THE LONG AND SHORT OF
The Digital

Revolution

Smart policies can alleviate the short-term pain of technological disruption and pave the way for long-term gain

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Digital platforms are recasting the relationships between customers, workers, and employers as the silicon chip's reach permeates almost everything we do—from buying groceries online to finding a partner on a dating website. As computing power improves dramatically and more and more people around the world participate in the digital economy, we should think carefully about how to devise policies that will allow us to fully exploit the digital revolution's benefits while minimizing job dislocation.

This digital transformation results from what economists who study scientific progress and technical change call a general-purpose technology—that is, one that has the power to continually transform itself, progressively branching out and boosting productivity across all sectors and industries. Such transformations are rare. Only three previous technologies earned this distinction: the steam engine, the electricity generator, and the printing press. These changes bring enormous long-term benefits. The steam engine, originally designed to pump water out of mines, gave rise to railroads and industry through the application of mechanical power. Benefits accrued as farmers and merchants delivered their goods from the interior of a country to the coasts, facilitating trade.

Adopt—but also adapt

By their very nature, general-purpose technological revolutions are also highly disruptive. The Luddites of the early 19th century resisted and tried to destroy machines that rendered their weaving skills obsolete, even though the machines ushered in new skills and jobs. Such disruption occurs precisely because the new technology is so flexible and pervasive. Consequently, many benefits come not simply from *adopting* the technology, but from *adapting to* the technology. The advent of electricity generation enabled power to be delivered precisely when and where needed, vastly improving manufacturing efficiency and paving the way for the modern production line. In the same vein, Uber is a taxi company using digital technology to deliver a better service.

An important component of a disruptive technology is that it must first be widely adopted before society adapts to it. Electricity delivery depended on generators. The current technological revolution depends on computers, the technical backbone of the Internet, search engines, and digital platforms. Because of the lags involved in adapting to new processes, such as replacing traditional printing with online publishing, it takes time before output growth accelerates. In the early stages of such revolutions, more and more resources are devoted to innovation and reorganization whose benefits are realized only much later.

For example, while James Watt marketed a relatively efficient engine in 1774, it took until 1812 for the first commercially successful steam locomotive to appear. And it wasn't until the 1830s that British output per capita clearly accelerated. Perhaps it is no wonder that the digital revolution doesn't show up in the productivity statistics quite yet—after all, the personal computer emerged only about 40 years ago.

But make no mistake—the digital revolution is well under way. In addition to transforming jobs and skills, it is also overhauling industries such as retailing and publishing and perhaps—in the not-too-distant future—trucking and banking. In the United Kingdom, Internet transactions already account for almost one-fifth of retail sales, excluding gasoline, up from just one-twentieth in 2008. And e-commerce sites are applying their data skills to finance. The Chinese e-commerce giant Alibaba already owns a bank and is using knowledge about its customers to provide small-scale loans to Chinese consumers. Amazon.com, the American e-commerce site, is moving in the same direction.

Meanwhile, anonymous cryptocurrencies such as Bitcoin are posing challenges to efforts to combat money laundering and other illicit activities. But what makes these assets appealing also makes them potentially dangerous. Cryptocurrencies can be used to trade in illegal drugs, firearms, hacking tools, and toxic chemicals. On the other hand, the underlying technology behind these currencies (blockchain) will likely revolutionize finance by making transactions faster and more secure, while better information on potential clients can improve the pricing of loans through better assessment of the likelihood of repayment. Regulatory frameworks need to ensure financial integrity and protect consumers while still supporting efficiency and innovation.

Looking forward, we may see even more disruption from breakthroughs in quantum computing, which would facilitate calculations that are beyond the capabilities of traditional computers. While enabling exciting new products, these computers could undo even some new technologies. For example, they could render current standards in cryptology obsolete,

potentially affecting communication and privacy on a global level. And this is just one aspect of threats to cyber security, an issue that is becoming increasingly important, given that almost all essential public services and private information are now online.

Accelerated pace

Digitalization will also transform people's jobs. The jobs of up to one-third of the US workforce, or about 50 million people, could be transformed by 2020, according to a report published last year by the McKinsey Global Institute. The study also estimates that about half of all paid activities could be automated using existing robotics and artificial and machine learning technologies. For example, computers are learning not just to drive taxis but also to check for signs of cancer, a task currently performed by relatively well-paid radiologists. While views vary, it is clear that there will be major potential job losses and transformations across all sectors and salary levels, including groups previously considered safe from automation.

As the McKinsey study underscores, after a slow start, the pace of transformation continues to accelerate. The ubiquitous smartphone was inconceivable to the average person at the turn of the 21st century. Now, more than 4 billion people have access to handheld devices that possess more computing power than the US National Aeronautics and Space Administration used to send two people to the moon. And yet these tiny supercomputers are often used only as humble telephones, leaving vast computing resources idle.

