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PROMETHEUS BOUND

How Regulations Stifle a U.S. Manufacturing Renaissance

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Mills served in the White House Science Office under President Reagan and has provided science and technology policy counsel to numerous private-sector firms, the Department of Energy, and U.S. research laboratories. Early in his career, Mills worked at Bell Northern Research (Canada's Bell Labs) and at the RCA David Sarnoff Research Center as a semiconductor manufacturing development engineer and as an experimental physicist, earning several patents. He holds a degree in physics from Queen's University in Ontario, Canada.

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Executive Summary

The conditions are ripe for a boom in American manufacturing, especially in high-tech, high-value-added sectors, including semiconductors, pharmaceuticals, refined hydrocarbons, chemicals, and cloud infrastructure. Moreover, considering energy costs, property rights, and the quality of its workforce, the U.S. remains one of the world's most competitive places to do business.

It is true that some manufacturers have fled the U.S. and many won't return—and 30% fewer Americans are employed in manufacturing now as compared with two decades ago. But the conventional wisdom that American manufacturing is destined for extinction is false.

There are obstacles standing in the way of a manufacturing revival. High corporate taxes are one, and unfavorable trade deals are another. But the biggest single drag on U.S. manufacturing has been the decades-long encroachment of the regulatory state—with an army today of 300,000 regulators and an annual budget of $60 billion.

Complying with regulations costs manufacturers an average of $20,000 per employee per year, twice as great a burden as for other businesses. For the smallest manufacturers (i.e., those with fewer than 50 employees), that annual cost is $35,000 per employee per year. In surveys, America's manufacturers routinely rank regulatory burdens as the top impediment to growth; a large majority also say that regulatory burdens are higher in America than in other nations.

If the administration is to fulfill its pledge to revive American manufacturing, it will have to work with Congress and industry to:

- Cut the Code of Federal Regulations, last done during the Reagan administration.
- Create a private-sector-managed, legislatively enabled Office for Manufacturing Regulatory Assessment (OMRA), modeled on the Financial Industry Regulatory Authority. OMRA would analyze regulatory failures and provide actionable recommendations to Congress and the administration.
- Launch a major prize for innovation in regulatory software. A "Z-Prize," modeled on the private sector's X-Prizes, could bring artificial-intelligence tools to regulators to radically improve transparency and efficiency in administering byzantine federal (and state) regulations.
- Rationalize the regulations constraining emerging FinTech firms. This would improve the flow of credit to small manufacturers, which often struggle to secure financing from conventional sources.

American manufacturers are drowning in red tape. Shrinking and rationalizing the regulatory state would spur a high-tech, high-value-added U.S. manufacturing boom. More broadly, it would help revive America's sputtering economic engine.

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How Regulations Stifle a U.S. Manufacturing Renaissance

Introduction

President Trump's promise to revive U.S. manufacturing played a prominent role in his election victory. In the six months since the inauguration, a steady stream of firms—including Apple,[1] Foxconn (Apple's China-based iPhone assembler),[2] Intel,[3] Exxon,[4] and Hasbro[5]—have announced plans to expand or restore U.S.-based manufacturing operations.

