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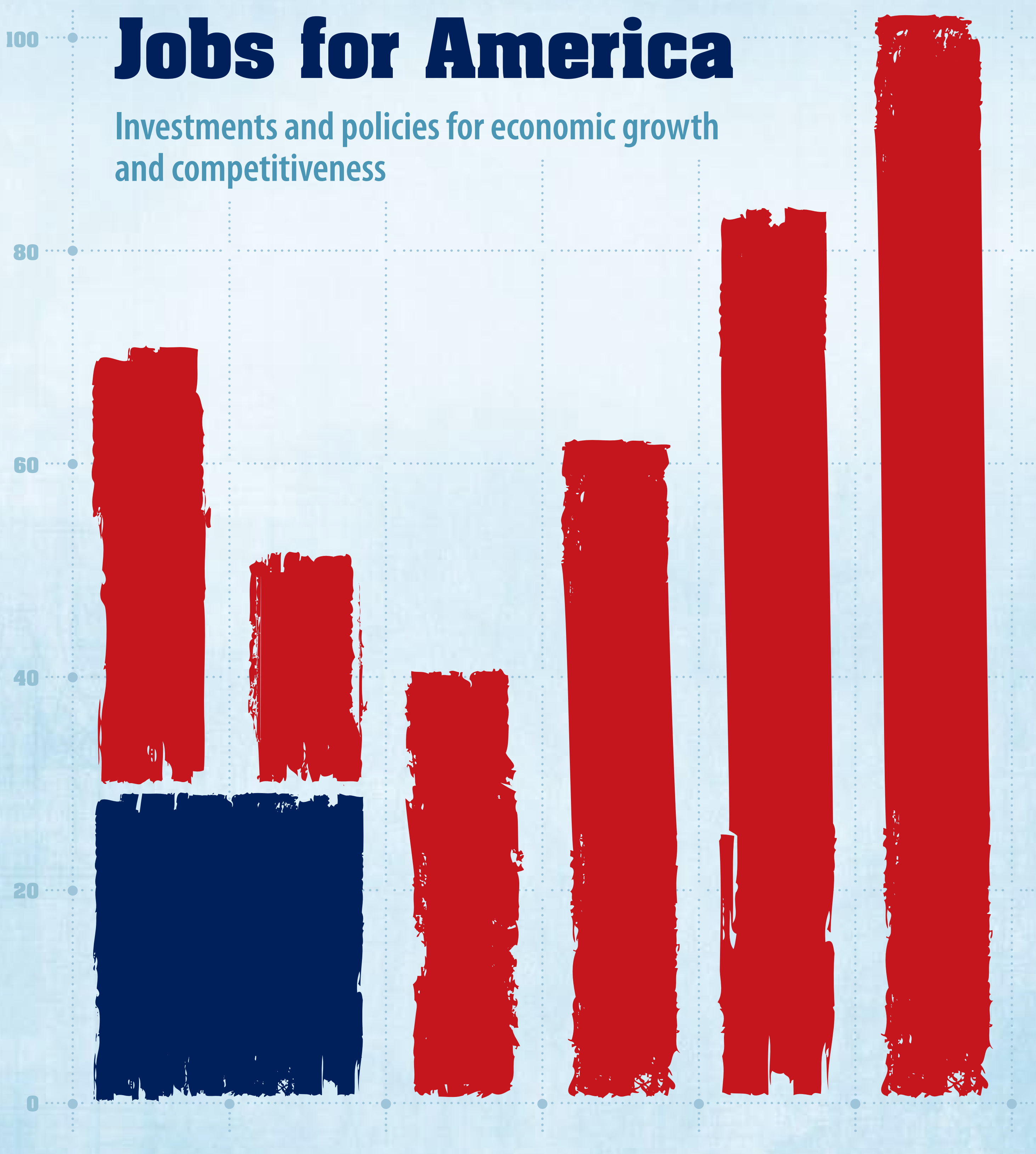
Jobs for America

Investments and policies for economic growth and competitiveness



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Jobs for America

Investments and policies for economic growth and competitiveness

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For an interactive look at some of the statistics included in this report, visit **www.milkeninstitute.org/jobsforamerica**.

Acknowledgments

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About the Milken Institute

The Milken Institute is an independent economic think tank whose mission is to improve the lives and economic conditions of diverse populations in the United States and around the world by helping business and public policy leaders identify and implement innovative ideas for creating broad-based prosperity. We put research to work with the goal of revitalizing regions and finding new ways to generate capital for people with original ideas.

