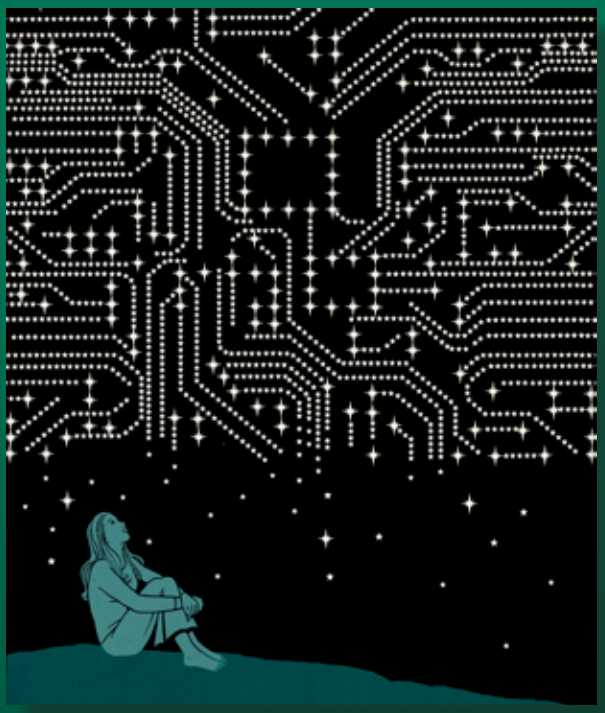
The Power of Technology Economics



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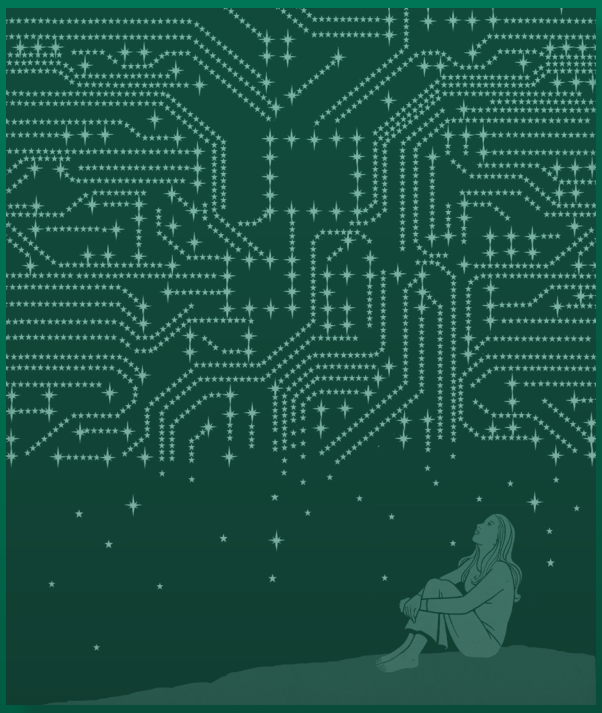

THE POWER OF TECHNOLOGY ECONOMICS

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INTRODUCTION

DESPITE ITS STARRING ROLE in business and everyday life, many economists openly question whether technology is visible in traditional economic metrics such as GDP, productivity, and corporate profits. In this report, The Boston Consulting Group shows that, on the contrary, declines in technology investment are followed by startling drops in all these measures of economic growth.

Whenever companies cut back on technology spending in order to shore up profits—as companies in many industries are doing now—profits plunge. GDP also falls dramatically. Within a few years, labor productivity across the economy falls as well. In effect, companies are cutting back on a critical investment that could power the next wave of growth. In many cases, that investment could create huge leverage, lowering other expenses much more quickly than technology spending rises.

But that can happen only if companies manage their technology spending well. To do that, senior executives require new metrics and new ways of thinking. To successfully navigate the "technology economy" they must create, measure, and track virtual economic measures just as carefully as they follow metrics about the physical world.

This report spotlights recent trends in "technology intensity," a proprietary calculation that reveals the economic impact of the $6 trillion that corporations around the world spend on IT each year. The technology intensity calculation uses a patented formula to analyze technology spending relative to a company's and an industry's revenues and operating expenses.

Across a range of industries, companies with high technology intensity also have high gross margins. Furthermore, technology intensity and gross margins tend to rise and decline together. This effect was seen before and after the Great Recession that started in 2007. In the run-up to the recession, companies were investing heavily in technology relative to revenues and operating expenses, and gross margins were rising. That trend continued to accelerate until 2009, when companies cut technology investment dramatically. After that, technology intensity dropped precipitously along with gross margins, GDP, and productivity.

With a powerful diagnostic we call the technology economics frontier, senior executives can understand where their company stands in relation to its competitors in terms of technology intensity—and act on that knowledge. In the face of rapid technological change and digital disruption, executives must become masters of the global technology economy. Those that succeed will create what BCG calls technology advantage.

WHY TECHNOLOGY MATTERS

More than a decade ago, writer Nicholas Carr caused a stir with a *Harvard Business Review* article titled "IT Doesn't Matter." He argued that as costs fall for infrastructural technologies such as computers and the internet, the technologies would—like railroads, electricity, and telephones—become widely available commodities. Once a technology is ubiquitous and available to all—neither scarce nor proprietary—it no longer confers a lasting competitive advantage.

> Executives must become masters of the global "technology economy."

Although we agree that factors such as commoditization can erode a product's advantage over time, we take fundamental issue with the notion that companies cannot create lasting advantage from widely available technology. In this report, we challenge the conventional wisdom that the powerful effects of technology aren't visible in economic metrics. Our research shows precisely why technology matters to a company's bottom line and exactly how it has impact. The use of proprietary metrics such as "technology intensity" to make the most of technology lies at the heart of creating what we call technology advantage.

Given the rapid emergence of disruptive products and business models and the transformative power of digital technologies on business and society, executives must become masters of the global "technology economy," capable of detecting the economic impact of rapid technological change and able to respond with speed and foresight. In this report, we explore the new metrics and consider the new ways that companies need to think in order to navigate the technology economy and approach the many investment decisions in which technology plays a role.