One thing is certain: there's no turning back now. Digital technology will spread further, and efforts to ignore it or legislate against it will likely fail. The question is "not whether you are 'for' or 'against' artificial intelligence—that's like asking our ancestors if they were for or against fire," said Max Tegmark, a professor at the Massachusetts Institute of Technology in a recent *Washington Post* interview. But economic disruption and uncertainty can fuel social anxiety about the future, with political consequences. Current fears about job automation parallel John Maynard Keynes's worries in 1930 about increasing technological unemployment. We know, of course, that humanity eventually adapted to using steam power and electricity, and chances are we will do so again with the digital revolution.

The answer lies not in denial but in devising smart policies that maximize the benefits of the new technology while minimizing the inevitable short-term disruptions. The key is to focus on policies that respond to the organizational changes driven by the digital revolution. Electrification of US industry in the early 20th century benefited from a flexible educational system that gave people entering the labor force the skills needed to switch from farm work as well as training opportunities for existing workers to develop new skills. In the same way, education and training should give today's workers the wherewithal to thrive in a new economy in which repetitive cognitive tasks—from driving a truck to analyzing a medical scan—are replaced by new skills such as web engineering and protecting cyber security. More generally, future jobs will probably emphasize human empathy and originality: the professionals deemed least likely to become obsolete include nursery school teachers, clergy, and artists.

One clear difference between the digital revolution and the steam and electricity revolutions is the speed at which the technology is being diffused across countries. While Germany and the United Kingdom followed the US take-up of electricity relatively quickly, the pace of diffusion across the globe was relatively slow. In 1920, the United States was still producing half of the world's electricity. By contrast, the workhorses of the digital revolution—computers, the Internet, and artificial intelligence backed by electrical power and big data—are widely available. Indeed, it is striking that less-developed countries are leading technology in many areas, such as mobile payments (Kenya), digital land registration (India), and e-commerce (China). These countries facilitated the quick adoption of new technologies because, unlike many advanced economies, they weren't bogged down in preexisting or antiquated infrastructure. This means tremendous opportunities for trial and error to find better policies, but also the risk of a competitive race to the bottom across countries.

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While the digital revolution is global, the pace of adaptation and policy reactions will—rightly or wrongly—be largely national or regional, reflecting different economic structures and social preferences.

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The revolution will clearly affect economies that are financial hubs, such as Singapore and Hong Kong SAR, differently than, for example, specialized oil producers such as Kuwait, Qatar, and Saudi Arabia. Equally, the response to automated production technologies will reflect possibly different societal views on employment protection. Where preferences diverge, international cooperation will likely involve swapping experiences of which policies work best. Similar considerations apply to the policy response to rising inequality, which will probably continue to accompany the gradual discovery of the best way to organize firms around the new technology. Inequality rises with the widening of the gap in efficiency and market value between firms with new business models and those that have not reorganized. These gaps close only once old processes have been largely replaced.

Education and competition policy will also need to be adapted. Schools and universities should provide coming generations with the skills they need to work in the emerging economy. But societies also will need to put a premium on retraining workers whose skills have been degraded. Similarly, the reorganization of production puts new strains on competition policy to ensure that new techniques do not become the province of a few firms that come first in a winner-take-all lottery. In a sign that this is what is already happening, Oxfam International recently reported that eight individuals held more assets than the poorest 3.6 billion combined.

The railroad monopolies of the 19th century required trust busting. But competition policy is more difficult when future competitors are less likely to emerge from large existing firms than from small companies with innovative approaches that have the capacity for rapid growth. How can we ensure that the next Google or Facebook is not gobbled up by established firms?

Avoiding a race to the bottom

Given the global reach of digital technology, and the risk of a race to the bottom, there is a need for policy cooperation similar to that of global financial markets and sea and air traffic. In the digital arena, such cooperation could include regulating the treatment of personal data, which is hard to oversee in a country-specific way, given the international nature of the Internet, as well as intangible assets, whose somewhat amorphous nature and location can complicate the taxation of digital companies. And financial supervisory systems geared toward monitoring transactions between financial institutions will have trouble dealing with the growth of peer-to-peer payments, including when it comes to preventing the funding of crime.

The importance of cooperation also implies a role for global international organizations such as the World Bank and the International Monetary Fund. These institutions, with their broad membership, can provide a forum for addressing the challenges posed by the digital revolution, suggest effective policy solutions, and outline policy guidelines. To be successful, policymakers will need to respond nimbly to changing circumstances, integrate experiences across countries and issues, and tailor advice effectively to countries' needs.

The digital revolution should be accepted and improved rather than ignored and repressed. The history of earlier general-purpose technologies demonstrates that even with short-term dislocations, reorganizing the economy around revolutionary technologies generates huge long-term benefits. This does not negate a role for public policies. On the contrary, it is precisely at times of great technological change that sensible policies are needed. The factories created by the age of steam also ushered in regulations on hours of work, juvenile labor, and factory conditions.

Similarly, the gig economy is causing a reconsideration of rules: for example, what does it mean to be self-employed in the age of Uber? To minimize disruptions and maximize benefits, we should adapt policies on digital data and international taxation, labor policies and inequality, and education and competition to emerging realities. With good policies and a willingness to cooperate across borders, we can and should harness these exciting technologies to improve well-being without diminishing the energy and enthusiasm of the digital age. FD

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