not be able to see the thing itself in the moment, we can at least begin to recognize it by its shadows.

› Technology, capital allocation, and deflationary pressure

Transforming the cost of doing business

The allocation of capital, whether by businesses or individuals, is a primary concern of economists. In a healthy, well-functioning economy, capital finds its way to those goods and services where it will produce the most favorable return by providing the most utility, or usefulness. Technology can help increase the efficiency of capital allocation and accelerate the pace of that efficiency.

This can happen through a number of channels. Firstly, technology can transform the “cost of doing business” into, essentially, unnecessary overhead. You can see this in the retail banking industry, where branch banking has begun to give way to app-based banking and movement is toward more capital efficiency in this regulated industry. A customer with a well-designed smartphone app can perform almost all the tasks a branch bank used to fulfill. The technology of the smartphone has created a literal one-stop shop that is easy and efficient for the customer, and cheap and scalable for the bank.

Fewer branches mean less lease expense. More scalability means serving more customers with less cost. Banks can reallocate the previous expenses incurred with branch banking to more productive uses over time. Technology-driven solutions such as peer-to-peer lending and mobile wallets also force the retail banking industry to respond by simplifying how they interact with customers in a less capital-intensive manner.

Monetizing your stuff

Technology also boosts economic progress and productivity by turning economically unproductive belongings into revenue-generating assets. For most people, an automobile is merely a possession. However, with the advent of companies and platforms like Uber and Lyft, millions around the world are creating new revenue streams by turning their personal automobiles into income-producing assets. What had previously been just car payments and insurance premiums has now turned into income. Similarly, a company like Airbnb brings this concept to people's living spaces.

These types of technology-enhanced business models have gained legitimacy primarily because they provide utility. All of these companies meet an unfulfilled need from consumers, whether that is merely as a cheaper alternative to taxi services and traditional hotels or as a better experience than what these established industries can provide.

Future potential

There are now technologies in their nascent stages that could have a profound impact on capital allocation and economic forces in the future: driverless vehicles and 3D printing. Driverless vehicles, once thought to be impossible, are now roaming our streets in long-term testing. When set against the potential safety advances that autonomous vehicles could provide, as the technology proves itself, I continue to believe that the public could essentially demand its rapid adoption. Safe, on-demand automated transportation creates an interesting wrinkle in the case for private ownership, where a car sits idle for more than 90% of its lifetime. When that car could go assist someone else after dropping you off, its economic productivity skyrockets. Once that happens, there is a dramatic amount of capital that can be repurposed elsewhere in the economy.

The future economics of owning a car:

A fleet of just 9,000 driverless vehicles could replace all of the taxi cabs (around 13,500) and other for-hire vehicles (about 44,500)¹ in New York City, according to a study from Columbia University. The study found that passengers would wait an average of 36 seconds for a ride that cost \$0.50 per mile.² For comparison, the current average price per mile for a taxi ride is approximately \$5.15.³

To compare against personal ownership, auto researcher Kelley Blue Book puts the average cost of a new car or truck in the United States at \$33,560. That equates to a price per mile of \$3.57, assuming a useful life of about eight years with 15,000 miles per year. And this only uses the vehicle's price as an estimate of cost. Scaled up, the economics mean that the cost of buying a car to let it sit vacant for 90% of its life could become somewhat unexplainable, if not untenable.

New York City (one car equal to 1,000 cars)



¹New York City Taxi & Limousine Commission; 2014. "2014 Taxicab Factbook." http://www.nyc.gov/html/tlc/downloads/pdf/2014_taxicab_fact_book.pdf

²Lawrence D. Burns, William C. Jordan, and Bonnie A. Scarborough; January 2013. "Transforming Personal Mobility." The Earth Institute-Columbia University. <http://sustainablemobility.ei.columbia.edu/files/2012/12/Transforming-Personal-Mobility-Jan-27-20132.pdf>. All figures shown are in U.S. dollars.

³2014 Taxicab Factbook. Calculated using the reported average yellow taxi fare of \$13.40 and the reported average trip distance of 2.6 miles.

The benefits of technology accrue not only to those economies that develop them. Indeed, with access to technology that is growing more affordable by the day, emerging markets may not have to track the painful step-by-step progress up the economic learning curve. Merely by virtue of adopting and using existing technology, they can stand on the shoulders of giants.

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Future potential (continued)

Another emerging technology with the power to transform several industries is three-dimensional (3D) printing. This process builds objects by building up layer upon layer of materials like plastic, metal, or ceramics. The most obvious impact of 3D printing would be on the manufacturing industry. Because 3D printers are generalists and can produce almost anything, a manufacturer could essentially have small 3D printing facilities located in more locations around the world, producing items for the immediate vicinity. A decentralized, on-demand manufacturing sector could mean more efficient manufacturing processes, decreased production times and shipping costs, and even reduced greenhouse gas emissions. Economically, this would all work to drive the prices of manufactured goods down further than they have already been pushed, allowing a great deal of capital to be redeployed.