The Impact of the Technology Economy

Technology infuses even the measurement of the market economy. The composition of indexes such as the Dow Jones Industrial Average (DJIA) and the S&P 500 has changed. Industrial companies are being replaced by tech powerhouses like Apple, Google, and Amazon, whose stocks are valued much higher than those of many long-time industrial members. Apple, with its high market capitalization, accounts for such a large share of the DJIA, for example, that a hiccup in its quarterly earnings moves the entire index. Just 20 or 30 years ago, the performance of Caterpillar or GM (the latter no longer part of the

DJIA) could have similarly shaken up the market.

Furthermore, technology permeates companies. Worldwide corporate IT spending—an important barometer of the technology economy that focuses on corporate spending for hardware, software, data centers, networks, and staff, whether "internal" IT or outsourced services—is nearly $6 trillion per year. This amount is what it would cost to give a $500 smartphone and $350 tablet to each of the 7.1 billion people on Earth. If the global technology economy were a country and that spending its GDP, it would rank between the economies of China and Japan and would be more than twice the size of the UK economy. (See Exhibit 1.) Corporate technology spending grew by a factor of almost 20 from 1980 through 2015, while global GDP barely tripled.

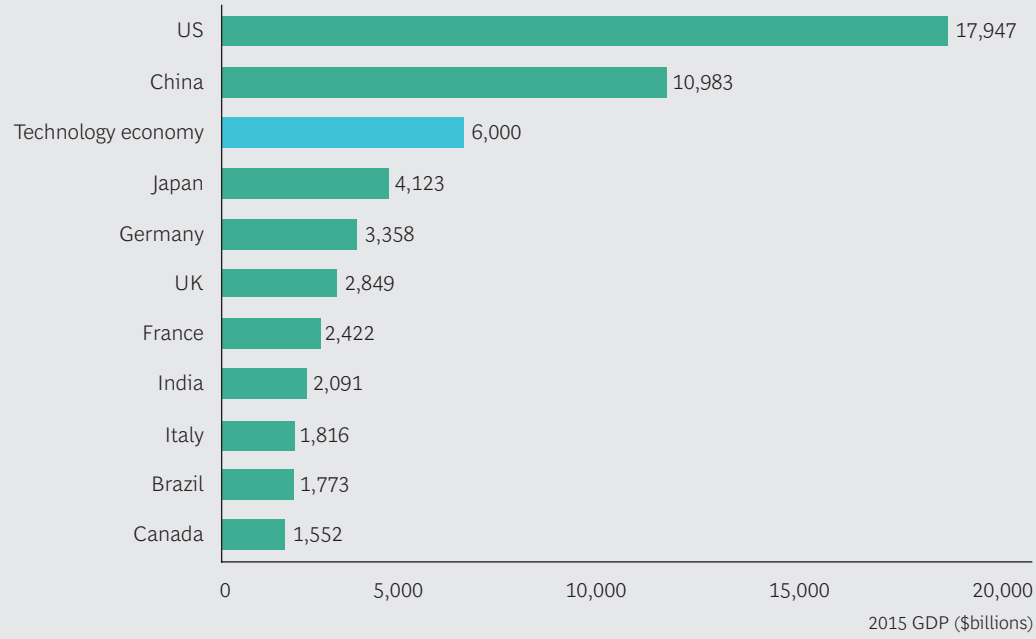
Of course, the $6 trillion figure for corporate IT spending does not include all the money companies spend on technology. It does not account for spending on the sensors, processors, and other technologies embedded in everyday products, including cars, aircraft engines, appliances, and the smart grid; nor does it include spending on robotics, process automation, and mobile technologies. If we include such investments, our technology-spending estimate increases dramatically.

In this chapter, we focus on IT spending data as a proxy for the technology economy. This measure of technology spending, which highlights the complexities of looking at technology through an economic lens, is a critical element of a company's overall digital transformation. (See "Simplifying IT to Accelerate Digital Transformation," BCG article, April 2016.)

But what is all this spending doing for companies? Using technology intensity, we can shine a spotlight that reveals the economic impact of this massive amount of technology spending. The technology intensity calculation uses a patented formula to analyze technology spending relative to a company's and an industry's revenues and to their operating expenses. (See the sidebar, "A Better Way to Calculate the Impact of Technology.")

In the past, business leaders tended to examine the two metrics in isolation. But that doesn't give leaders the whole picture. Reve-

EXHIBIT 1 | The Technology Economy Takes Third Place Among the World's Economies



Sources: IMF World Economic Outlook, April 2016; Rubin Worldwide.

A BETTER WAY TO CALCULATE THE IMPACT OF TECHNOLOGY

To calculate technology intensity, we use a patented formula that balances technology spending as a percentage of revenues with technology spending as a percentage of operating expenses. Technology intensity plots each of these figures on a right triangle, on which IT spending as a percentage of revenues is the base of the triangle and IT spending as a percentage of operating expenses is the vertical side of the triangle. The hypotenuse is technology intensity and is computed using the Pythagorean theorem: by taking the square root of the sum of the squares of IT as a percentage of revenues and IT as a percentage of operating expenses.

Although individually these two metrics are popular ways to benchmark the performance of the IT function, they are static measures of spending that just don't stand on their own. The problem is with the denominator of each ratio. Revenues are unstable and not tightly coupled to technology spending over the short term. Operating expenses, or noninterest expenses, have similar problems. Technology spending doesn't always or immediately lower operating expenses in the ways leaders hope.

Technology intensity offers a dynamic view that shows how these metrics interact and change over time. The relationship between the two ratios is like a seesaw. When a company is getting the balance right, revenues rise faster than its technology investment and the ratio of technology spending to revenues goes down. At the same time, if the company automates more operations, lowering labor costs and other expenses faster than technology expenses increase, the ratio of technology spending to operating expenses goes up.