We focus on:

human capital: the talent, knowledge, and experience of people, and their value to organizations, economies, and society;

financial capital: innovations that allocate financial resources efficiently, especially to those who ordinarily would not have access to them, but who can best use them to build companies, create jobs, accelerate life-saving medical research, and solve long-standing social and economic problems; and

social capital: the bonds of society that underlie economic advancement, including schools, health care, cultural institutions, and government services.

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Executive Summary

The U.S. economy appears to be emerging from recession, but the severity of this downturn has left substantial underutilized resources in labor and product markets. To close the gap between actual and potential GDP (that is, the full-employment level of output) as quickly as possible, economic growth must accelerate beyond current expectations. Unless sustainable growth is achieved, the unemployment rate will remain close to 10 percent in the immediate future and a portion of the nation's manufacturing capacity will continue to sit idle.

Economic and tax policy changes, combined with targeted investment in infrastructure, could effectively stimulate the economy in the near term while positioning the nation for sustained higher economic growth over the medium and long term. Given the current economic environment, a government-backed infrastructure program should be considered as an insurance policy to prevent further layoffs, stimulate job growth, and help restore the confidence of the American labor force.

Key Findings

Economic and Tax Policy

- Reducing the U.S. corporate income tax rate to match the OECD average would trigger new growth. By 2019, it could boost real GDP by $375.5 billion (2.2 percent), create an additional 350,000 manufacturing jobs, and increase total employment by 2.13 million.
- Increasing the R&D tax credit by 25 percent and making it permanent could boost real GDP by $206.3 billion (1.2 percent), generate 270,000 manufacturing jobs, and raise total employment by 510,000 within a decade.
- Modernizing U.S. export controls could increase exports in high-value areas. By 2019, these policy adjustments could enhance real GDP by $64.2 billion (0.4 percent), create 160,000 manufacturing jobs,

Infrastructure Investment

- The proposed investments analyzed in this report, totaling $425.6 billion across 10 projects over three years (with just over half in highway and transit initiatives), translate into $1.4 trillion in total output, including the ripple effects generated across all sectors.
- Taken together, these 10 investments have the potential to create 3.4 million jobs directly and, including all the ripple effects, 10.7 million jobs in total (an average annual increase of 3.5 million across three years).
- The projects outlined could generate direct earnings of $147.1 billion (and total earnings of $420.6 billion, including all ripple effects).

Improving Economic and Tax Policy

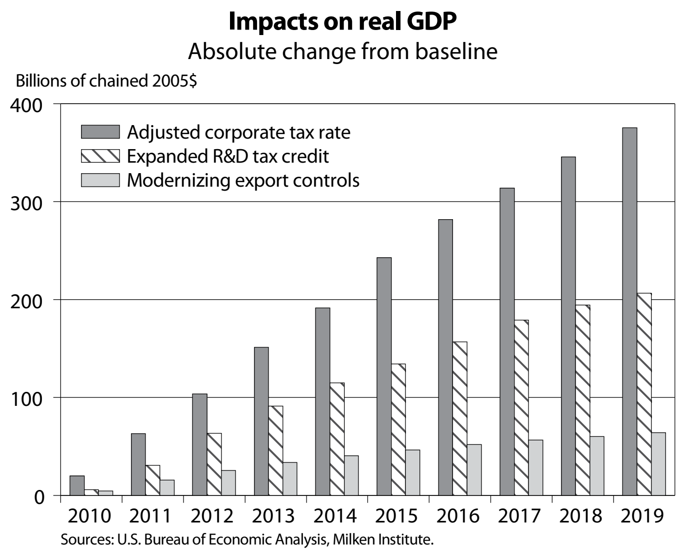
Globalization has forever changed the international competitive landscape. Cross-border transactions, from trade to foreign direct investment, are now the norm. Given these developments, the United States must re-evaluate its policies relative to other nations on a regular basis. With this objective in mind, the Milken Institute set out to evaluate the impact of changing certain economic and tax policies that currently impede the nation's ability to compete.

Specifically, we analyzed the potential effect of changing U.S. corporate tax rates, expanding the R&D tax credit, and modernizing controls on exports of commercially available products to a representative group of countries. While the response to altering these policies would not be immediate, economic growth would improve during the second year of their enactment.

To perform these three alternative simulations, we utilized a macro-econometric dynamic equilibrium growth model of the U.S. economy. This allows us to estimate the resulting changes in investment, exports, industrial production, manufacturing and total employment, wages and incomes, federal fiscal conditions, and overall real GDP growth. We can quantify these impacts by comparing a scenario in which the policy in question is adjusted to a baseline economic projection in which current policy is assumed to continue.