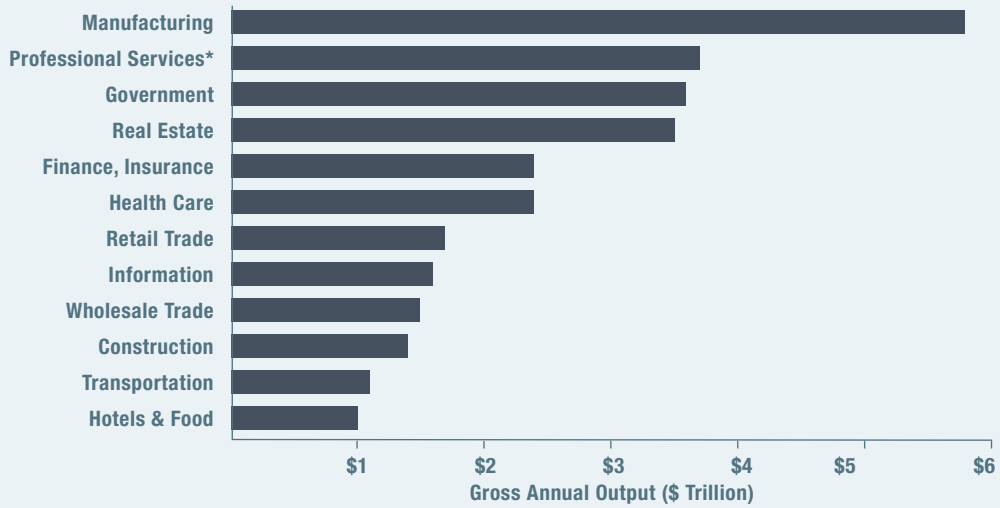
Postindustrial skeptics argue that such efforts are political window-dressing and cannot reverse manufacturing's shrinking role in the U.S. economy. They say that talk of a manufacturing renaissance is an unhelpful distraction.[6] But the evidence suggests that the skeptics are wrong.

Manufacturing Is the Biggest Single Part of the U.S. Economy

The U.S. economy is commonly viewed as comprising three kinds of activities: manufacturing, agriculture, and services. But far too many diverse activities are conflated under "services." A hospital, a shopping mall, a Department of Motor Vehicles office, and a data center are all grouped under "services," but all are as different from one another as each is from agriculture. When properly disaggregated, manufacturing emerges as the biggest—by far—of the 12 largest segments of the U.S. economy (**Figure 1**).

FIGURE 1.

Top 12 U.S. Economic Sectors: Gross Output



*Includes scientific, technical, management, and administrative services, as well as the design of computer systems
Source: Bureau of Economic Analysis[7]

Manufacturing Has the Biggest Economic Multiplier

Manufacturing entails a deep and broad interaction with many other businesses, upstream and downstream from the factory floor—from industries that produce and deliver raw materials and supplies to industries that transport, distribute, operate, and service the final products.[8] Such interdependencies create the well-documented multiplier effect (i.e., the spill-over benefits from each dollar of economic activity in a sector), which is nearly twofold greater for every dollar of GDP in manufacturing than, say, in health-care services.[9] Indeed, the evidence points to a manufacturing multiplier that is far greater than commonly recognized.[10]

Manufacturing Is Integral to Services

Manufacturers operate within an innovation ecosystem that includes much of what we call "services." Service industries are also not possible without manufactured goods: there is no FedEx without trucks and aircraft; there is no Amazon without computers. There is also a gray zone that separates services from manufacturing. Government tracking of growth in these domains involves "often arbitrary distinctions" that can misclassify a factory job as a service (and vice versa), as a 2017 Congressional Research Service report noted.[11] For example, a coder working on manufacturing software would be identified as having a manufacturing job if on a factory payroll; but he would be classified as a service worker if on a contractor's payroll.

Manufacturing Dominates R&D Spending

America's manufacturing sector accounts for two-thirds of U.S. private-sector R&D spending.[12] Compared with that of other nations, U.S. manufacturing R&D spending is also more focused on high-tech products, such as electronics, pharmaceuticals, and aviation.[13]