In a healthy company, technology spending as a percentage of revenues decreases as investments both protect existing revenues and generate new revenue streams. Simultaneously, technology investment to reduce costs, avoid costs, and manage risk becomes a bigger component of operating expenses as automation increases.

nues don't automatically rise when companies spend more on technology. And it's not necessarily a bad thing if a company's technology spending is high relative to operating expenses. However, if leaders compare technology spending simultaneously with revenues and operating expenses, as technology intensity does, several interesting relationships emerge.

We have found that, across a range of industries, companies with high technology intensity have high gross margins. For instance, in the insurance sector, top-performing companies enjoy gross margins that are more than three times the margins of average performers and technology intensities that are more than 50% higher. In banking and financial services, companies with the highest gross margins have technology intensities and margins that are roughly double those of average performers. (See Exhibit 2.) This industry has seen extremely high levels of automation over the past five years—including technology systems that streamline processes, and advances in artificial intelligence that allow robots to answer clients' questions and, eventually, to execute trades. Michael Rogers, the president of State Street, estimated in *Bloomberg Markets* that by 2020, automation will have replaced one in five of the company's workers. A Citigroup report estimates that within a decade, 1.8 million employees in US and European banks could be out of jobs.

In fact, we see not just a connection between technology intensity and gross margins but also a strong correlation. That is, technology intensity and gross margins tend to rise and

EXHIBIT 2 | Across Industries, Companies with Higher Technology Intensities Have Much Higher Gross Margins

	TOP-PERFORMING COMPANIES		AVERAGE-PERFORMING COMPANIES	
	TECHNOLOGY INTENSITY	GROSS MARGIN (%)	TECHNOLOGY INTENSITY	GROSS MARGIN (%)
Banking and financial services	1.90	42.9	1.07	21.4
Insurance	0.68	39.0	0.44	12.1
Telecommunications	0.95	46.0	0.56	30.4
Media	0.98	39.0	0.69	7.8
Health care	0.98	24.0	0.60	6.8

Source: Rubin Worldwide.
Note: Company performance was defined by gross margins.

decline together. This effect was seen before and after the recent world economic crash. (See Exhibit 3.) In the run-up to the Great Recession that started in 2007, companies were investing more and more heavily in technology relative to revenues and operating expenses, and gross margins were rising. That trend accelerated through 2008 and until 2009, when companies belatedly realized the magnitude of what had happened and began to cut technology investment dramatically. After that, technology intensity dropped precipitously along with gross margins.

Other Measures of Success

Along with the technology intensity metric, companies can add other measures to their management dashboard, such as income per dollar of technology spending. (We define income as revenues minus operating expenses.)

For example, the energy industry produces the highest income per dollar of technology spending ($24.24). At the other end of the spectrum, the software publishing and internet services industry produces the lowest ($0.98). In both total technology spending and the technology spending required just to "keep the lights on," we saw a similar rise until 2008, followed by a plunge in income per dollar of technology spending during the market collapse. Afterward, we saw what might be called the failure of recovery as a result of sluggish growth. Income per dollar of technology spending in 2014 and 2015 has basically flatlined, reaching only precrash levels.

Another measure that companies can use to connect the dots between the business and the IT function is the IT cost of goods. For example, in the US, the IT cost per day of a hotel bed is $2.50, and for a hospital bed, it is $65. The IT cost of a car is $323.

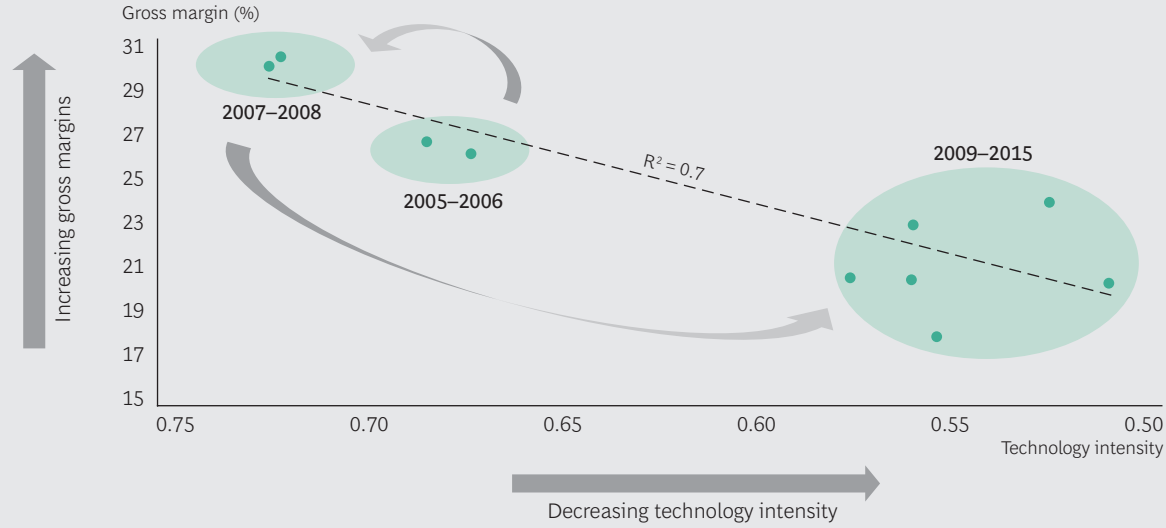
More than such individual measures, however, companies require different measures at different points in time. It is not enough simply to measure whether a project is on time and on budget. When companies are in the early stages of building new IT systems, leaders need *progress measures* to tell them whether a project is on track. For example, a bank may invest in automation and artificial intelligence in order to process loans better, cheaper, and faster. It needs metrics to understand how these projects are progressing.

Later on, a company may need *deployment measures* that determine whether the original business case is still valid. For example, while the bank is building its new system, it might shift a lot of work to the Philippines, cutting the cost of loan processing in half. With the new system, however, the context may change and the original plan may no longer make sense.

Finally, once a company has implemented a project, it needs *realization measures* that can discern whether the project has yielded the intended results.

These microeconomic metrics aren't the only way to look at the impact of technology spending, of course. We can see how technol-

EXHIBIT 3 | Over the Past Decade, Gross Margins Have Fallen in Tandem with Declines in Technology Intensity



Source: Rubin Worldwide.

ogy matters in a host of macroeconomic measures. In short, technology matters both to companies and to the larger economy, as we will explore in the next chapter.