Technology in non-tech industries

Technological advantage is not a concept exclusive to just electronics or computer companies. Long before any sort of modern technology, farmers had been engaged in selective breeding to develop and refine beneficial traits in crops and livestock. Progress continues today; agriculture has seen huge increases in production, decreases in water and fertilizer use, and more efficient land use. This is supported by technological change including improved plant varieties, better irrigation methods, and mobile technology. A decade or two ago, many expected worldwide food shortages by 2016. Instead, rising production has created a global surplus of food. There are still those who predict catastrophe, for example grain shortages, resulting from an increasing appetite for meat in emerging countries. But on balance, it seems likely that human ingenuity and innovation will allow supply to keep up with demand. Malthus, with his suggestion that population growth will exceed the growth of the food supply, will likely be wrong again.

Elsewhere, social technologies could raise the productivity of high-skill knowledge workers by 20 to 25 percent, according to McKinsey & Company, a global management consultancy.⁴ McKinsey tags this additional value at US\$900 billion to US\$1.3 trillion, and attributes this to enhanced “collaboration and communication within and across enterprises.”

Technology and emerging markets

With the volatility and pessimism currently associated with emerging markets, it feels important to discuss the potential for emerging markets to leverage technology as they progress their economies. The benefits of technology accrue not only to those economies that develop them. Indeed, with access to technology that is growing more affordable by the day, emerging markets may not have to track the painful step-by-step progress up the economic learning curve. Merely by virtue of adopting and using existing technology, they can stand on the shoulders of giants.

For example, in India, the expense associated with mobile phones is so minimal that fishermen can call multiple harbors from the water to find the best place to sell their catch. India did not have to invent the mobile phone for this to happen. This brings economic power to an area where it would be absent without technology. Similarly, in Africa, where traditional retail banking is hampered by a lack of infrastructure, mobile phones are rapidly becoming the go-to mode of accessing financial services. According to the World Bank, the percentage of adults with accounts grew by 20% between 2011 and 2014. “In particular,” the report states, “mobile money accounts in Sub-Saharan Africa are helping rapidly expand and scale up access to financial services.”⁵ Easy access to capital is another primary force in economic progress.

One might even say that emerging economies must use technology to leapfrog their way up the economic learning curve. In the long run, economies powered by

low-cost labor or non-renewable commodities, as many emerging markets are, can be unsustainable. There is also a massive potential in improving and expanding education in developing economies through the use of technology. In fact, technology-enhanced productivity and education could become an imperative to remain competitive in the global economy.

Economic implications

Deflationary pressures

Technologically driven advances in utility and convenience, combined with the reduction of input and production costs, essentially act as a deflationary factor around the world. For the last three-quarters of a century, the cost of manufactured goods has plummeted and their quality has skyrocketed. Look no further than the automobile for proof. Henry Ford’s original Model T cost around \$850 in 1908. Adjusted for inflation, a Model T would cost around \$21,000 in 2016. That amount of money today buys features, performance, and safety that were unimaginable at the beginning of the twentieth century.

High-quality manufactured goods inundate the world and I believe that, unlike the second half of the twentieth century, the world is entering a period where there is a structural excess supply of both manufactured goods and commodities. As we see in the example above, even when adjusted for inflation, manufactured goods have not sustained their pricing power over time.

The overlap of technological progress and the rise of the middle class is significant, and not coincidental. Over the years, technology has ground down the costs associated with a middle class standard of living, making the middle class more accessible for more people around the world. This has been a trend for decades, and with just the innovation that is currently on the horizon, looks to be one that will continue for some time.

⁴Michael Chui, James Manyika, Jacques Bughin, Richard Dobbs, Charles Roxburgh, Hugo Sarrazin, Geoffrey Sands and Magdalena Westergren; July 2012. “The Social Economy: Unlocking value and productivity through social technologies.” The McKinsey Global Institute. <http://www.mckinsey.com/industries/high-tech/our-insights/the-social-economy>

⁵The World Bank, 15 April 2015. “Massive Drop in Number of Unbanked.” <http://www.worldbank.org/en/news/press-release/2015/04/15/massive-drop-in-number-of-unbanked-says-new-report>

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Economic implications (continued)

It is interesting, then, to compare this with classic deflation, which is often thought of as a bad thing. At its worst, deflation leads to economic stagnation and high unemployment because the expectation for lower prices in the future causes consumers to postpone present purchases, thereby slowing economic activity. But a different dynamic appears to be in place now.

