



U.S. Council on
Competitiveness

2016 Clarion Call

A Competitiveness Agenda for the
45th President of the United States

Call to Action

Every four years there is a contest to re-imagine the Great American Experiment—to tackle the challenges of the time, to reflect on how the nation is changing and to consider new paths. As a nation built by pioneers from every corner of the globe, one could say the United States has in its DNA a built-in restlessness to remake its future. This *2016 Clarion Call* from the U.S. Council on Competitiveness suggests how American citizens and their elected representatives can do just that.

In simple economic terms, how will Americans create good jobs? How can we prosper and build good lives for our children? The Council believes that annual economic growth of at least 3.75 percent is necessary to create such jobs, jump start new industries and increase the standard of living for all Americans. For 30 years, the Council has emphasized that increasing innovation-driven productivity is the key to achieving that kind of economic growth. The *2016 Clarion Call* is a road map to drive productivity, revive growth and generate the good-paying jobs America needs.

The Council urges the President-elect to:

- 1. Ensure American Leadership in Innovation and Strategic Technologies.** Several technologies are opening new realms of discovery and changing the way that companies compete. Knowledge and capabilities unlocked by these technologies are already shaping American leadership in science, security and commerce. The *2016 Clarion Call* offers ideas to spark innovation and bring together the creative abilities of industry, academia and the national laboratories.
- 2. Strengthen America's Talent Base.** The competitiveness of the nation and the prosperity of its citizens rely more than ever on the education and skills of the American workforce. The *2016 Clarion Call* suggests several ways to teach, train, attract and retain talent more effectively and affordably for more people.
- 3. Bolster America's Investment Environment.** The President-elect must reach across party lines to enact compromises that will reduce debt and restore the nation's long-term fiscal health. Doing so would: facilitate essential investments in areas like research, training and infrastructure; enable a competitive tax regime; and renew confidence in the United States.
- 4. Build World-Leading Physical, Cyber and Policy Infrastructure.** The foundation of a competitive economy and a high standard of living is modern, secure and resilient infrastructure—including transportation, communication, energy and water. Unleashing the economic potential of the private sector also requires policy choices that encourage and attract economic activity on American soil. The *2016 Clarion Call* urges the President-elect to act on these urgent priorities.

Where America Stands Today

This year marks the 30th Anniversary of the U.S. Council on Competitiveness. Since its inception, the Council has shaped the global economic conversation by defining competitiveness, identifying its drivers, explaining changes in the competitiveness landscape, offering recommendations and building public-private partnerships to tackle key challenges. Although the drivers and factors influencing economic competitiveness have changed in many ways over 30 years, there are echoes today of the challenges and anxieties that helped form the Council in 1986.

Productivity

For 30 years the United States has remained the most productive large economy in the world. U.S. GDP per hour worked rose 56 percent from 1986 to 2015, from \$40.30 to \$62.90.¹ Despite this long term success story, American productivity growth over the past several years has lagged significantly behind historical norms. In the 1990s, the annual labor productivity growth rate averaged 2.0 percent and in the 2000s the rate averaged 2.5 percent. Since 2011, annual U.S. productivity growth has averaged 0.6 percent (Figure 1). In the first two quarters of 2016, the productivity growth rate was negative.²

Productivity is a crucial metric because workers who generate more output per hour tend to receive higher wages. In advanced economies productivity growth also preserves jobs on balance by making them more competitive, even though some jobs are

replaced by automation. If the United States is to remain a high-wage nation that competes in both the production of goods and the provision of services, we must take steps to reinvigorate productivity.

In addition, highly productive economies have a greater capacity to solve grand challenges and shape the world's future. The productivity driven by the digital revolution not only created new jobs, products and services, it also transformed industries and created entirely new industries. High productivity unleashes people from old norms and allows them to dream, invest and create the future.

Markets and Globalization

In 1986 the Berlin Wall still stood and roughly half of the world's nations remained outside the global trading system. With the end of the Cold War, previously closed economies opened their markets to trade and investment. More nations than ever before began to compete—through the skills of their workers; through their tax and regulatory codes; and through public investment in infrastructure, research, and domestic start-ups.

The playing field changed rapidly, as did the competition for new opportunities and the world's work with approximately 1.5 billion people entering the global labor force (and consumer markets) by 2000.³ For companies, this shift required new strategies for where they invested and how they managed their production, supply chains, services, personnel and other operations. Large firms could not stand pat and cede market share, revenue and economies of scale to their competitors. Their shareholders and their survival demanded new strategies to compete.

1. Organization for Economic Cooperation and Development, GDP per hour worked in constant 2010 US dollars, https://stats.oecd.org/Index.aspx?DataSetCode=PDB_LV, data extracted October 2016.

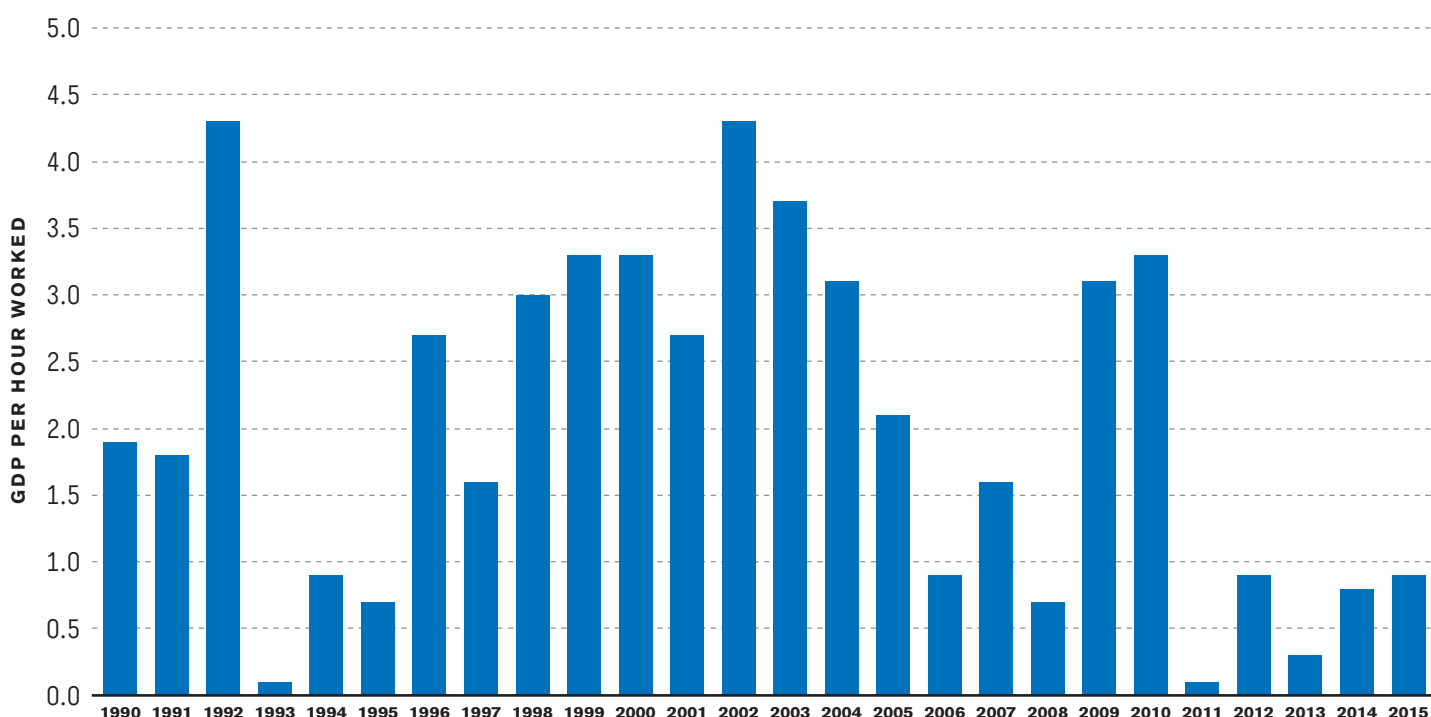
2. Bureau of Labor Statistics, Nonfarm Labor Productivity Growth, United States Department of Labor.