Taking the Next Step

Top performers are different from average companies. Many top performers achieve higher margins by spending their technology dollars more efficiently and with greater focus than average companies.

Consider the case of a global financial services company that for years had prided itself on its low levels of technology spending. However, the company's gross margins were the lowest in its industry. (Incidentally, its peers with higher margins had higher technology intensities.) The company turned things around by rebalancing its technology spending and increasing automation. It invested hundreds of millions of dollars in technology, funded by the lower operating expenses and greater revenues it gained through automation. Now, compared with its peers, it is the only company whose gross margins are increasing faster than its change in technology spending relative to revenues.

To support this kind of digital transformation, executives must define metrics such as technology intensity as KPIs for the organization and benchmark their performance relative to that of competitors and companies in adjacent industries. They must then incorporate new metrics into monthly management reports and dashboards and review the role and purpose of technology investments in light of these measures. For their part, CIOs can embed KPIs into the business on the basis of metrics such as those outlined in this chapter, conducting regular reviews and supporting efforts to optimize performance. Finally, executives should develop even more sophisticated metrics that truly measure the disruptions that technology fuels.

Adopting best practices in these areas will enable a new generation of executive-level "technology economists" not only to measure what really matters to company performance but also to thrive in the technology economy.

WHY THE TECHNOLOGY ECONOMY MATTERS

Despite technology's starring role in business and everyday life, many observers openly question whether it has really had much of an impact on the global economy. Their skepticism is misplaced.

As we demonstrated in the previous chapter, technology plays a vital role in boosting company performance. In short, we've found that companies with high technology intensity have high gross margins. (Technology intensity is a proprietary metric that analyzes technology spending relative to a company's and an industry's revenues and to their operating expenses.)

Declines in technology investment are followed by drops in macroeconomic growth.

But if technology is so important, many economists ask, why hasn't the digital revolution generated the hoped-for increases in traditional macroeconomic metrics such as GDP and productivity? For example, annual productivity growth in the US from 2007 through 2015 hovered at a sluggish 1.3% average rate, half the rate from 2000 to 2007. The US economy experienced three consecutive quarters of falling productivity, from the fourth quarter of 2015 through the second quarter of 2016, the longest slide since the late 1970s.

Critics point to technology's failure to deliver. The failure may be one of imagination rather than of technology itself, however. As we will show, declines in technology investment are followed by startling drops in macroeconomic growth. In fact, you can see that the technology economy has close relationships with GDP, productivity, and other measures of economic health—if you look closely.

The Effect of Technology on Economic Growth

For years, economists have cast doubts on the importance of technology to economic growth. The apparent powerlessness of new technologies to improve productivity has become known as the Solow paradox, named after Nobel Prize–winning economist Robert Solow. "You can see the computer age everywhere but in the productivity statistics," Solow said in 1987.

In his book *The Rise and Fall of American Growth: The U.S. Standard of Living Since the Civil War,* economist Robert Gordon argued that the new technologies of today are not as world changing as were, for example, electrification, cars, and wireless communications during the second Industrial Revolution. Others argue that information technology could

be at a stage of development in which its potential impact has not yet revealed itself, just as early-20th-century inventions, such as electric lighting, failed to immediately lift the slow productivity growth that prevailed after their introductions.

John Fernald, a leading expert on productivity at the Federal Reserve Bank of San Francisco, has determined that the recent slowdown in productivity was not connected to a host of factors, including housing, educational attainment, capital intensity, and the Great Recession that started after 2007. Technology itself was the cause. As industries reorganized after the internet explosion that began in the mid-1990s, the potential for transformative gains from technology shrank dramatically. Fernald recently asserted that, in general, measurement errors are not to blame and free internet services have a negligible impact on the economy.

A strong relationship exists between technology spending and economic growth.

Erik Brynjolfsson and Andrew McAfee, co-directors of the MIT Initiative on the Digital Economy, argue more optimistically that productivity increases associated with new technologies happen only after a long period of time, when technologies become powerful and cheap enough for their truly transformative powers to kick in. Others say that we're only just now beginning to see the transformative potential from recent innovations such as big data, artificial intelligence, advanced robotics, nanotechnology, and biotechnology. Robert Atkinson, of the Information Technology & Innovation Foundation, argues that over the next few decades, the US may see productivity rise to perhaps 3.0% to 3.5% per year—as much as a percentage point higher than the relatively rapid pace of 1995 through 2007—once transformative technologies such as these come into wide use.

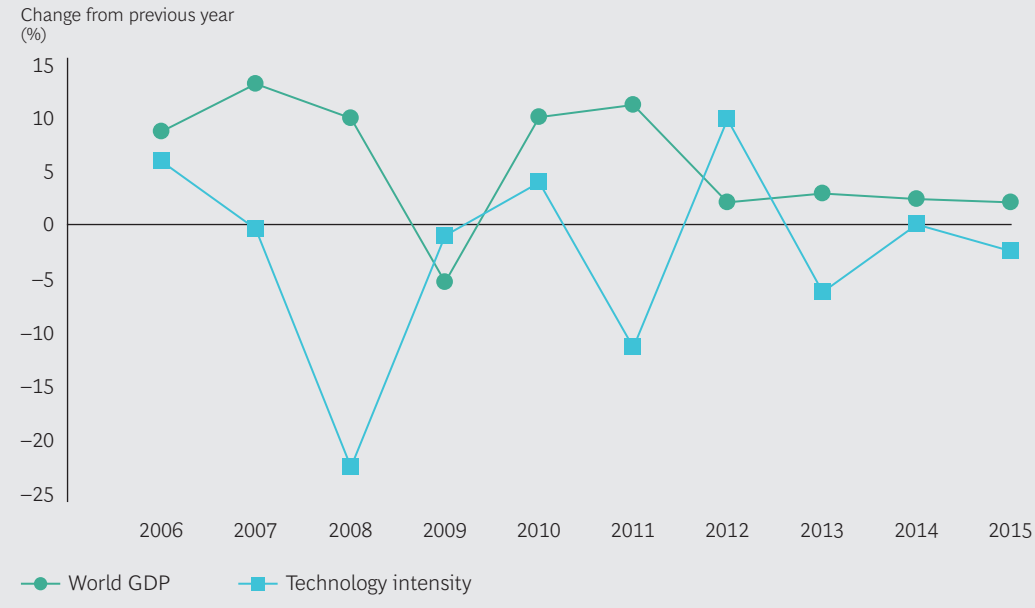
In general, we agree with a more optimistic line of reasoning about technology, but we have reached a different conclusion. We think that in many cases, traditional measures of economic growth don't take into account important benefits of technology and are less relevant to prosperity than they were in a mass-production world. For example, GDP, an important factor in the calculation of productivity, fails to capture many technology-generated improvements in living standards. These benefits include the greater convenience and better customer experience provided by digital services and the vast amount of information—such as online maps, search results, and social media—available for free and with zero marginal distribution cost. Measurement flaws such as these could partially explain why productivity growth has been so slow over the past few decades, at least according to current metrics.