The Digital Economy Is Built with Manufactured Goods

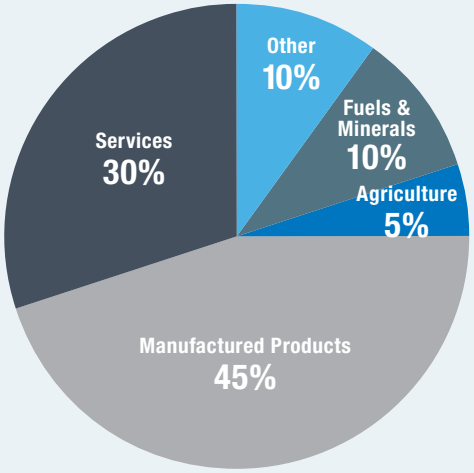
The world's digital infrastructure requires information and communications technology (ICT) hardware. Annual global spending on such hardware exceeds $3 trillion.[14] In order to produce all that manufactured equipment, yet more hardware is needed to extract, transport, and process minerals and materials. And to build and operate enough power plants to power the ICT equipment, still more manufactured equipment is required.

Manufacturing Accounts for the Largest Share of U.S. Exports

America increasingly consumes more foreign goods than it exports, leading to today's annual manufacturing trade deficit of about $600 billion.[15] Nonetheless, manufacturing accounts for the single largest share of all U.S. exports (**Figure 2**).[16]

FIGURE 2.

U.S. Exports by Component



Source: International Trade Administration

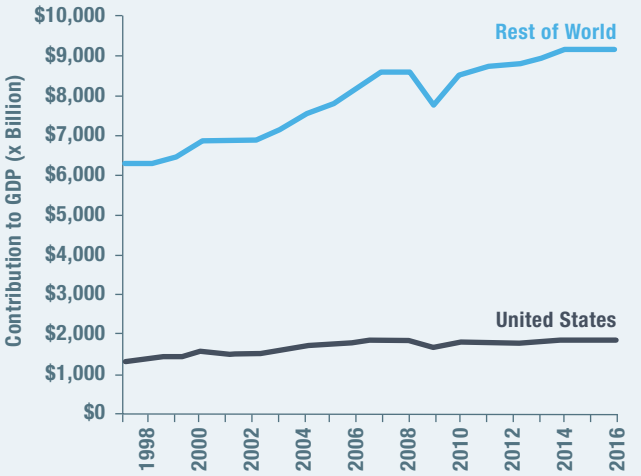
U.S. Manufacturing: Down but Not Out

Compared with 1997, there are 30% fewer jobs in the U.S. manufacturing sector today. (Note that such jobs include, for instance, managers, accountants, and secretaries who work for manufacturers, as well as workers on the factory floor.) Over the past decade, world manufacturing's contribution to global GDP has risen by nearly $3 trillion while U.S. manufacturing's contribution has risen by only $500 billion (almost all of which occurred before 2008). Thus, the U.S. share of global manufacturing has declined, from its longtime level of 25% to about 15%.[17] In other words, America has experienced a declining share of an expanding global manufacturing pie (**Figure 3**).

If the U.S. had just maintained its 1997 share of global markets, America's manufacturing sector would be $1 trillion bigger today. Such growth would have been associated with a dramatic increase—rather than decrease—in manufacturing jobs. Clearly, much has been lost because of the slowing of manufacturing growth in America.

FIGURE 3.

Manufacturing in U.S. and in Rest of World: Contribution to Global GDP



Source: Federal Reserve Bank of St. Louis, World Bank

In 1973, Harvard sociologist Daniel Bell proposed his famous hypothesis, which stipulates that all societies inevitably transition from predominantly low-skilled agricultural work to higher-skilled manufacturing jobs, and later, to knowledge-centric services.[18] Widespread acceptance of this idea has led policymakers to become preoccupied with the need to create various welfare programs to deal with the employment and business dislocations thought to be inevitable.

The numerous problems with Bell's analysis include the notion that the service sector as a dominant employer is something new. On the contrary, more Americans have been employed in services than in the industrial sector every year *for the past 200 years*.[19] That should be unsurprising in light of the fact that "services" encompass a huge array of diverse activities (Figure 1). In addition, many manufacturing jobs are incorrectly counted as services, especially in recent years.[20]

Manufacturing productivity, like agricultural productivity, has risen remarkably since 1917; in both domains, technology has caused output per employee to soar. Overall, however, factory employment has not followed the trajectory of farming employment. Technology eliminated over 98% of the agricultural workforce long ago. Yet we have seen only a 30% decline in manufacturing's share of the labor force. (As discussed below, a significant share of that decline was not caused by technology but by policy decisions that permitted—and occasionally encouraged—the offshoring of U.S. factories.)