3. Friedman, Thomas. *The World is Flat*, 2005.

Figure 1. U.S. Labor Productivity Growth Rate

Annual percent change in GDP per hour worked, 1990-2015

Source: Bureau of Labor Statistics



The shift to more open markets has integrated the American economy more closely with the world. Total U.S. trade (exports and imports) as a share of GDP rose from 16.9 percent in 1986 to 28.1 percent in 2015—a jump of 66 percent.⁴ Net foreign direct investment inflows to the United States as a share of GDP have almost tripled, from 0.77 percent in 1986 to 2.28 percent in 2015.⁵ These figures are impressive measures of integration given that U.S. GDP grew 109 percent over this period, from \$7.86 trillion to \$16.40 trillion.⁶

The United States must remain globally engaged and pursue a robust trade agenda that both opens markets and enforces rules of fair play with other nations. Americans cannot retreat from trade negotiation and enable other nations to enjoy lower tariffs and greater market access for their exports across the globe. That would place U.S.-based firms and their employees at a disadvantage. As with trade agreements in the past, special care should be taken to support workers and their families who may need to transition to new work as a result of making markets in certain U.S. industries more open.

4. Trade as a Percent of GDP, National Accounts Data, the World Bank.

5. Foreign Direct Investment—Net Inflows, National Accounts Data, the World Bank.

6. Bureau of Economic Analysis, *Real U.S. Gross Domestic Product in 2009 constant dollars*, United States Department of Commerce.

Technology

Most Americans had never heard of the Internet in 1986 and the World Wide Web did not exist. The digital revolution has rewritten the way work is done, where it is done and the skills required to do it. It has reordered the ranks of the world's most profitable firms; disrupted old business models; and rewired supply chains, customer engagement and other business processes. The digital world also brings new challenges, like cybersecurity and theft of intellectual property. Other technologies also are having an impact on competitiveness. Profound advances in bio- and nano-technologies, for example, have opened new worlds in medicine, materials and food production.

The development and deployment of technology drives productivity and higher living standards. For that reason, the Council has worked consistently over 30 years with its members and political leaders to identify strategic technologies and spur action to ensure American leadership. One example is high performance computing (HPC). Over the past 30 years, the United States has invested a great deal in supercomputers and the ecosystem of talent, software, algorithms and models that make HPC a force multiplier for competitiveness. Although the United States remains the world leader in leveraging HPC for science, security and business, China has made rapid gains in developing indigenous technologies and building world-class systems.

Innovation

Thirty years ago almost no one discussed innovation as a key to national competitiveness or as an economic development strategy. Today, nations, provinces and localities world-wide recognize that their long-term productivity and competitiveness are linked tightly to innovation. Innovation is more than invention—it brings talent, technology, entrepreneurship and investment together to create value. It is the key to high-margin growth and good jobs through new firms, new products and services and entirely new industries.

The new focus on innovation has resulted in a wider scope of activities to encourage high-growth technologies and start-ups. Activities include boosting research budgets; launching incubators, accelerators and angel networks; teaching entrepreneurship; building hubs around strategic technologies; and fostering a larger and more diverse population of students in science, technology, engineering and mathematics (STEM) disciplines.

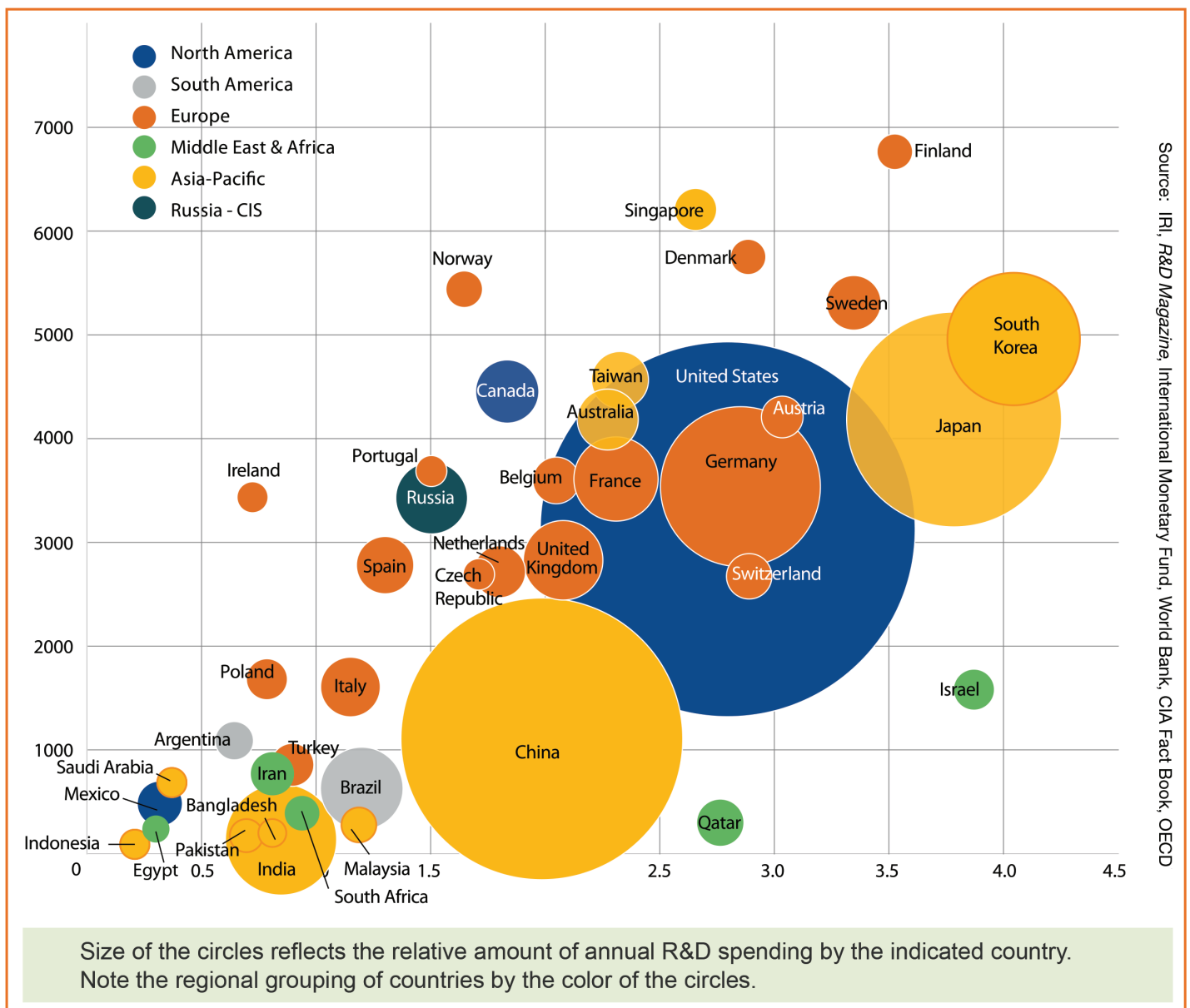
Innovation is measured in many ways, including both inputs and outputs. One input measure is research and development investment, where the United States remains a global leader (Figure 2). Looking beneath the macro numbers, however, reveals a more nuanced picture. In 1986, federal investment in R&D as a share of the economy was 1.2 percent. By 2015, that share had dropped to 0.77 percent—a 36 percent decline.⁷ In general, the United States remains a global leader across multiple metrics, but its lead is declining relative to a growing number of competitors.

7. Historical Trends in Federal R&D, American Association for the Advancement of Science.

Figure 2. Global R&D Forecast, 2016

Vertical axis: Scientists per million people / Horizontal axis: R&D as share of GDP / Circle size: Size of R&D spending

Source: Industrial Research Institute & R&D Magazine, March 2016



What stands out about the competitiveness challenge today is the growing number of challengers and the pace at which they are building their own versions of the U.S. innovation model. Sticking with the R&D investment metric, the growth rate in China has been especially dramatic. The OECD began collecting data in China on gross domestic spending on R&D (public and private) in 1991. From 1991 to 2013, that investment increased from \$13.5 billion to \$316.3 billion—a giant leap of 2,242 percent.⁸ Over the same 22-year span, gross domestic spending on R&D in the United States rose from \$236.8 billion to \$432.6 billion—a jump of 82.7 percent.⁹ Although innovation requires much more than investment in R&D, the rapid narrowing of the investment gap between China and the United States reflects the commitment competitors are bringing across a variety of metrics like talent development and technology infrastructure.