Rather than seeing technology as having a marginal effect on productivity, we have found a strong relationship between technology spending and economic growth as measured by productivity and GDP. For example, executives can predict with some accuracy the impact on the overall economy of a decline in technology spending. Whenever companies cut back on discretionary spending in order to shore up profits during a downturn, they slash their investments in technology. Soon afterward, GDP falls dramatically, and, within a few years, labor productivity across the economy falls. (Remember that technological innovation is an important component of productivity.)

The drop in technology intensity that results from a decline in technology spending causes the labor force to shrink, which shows up in productivity up to three years later because productivity is a "stickier" measure. Exhibit 4 shows the relationship between technology intensity and GDP. (A similar pattern exists for productivity.)

The global economy is showing other signs of this effect, as Mary Meeker, a general partner at Kleiner Perkins Caufield & Byers, recently highlighted in her influential 2016 *Internet Trends* report. Global GDP growth has been lower than the 20-year average in six of the past eight years. As GDP comes under pressure, global growth in the use of technol-

EXHIBIT 4 | GDP Falls Dramatically When Companies Cut Back on Tech Spending



Sources: IMF World Economic Outlook, April 2016; Rubin Worldwide.

ogies such as the internet and smartphones has slowed. This downward cycle reduces new opportunities for productivity and GDP growth.

One likely explanation for the past decade's slowdown in productivity, as reflected in the official statistics, could be that economists and business leaders are not tracking the metrics that make the impact of technology most evident. It could be that to see the economic lift from technology, which centers on digital information, we need to look elsewhere than the traditional economy, which centers on the physical, Industrial Age world.

Measures such as the price of cloud storage, data processing rates, broadband speed, and 21st-century skill development could be more relevant. That requires a shift in thinking about how we invest in technology and how we measure its macroeconomic effects.

Investing for Critical Mass

In addition to arguing that existing metrics have failed, we maintain that the slowdown in productivity also signals a failure to reach a critical mass of technology. Despite rapid growth in spending and technology's significant impact, the level of technology intensity at the world's companies fell steadily from 2005 through 2015. Yes, you read that right: despite record spending on technology, technology intensity is plummeting.

While technology expenses are rising faster than the revenues that result from those investments, operating expenses are rising even faster. (The higher ratio of technology spending to revenues in the calculation of technology intensity is offset by a disproportionately lower ratio of technology spending to operating expenses.) In effect, companies are getting less and less for their significant investment in technology.

This counterintuitive trend—companies are spending more but getting worse results—is the paradoxical result of some companies' failure to spend *enough* on technology. Most companies spend about 5% of revenues on technology, which is not a staggering amount relative to other important expenses. In fact, the pendulum is once again swinging back toward a major slowdown in technology spending. Major banks, normally heavy spenders on IT, have announced 25% to 30% cuts in technology expenditures. IDC forecasts that global spending on IT is set to grow by only 2%, after growth of 5% to 6% over the past five years.

The situation is akin to delivering a vaccine that works for only 10% of the population because the company didn't test enough variations of the vaccine. The company saved money, but that choice had negative repercussions.

What if, when things weren't going well during the Industrial Revolution, companies had cut down on machines, automation, waterways, or electricity? Today, many companies are cutting back on a critical investment that could power the next wave of growth. In many cases, that investment could create huge leverage—lowering other expenses through automation, for example—much more quickly than technology spending rises. But that can happen only if companies manage their technology spending well.

New Ways to Measure Success in the Global Economy

If we're looking in the wrong places and, paradoxically, not spending enough on technology, how can we gain a better understanding of the technology economy? We maintain that businesses can learn to think about economic growth in new ways, as well as develop new macroeconomic measures that highlight the impact of the technology economy.

A more nuanced way to think about productivity involves focusing on technology's ability to increase reach and generate leverage. For instance, the internet enables companies to reach millions of potential customers, magnifying the results of their investments. Social networking services such as Twitter and Facebook change the productivity of reach: the incremental cost of reaching 3 million instead of 1 million people is zero. In addition, automation allows companies to replace labor-intensive manual processes with algorithms.

One day, executives will be able to measure the rise in productivity resulting from innovations such as self-driving vehicles and nanorobots. In the more immediate arena of IT-enabled health care, we are already starting to measure technology's contribution to health care productivity. Better-trained physicians are able to make diagnoses more quickly and accurately. In other words, they are increasing their labor productivity, and this improvement—even if it doesn't currently show up in official productivity statistics—leads to better health outcomes. For example, thanks in part to recent efforts to increase health care efficiency and institute value-based health care, inflation-adjusted Medicare spending per beneficiary has declined over the past few years, after years of rapid increases.

Businesses can learn to think about economic growth in new ways.

To keep bending the cost curve downward and thereby improving the productivity of health care overall, we need to take a fresh look at increasing efficiency. The Dell Medical School at the University of Texas at Austin is at the forefront of such efforts to improve health care productivity and outcomes: its curriculum aims at training doctors to navigate a collaborative, data-driven, results-oriented world.