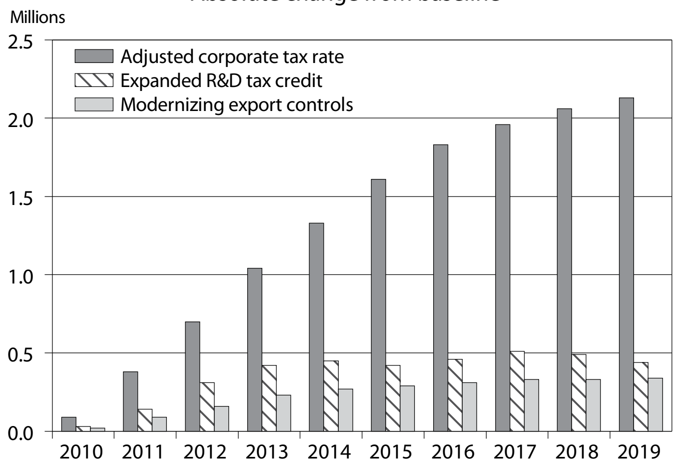
Corporate Income Tax Policy Simulation

International differences in corporate income tax rates are a factor when firms determine where to locate their corporate headquarters, R&D activities, production facilities, and distribution networks—and today, the U.S. corporate income tax rate is second-highest among nations belonging to the Organisation for Economic Co-operation and Development (OECD). With that in mind, we ran a simulation in which the U.S. federal corporate income tax rate was cut by 13 percentage points to 22 percent, with the reduction being phased in over a five-year period. This new rate would match the current OECD average.



Our results show that a lower corporate tax rate makes the United States a more attractive location for business investment by filtering through a reduction in the user cost of capital. After a rate cut is implemented, existing productive capacity in the U.S. is initially more heavily utilized to fulfill domestic final demand and boost exports. In today's economic climate, there are few capacity constraints that would restrict production from rising to meet increased demand. The impacts on annual economic growth in 2010 are not as large as in subsequent years, as it would take time for businesses to adjust their investment and production plans.

Impacts on total employment
Absolute change from baseline

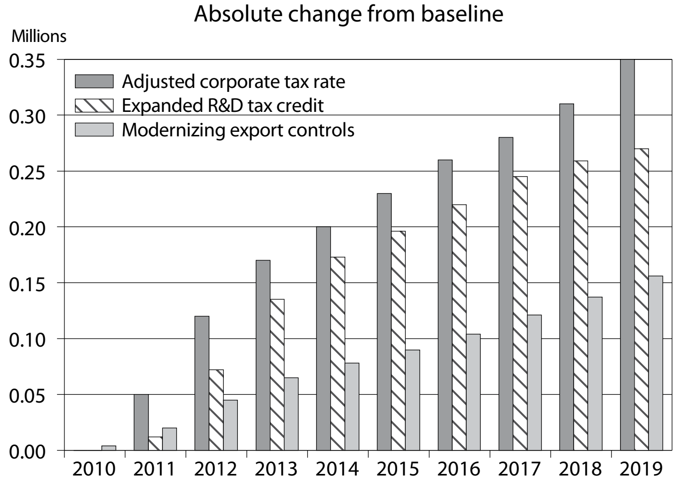


Sources: U.S. Bureau of Labor Statistics, Milken Institute.

The long-term impacts of reducing the corporate income tax rate include the following:

- Real GDP growth improves by 0.3 percentage point on an annual basis from 2011 to 2013, an average of 0.2 percentage point from 2014 through 2017, and 0.1 percentage point in 2018 and 2019, relative to a baseline projection without a change in tax policy.
- Real GDP is $375.5 billion, or 2.2 percent, above the baseline projection in 2019.
- Exports respond to the lower corporate tax rate. By 2019, real exports stand at $233.3 billion, or 7.8 percent, above the baseline projection.
- Real business fixed investment jumps 4.6 percent, or $102.4 billion, above the baseline scenario in 2019.
- Industrial production in the rate-cut scenario exceeds the baseline by 3.9 percent in 2019, while total employment increases by 2.13 million (1.4 percent) and manufacturing employment rises by 350,000 (2.7 percent).

Impacts on manufacturing employment
Absolute change from baseline



Sources: U.S. Bureau of Labor Statistics, Milken Institute.