An example of an innovation output metric would be start-ups. From 1986 to 2008, the birth of start-ups in America outpaced business closings.¹⁰ The recession reversed that dynamic for two years, but beginning in mid-2010 start-ups again outpaced business closings and have almost returned to pre-recession levels (see Figure 3). The entrepreneurship and risk capital components of successful innovation have long been an American advantage, but they remain far from optimal. U.S. technology start-ups still face daunting “Valley of Death” challenges to remain financially viable as they move from concept to start-up to scale-up.

8. Organization for Economic Cooperation and Development, *Gross Domestic Spending on R&D in US dollars*, accessed October 2016.

9. Ibid.

10. Clifton, Jim. *American Entrepreneurship: Dead or Alive?* Gallup Business Journal, January 13, 2015

Energy

In 1986 a glut in global oil production caused prices to collapse and over half of the rigs operating in the United States shut down.¹¹ Though consumers benefited from lower prices, the country gradually became more reliant on energy imports and other energy sources like coal. U.S. oil production declined to a nadir in 2006, approximately 29 percent below its 1986 production levels.¹²

The advent of hydraulic fracking and horizontal drilling altered the energy landscape dramatically. In 2015, the United States was the world’s largest producer of petroleum and natural gas, despite the recent glut and price drop reminiscent of 1986.¹³ Although reduced prices have slowed U.S. oil and gas production and investment, the sector appears more resilient than 30 years ago, and consumers of energy continue to benefit from lower costs. Natural gas electricity plants are replacing those fired by coal, and energy intensive manufacturers are investing in the United States. America finds itself at the edge of a new frontier, shaped by the convergence of a modern breed of energy abundance and America’s re-emergent manufacturing sector.

America’s energy abundance offers a distinct and temporary competitive advantage to bridge to a more sustainable, green and resilient economy. The challenge is to take the opportunity now to develop reliable and cost-competitive renewable energy sources, and to improve energy efficiencies.

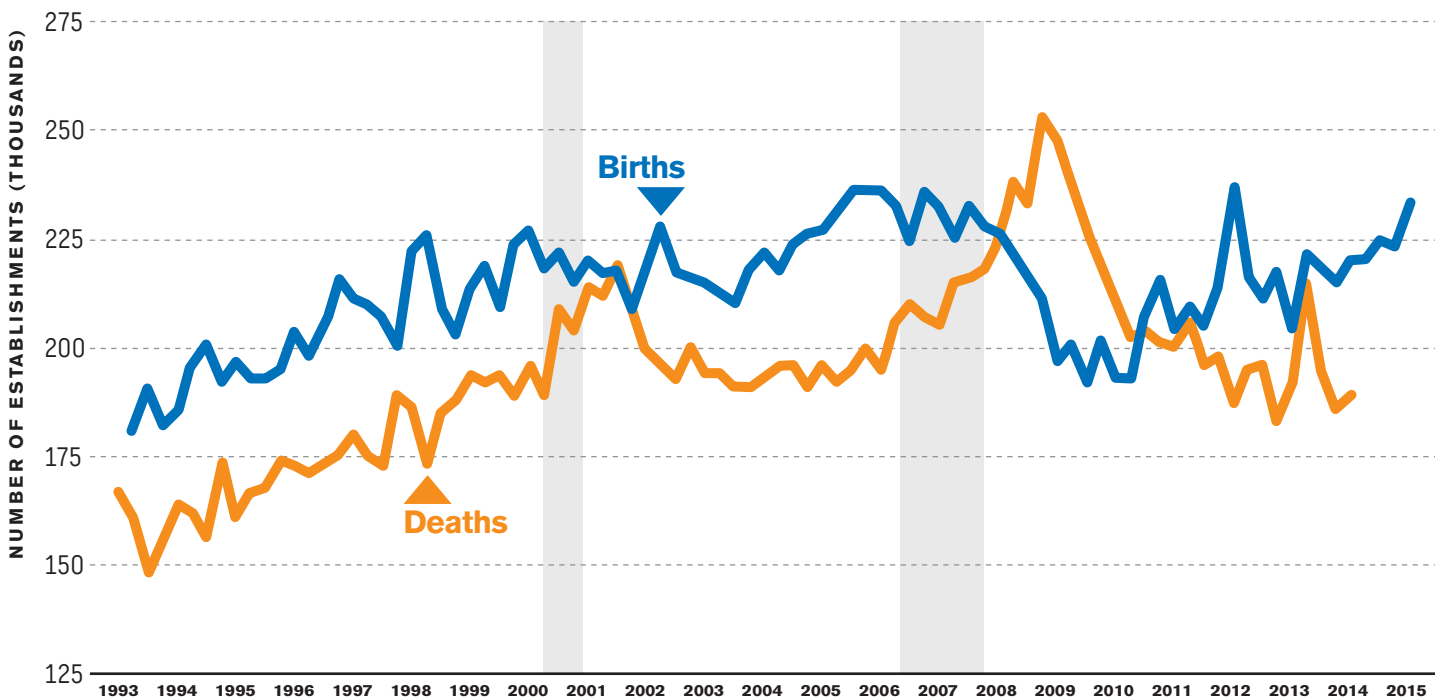
11. Oil & Gas 360, *Oil: the 30-Year Anniversary of the 1986 Collapse*, January 29, 2016.

12. International Energy Statistics, Energy Information administration, United States Department of Energy.

13. Energy Information administration, United States Department of Energy, <http://www.eia.gov/todayinenergy/detail.cfm?id=26352>.

Figure 3. U.S. Start-ups vs Establishment Closings

Source: U.S. Bureau of Labor Statistics



Thirty years ago, renewable sources like hydro and geothermal made up about 1.4 percent of American energy consumption. In 2015, renewable sources supplied 9.9 percent of U.S. energy consumption, with significant gains made by biomass and wind sources.¹⁴ Diversifying the U.S. energy portfolio is about more than reducing climate risk. It also is about leadership in the technologies, industries and jobs emerging from this transition.

Demographics and Debt

Like many advanced economies around the world, America is aging. In 1986, Americans over age 65 accounted for 12.1 percent of the population.¹⁵ Today, increasing longevity and a baby boom generation beginning to retire has grown that share to 14.9 percent of Americans. Projecting to 2045, Americans over age 65 will comprise 21.8 percent of the population, almost twice the share of 1986.¹⁶

14. Data drawn from 1986 and 2015 Energy Flow Charts, Lawrence Livermore National Laboratory.

15. National Center for Health Statistics, United States Census Bureau.

16. 2014 National Population Projections, United States Census Bureau.

This demographic change has major implications for the national debt, which is at a historically high level. Debt held by the public as a share of gross domestic product is a standard measure of how well a nation is positioned to finance its debt. In 1986, debt/GDP stood at 38.4 percent, near the U.S. historical average. That ratio is projected to rise to 76.5 percent in 2016,¹⁷ levels not seen since the end of World War II.