Automation, or the "robot effect," is commonly offered as the primary explanation for the loss of U.S. factory jobs. While deconstructing that claim is beyond the scope of this paper, substantial evidence suggests otherwise.[21] History shows that increased productivity—which emerges mainly from technologies that reduce the number of labor-hours per unit of output—leads to lower costs for goods, increased wealth, and faster economic growth. These factors, in turn, stimulate greater manufacturing output, as well as stable, or rising, manufacturing employment. But the evidence shows that America's manufacturing sector is underinvested in technology.[22]

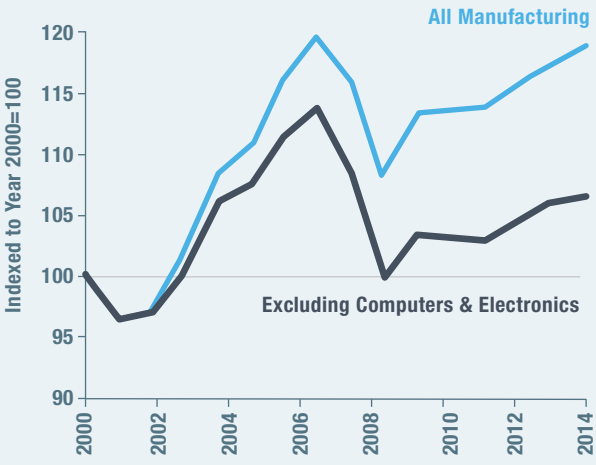
It's true that the manufacturing sector is somewhat bigger now compared with two decades ago. But not only has the overall economy grown faster; manufacturing's modest expansion is attributable almost entirely to just one sector: computers and electronics. Put another way, exclude computers and electronics, and the size of America's manufacturing sector is nearly unchanged compared with two decades ago[23] (**Figure 4**). What's been holding back the overall manufacturing sector from investing and expanding?

Is America an Inherently Uncompetitive Place for Manufacturers?

The World Economic Forum's 2016–17 Global Competitiveness Report—which measures "the set of institutions, policies, and factors that determine the level of productivity of an economy"—ranked the U.S. as the

FIGURE 4.

Growth of U.S. Manufacturing Output: Overall vs. Manufacturing Without Computers & Electronics



Source: *Journal of Economic Perspectives*[24]

world's third most competitive economy, after Singapore and Switzerland[25] (Germany was fifth, the U.K. was seventh, and Japan was eighth).

The Boston Consulting Group's 2014 Global Manufacturing Cost-Competitiveness Index—which measured labor, energy costs, and productivity—ranked the U.S. superior to all but China, South Korea, and Mexico.[26] And China's overall manufacturing costs were only 5% lower than those in America.[27]

In Deloitte's 2016 Global Manufacturing Competitiveness Index—which measured talent, innovation, energy policy, infrastructure, and legal/regulatory hurdles—the global top five were: China, U.S., Germany, Japan, and South Korea. Deloitte forecasts that its global top five rankings in 2020 will be: U.S., China, Germany, Japan, and India.[28]

These studies are typical and illustrate important trends. The cost of labor is rising fast in China and in many other previously low-wage countries. U.S. energy costs have plummeted, thanks to the shale boom. America enjoys big advantages in areas such as supply-chain logistics, ease of doing business, and (less) corruption. U.S. firms are also less eager to offshore manufacturing than they once were, as the oversight, quality control, and intellectual-property costs of offshoring have grown more apparent.[29]

With so many advantages, what's holding back U.S. manufacturing? Are bad trade deals, unfair tariffs, and subsidies to foreign competitors to blame? Certainly, these all have an impact.