R&D Tax Credit Simulation

Although the United States pioneered the R&D investment tax credit in 1981, most other advanced economies have implemented their own more aggressive versions of this policy. Based on OECD calculations, the United States ranks 17th among member nations on the effective rate of the R&D tax credit. Furthermore, the U.S. has kept the R&D tax credit "temporary" for 29 years (in fact, it was recently allowed to expire again on December 31, 2009) and has imposed restrictions on qualifying. Many other OECD countries appear to have created a more attractive landscape for innovation and sustainable growth.

We evaluated the economic impact of increasing the R&D tax credit by 25 percent and making it permanent. In this scenario, businesses increase their research and development spending, therefore creating new products and services; enhancing productivity growth; expanding investment in technology-intensive capital equipment; spurring greater exports, production, employment, and incomes; and boosting overall real GDP growth.

The expanded R&D tax credit scenario produces the following results:

- Real GDP growth improves by 0.2 percentage point on an annual basis from 2011 to 2013, and by 0.1 percentage point after 2013, relative to a baseline projection without a change in policy.
- After 10 years, real GDP is $206.3 billion, or 1.2 percent, above the baseline projection in 2019.
- Real business fixed investment rises 5.6 percent, or $124.6 billion, above the baseline scenario in 2019.
- Exports, especially technology-related goods and services, experience higher growth. By 2019, real exports stand at $63 billion (2.1 percent) above the baseline projection.
- Industrial production exceeds the baseline scenario by 4.4 percent in 2019. Total employment rises by 510,000 jobs (0.4 percent) above the baseline at its peak in 2017, and manufacturing employment jumps by 270,000 jobs (2.1 percent) above the baseline in 2019.

Modernization of Export Controls Simulation

Here we assess the possible economic impacts of modernizing export controls on commercially available technology products for a representative group of countries. Proponents of modernization argue that "many current controls (outside of narrowly defined military niches) aimed at protecting national security harm U.S. innovation and competitiveness in global markets, thereby reducing economic prosperity, which is an essential element of U.S. national security."[1]

It is not in our best economic interest to preclude the export of technology products that are legally available from other advanced and NATO member nations. The logic is that if the United States will not supply the desired technology, some other country will. For example, some multilateral agreements on export controls afford member countries the latitude to exercise their own discretion; this sometimes undermines the intent of such trade agreements. Because purchasing nations are able to obtain this technology elsewhere, U.S. policy is not ultimately effective—it simply prevents American firms from accessing new markets.

We assume that a responsible modernization of export controls for certain goods and certain countries would narrow the gap between U.S. market share in these nations and its share in the total world market by 50 percent.

The results of the adjusted export control scenario include the following:

- Modernizing U.S. export controls would produce higher export growth in the future, particularly in the high-valued-added areas in which the United States excels.
- The most rapid period of export growth (0.2 to 0.3 percentage point on an annual basis) relative to the baseline occurs from 2011 to 2016, based on a 2010 implementation. After that, export growth relative to that in the baseline moderates to 0.1 percentage point annually. Real exports are $56.6 billion (1.9 percent) higher than the baseline in 2019.
- Real GDP rises by $64.2 billion (0.4 percent) relative to the baseline projection in 2019.
- Real business fixed investment grows faster in the adjusted export control scenario than in the baseline scenario over the next decade. It stands $18.7 billion (0.8 percent) above the baseline in 2019.
- Industrial production exceeds the baseline by 1.5 percent in 2019, while total employment increases by 340,000 jobs (0.2 percent) and manufacturing employment rises by 160,000 jobs (1.2 percent).

Infrastructure Investment

Globalization has upended the way we think about America's place in the world. Even with an issue like infrastructure, which once was considered purely a domestic concern, we have to consider the implications for the nation's ability to compete on an international stage. It has become painfully apparent that U.S. infrastructure, once the envy of the world, is now strained and aging, while other nations are constructing bullet trains, cutting-edge broadband networks, public transit systems, modern ports, and energy delivery systems, while making significant investments in alternative energy.

Modernizing the nation's infrastructure represents an opportunity to create thousands of jobs and stimulate the economy in the near term. In assessing the need, the American Society of Civil Engineers estimates it would take $2.2 trillion over the next five years to fix all the nation's infrastructure issues, including a projected $549.5 billion for highway spending.[2]

Given the current pressures on federal, state, and local budgets, government's ability to finance ambitious infrastructure investments is limited. It will be necessary to examine alternative approaches to funding, including public-private partnerships.