People regularly replace their cars and mobile phones, even though they know the products will be better and cheaper in future. This could hint at an emotional component to the purchasing decision, because improvements in features and product performance encourage people to upgrade in spite of price expectations. It could also point to the effects of this growing middle class, with ever-larger pools of consumers able to purchase these goods that overwhelm the effects of wait-and-see deflation.

At the beginning of this paper, I suggested that there are direct and indirect effects of technology on economies. I propose that this deflationary pressure is one of those difficult-to-quantify indirect effects. To explain, I look

at the very intense focus placed on real gross domestic product (real GDP); that is, GDP adjusted for the effects of inflation. Real GDP has become a prime metric in comparing the relative successes of different economies. Accuracy in calculating real GDP depends on two things: relative prices and an accurate measurement of the GDP deflator, a measure of price inflation. As opposed to other measures of inflation like the consumer price index (CPI), the GDP deflator is not built upon a fixed basket of goods and services. It changes based on patterns of consumption and investment. This process appears more unreliable in this time of rapid technological change and a tendency toward deflation, and I would suggest that it may have become somewhat undependable.

This could be one of the reasons for the disappointing apparent growth rates in developed countries since the recession of 2008 and 2009. Said another way, perhaps 2% growth in a time of improving quality in goods and services may be a good situation for consumers in the long run. This may also explain why U.S. employment has risen faster than might have been expected given the real GDP we saw since the recession. Instead of the continued, intense focus on real GDP, perhaps it is time for more analysis of nominal GDP.

Implications for investors

These forces seem to indicate that interest rates and bond yields will stay lower for longer than most commentators think. Besides technology's deflationary influence, other factors like demographics are exerting force to keep rates down. In the high-inflation decades of the late twentieth century, baby boomers around the world were in their highest earning and consumption period. Now they have begun to turn those accumulated assets into income.

This also points toward a period of relatively low inflation and interest rates. With that in mind, today's conditions may reflect the rule, rather than the exception that many market participants have grown used to over the last few decades. When looking at interest rates from an extremely long-term perspective, the high-interest rate environment of the 1970s, 80s, and 90s might prove to be an anomaly. And it may be that a majority of investment professionals around the world have worked almost their entire careers under an extended, but temporary, spell of high interest rates. Asset managers, insurers, annuity providers, investors, and other long-term savers might do well to recognize and adjust to this new "lower-for-longer" regime, rather than wistfully remembering previous decades and hoping the days of higher rates return to save them.

Significantly, I see equities becoming more of a stock-picker's market. Growth becomes far more valuable to investors in the absence of high interest rates, and hence, a high discount rate. In addition, deflationary pressures will tend to choke off weak business models quite rapidly. To me, this environment would favor active management, and suggests that the ability to identify companies and business models that are susceptible to industry disruption and deflationary obsolescence will be a key skill. If these themes take hold and build, there is an even bigger implication: at some stage, this

trend could stem the proportion of assets invested on a passive basis.

I continue to believe that the United States should remain a primary destination for capital in the near future. Its economy is the once and future paradigm of technology-inspired productivity gains. Global growth is slowing, and that will affect the United States; however, the U.S. economy produces goods and services that the world wants, and that are not particularly price sensitive (e.g., airplanes, pharmaceuticals, technology). That said, looking at U.S. companies with strong domestic earnings could be good strategy until global growth normalizes.

With so many investors around the world focused on income, any investment that offers a premium on income measures, especially if not efficiently priced, seems worth pursuing. This will be more prevalent in niche markets, which are structurally and informationally less efficient; hence, they are more attractive for active managers. Here, I am thinking of real estate, commercial mortgage-backed securities, municipal bonds, or emerging market debt. In many sectors, though, bouts of short-term volatility could deliver some turbulence, so I caution investors to keep their focus on the long term.

Inventors and investors

Technology is the physical form of human creativity. It is how we have transcended our own limitations. Technology has played a progressive role across the entirety of economic thought. Inventors and scientists have undoubtedly been at the forefront of advancing economic growth. And investors share a common attribute with inventors: a focus on the future. Inventing necessitates a leap into the unknown, a leap that entails risk. Investors make that same leap, and take a similar risk.

My intention with this conversation is not to propose that technology is the magic potion that will solve all of the world's problems. Rather, I hope to counteract much of the economic pessimism that is all too prevalent among pundits and market participants these days. When put into financial and monetary terms, it is usually a poor proposition to bet against human ingenuity. By attempting to understand the positive influence that technology brings to the market, whether we can fully measure that influence or not, we can begin to uncover the optimism that underlies our present and better understand our future.

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