But the fact that the steady, multi-decade erosion of U.S. manufacturing output has spanned many different foreign trade and subsidy regimes suggests that these are not the principal factors. Instead, two factors deserve far more of the blame: excessive taxation and regulation. As the Congressional Budget Office has documented, in recent years, taxes on all U.S. businesses have risen sharply, from among the lowest to among the highest in the G20 group of large economies.[30] But in many ways, especially for small businesses, America's onerous regulations are the real jobs killer.

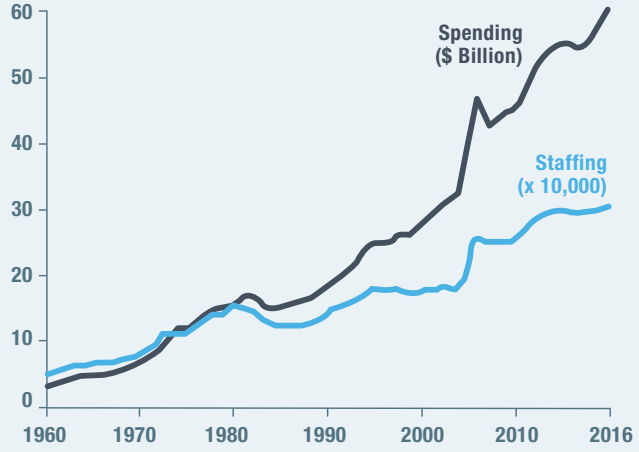
America's Competitive Disadvantage

America's ability to compete on the world manufacturing stage will increasingly be determined by the willingness of Congress and the White House to shrink the regulatory state. Regulatory agencies—now a de facto fourth branch of government that directly employs 300,000 people with a collective operating budget of over $60 billion a year (**Figure 5**)—constrain the U.S. economy by creating and enforcing a bewildering tsunami of rules.[31]

The stifling regulatory burden imposed on American business is well documented.[33] In 2016, the Business Roundtable, an industry group of CEOs that collectively employ 15 million people, ranked regulation as the top cost pressure for the fourth year in a row.[34] Business as a whole suffers under the regulatory state, but

FIGURE 5.

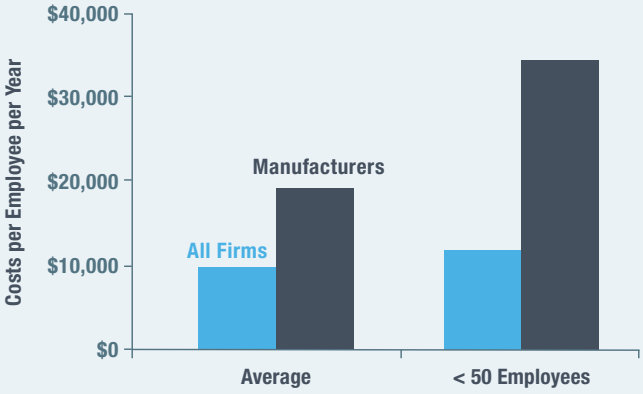
Federal Spending and Staffing to Administer Regulations



Source: Heritage Foundation[32]

FIGURE 6.

Costs of Regulatory Compliance



Source: National Association of Manufacturers[36]

manufacturers suffer disproportionately (**Figure 6**). The average compliance cost—$20,000 per year per employee—borne by manufacturing firms is more than double that incurred by other kinds of businesses. The smallest manufacturers (those with fewer than 50 employees) are hurt the most, with annual per-employee regulatory compliance costing nearly $35,000.[35]

The Environmental Protection Agency is among the worst offenders. The compliance costs of its manufacturing-related regulations are more than twice those of all other regulatory agencies combined.[37] Overall, spending on regulatory compliance has been rising far faster than any other cost in the manufacturing process.[38]

The scales appear to be tipping internationally, too. According to a 2017 survey, 70% of American manufacturers that operate both in the U.S. and abroad reported a higher regulatory burden in America; 72% of such firms believe that the U.S. regulatory burden will be "significantly higher" in the future.[39] According to a 2017 National Association of Manufacturers' report:[40]

- The majority of manufacturers overwhelmingly say that federal regulation is a major impediment to their future growth.
- Manufacturers spend over $90 billion a year on employees and consultants devoted to regulatory compliance—two-thirds of which would otherwise have been invested in expanding their business.