With this backdrop, we set out to determine the potential effects of various infrastructure investments on the job market, choosing 10 projects for study. The selected projects are high-impact investments in both high-growth and traditional industries that provide high-paying jobs, offering solid potential for sustainable development. All 10 projects fall under the broad themes of public safety, competitive transportation, and energy security, all of which are crucial for the United States.

The proposed investment funding was derived from various sources, including congressional reports, industry analysts, academia, the National Association of Manufacturers (NAM), and the Milken Institute. The particular projects were modeled on departments' recent allocations, using the distribution of that funding to indicate how new investments might be disbursed.[3] The Milken Institute collected these proposals and analyzed the economic impacts on an individual project basis so that policymakers can make informed decisions about where to allocate resources.

We analyzed proposed investment funding over a three-year period to determine near-term job creation and economic impacts. It is important to note that these infrastructure investment proposals utilize a mix of public funding, public-private partnerships, and other types of government-provided incentives such as loan guarantees.

We used the Bureau of Economic Analysis' (BEA) Regional Input-Output Modeling System (RIMS II) to compute the economic and employment impact of proposed investments. To capture the extent of an industry's economic impact, the BEA assigns unique coefficients, known as "multipliers," to specific industries. Multipliers enable us to quantify how an industry's employment, earnings, and output ripple through other economic sectors. For example, because highway expansion mainly involves construction, the BEA multiplier for construction was applied to those funding amounts. Indirect employment effects capture the impact on the supply chain (which in this case includes manufacturing, engineering services, the wholesale and retail trade, and a broad array of material suppliers).

Investment Impacts

Taken together, the proposed investments amount to $425.6 billion. Highway and transit projects account for just over half the total investment pool. Investments in broadband infrastructure and onshore and offshore oil exploration account for the next largest investment amounts. All the projects combined will create 3.4 million construction- and R&D-related jobs, which will generate an estimated $147 billion in earnings. Accounting for ripple effects across other sectors, the total impact will add up to 10.7 million jobs, $420.6 billion in earnings, and $1.4 trillion in output. Because these impacts will likely be spread across a three-year period, it is important to note that the average annual increase would be 3.5 million jobs and $468 billion in output.

Summary of economic impacts by project

(2010–2012)

Project	Proposed investment amounts (US$B)	Direct impact on employment (# of jobs)	Direct impact on earnings (US$B)	Total impact on employment (# of jobs)	Total impact on earnings (US$B)	Total impact on output (US$B)
Highway and transit system	225.0	2,106,914	85.8	6,189,480	238.2	775.4
Broadband infrastructure	55.0	293,736	15.1	1,048,064	43.9	158.3
Onshore exploration and development/offshore drilling	46.5	194,844	9.9	896,185	38.8	145.0
Drinking water and wastewater infrastructure	30.0	280,922	11.4	825,264	31.8	103.4
Smart grid	24.0	219,578	9.1	649,627	25.1	82.0
Nuclear energy	15.0	139,145	6.1	397,271	15.6	48.7
Renewables (solar, wind, biofuels)	14.5	115,874	4.8	337,558	13.1	44.3
NextGen air traffic control	10.4	30,631	2.7	181,921	8.9	32.1
Inland waterways	2.6	23,951	1.1	67,100	2.7	8.1
Clean coal technology	2.55	24,018	1.1	66,127	2.6	7.9
Total of all projects	**425.6**	**3,429,612**	**147.1**	**10,658,597**	**420.6**	**1,405.3**

Note: Total economic impact is an accumulated statistic over the three-year period. For example, total employment translates to an annual average of 3.5 million jobs.

Average output per employee stemming from the total impacts from all projects amounts to about $132,000. Output per employee in 2009 across all non-farm sectors was slightly more than $108,000.[4] The additional output per employee generated through these infrastructure projects reflects the valuable nature of such activity, the quality of the jobs that would be generated, and the incremental wealth that would be created.

Average wages across these projects would amount to $43,000 annually—substantially more than the current average of $30,500 across all private, service-providing sectors.[5]

In addition, for every dollar invested in these projects, an additional $2.30[6] would be generated across all sectors. For every $1 billion invested in these projects, slightly more than 25,000 jobs are created.

Because most of the investments would be injected directly into the construction industry, some of the direct impacts may be short-lived as the initial funding dries up. But the indirect impacts would provide other sectors with a tremendous boost. In fact, of the 3.5 million jobs created per year, 9.2 percent (or 327,100 of them) would be in manufacturing. Manufacturing, services, and trade, all of which support various construction activities, would have the opportunity to capitalize on the investments.