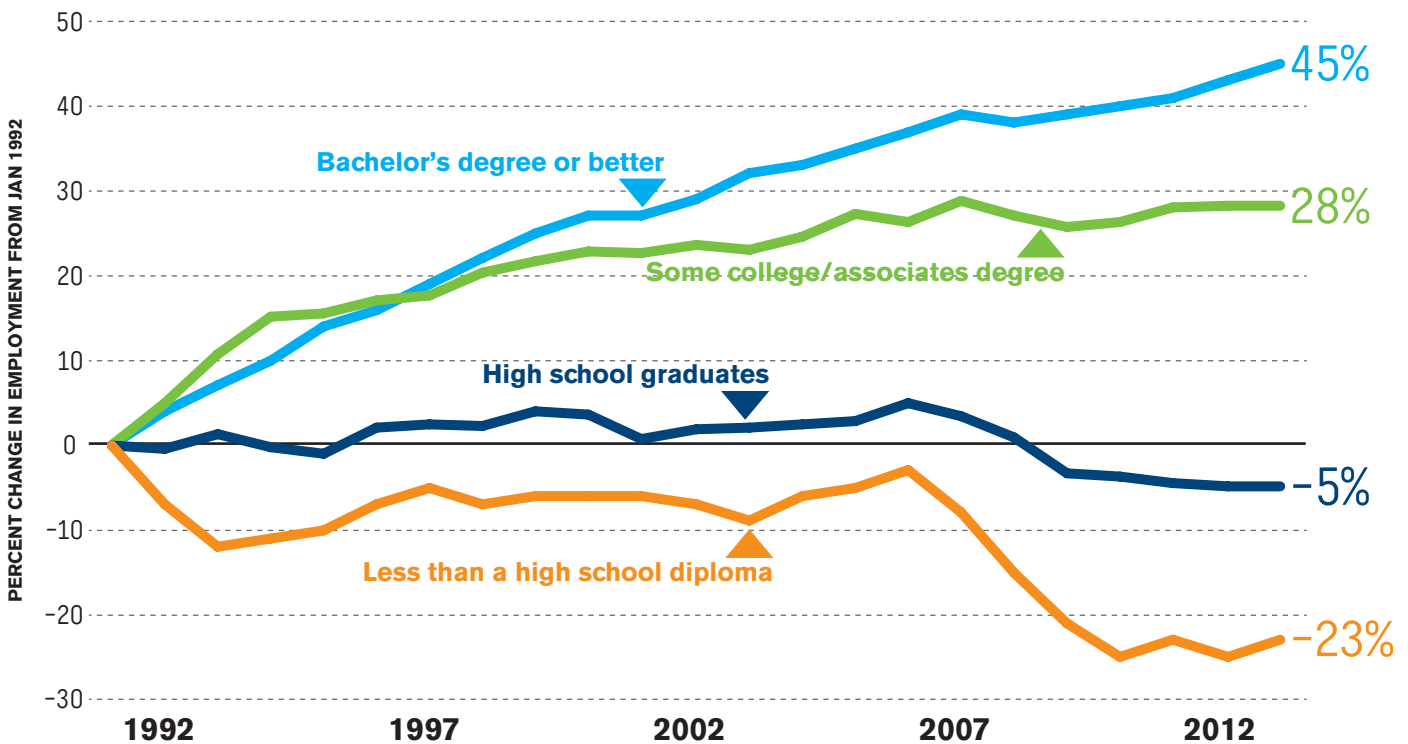
Due to an aging population, the Congressional Budget Office projects Medicare, Social Security and interest on the debt to be the fastest growing components of the federal budget.¹⁸ Without tax and spending reforms, America will struggle to invest adequately in strategic areas like infrastructure, research, education and security.

Labor Market Polarization

In 1986, the United States and other advanced economies were in the early stages of a shift in the degree to which education and skills determined employment and wage growth. As a global labor pool became more accessible, affordable and skilled, Americans without trade skills or higher educational attainment found it more difficult to find work—and those that did saw their wages stagnate or decline. People who formerly went from high school to decent paying factory jobs with no further training found their prospects greatly diminished. Conversely, those with advanced skills or degrees found themselves in greater demand, and experienced higher levels of employment and income growth (Figure 4).

Figure 4. Employment Growth by Educational Attainment

Source: U.S. Bureau of Labor Statistics



17. Historical Tables, Office of Management and Budget, Executive Office of the President.

18. The 2016 Long Term Budget Outlook, Congressional Budget Office.

Corporate Tax Rates

In the 1980s and 90s countries began lowering corporate tax rates in search of greater business investment and expansion. In 1986, the U.S. corporate rate of 49.8 percent was 1.6 percentage points higher than the OECD average.¹⁹ In 1988 America's rate dropped to 38.6 percent and has remained roughly there for the past 27 years. Competing nations, however, continued lowering their corporate tax rates. In 2016 the U.S. corporate tax rate stands at 38.9 percent. A study by the Tax Foundation notes that the United States imposes the highest such rate in the OECD and third highest of 188 tax jurisdictions around the world, trailing only the United Arab Emirates and Puerto Rico. The U.S. corporate tax rate is 16 percentage points higher than the worldwide average of 22.5 percent.²⁰

A further tax drag on U.S. competitiveness is a worldwide double taxation system that results in \$2.6 trillion in earnings held overseas.²¹ Firms that could otherwise invest those earnings or pay them as dividends in the United States are compelled to borrow or issue debt instead.

Manufacturing

U.S. manufacturing employment peaked in 1978. By 1986 it had fallen 9.6 percent from that peak to 17.5 million workers. Automation, outsourcing and a lack of competitiveness in some sectors due to factors like taxes, regulation or currency values drove manufacturing employment to its nadir during the recession in 2009. Since then, employment in the sector has grown each year. At the end of 2015 U.S. manufacturers employed 12.3 million people, a 7.4 percent rise from the 2009 nadir.²²

U.S. manufacturing production is another story. It has risen steadily over the past 30 years, with short dips for the 2001 and 2009 recessions. Gross output

in U.S. manufacturing has risen 169 percent since 1986, from \$2.21 trillion to \$5.9 trillion in 2015. U.S. manufacturing value-added grew 160 percent over that time, peaking in 2015 at \$2.17 trillion.²³

As a share of GDP, manufacturing has declined over the past 30 years as the growth of services and the digital economy have changed the economic landscape. This dynamic is true in almost all major manufacturing nations, including the United States, China, Germany, France, the United Kingdom and Japan.²⁴

This is not to say, however, that manufacturing is growing less important. To the contrary, manufacturing has the highest multiplier effect of any sector in the economy. For every dollar of U.S. manufacturing value-added created, another \$3.60 of value-added is created elsewhere in the economy. For every full-time U.S. manufacturing job created, 3.4 full time jobs are created in non-manufacturing industries.²⁵ Manufacturing firms also fund a disproportionate share of business R&D.²⁶

Student Debt

The average student loan debt for the 2015-16 school year for U.S. graduates with a bachelor's degree is estimated to be \$37,173.²⁷ Although a 30-year data set was unavailable, average debt for bachelor's degree earners has risen 299 percent since the 1992-93 school year (then an average of \$9,320). Total debt, including student and parent debt for higher education, rose from an average of \$9,797 in 1992-93 to \$45,305 in 2015-16, a jump of 362 percent. The share of graduating bachelor degree students with loans also has risen dramatically over this time period—from 45.5 percent

19. OECD Corporate Income Tax Rates, 1981-2013, The Tax Foundation.

20. Pomerleau, Kyle and Potosky, Emily. *Corporate Income Tax Rates Across the World*, The Tax Foundation, August 18, 2016.

21. Lawler, Joseph. *Untaxed offshore earnings of US companies rises to \$2.6 trillion*, Washington Examiner, September 29, 2016.

22. National Employment Statistics Survey, Bureau of Labor Statistics, United States Department of Labor.

23. Gross Domestic Product by Industry Data, Bureau of Economic Analysis, United States Department of Commerce.

24. Manufacturing Value Added as a Percentage of GDP, National Accounts Data, the World Bank.

25. Meckstroth, Dan. *A New Model for Manufacturing's Multiplier Effect*, Manufacturers Alliance for Productivity and Innovation, April 27, 2016.

26. *Advanced Technologies Initiative, Manufacturing and Innovation*, Deloitte and U.S. Council on Competitiveness, 2015.

27. Kantrowitz, Mark. *Debt at Graduation for Bachelor's Degree Recipients with Geometric Interpolation/Projection*, MK Consulting, Inc.