Adding to the challenges: financial regulations promulgated by Congress to avoid another Great Recession have radically, if unintentionally, diminished the ability of small manufacturers—which constitute more than 90% of America's 250,000 manufacturing firms—to borrow money.[41]

According to the Small Business Administration, access to credit is particularly important for small manufacturers engaged in exporting because of additional risks associated with foreign contracts, as well as cash-flow delays.[42] New financial regulations have hit small lenders hardest, helping drive half of local community banks out of business—the very banks that typically service small manufacturers. Indeed, compared with two decades ago, the share of loans to small businesses in general has dropped by nearly half.[43]

Worse, all the aforementioned estimates likely understate the costs of the regulatory state. Most regulatory analyses do not include the costs of state and local regulations, according to NERA Economic Consulting.[44] And most estimates of federal regulatory costs focus on the most costly "major" rules, not on the blizzard of smaller rules also issued by regulators.

Manufacturing Sectors with Strong Growth Potential

In the years ahead, the average cost of goods will likely fall (thanks to rising productivity), and global demand for goods will increase (thanks to rising incomes). If the burdens of the regulatory state were reduced, what U.S. manufacturing sectors might flourish most? Consider five tech-centric sectors where American firms enjoy a significant comparative advantage: hydrocarbon refining, chemicals, semiconductors, pharmaceuticals, and cloud data centers.

Refined Hydrocarbons

Refined hydrocarbon products now constitute America's fastest-growing source of manufactured exports. In a decade, America has gone from being a net importer to one of the world's major exporters of refined products, such as gasoline and aviation fuel.[45] U.S. refineries are the world's most sophisticated and have the capacity to expand even further—if regulators let them.

The U.S. shale boom, of course, is responsible for the enormous rise in the supply of hydrocarbons to U.S. refiners. It is a boom that was fueled by private-sector investments in the shale ecosystem that has, in total, added roughly $1 trillion to the U.S. economy since the Great Recession. (Absent the shale boom, America would have remained in, or near, recession levels for most of President Obama's two terms.)[46]

The shale ecosystem is deeply manufacturing-centric. It requires tens of thousands of drilled wells that require the fabrication of billions of dollars of hardware and thousands of miles of pipes. The vast majority of those jobs stay in America. Meanwhile, global demand for hydrocarbon products—and the manufactured products that go with them—will continue to rise for the foreseeable future.

By driving down energy costs, the shale boom is also beginning to have a broad stimulative effect on many other U.S. manufacturing businesses. According to Thomas Michielsen of Oxford University, "energy is more important than capital and skilled labor for the location of manufacturing industries in the USA."[47]

Chemicals

The $5 trillion global chemical-fabrication industry makes products used in nearly everything, from polymers (needed in cars and smartphones) to fertilizers and pharmaceuticals.[48] U.S. firms now enjoy a huge competitive advantage in the energy-intensive production of chemical products, thanks to dramatically lower energy costs.[49]

A recent analysis in the *LSE Business Review* found that for "every dollar increase in the price gap of natural gas between the United States and Europe, [America's] output [lead over Europe] in chemical manufacturing increased by 1.6%."[50] The average price of natural gas in Europe is typically at least double that in the U.S.[51]