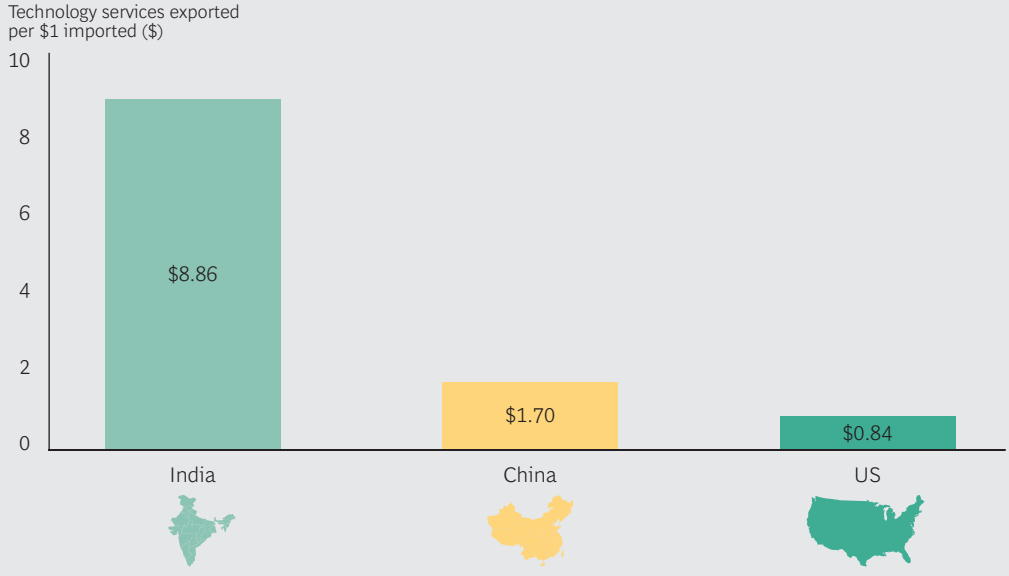
Another area of productivity-related inquiry focuses on metrics of global labor costs. Thanks to the globalization of manufacturing and many other industries, companies have circled the globe looking for rapidly developing economies with low average wages. Now they are discovering that in terms of *output per dollar of wages* and other new measures, these low-wage countries may not have an advantage over a high-wage country with high levels of automation. (See *The Shifting Economics of Global Manufacturing: How Cost Competitiveness Is Changing Worldwide,* BCG report, August 2014.) Among other factors that affect output, the economic impact of each dollar in wages could be far greater owing to technology. As a result, output per dollar of wages is a much more revealing metric for decision makers than a country's average wages.

In addition to productivity, executives need to watch a macroeconomic measure that shows "flows" in the technology economy: the *tech-*

nology balance of trade, or the technology services exported per dollar imported. India, for example, exports $8.86 in technology services per dollar imported, while the US exports only $0.84 in technology services per dollar imported. (See Exhibit 5.) Understanding flows such as these helps companies identify promising markets and do a better job of predicting economic growth in the technology economy.

Ultimately, these new ways of thinking about and measuring economic growth point to the need for new ways to discern whether companies are successfully navigating the technology economy. In the previous chapter, we describe critical company-level metrics that measure the state of the digital world. Executives will also need to create, measure, and track virtual macroeconomic measures—and do that just as carefully as they work with metrics about the physical world. And they must adapt to changes in these indicators in near-real time. But to truly succeed, senior leaders must understand where they stand in relation to competitors—and act on that knowledge.

EXHIBIT 5 | The Technology Balance of Trade Shows Areas of Growth and Opportunity



Sources: IMF World Economic Outlook, April 2016; Rubin Worldwide.

HOW TO REACH THE TECHNOLOGY ECONOMICS FRONTIER

To navigate the physical world, ship captains use longitude and latitude. To navigate the technology economy, business and technology leaders need other tools.

In the first two chapters, we explored the strong relationships among technology spending, corporate profits, GDP, and productivity. To track the impact of their spending, we've recommended that business leaders keep a close eye on technology intensity, a proprietary metric that analyzes technology spending relative to a company's and an industry's revenues and operating expenses simultaneously.

Each industry has an optimal level of spending on technology.

In this chapter, we argue that each industry has an optimal level of spending on technology and that it can be determined on the basis of technology intensity. The diagnostic we outline is superior to conventional approaches, such as simply assessing technology spending as a percentage of revenues or operating expenses without considering business performance. Consideration of technology intensity in the context of profitability links technology and business performance in a new way and provides a basis for maximizing and optimizing the return on technology investments. This structured way of investing in technology can differentiate companies from their competitors and deliver tangible results.

The Efficient Frontier of Technology Spending

In 1990, Harry Markowitz won a Nobel Prize in economics for his contribution to the development of modern portfolio theory. Central to the theory is the "efficient frontier," a curved-line chart that reflects the optimal balance between risk and return in a portfolio of investments.

The close relationship between technology intensity and gross margins, highlighted in the first chapter, makes it possible for companies to derive a *technology economics frontier,* which our research has validated across 3,000 companies in 21 sectors over the last decade. This diagnostic can indicate whether executives are generating higher- or lower-than-expected returns on their technology investments.

This frontier shows how reductions in technology investments can put a drag on company performance. Likewise, it can illustrate the performance penalty for overinvestment. The

diagnostic can identify a company that generates outsize returns by making highly surgical technology investments into infrastructure that supports big data and advanced analytics, and it can highlight another company that scatters its investments across so many subscale projects that few achieve critical mass and have a lasting impact.

Exhibit 6, which shows the technology economics frontier for a set of companies in the banking industry, compares the performance of individual companies along the dimensions of technology intensity and operating margins. With sufficient data about the performance of many companies in an industry, we can draw a curve—the technology economics frontier—that best reflects all the individual data points. The apex of the curve represents the level of technology spending that maximizes profits: specifically, the point at which margins and technology intensity reach an optimal level.