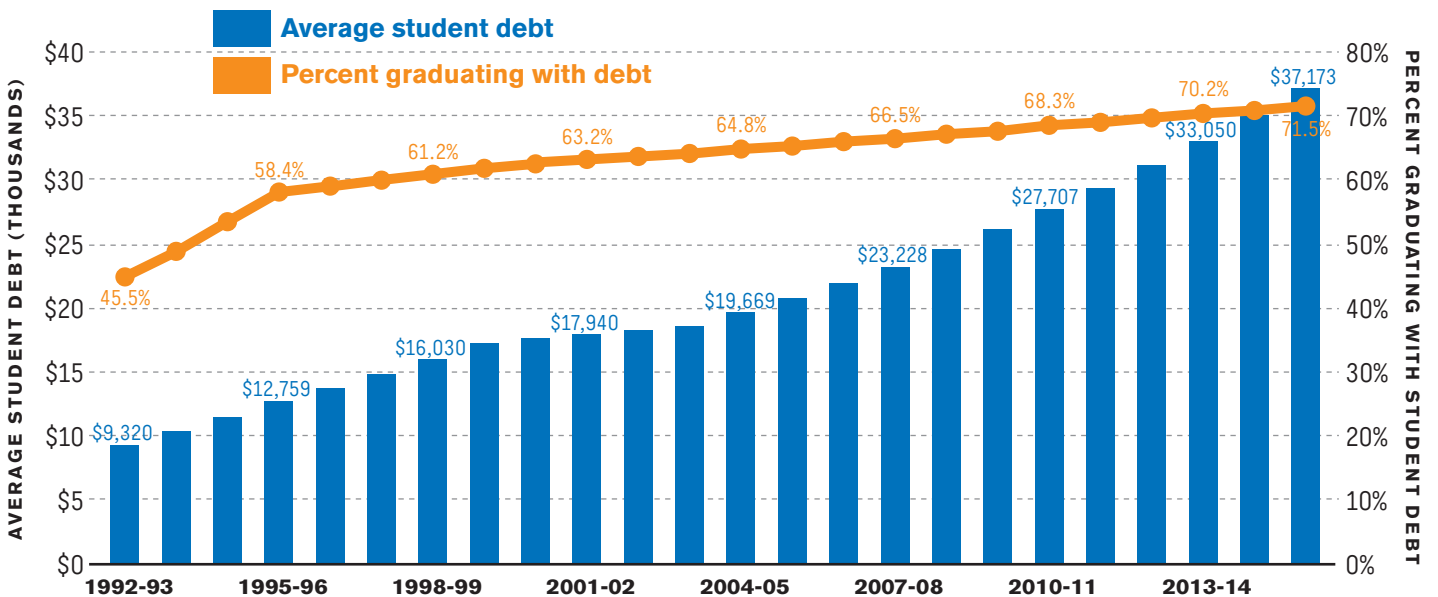
to 71.5 percent.²⁸ Part of this growth is due to the fact that more Americans now pursue degrees—thus growing the share with financial need. The share of Americans aged 25 and older completing four years of college has risen from 21.4 percent in 1992 to 32.5 percent in 2015.²⁹

One can make the case correctly that earning a degree is still worth the investment. Over an American adult’s working life, the Census Bureau finds that high school graduates earn on average \$1.2 million, while those with a bachelor’s degree

will earn \$2.1 million. Master’s degree holders earn on average \$2.5 million.³⁰ This value proposition, however, does not change the reality that a substantially higher share of students today are graduating with debt than was the case 23 years ago, and that the average level of that debt is significantly higher. Many economists suggest that the rapid growth of student debt has served to dampen U.S. consumption.³¹

Figure 5. U.S. Student Debt

Source: Mark Kantrowitz



28. Ibid.

29. Current Population Survey Historical Time Series, Educational Attainment, United States Census Bureau.

30. Longley, Robert. *Lifetime Earnings Soar with Education*, About News, July 7, 2016.

31. Nasiripour, Shahien. *Student Debt May Hurt Economy As Record Levels Dampen Other Loans*, Huffington Post, May 10, 2013.

Health Care

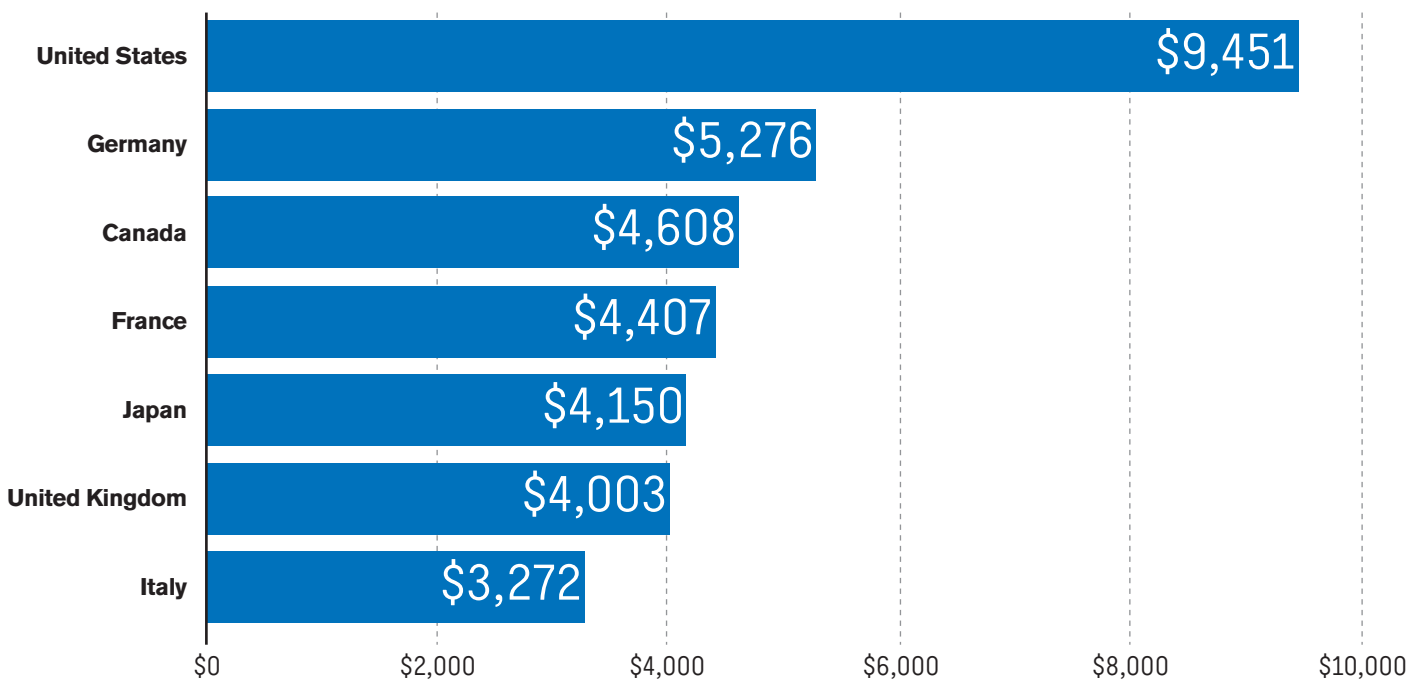
In 1986, health care spending accounted for 9.7 percent of U.S. GDP. In 2015, that share rose to a record-high 16.9 percent—88 percent higher than the OECD average of 9 percent.³² The United States also spends a considerably higher amount for healthcare on a per capita basis than any industrialized nation. America spends \$9,451 per person—a figure 79 percent higher than the next biggest spender, Germany, among the Group of Seven Highly Industrialized Nations (Figure 6).

There is little evidence that Americans enjoy better health outcomes commensurate with this higher level of expenditure.

A study produced by Gallup and the Council suggests that improving efficiency in sectors like healthcare, housing and education could pay large dividends in the form of U.S. growth.³³ Public and consumer spending for these purposes have grown over the past several decades without clear relative improvements in quality. Making these sectors more productive would enable greater public investment and private consumption for other priorities.

Figure 6. Health Spending Per Capita in G7 Industrialized Nations

Source: OECD



32. Health Expenditure as a percentage of GDP, Organization for Economic Cooperation and Development.

33. Rothwell, Jonathan. *No Recovery: An Analysis of Long-Term U.S. Productivity Decline*, Gallup and the U.S. Council on Competitiveness, 2016.

On the Horizon

Thirty years ago, U.S. companies faced significant competition from nations like Japan and Germany. Although the causes included issues like dumping and foreign government support for domestic industries, a deeper concern was that America was losing its edge in innovation and quality. The public and private sectors responded with policies like the Bayh-Dole Act to boost U.S. innovation, management reforms like Six Sigma to strengthen quality, and public-private partnerships like SEMATECH to reclaim competitiveness in the strategic semiconductor industry.

Today, America is in the midst of another transition. Great revolutions in science and technology are ushering in a new age of unprecedented knowledge, unparalleled technological power and almost inconceivable innovation with profound implications for U.S. competitiveness.