The American Chemistry Council, an industry association, has identified 264 new chemical-production projects involving more than $160 billion in capital investments committed since 2010. Despite the many obstacles posed by the regulatory state, these projects are expected to come on line by 2020, and they will likely generate more than 400,000 new jobs.[52] The opportunity for even more growth is evident in the fact that America's 10,000 chemical firms account for only 15% of global chemical exports.[53]

Semiconductors

The U.S. is the world's largest producer of silicon devices, with half of the $100 billion global market and some $45 billion in annual exports.[54] Semiconductor factories ("fabs"), located in 21 states, collectively account for half the total silicon-device production of U.S. firms.[55] Such fabs are extremely electricity-intensive—consuming more power than steel mills—and benefit considerably from America's low-cost energy.

Future opportunities for semiconductor growth will emerge from applications beyond the conventional computers and communications equipment that currently account for about 60% of semiconductor production. For example, new applications are emerging in industrial equipment (Internet of Things, or IoT)[56] and in "smart" automobiles.

Only 13% of industrial companies have adopted the IoT to connect machines and internal infrastructure over the Internet.[57] According to market researchers at IC Insights, today's $18 billion in IoT semiconductor sales will double in the next few years.[58] Meanwhile, electronics, which used to be a negligible share of the cost to build a car, now account for about one-third of the total cost and will rise to 50% within a decade.[59] As a result, silicon demand from the global auto sector is expected to rise well above today's 10% share of semiconductor sales.[60]

Pharmaceuticals

America is home to most of the world's largest pharmaceutical manufacturers. At $400 billion in annual sales (40% of the global total),[61] the U.S. pharmaceutical market is three times larger than second-place China.[62] Nevertheless, the U.S. still imports nearly $90 billion worth of pharmaceutical products and exports less than $50 billion.[63] As consumers in emerging markets grow wealthier and more health-conscious, the demand for U.S. pharmaceuticals will rise.

Meanwhile, the pharmaceutical industry is on the cusp of a revolution in how drugs are developed and produced.[64] New classes of advanced instrumentation, as well as new forms of automation and process controls, are allowing drugs to be produced far more cheaply.[65] 3D printing, already deployed in other manufacturing niches, has the potential to produce highly specialized drugs:[66] in 2015, the FDA approved a 3D printed drug for epileptic seizures.[67] Big-data analytics and advances in molecular biology are driving the development of new drugs as well.[68]

Cloud Data Centers

Globally, businesses spend about $500 billion a year on computing and data storage.[69] But that spending is now rapidly migrating to cloud-based computing and storage involving a utility-like infrastructure of massive data centers connected by high-speed networks. These so-called hyperscale data centers cost billions of dollars to build.

There are more than 300 hyperscale data centers globally, a number set to rise to 400 by 2018 and to at least 600 by 2022.[70] America is home to the majority of the world's roughly two dozen hyperscale companies; it is also home to half of all hyperscale data centers. The three leaders—Amazon, Alphabet, and Microsoft—collectively spent more than $30 billion building hyperscale data centers in 2016.[71]

Conclusion

Even if America succeeds in negotiating more advantageous trade deals and cutting its corporate tax rate, such actions will amount to little if nothing is done about the regulatory anchor dragging down U.S. manufacturers. Reversing the Obama administration's frenzy of last-minute regulations was a good start.[72]

But it was only a start: more dramatic action is needed to unleash America's Promethean manufacturing sector. Lightening and rationalizing the regulatory burden on U.S. manufacturers does not mean eliminating *all* reg-

ulations. Regulations play an important role in society. But they have to be sensible, transparent, and cost-effective, and there should be far fewer of them.

Shrinking and reforming the regulatory state would deliver major gains to manufacturing and to the broader U.S. economy. The new administration and Congress can do this through the following four actions:

1. Cut the Code of Federal Regulations

President Trump has directed federal agencies to eliminate two regulations for every new one proposed. This directive, if followed, promises to restrain the growth of the regulatory state, but it does little to shrink it. Only once since World War II—under President Reagan—has there been an absolute reduction in the number of pages in the Code of Federal Regulations.