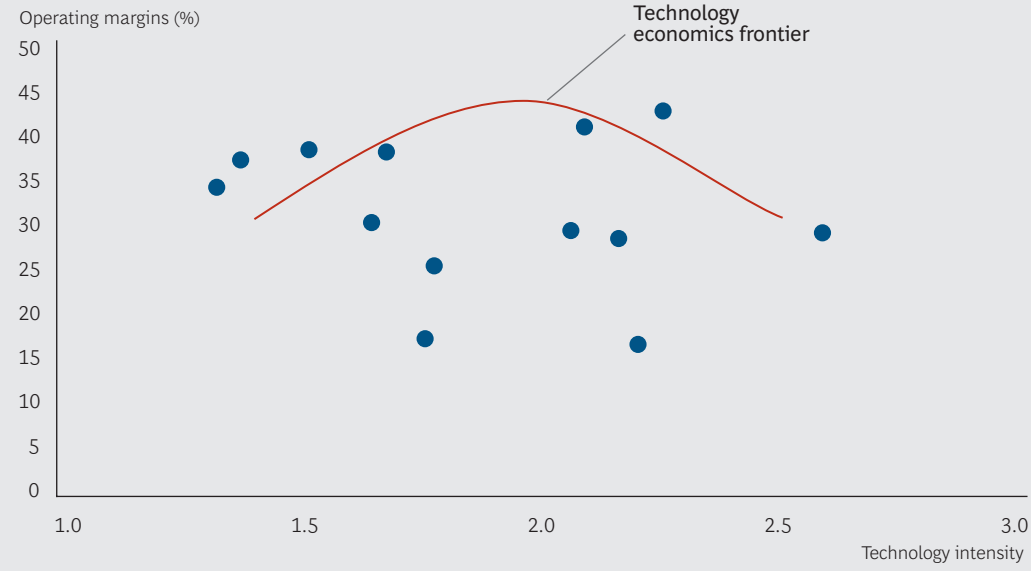
The technology economics frontier reveals several insights:

- Companies that are to the left of the curve's apex could be spending too little on technology: technology spending has the potential to improve their performance.
- Companies that are to the right of the apex could be spending too much on technology: technology spending is no longer improving their performance.
- Companies that are directly below the apex have found the right level of technology spending, but they might be investing in areas that don't generate results.
- Companies that are directly above the apex are spending the right amount on technology, and they are also getting above-average returns from their investments.

Organizations can benchmark themselves at the company, business unit, and industry segment levels. A company that consists of business units with different characteristics can, for instance, benchmark itself unit by unit. Furthermore, the technology economics frontier is a valuable tool for industries that are facing disruption. Companies can chart themselves against disruptive new competitors. The exercise can reveal what companies aspire to and what they must change.

Executives can use their position relative to the technology economics frontier to target specific improvements in technology spending. One caveat: the technology economics

Exhibit 6 | Top Performers Lie Beyond the Technology Economics Frontier



Sources: Rubin Worldwide; company annual reports.

frontier shows a point-in-time view of the historical link between technology intensity and profitability. It is an indicator that can fuel further analysis, not an absolute final judgment.

Reaching the Technology Economics Frontier

As they do with any other investments, executives must strive to achieve the right return on their technology investments. Masters of technology economics generate superior business performance while optimizing their spending. The following strategies can help executives manage their investment portfolios and reach the technology economics frontier.

Monitor the right metrics. To calculate the technology economics frontier, technology and business leaders must start by tracking a KPI, such as technology intensity, in management reports and dashboards. They should also look at other metrics that affect technology investments such as those we addressed in the first two chapters, including income per dollar of technology spending, the IT cost of goods, and output per dollar of wages.

Any metric that leaders choose to track should focus on both input measures of what the business aims to achieve with technology and outcome measures of true business impact. These metrics must be in alignment with the company's business strategy and aspirations, connecting the dots between IT and the business. The right KPIs can include goals such as operational efficiency, customer intimacy, and product leadership. The ways leaders convey company performance to investors offer an excellent starting point.

Once they are monitoring the right metrics, those who influence technology investment—and those influencers include more functions and higher management levels than ever before—need to think about ways to embed the emerging KPIs into the business and use them to improve performance. Furthermore, executives need to periodically refresh the metrics. Today's new digital metrics might be relevant now, but things can change. Management must review the metrics from time to time to ensure that they are still the ones that tell the most relevant story.

Calibrate performance. Once executives have a solid understanding of the business's individual performance, they should put that information into perspective by benchmarking it against other companies in their industry, sector, or both. In particular, they should focus on those companies they aspire to beat, not those that have already lost the game. They can also look at companies in adjacent industries outside their peer group. For instance, a telecom company might want to benchmark itself against an online retailer, a chain of retail stores, and a media company, if it plans to compete with such businesses. The future business might not look like the current business.