Our project-by-project analysis shows the following results:

- Highway and transit investment of $225 billion over three years creates 6.2 million jobs (roughly 2 million per year), along with $238.2 billion in earnings and $775.4 billion in output.
- Broadband infrastructure investment of $55 billion generates nearly 1.1 million jobs (349,300 per year), along with $43.9 billion in earnings and $158.3 billion in output.
- Investment in offshore drilling and onshore exploration and development of oil and natural gas wells totaling $46.5 billion over three years creates 896,200 jobs (298,700 per year), along with $38.8 billion in earnings and $145 billion in output.
- Drinking water and wastewater infrastructure investment of $30 billion over three years results in 825,300 jobs (275,100 annually), along with $31.8 billion in earnings and $103.4 billion in output.
- Smart-grid investment of $24 billion over three years produces 649,600 jobs (216,500 annually), along with $25.1 billion in earnings and $82 billion in output.
- Nuclear energy investment of $15 billion over three years creates 397,300 jobs (132,400 annually), along with $15.6 billion in earnings and $48.7 billion in output.
- Renewable energy investment of $14.5 billion over three years generates 337,600 jobs (112,500 per year), along with $13.1 billion in earnings and $44.3 billion in output.
- Next Generation Air Transportation System (NextGen) investment of $10.4 billion over three years creates 181,900 jobs (60,600 per year), along with $8.9 billion in earnings and $32.1 billion in output.
- Inland waterway investment of $2.6 billion over three years generates 67,100 jobs (22,400 annually), along with $2.7 billion in earnings and $8.1 billion in output.
- Clean coal technology investment of $2.6 billion over three years creates 66,100 jobs (roughly 22,000 per year), along with $2.6 billion in earnings and $7.9 billion in output.

Introduction

In this study, we estimate the number of jobs and overall economic activity generated through changes in economic and tax policies and specific infrastructure investments. The first section evaluates the likely economic impacts of changes in policy impeding U.S. competiveness over the medium and long term. Globalization has forever changed the international competitive landscape with multiple cross-border transactions from trade to foreign-direct investment. Specifically, we analyze changes to U.S. corporate tax rates, the R&D investment tax credit and some modernizing controls on exports of commercially available products to countries subject to restrictions.

Using a macro-econometric model of the U.S. economy, we evaluate the probable economic impacts over 10 years of a 13 percentage point reduction in the U.S. statutory corporate income tax rate, phased in over a five-year period. The rate would match the current average of Organisation for Economic Co-operation and Development (OECD) member nations. A lower corporate income tax rate makes the United States a more attractive location for investment by cutting the user cost of capital and boosting economic activity.

The second simulation looks at the stimulus provided by expanding the R&D investment tax credit and making it permanent. The R&D tax credit is a key policy promoting U.S. innovation. The third simulation assesses the potential results of modernizing export controls on commercially available technology products for a representative group of countries. While it is in the United States' national security interests to restrict the sale of nuclear and other sensitive military technologies, it is not in our best economic interest to prohibit the export of technology products that are available from other OECD member nations.

The second section of the study investigates the near-term job creation, earnings, and output created in other industries through targeted investments in 10 infrastructure categories, including highways, inland waterways, nuclear power, renewable energies such as solar, the smart grid, and broadband. In the near term, infrastructure investment can create thousands of jobs and stimulate the economy; in the long term, it can provide significant competitive advantages through improved highways, shipping, and upgraded electrical distribution, among other benefits.

Many innovations have either been created or facilitated through infrastructure investment, both in the public and private sectors. Although the construction jobs created by infrastructure investment are typically only short-term, the new opportunities and economic activity fueled by infrastructure investment continue for years, if not decades, after the projects are completed. We analyze proposed investment funding over a three-year period. These new investments would be in addition to recent funding. It is important to note that these infrastructure investment proposals are a mix of publicly funded, public-private partnerships and other types of government-provided incentives such as loan guarantees.

We use the Bureau of Economic Analysis' Regional Input-Output Modeling System (RIMS II) to compute the economic and employment impact of the allotted and proposed investments. To capture the extent of an industry's economic impact, the BEA assigns unique coefficients, known as "multipliers," to specific industries. Multipliers enable us to quantify how an industry's employment, earnings, and output ripple through other economic sectors. For example, because highway expansion mainly involves construction, the BEA multiplier for construction was applied to those funding amounts. Indirect employment effects capture byproducts, like manufacturing, and wholesale and retail trade.