One of the most exciting changes includes working towards **extending Moore's law**. For the last half century, Moore's law has been a guiding principle of computing. It states that the number of transistors on a microprocessor chip will double about every two years, which has generally meant that the chip's performance will, too.³⁴ The law, articulated by Intel founder Gordon Moore, is less a scientific law than an economic rule of thumb that drove process engineering.³⁵ Essentially, it set manufacturing targets for future processors based on an understanding of what should be possible.

The law, however, is facing challenges under existing technology due to the heat generated by more circuitry concentrated on silicon. Another fundamental limit looms less than a decade away. Top-of-the-line microprocessors have circuit features around 14 nanometers across, smaller than most viruses. But by the early 2020s, that span might decrease to 2 or 3 nanometers, where features are just 10 atoms across. At that scale, electron behavior will be governed by quantum uncertainties that will make transistors unreliable.³⁶

Research is underway to continue improving chip performance through new materials and spintronics that utilize the magnetic spin of an electron in addition to its charge. Other researchers are exploring new 3-D chip silicon architectures, but neither approach appears primed to reach the marketplace soon. Industry leaders have signaled that innovation will rely on both the chip industry and on a broad ecosystem (e.g. equipment manufacturers, software, computer models, cloud computing and architectures tailored to applications).

In the midst of this shift, the U.S. military has to ensure that it has trusted sources for microelectronics. As specialty chip production has become increasingly less competitive in the United States, the Defense Department announced this year that it will rely on a non-U.S. company to supply advanced microchips for U.S. military and intelligence purposes. Military and intelligence agencies are working to ensure that they have a trusted environment—one where sensitive technologies are

34. Waldrop, M. Mitchell. *The Chips are Down for Moore's Law*, Nature, February 9, 2016.

35. *Beyond Moore's Law*, The Economist, May 26, 2015.

36. Waldrop, M. Mitchell. *The Chips are Down for Moore's Law*, Nature, February 9, 2016.

safeguarded and rogue elements are not added to microelectronics that could eavesdrop or disable equipment.³⁷

Congress included language in the most recent Defense authorization bill requiring the Secretary of Defense to “implement a strategy for developing and acquiring trusted microelectronics from various sources by 2020.” That strategy must be submitted to the congressional defense committees within a year after passage of the 2017 Defense authorization bill.³⁸

And electronics represents only the tip of the iceberg in technology change. The world is entering a **new stage of the digital revolution**. The physical and digital worlds are converging across numerous dimensions through sensors, networks and a data tsunami. We are connecting things on a scale once unimaginable through the Internet of Things (IoT). The stunning potential of these technologies for driving optimization, efficiency and discovery is an industrial productivity revolution in the making. Firms will gain insights on the operation of every machine, the movement of supplies, the performance of products and the consumption of energy in real time. Big data will transform the way manufacturers approach markets, manage their organizations, design products, deploy people, conduct R&D, and more. Taking advantage of big data and IoT will require further innovation in energy efficiency and power generation, however, as it is unclear at current rates of development whether adequate energy will be available to power the growth of devices.

37. Cameron, Doug. *Pentagon Hires Foreign Chips Supplier*, Wall Street Journal, June 5, 2016.

38. McCormack, Richard A. DOD, *NSA Enter A New World Order: U.S. Is Now Dependent On Foreign Companies For Its Most Sensitive Electronics*, Manufacturing & Technology News, May 31, 2016.

As data and intellectual assets become increasingly valuable, firms also need to renew their commitment to best practices in **cybersecurity** and elevate the issue to their C-suites and boardrooms. Cybersecurity should be viewed as a business enabler rather than a technology expense. An effort by more senior U.S. corporate leaders to close their firm’s gaps between best practices and execution would make a significant impact.

In addition to these digital revolutions, companies are working to leverage advances in robotics and artificial intelligence for everything from self-driving vehicles to new production models. Industry experts estimate that investments in **smart manufacturing** could generate cost savings and productivity gains that could add \$10-15 trillion to global GDP over the next 15 years; that is an enormous value, almost the size of the U.S. economy today.³⁹

As a new manufacturing paradigm for processes and products, **nanotechnology** is no longer coming of age. It is here, reaching the \$1 trillion market milestone.⁴⁰ It will shape the future of key industrial sectors such as chemicals, pharmaceuticals, materials, food production and energy.

The commercialization and use of **biotechnology** is at an inflection point. It took 13 years and \$3 billion to sequence the first human genome.⁴¹ Today, sequencing a genome takes about 24 hours at a cost that could be paid on a credit card.⁴² These remarkable cost reductions will have profound

39. Wince-Smith, Deborah. *Testimony before the Senate Committee on Energy and Natural Resources*, Hearing on Innovation Technologies in Advanced Manufacturing, April 16, 2016.

40. Ibid.

41. Ibid.

42. Ibid.

implications for the pharmaceutical industry. As biomanufacturing emerges, new tools could allow the United States to engineer biological systems with applications for fuels, medicine and electronics.

One particularly promising biotechnology tool is a new method to modify plant and animal DNA and to understand the impacts faster, less expensively, and more precisely. The method uses a specifically engineered RNA molecule known as a CRISPR (Clustered Regularly Interspaced Short Palindromic Repeat), paired with an enzyme known as a CRISPR associated protein (Cas). The CRISPR attaches to a target piece of DNA strand and the Cas cuts the strand much more accurately than was possible with prior approaches.

Using this method, scientists foresee great new potential to combat genetic and other diseases, improve agricultural yields and make crops more drought, pest or disease resistant. The ability to more precisely edit genes raises ethical and legal questions about human engineering that societies must sort out as the technology continues to mature and potential uses are better understood.

America and its competitors also are in the midst of a fundamental **energy** system transition, representing a once-in-a-generation opportunity to capture a large share of the manufacturing and jobs associated with a \$300 billion per year set of clean energy markets, expected to grow into the trillions of dollars per year. In addition, companies are learning to leverage new technologies and data from sensors to drive energy efficiencies in their buildings, vehicles and industrial processes. Similarly, many firms are pursuing **sustainability** strategies with an eye

toward boosting growth rather than simply complying with regulations. A sound strategy can boost the bottom line through less energy consumption, reduced waste, or more efficient water management. Sustainability practices also differentiate a company and help it meet the expectations of investors, customers and employees.

Another change is the **democratization of innovation and production**. The tools of production are now available to individuals. Disruptive technologies like 3D printers, prototyping tools, laser cutters, easy-to-use design software, off-the-shelf electronics and desktop machine tools are lowering barriers to entry. An individual innovator can design and make a product without owning any manufacturing infrastructure—no warehouse, no assembly line, no forklifts, no heavy equipment, no inventory. Things can be made through micro-factories or using small production contracts. It is becoming possible for someone to imagine, develop and scale a disruptive technology independent of traditional institutions of innovation and production. This “Maker Movement” is growing across the United States and represents a major opportunity to gain competitive advantage by expanding and empowering America’s pool of creators, innovators, and entrepreneurs.

Innovation also is evolving through new forms of **partnerships** between industry, academia, research labs and government. A prominent example is the National Network of Manufacturing Innovation Institutes, now known as Manufacturing USA. The institutes illustrate a larger and growing movement among U.S. universities to be more engaged in

the economic life of their community and country. Similarly, companies and the national laboratories are exploring new ways or new terms on which to partner with each other and academia.

American higher education also is pursuing new ways to teach entrepreneurship, enable innovation and prepare students to prosper. Universities are launching incubators and accelerators, hiring professors of practice, encouraging experiential learning on real world problems and engaging with community leaders and companies to ensure that graduates can align their education to skills in demand. Universities and national laboratories also are experimenting with new forms of research partnerships, including alternative intellectual property practices and leveraging technologies like high performance computing systems. Institutions are even comparing notes on best practices and models, such as the Economic Engagement Framework of the Association of Public and Land Grant Universities and the University Economic Development Association.

The U.S. Council on Competitiveness and its members are excited about the promise of the nation's future if we work together to seize the opportunities unfolding before us and to reform those policies that limit America's potential. The *2016 Clarion Call* offers a road map to achieve these objectives and usher in a renewed era of growing and widely-shared prosperity.