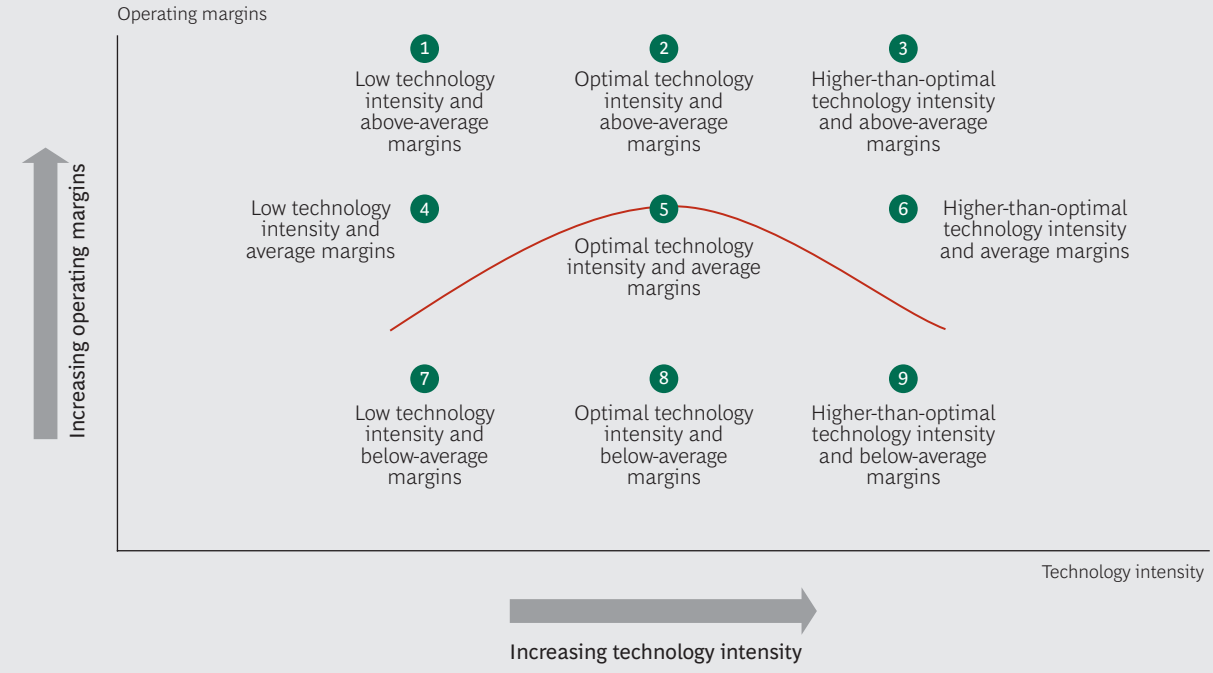
> Masters of technology economics generate superior business performance.

Next, executives should chart the technology economics frontier for their competitive context. No company can compare itself with others on every metric. One or two key metrics—such as technology intensity and operating margins—per industry, sector, or business unit could be enough. And leaders need to make sure that they're comparing apples with apples. The ways companies define revenues and IT expenses must line up across business units. The benchmark must have meaning to be meaningful.

Optimize performance. A company should use its position along the technology economics frontier to help identify specific strategies for improvement. (See Exhibit 7.) Where your company falls in relation to the apex of the frontier will be within one of nine zones, each of which implies a strategic response.

- **Zone 1: Low Technology Intensity and Above-Average Margins.** Adjust your technology investments to target higher-impact business processes. You are "beating the curve," but competitors with a

EXHIBIT 7 | Performance in Relation to the Frontier Reveals Issues to be Addressed



Source: Rubin Worldwide.

higher level of technology investment and a keener focus on business process improvement are achieving superior operating efficiency from technology.

- **Zone 2: Optimal Technology Intensity and Above-Average Margins.** Consider ways to further optimize costs and drive the return on technology investment to new levels. Think about alternatives such as cloud computing and big data tools while focusing on innovations in business products, operational processes, and the customer experience.

- **Zone 3: Higher-Than-Optimal Technology Intensity and Above-Average Margins.** Recalibrate your technology investments so as to shift your profile to the left and achieve the same—or perhaps more—with less. Your margins are better than those of many of your competitors, but your costs are not. Generating the same results with less spending will set a new best-in-class performance bar for your competitors.

- **Zone 4: Low Technology Intensity and Average Margins.** Increase your technology spending while shifting the balance to investments that improve operational efficiency. Such investments typically involve business process automation to reduce costs.

- **Zone 5: Optimal Technology Intensity and Average Margins.** Focus on staying ahead of the pack. As you regularly benchmark your performance, look for opportunities to invest in ways that do more than create operational efficiencies through cost reductions. Focus on technology's impact to beat the curve through revenue growth.

- **Zone 6: Higher-Than-Optimal Technology Intensity and Average Margins.** You are not getting enough "bang for your buck." Your technology intensity is above the optimal level, but you have nothing but average returns to show for it. Extraordinary intensity should support extraordinary results.

- **Zone 7: Low Technology Intensity and Below-Average Margins.** Rethink where and how much you invest in technology. Also, assess your balance of run-the-business versus change-the-business

spending. Perhaps aging or inefficient infrastructure is inhibiting your ability to invest; perhaps your core costs for people, hardware, and software are too high. Benchmark to gain insights into what could be causing underinvestment and underperformance.

- **Zone 8: Optimal Technology Intensity and Below-Average Margins.** Restructure your technology investment portfolio. Perhaps the total amount of spending is right, but it is going to too many or too few places. Benchmark to find out where the "smart money" is going. Shift your margins upward by increasing the yield of your investments.

- **Zone 9: Higher-Than-Optimal Technology Intensity and Below-Average Margins.** You're spending too much and generating too little. Transform what you do with technology to shift your profile to the left—to optimal technology intensity levels as well as on-the-curve returns. Your technology is too expensive, and it's ineffective at fueling operational efficiency and increasing revenues.

While taking these steps, you can focus technology investments on innovation and on changing ways of working. You can also focus on reducing costs, delivering growth (for companies and GDP overall), and improving wealth and the quality of life on our planet. (See "Saving Globalization and Technology from Themselves," BCG article, July 2016.)

At most companies, technology investment is growing faster than revenues—and faster than the GDP of any country. Clearly, technology is essential to the success of companies and the global economy. But managing technology spending well in the future will require an increasingly sophisticated way of looking at the world and at a company's performance.

Companies must monitor, calibrate, and optimize investments in real time according to market conditions and on the basis of new forms of market data. They must consider both inputs and outcomes. They must look at technology economically to gain competitive advantage—before others beat them to the punch. Ultimately, when executives view investments in this way, technology will not only matter, it will make all the difference.

FOR FURTHER READING

The Boston Consulting Group publishes many reports and articles that may be of interest to senior executives. Examples include those listed here.

Acting on the Digital Imperative
An article by The Boston Consulting Group, September 2016

Saving Globalization and Technology from Themselves
An article by The Boston Consulting Group, July 2016

Simplifying IT to Accelerate Digital Transformation
An article by The Boston Consulting Group, April 2016

The Digital Imperative
An article by The Boston Consulting Group, March 2015

NOTE TO THE READER

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