Building a Foundation for Growth

Infrastructure is the lifeblood of any modern economy—and the story of America's rise to global economic leadership cannot be told without taking into account the vast and ambitious building projects that paved the way for growth and commerce. The workers who bridged waterways, built a mighty railroad that spanned a continent, and constructed our nation's backbone from steel and concrete did much more than transform the American landscape. They provided the underpinnings for future generations' prosperity.

For centuries, America's economic growth has been inextricably bound to visionary investments in infrastructure. That fundamental link has become urgently relevant again today, as the United States finds itself bombarded with simultaneous challenges. The aftermath of a once-in-a-generation financial crisis has left high unemployment and a sluggish economy in its wake. Meantime, the imperatives of remaining competitive in the new global marketplace grow more pressing with each passing year.

At the very moment government budgets have come under intense pressure, it has become painfully apparent that U.S. infrastructure, once the envy of the world, is now strained and aging, while other countries are constructing bullet trains, cutting-edge broadband networks, public transit systems, and modern ports. In fact, the American Society of Civil Engineers estimates it would take $2.2 trillion in infrastructure spending over the next five years to fix all of the nation's infrastructure issues, including a projected $549.5 billion shortfall in highway spending.[7]

Spending on vast public works is a daunting prospect in this environment, but the United States has a remarkable history of using infrastructure to fuel economic growth, even in times of crisis. Out of the depths of the Great Depression rose the Tennessee Valley Authority, monumental engineering achievements like the Hoover Dam, and countless highways, bridges, irrigation projects, and public buildings. These projects provided much-needed jobs—and set the stage for an era of tremendous post-war expansion and further innovation. Although the construction jobs created by infrastructure investment are short-term, the new opportunities and economic activity that result continue for years, if not decades, after the projects are completed.

The U.S. economy has lost 7.2 million jobs since December 2007.[8] National unemployment stands at 10 percent, a rate not seen since the early 1980s. The Congressional Budget Office projects a slow economic recovery in 2010, and the jobless rate is expected to remain stubbornly high throughout the year if no additional investment is injected into the economy.[9]

Infrastructure investment—whether undertaken by government or initiated via public-private partnerships—offers a particularly compelling potential solution to the nation's urgent need for immediate job creation. Undertaking infrastructure development will put manufacturing's labor force back to work and take advantage of its idle capacity through the use of domestically produced products.

Policymakers have echoed industry's call for a stronger manufacturing sector as a way to rebuild the economy. The White House recently released "A Framework for Revitalizing American Manufacturing," which states that "a competitive manufacturing base can help build a strong foundation for future job and economic growth in both manufacturing and services." [10]

Recently approved (and currently debated) efforts to restart the economy have focused on specific investments in critical infrastructure needs such as broadband, smart-grid technology, and delivery of alternative energy, among others. All of these depend heavily on U.S. manufacturing, particularly for research and development. As policymakers consider various options to spur economic growth and job creation, it makes sense to direct efforts toward jumpstarting the manufacturing sector, given the depth and breadth of additional economic activity generated within the sector and the opportunities for further growth the sector provides for other parts of the economy.

Encouraging growth in the manufacturing sector is critical to overall economic recovery and middle-class prosperity. This sector, which has come under great pressure in recent years, can still generate powerful ripple effects: Every job created in manufacturing generates more than two-and-a-half jobs elsewhere in the economy.[11] These jobs also typically pay significantly more than others requiring a similar level of skills. Higher wages mean healthier consumer spending, which has been the primary driver of U.S. economic growth. This makes job creation in manufacturing a powerful economic stimulus strategy.

In addition to the obvious short-term imperative of job creation, infrastructure development cannot be neglected if America is to remain competitive on the global stage. In multiple areas, the nation needs to make a commitment to modernizing its infrastructure. These investments will provide the building blocks for further innovation, driving broad, sustained economic growth.

Expanding broadband capacity is a case in point. From the earliest days of the telephone and the telegraph, the United States has always set the pace for the rest of the world when it comes to communications. But today it lags behind other nations in terms of the speed, reach, and efficiency of its broadband network. Upgrading our capacity will not only create jobs in the short term, but will also set the stage for a host of new efficiencies (including smart-grid technologies and revolutionary health IT, to name just two). Many rural communities have watched as the digital revolution passed them by, but connecting these areas will create additional commerce and opportunities. There is no limit to the innovation that may result if we create a network that can allow a greater flow of goods and ideas.