Recommendations

The recommendations issued by the Council stem from America's most senior leaders in industry, academia, labor and the national laboratories. Council Members exchange ideas and offer solutions through several initiatives such as the:

- **Exploring Innovation Frontiers Initiative (EIFI)** is a national, public-private partnership to understand the over-the-horizon, transformative innovation models that will drive U.S. competitiveness
- **Energy and Manufacturing Competitiveness Partnership (EMCP)** is a C-suite peer group that analyzes critical sectors of the economy shaped by an altered energy landscape, coupled with a focus on energy productivity and an emergent advanced manufacturing sector
- **Technology Leadership & Strategy Initiative (TLSI)** is a progressive dialogue since 2009 of 50 chief technology and science officers from America's premier companies, universities and national laboratories. The TLSI: advocates for better public policies to optimize America's investments in research, talent and technology; catalyzes new forms of collaboration; and develops new management strategies in this rapidly evolving environment
- **High Performance Computing Advisory Committee (HPCAC)** is the pre-eminent forum for HPC experts in the United States, including industrial HPC users, hardware and software vendors, and directors of academic and national laboratory advanced computing centers. The HPCAC works to maintain U.S. leadership in the development and deployment of HPC hardware and application software that are crucial for global leadership in science, security and business.

The recommendations also stem from the Council's body of work and continuing interest in areas like workforce dynamics, regional drivers of competitiveness, infrastructure and resiliency.

The Council's integrated view of competitiveness cuts across four pillars: talent, technology, investment and infrastructure. The Council urges the President-elect to include these priorities in the agenda of the next administration and to commit to act upon them in the first year of taking office. The Council and its members stand ready to work with incoming officials to translate high-level recommendations into specific action items.

Talent

America's industry executives in every sector, in every Council initiative, make clear that their highest priority is finding and developing the talent they need. It is the key to expanding U.S. operations, attracting new investment, and filling hundreds of thousands of available U.S. jobs that remain open due to a lack of skilled applicants. Over the next decade, this skills gap is likely to leave up to 2 million American jobs unfilled.⁴³

More than ever, America must teach, train, and attract people with a high level of knowledge and skills in order to compete and prosper. Political leaders must implement ideas that enable industry to work more effectively in partnership with universities, community colleges and unions to:

- Expand the number of degree earners in science, technology, engineering and math disciplines; encourage the diversity of this population; and link them to cultures of entrepreneurship

43. 2014 Skills Gap Study, Deloitte and The Manufacturing Institute.

- Establish more opportunities for creative and experiential learning that includes internships, mentorships and cross-disciplinary work. Industry and academia should partner in these activities to align skills and jobs more effectively
- Incorporate more professors of practice into education, bringing experienced practitioners into the classroom
- Strengthen career and technical education and training programs that bring industry and labor together, and ensure that programs under the Workforce Investment Act are administered and evaluated effectively
- Integrate technical training into K-12 education, including the return of contemporary shop classes that build a base for skilled trades
- Encourage state and local efforts to build a continuum of talent across disciplines—from secondary education to higher education to continuing education—where individuals can make informed decisions, find affordable options and acquire skills with which they can succeed
- Reform broken immigration policies to retain the world's best talent. As a start, a green card should be stapled to the diplomas of immigrants earning advanced degrees from American universities. Highly-skilled immigrants have proven to be a crucial element of the startup culture in the United States that generates faster growth and thousands of jobs
- Enable greater lifelong learning opportunities by reforming federal savings plans to allow tax-exempt contributions by workers for training and tax credits for employers who match contributions
- Issue innovation-specific “H-1B training grants” to ensure Americans are trained in skills and fields for which companies now bring in foreign nationals

Technology

The United States must continue to lead in strategic technologies that underpin the nation's national security, economic competitiveness and standard of living. The federal government can create an environment that facilitates leadership by industry, academia, and the national laboratories to collaborate and:

- Expand the national network of advanced manufacturing clusters and smart factory ecosystems. Several hubs were launched under the National Network for Manufacturing Innovation (now Manufacturing USA). The Council encourages the President-elect to work with private sector leaders and localities to sustain and extend this network
- Lead in high performance computing that enables cutting-edge breakthroughs in virtually every scientific discipline, multiple defense and intelligence applications and across business sectors. This bipartisan priority requires federal leadership to develop next-generation technologies, software and partnerships that expand adoption of modeling, simulation and analytics
- Launch an initiative on technology commercialization that learns from state and local efforts, federal initiatives and global partnerships. The initiative should explore new ways to: incentivize entrepre-

neurship, facilitate startups to scale up, improve access to capital and encourage industry partnerships with academia and the national laboratories

- Develop and implement a “whole of nation” Presidential strategy for a large, sustained public-private partnership to support America’s ecosystem for global leadership in the research, design and protection of trusted semiconductors and microelectronics
- Protect intellectual property, promote best practices globally and secure critical infrastructure against cyberattacks. Solving these issues is not only a matter of technology leadership, but also of building a cybersecurity workforce and adopting best practices more widely

Investment

To create the conditions necessary for a thriving economy, government must have a stable fiscal position that allows for: competitive tax rates, strategic investments by government and confidence from global financial markets. These conditions: encourage greater investment in the United States by private firms domestic and foreign; enable modern infrastructure to be built; support effective military, police and judicial systems; and facilitate strategic investments in areas like education, training and scientific research. The Council urges the President-elect to:

- Work across party lines and enact compromises on spending and revenue that will bring America’s debt back to historic norms as a share of the economy. Reforms are needed to secure the solvency of health and pension programs on which Americans rely, and to enable the government to invest strategically, make tax rates competitive, and have adequate resources to address future emergencies
- Prioritize federal research investment, which continues to decline as a share of the economy. Research and innovation are essential for economic growth. The Council supports the America COMPETES strategy to double research

investment, particularly in the physical sciences and engineering, and to encourage cross-disciplinary partnerships and commercialization

- Lower the U.S. corporate tax rate—now the highest among advanced economies—to 23 percent and reduce exemptions. The new administration also should encourage the repatriation of over \$2.6 trillion held overseas by lowering the tax on foreign earnings to less than 5 percent. These reforms would encourage long-term investment in the United States

Infrastructure

A healthy modern economy relies on robust physical, cyber and policy infrastructure. America’s drinking and waste water systems, roads, bridges, ports, energy networks, levees, communication systems and airports are all in need of significant upgrades. Critical public and private networks remain vulnerable to cyber-attack. And America should not be left behind as other nations open markets for their exporters. The President-elect should:

- Work with states and localities to deploy modern and resilient infrastructure
- Re-assert leadership in global trade by forging strategic bilateral and multilateral agreements
- Review regulatory burdens that deter or inhibit investment in the United States and streamline or eliminate rules that add cost or delay without a clear benefit to consumers
- Support research, development and deployment of clean energy and energy efficient technologies
- Sustain the Ex-Im Bank so it can extend the reach of U.S. exporters. The bank also could be leveraged to support needed domestic infrastructure projects that would sustain jobs not subject to offshoring

The Competitiveness Report Card

The U.S. Council on Competitiveness grades policymakers on their progress, or lack thereof, addressing several key competitiveness policy recommendations. The Council recommendations are informed by over a decade of research and the insights of the nation's leading corporate executives, academic and labor leaders and national lab directors. The 2016 Competitiveness Report Card assesses policymakers' actions over the course of the past year. For comparison, the 2015 grade is shown in parentheses. Only the Council recommendations specific to policymakers are contained in the Competitiveness Report Card.

