

The Potential Economic Impact of Technologies - A Study

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ABSTRACT

The increasingly notable presence of technology in our world, the ability to fully measure its impact remains limited, the effects of new technologies as they rapidly change our work routines, the way to spend our leisure time, or the products and services often or increasingly use for free. The pace and direction of technological progress increasingly determines who gets hired, how the children are educated, how to find information and entertainment, and how to interact with the physical world. This puts the onus on society to find the most meaningful measures of the value derived from new technologies so that we can truly understand and control what is happening to our economies and our lives. It experience the benefits of new technologies in profound ways when they save or extend our lives or those of our loved ones. But existing economic statistics such as GDP struggle to fully account for this value, which is often realized as consumer surplus and can take decades to show up in the numbers. Better approaches are needed to measure the full economic impact of technologies, both to evaluate their potential and to set an appropriate course.

Key Words: economy, global business, new technologies, mass media,.etc

Introduction:

The power of new technologies is everywhere. They change how businesses make money and how we live and work, sometimes with amazing speed. Social media was practically unknown a decade ago, yet almost one billion people now have Facebook accounts; in fact, entirely new ways of socializing and interacting with friends, family, and colleagues have become the norm.¹ Around the world, hundreds of millions of people have been lifted out of poverty as developing nations have adopted the technologies that drove growth in advanced economies in earlier times. Today, technologies such as the mobile Internet are helping to accelerate economic development, allowing millions of people in remote areas of developing regions to leapfrog into the 21st-century global economy.

Technology's power is particularly transformative in business. Technology can create immense value, but it often does so through a highly

disruptive process. In the past, technological change has reordered industry after industry. Profit pools have shifted between owners of capital, labor, and consumers. Incumbent businesses have lost out, and startups have become dominant players. Whole product lines have been relegated to niches or forgotten altogether.

How Technology Drives Growth

Since the start of the Industrial Revolution more than 250 years ago, the global economy has been on a steep growth trajectory propelled by a series of advances in technology. From steam engines that replaced water mills to electricity, telephones, automobiles, airplanes, transistors, computers, and the Internet, each new wave of technology has brought about surges in productivity and economic growth, enabling efficient new methods for performing existing tasks and giving rise to entirely new types of businesses. Certain technologies, particularly general-purpose ones such as steam power or the Internet that can be applied across economies, have massive and disruptive effects. In this report we focus on the

potential impact of such economically disruptive technologies.

Technological progress is not the only force that drives transformative growth in economies; for example, US growth during the 1970s was driven by the entry of millions of women and baby boomers into the labor force. However, technological advances have been an especially valuable source of growth because they tend to be “non-rival” in nature, meaning they can be used over and over, benefiting different users and driving increasing returns. And unlike other sources of growth, such as increases in the labor force, the effects of technology do not go away.²

General-purpose technologies are particularly powerful. They are not only non-rival and long lasting, but their pervasiveness also makes them especially disruptive. The Internet is an excellent example. It introduced new ways of communicating and using information that enabled major innovations, imposing new rules from outside on all sorts of industries, rearranging value chains and enabling new forms of competition. In industry after industry, Internet-enabled innovations brought transparency to pricing, disrupted commercial relationships, created new customer expectations, and made old business models obsolete. Napster and iTunes all but eliminated record stores, online booking systems have made travel agents largely redundant, and Amazon has forever changed both bookselling and the book publishing industry as a whole.

General-purpose technologies also tend to shift value to consumers, at least in the long run. This is because new technologies eventually give all players an opportunity to raise productivity, driving increased competition that leads to lower prices. General-purpose technologies can also enable or spawn more technologies. For example, steam power enabled the locomotive and railroads, and the printing press accelerated learning and scientific discovery. General purpose technologies can take many forms including materials, media, and new sources of energy but they all share the ability to bring about transformative change. Three

general-purpose technologies that changed the world.

The development of steel-manufacturing technology enabled the spread of a new material that accelerated growth and innovation in the Industrial Revolution. Steel is a stronger, lighter, and more ductile material than iron, but it was not easily produced until Henry Bessemer developed a technological advance that blew air through molten iron to remove the impurities. The Bessemer process enabled rapid, inexpensive mass production of steel, which could be done with mostly unskilled labor.³ Steel was quickly adopted for tools and machinery and in construction, ship-building, trains, and later in automobiles. Steel became an engine of growth, helping double global GDP per capita between 1850 and 1900. Since then, steelmaking has been used repeatedly as an engine of growth for developing economies. The printing press, one of the first great information technologies, illustrates how a general-purpose technology can have unpredictable effects. First used as a way to make the bible accessible, the printing press almost immediately became the agent of seismic social disruption in Europe as the leaders of the Reformation adopted the technology to print the tracts and pamphlets that spread the movement at unprecedented speed. Next, printing presses helped spark the scientific revolution and the Enlightenment by disseminating research and discoveries across the continent. Indirect effects included accelerated city growth; between 1500 and 1600, cities with printing presses grew 60 percent faster than other cities.⁴ Some historians attribute Europe’s rapid growth and global influence and the eclipse of Islamic nations after the 15th century to printing’s rapid adoption in Europe and its slow adoption in Islamic economies.⁵ The story of the electric dynamo (the first type of electric motor) demonstrates that unleashing the full disruptive potential of new technology can be a long and difficult process. The electric dynamo represented a major improvement over existing steam and water-powered engines because manufacturing stages or workstations no longer had to be tied to central power shafts in each factory. This allowed