The White House's Office of Information and Regulatory Affairs (OIRA) should take the lead on cutting the Code of Federal Regulations. Though much can be done by fiat, OIRA will need congressional support, too. What to cut first? The Rethink Red Tape project, an initiative cosponsored by the National Association of Manufacturers, offers many helpful suggestions.[73] Congress would also do well to emulate Canada, which passed a "one-for-one" law in 2015, requiring the elimination of an old regulation every time a new one is adopted.[74]

2. Create an Office for Manufacturing Regulatory Assessment

There is no central place for people in the government or the private sector to report regulatory problems, such as cross-agency conflicts, inconsistencies, and unintended consequences.[75] Congress and the private sector should collaborate to create an Office for Manufacturing Regulatory Assessment (OMRA) that would use modern computing, analytics, and mobile tools.

OMRA could serve as a repository for reporting problems, as well as for identifying and analyzing regulatory complexities for the purpose of providing recommendations to OIRA and Congress. OMRA should be modeled on private-sector-managed, legislatively enabled oversight bodies, such as the Financial Industry Regulatory Authority and the North American Electric Reliability Corporation.

3. Launch a Z-Prize for Innovation in Regulatory Software

The Department of Commerce—or a multiagency and private-public collaboration led by the new White House Office of American Innovation—should create a "Z-Prize" for regulatory innovation, modeled on the private sector's multimillion-dollar X-Prizes, which create and fund competitions to achieve bold goals (such as the first civilian in space). The Z-Prize could stimulate the development of enterprise-class software and artificial-intelligence tools that would add efficiency and transparency to the government's management of regulations.

Numerous software companies sell enterprise-class software to help private companies deal with regulatory compliance. But few focus on developing software to make regulators more efficient.

4. Rationalize Regulations to Unleash FinTech Firms

For businesses seeking loans, new "financial technology" (FinTech) companies offer a fast, online application process, as well as efficient new analytics tools to determine creditworthiness. This is a promising development for the many small manufacturers struggling to access financing from conventional sources.[76] Yet the Dodd-Frank Act imposed on FinTech companies a burdensome web of regulatory oversight, involving several federal agencies. The secretaries of Commerce and the Treasury should intervene to identify administrative fixes, and they should work with Congress to identify long-term legislative solutions to this burdensome multiagency oversight.

The world economy is poised to grow as nations shake off the lingering effects of the last recession. Most forecasts see global GDP rising in the next two decades by at least twice as much as it did over the past 20 years.[77] That increase in wealth will lead to history's biggest expansion in demand for new products. The time is right to ensure that American manufacturers can capture a greater share of such an enormous opportunity.

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Abstract

The conditions are ripe for a boom in American manufacturing, especially in high-tech, high-value-added sectors, including semiconductors, pharmaceuticals, refined hydrocarbons, chemicals, and cloud infrastructure. Moreover, considering energy costs, property rights, and the quality of its workforce, the U.S. remains one of the world's most competitive places to do business.

It is true that some manufacturers have fled the U.S. and many won't return—and 30% fewer Americans are employed in manufacturing now as compared with two decades ago. But the conventional wisdom that American manufacturing is destined for extinction is false.

There are obstacles standing in the way of a manufacturing revival. High corporate taxes are one, and unfavorable trade deals are another. But the biggest single drag on U.S. manufacturing has been the decades-long encroachment of the regulatory state—with an army today of 300,000 regulators and an annual budget of $60 billion.

Complying with regulations costs manufacturers an average of $20,000 per employee per year, twice as great a burden as for other businesses. For the smallest manufacturers (i.e., those with fewer than 50 employees), that annual cost is $35,000 per employee per year. In surveys, America's manufacturers routinely rank regulatory burdens as the top impediment to growth; a large majority also say that regulatory burdens are higher in America than in other nations.

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