CALL TO ACTION	GRADE (2015)	JUSTIFICATION
TALENT		
<p>Reform immigration rules to ensure that the world's best talent innovates and creates opportunities in the United States. Staple a green card to the diplomas of highly skilled immigrants who acquire an advanced degree in the United States.</p>	<p>F (D)</p>	<p>Despite continued broad support for high-skill immigration reform, disagreement on other immigration issues blocked progress in 2016. Highly charged campaign rhetoric on the issue makes the outlook for 2017 appear equally difficult.</p>
<p>Expand degree earners in science, technology, engineering and math (STEM) and encourage the diversity of this population.</p>	<p>B (B)</p>	<p>The number of STEM degrees awarded each year continues to rise. Women earn more STEM degrees than men, but men account for 81 percent of bachelor's degrees in engineering.⁴⁴ Overall, 38 percent of bachelor's degrees earned by men and 29 percent earned by women are in STEM fields. Hispanic students are earning an increasing share of bachelor's degrees in STEM fields, rising from 7 to 11 percent since 2000.⁴⁵</p>
<p>Strengthen career and technical education (CTE) and training programs through partnerships with business or labor that prepare students and workers for good jobs that fill labor market needs. Issue H-1B training grants to train Americans in fields for which companies now rely on foreign nationals.</p>	<p>B (B)</p>	<p>The Workforce Investment and Opportunity Act went into effect in July 2015. Five implementing regulations took effect in September and October of 2016. The law streamlines coordination between major programs; establishes common performance measures; and works to align adult education, postsecondary education and employer programs. The Labor Department in June 2016 called for proposals under the America's Promise Job Driven Grant Program to train in H-1B fields. \$1 billion is available under the program.⁴⁶</p>
<p>Enable greater lifelong learning opportunities by allowing workers to make tax-exempt contributions to a savings account for that purpose. Offer tax credits to employers who match contributions.</p>	<p>C (N/A)</p>	<p>This is a new Council recommendation. Legislation for this purpose was introduced in 2011, but no action was taken. Current law permits a non-refundable tax credit for lifelong learning up to \$2,000 annually. Non-refundable means that the credit can zero out a person's tax liability but no payment in excess of the liability is paid.</p>

44. National Science Board. Science and Engineering Indicators 2016, National Science Foundation.

45. Ibid.

46. Employment and Training administration. *Notice of Availability of Funds and Funding Opportunity Announcement for America's Promise Job Driven Grant Program*, U.S. Department of Labor, June 6, 2016.

CALL TO ACTION	GRADE (2015)	JUSTIFICATION
TECHNOLOGY		
Continue expanding the National Network of Manufacturing Innovation Institutes (now Manufacturing USA Institutes).	A (A)	Two more institutes were launched in 2016, raising the total number of hubs to nine. In June, the President announced five new manufacturing hub competitions, which will invest nearly \$800 million in federal and non-federal resources to support manufacturing technologies including robotics, biofabrication and new ways to reuse and recycle materials. ⁴⁷ The Obama administration aims to launch 15 hubs.
Launch an initiative on technology commercialization that examines local, state, federal and global efforts. Propose new actions to incentivize entrepreneurship, facilitate startups to scale up, improve access to capital and encourage partnerships between industry, academia and national laboratories.	C (N/A)	This is a new Council recommendation. The incoming administration should pursue an innovation and commercialization initiative as part of its economic strategy to increase productivity and economic growth.
Develop and implement a “whole of nation” President-led strategy for a large sustainable public-private partnership to support America’s ecosystem for global leadership in the research, design and protection of trusted semiconductors and microelectronics.	C (N/A)	This is a new Council recommendation. The incoming administration should support a public-private partnership network for trusted semiconductors and microelectronics as part of the trusted source strategy mandated by Congress.
Lead in High Performance Computing (HPC) by committing to exascale computing; addressing issues of software, skills and industry access; and launch pilots that enable U.S. small- and medium-sized businesses to leverage modeling and simulation tools.	B (A)	In 2015, President Obama established the National Strategic Computing Initiative (NSCI). It is important to sustain this effort in the new administration and increase private sector engagement. Part of the NSCI is the Exascale Computing Project that aims to build “capable exascale systems” that have all the components to solve complex problems. The competition is intense with rapid investment and progress being made in China.
Promote best practices in the protection of intellectual property rights around the world and secure critical infrastructure against cyber-attacks.	C (C)	Piracy of data and intellectual property remains a significant concern. The number of U.S. data breaches plateaued in 2015 with 781 breaches. Most attacks were on private sector entities, including firms, health organizations and financial institutions. ⁴⁸ Congress is considering cyber security measures to promote best practices in government agencies and to secure critical non-government infrastructure. In addition, up to 25 states enacted or have pending cybersecurity measures in 2016. ⁴⁹

47. The White House. *Fact Sheet on Winner of New Smart Manufacturing Innovation Institute and New Manufacturing Hub Competitions*, June 20, 2016.

49. National Conference of State Legislatures. *Cybersecurity Legislation 2016*, April 11, 2016.

48. Identity Theft Resource Center. *Data Breach Report*, December 29, 2015.

CALL TO ACTION

GRADE
(2015)

JUSTIFICATION

INVESTMENT

Double the investment in federal research and development and encourage cross disciplinary partnerships to commercialize results.

F
(F)

Despite urgent calls to increase federal R&D investment, basic research has largely been flat since 2002, and total federal research and development as a share of GDP dropped to 0.77 percent in 2015, the lowest level in at least 40 years.⁵⁰

Work across party lines to compromise on spending and revenue measures that will bring the nation's debt down to historical norms.

D
(C)

The federal debt as a share of GDP rose in 2016 to 77 percent, its highest level since 1950 in the wake of WWII. Under current law, that ratio is projected to rise to 86 percent in 10 years—driven by an aging population, growing health costs, and rising interest payments.⁵¹ Congress and the administration did not enact structural reforms to begin addressing these issues.

Lower the corporate tax rate to 23 percent, in line with the upper quartile of OECD economies.

D
(D)

The United States has the third highest general top marginal corporate income tax rate in the world, at 38.9 percent, trailing only the United Arab Emirates and Puerto Rico.⁵² The worldwide average across 188 countries and tax jurisdictions is 22.5 percent.⁵³

Reduce taxes on repatriated earnings to less than 5 percent, in line with other OECD economies.

D
(D)

Corporate tax reform remains elusive while \$2.6 trillion⁵⁴ is held overseas due to tax rules that discourage companies from repatriating foreign earnings back to the United States.

50. American Association for the Advancement of Science. *Historical Trends in Federal R&D*, June 2016.

51. Congressional Budget Office. *Update to the Budget and Economic Outlook: 2016 to 2026*, August 23, 2016.

52. Pomerleau, Kyle and Potosky, Emily. *Corporate Income Tax Rates Across the World*, The Tax Foundation, August 18, 2016.

53. *Ibid.*

54. Lawler, Joseph. *Untaxed Offshore Earnings of US Companies Rises to \$2.6 Trillion*, Washington Examiner, September 29, 2016.

CALL TO ACTION	GRADE (2015)	JUSTIFICATION
INFRASTRUCTURE		
Deploy modern and resilient energy, transportation, and cyber infrastructures to encourage investment and production in the United States. Energy investments should include renewables and energy efficiency technologies.	F (F)	The United States continues to have significant infrastructure issues, but it appears that progress is being made. The President and Congress agreed to a 5-year, \$300 billion highway bill at the end of 2015. In addition, state and local governments are taking advantage of low interest rates to finance infrastructure at its highest level since 2010. ⁵⁵
Re-assert leadership in global trade, expanding access to markets and ensuring fair enforcement of trade rules. The United States should forge strategic agreements with Brazil, China, India, Japan, the EU and other major trade partners.	C (B)	The United States and 11 other nations signed the Trans Pacific Partnership Agreement (TPP) in February, 2016. Significant opposition from both parties in Congress and the President-elect effectively block this pact. The future of new and existing agreements also are in flux as the incoming administration has pledged to renegotiate America's trade relationships.
Re-authorize the Export-Import Bank and expand its mission to fund domestic infrastructure projects.	B (C)	The Export-Import Bank was reauthorized through September 30, 2019.
Review regulatory burdens that deter or inhibit infrastructure investment in the United States and streamline or eliminate rules that add cost or delay to such investments without a clear benefit to consumers.	C (N/A)	This is a new Council recommendation that should be pursued by the incoming administration.

55. Varghese, Romy. *Long-Awaited U.S. Infrastructure Spending Comes to Fruition*, Bloomberg, August 26, 2016.

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U.S. Council on
Competitiveness

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The U.S. Council on Competitiveness is a nonpartisan leadership group of CEOs, university presidents, labor leaders and national lab directors working to ensure U.S. prosperity. Together, we advance a pro-growth policy agenda and promote public-private partnerships in the emerging “innovation ecosystem” where new technologies are born.

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How We Operate

The Council Operates by:

- Identifying emerging competitive challenges.
- Generating new policy areas to shape the competitiveness debate.
- Forging public-private partnerships to drive consensus.
- Galvanizing stakeholders to translate policy into action and change.

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