for improved factory organization and increased efficiency. However, as Stanford economist Paul David has noted, it took two decades (between 1900 and 1920) for this technology to reach 50 percent of factories in the United States and several more decades for the full impact to be seen in productivity numbers.⁶ This was because firms were heavily invested in the legacy technology of the day (steam) and adopting the dynamo required redesigning equipment and reconfiguring facilities. David argues that similar factors could explain the observed lag between adoption of IT systems and measurable productivity increases. Some economists today raise concerns that technology-driven growth could be slowing down. Economists Robert Gordon of Northwestern University and Tyler Cowen of George Mason University both cite slowing growth in productivity in advanced economies in recent years, arguing that technological advances such as the Internet may not have the same power to drive growth as prior generations of technology, such as those that occurred during the first and second Industrial Revolutions.⁷

Neither technology skeptics nor optimists can predict the future. Technologies and innovations are diffused and adopted at unpredictable rates. Wholly unanticipated applications may arise and become dominant, while the most obvious potential uses may not pan out. Moreover, when technologies are commercialized and widely used, the ways in which their impacts are measured can provide a distorted picture. Most metrics focus on industry impact the amount of GDP generated by the production and consumption of a new technology in sectors where there is clear and direct impact (for example, how many microchips are made and then sold in computers). This misses the economic surplus that accrues to users, which can be the largest pool of value from disruptive technologies (such as the Internet). It also ignores effects on third parties, like children afflicted with asthma as a result of poor air quality or fishermen whose livelihoods are affected by water pollution.

The debate over how to measure technology impact is ongoing. In the 1980s economist Robert

Solow caused a stir when he noted that despite the large investments that had been made in information technologies, there was no evidence of higher productivity in the service industries (e.g., banking) that had made the largest investments. GDP and other growth accounting metrics of IT impact do not fully account for improved quality of outputs through use of technology. Nor do they measure the surplus that users capture through improvements in quality and other benefits that new technologies provide. In fact, GDP doesn't directly measure any aspect of sustainability whether in terms of environment, debt levels, or income distribution.

Another problem with judging the economic impact of technologies is timing. Because technologies often create value in unpredictable ways, early assessments frequently turn out to be misleading. For example, many social media technologies have been dismissed as trivial based on how they are used by consumers. However, when applied to complex business organizations to improve communications, collaboration, and access to knowledge, the same tools that are used to share links to cute cat videos have enormous potential to improve the productivity of knowledge workers.⁸ Realizing the full value of new technology can also be a long, difficult process. The electric dynamo was a major innovation that ushered in a revolution in manufacturing during the early 20th century but nevertheless took decades to reach widespread adoption and drive major productivity impact.

Finally, the rate of adoption for a technology can vary a great deal from one economy to another. While it is true that productivity and GDP growth have been modest in the United States which is on the leading edge of technology adoption rapid technology adoption (albeit of older technologies) is driving growth in developing economies. For example, mobile phone carrier Roshan has become Afghanistan's largest employer by introducing the kind of mobile technology that is now several generations behind in advanced economies.⁹

Some economists have used alternative metrics to estimate the true impact of technologies.

For example, Robert Fogel, a Nobel laureate at the University of Chicago, calculates social savings from technologies by estimating what it would cost society to accomplish a task in the same way that it did before an innovation was adopted (e.g., comparing the cost of transportation using railroads to the cost in a hypothetical scenario in which railroads were never adopted).¹⁰ Today, policy makers are increasingly aware of the limits of GDP. Institutions like the Organisation for Economic Co-operation and Development, the European Commission, and the United Nations have all examined or adopted alternatives ranging from the Human Development Index to Bhutan's Gross National Happiness measure. Erik Brynjolfsson and Andrew McAfee have argued, some advances that have the potential to drive productivity growth, such as advanced robotics and automated knowledge work, could also cause worrisome employment effects.¹¹

As new technologies come into use, society will need to continually balance their benefits and risks. Consumers can be relied upon to embrace technologies that make their lives more convenient and provide new sources of entertainment. Businesses and public-sector institutions will not forgo the productivity gains and other benefits that new technologies will make possible. We also believe that over the long term and on an economy-wide basis, productivity growth and job creation can continue to grow in tandem, as they generally have historically, if business leaders and policy makers can provide the necessary levels of innovation and education.¹²

However one measures its impact, the role of technology is growing in our economy and in society. In addition to GDP measures that focus on economic activity, we need metrics that account for true value such as the consumer surplus that arises when a student using a tablet computer suddenly connects the dots and can solve a math equation on her own, or the value that an elderly person might place on the ability to move without assistance.

Conclusion:

Many efforts have been made to supplement GDP as a measure of value, but every alternative has its challenges, and GDP continues to dominate global discourse and decision making. This report attempts to examine the potential economic impact of disruptive technologies using a consistent methodology that includes consumer surplus. But producing broad estimates of the potential economic impact of specific technologies is easy compared to the challenges of measuring the actual, full value that technologies create in the global economy. This challenge is likely to remain and grow over the coming decade.

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