Delivering renewable energy is another area in which infrastructure investment can have a transformative effect. In the East Coast blackout of 2003, the nation learned the hard way that its existing electric grid is antiquated and straining at maximum capacity. To handle the load, America needs to complete a national smart grid. Perhaps even more important than its ability to increase capacity, this project will allow us to begin delivering renewable energy, enhancing the nation's energy security and reducing carbon emissions. Because the best wind and solar resources are concentrated far from where they are needed, the grid must be able to transport electricity over hundreds or even thousands of miles. These resources are also intermittent—the sun doesn't always shine and the wind doesn't always blow—so the grid must be able to either store energy or add supply from conventional sources during peak periods. The smart grid is even necessary to meet future alternative transportation needs, as plug-in hybrid vehicles continue to grow more popular. The ability to tap more alternative fuel and power sources lies at the crux of efforts to transform the United States into a green economy.

Whether the challenge is upgrading our water delivery systems or streamlining the transportation networks that enable mobility and trade, it's important to consider infrastructure improvements as more than short-term construction projects. They are vital elements of remaining competitive in the global economy.

The United States cannot afford to fall behind nations such as Germany, which is already staking out a leadership position in green technologies. China, too, is using infrastructure investment not only for short-term stimulus but also to provide significant long-term competitive advantages through high-speed rail, improved highways, shipping, and upgraded electrical distribution. As the developing world starts a push for energy efficiency and advanced telecommunications, it is essential that the United States remain at the forefront of such technologies.

The global economy and the competitive landscape have been profoundly altered in the past decade. The rules of the game have changed. To come out among the winners, the United States will have to reconsider many of its long-held policy assumptions and reassess its priorities.

To address the challenges of globalization, the United States needs updated and consistent policies that promote the interests of U.S. manufacturers by enhancing their ability to invest in R&D, to compete, and to expand to growing markets quickly. Steps that facilitate new trading relationships, expand the production of goods, and promote more aggressive investment in R&D can enhance the manufacturing sector's long-term ability to create jobs domestically.

Despite the recession, the United States remains the global leader when it comes to manufacturing, producing more than 20 percent of the world's manufactured goods. (By way of comparison, second-place China produces 12 percent).[12] The U.S. economy remains more dependent on its own capacity to make things domestically than on its ability to buy them from somewhere else. But there is no denying that the dominance of U.S. manufacturing has been steadily eroding—and that trend has been exacerbated by the downturn. Nearly 2 million American manufacturing jobs have been lost since December 2007, more than in any other industry. Some manufacturers have even outsourced their research and development operations to foreign partners or subsidiaries.[13]

It is not too late to reverse this decline. The United States remains the world's cradle of technological innovation, thanks in large part to manufacturing. In 2007 (the most recent year for which data is available), the manufacturing industry spent $187 billion on research and development, or 70 percent of all R&D spending in the nation that year.[14] To reassert their leadership role, some of America's top manufacturers are taking steps to reinvigorate the sector. General Electric, which has begun bringing off-shored jobs back to U.S. soil, has called for the United States to increase its manufacturing base employment to 20 percent of the workforce, saying the nation has outsourced too much in some areas and can no longer rely on the financial sector and consumer spending to drive demand.[15]

As it considers the best route out of a tough recession, the United States stands at a crossroads. The nation can no longer afford to take its leadership position for granted in a fiercely competitive global economy. But if we are willing to make strategic and forward-looking investments and discard the outdated policies that hinder our ability to compete, America can emerge from this downturn with greater efficiency, a greener economy, and renewed prosperity.

Improving Economic and Tax Policy

Globalization—the process of establishing greater global economic integration and interdependence[16]—has almost become a cliché that analysts fall back on to explain economic and social phenomena that seem to have no documented or empirical underpinnings. However, in the context of understanding how firms make location and investment decisions and affect national economic growth rates, globalization is indeed a powerful, tangible factor—one that heightens the importance of international competition and tax and economic policy considerations more than ever before.

We begin our analysis with an evaluation of the likely medium- and long-term economic impacts of changing policies that currently impede U.S. competiveness.

- First, we evaluate the probable economic impacts over 10 years of a 13 percentage point reduction in the U.S. statutory corporate income tax rate, phased in over a five-year period.
- The second simulation looks at the impact of expanding the R&D investment tax credit—a key policy promoting U.S. innovation—and making it permanent.
- The third simulation assesses the potential results of modernizing export controls on commercially available technology products for a representative group of countries.

Methodology

To perform these three simulations, we utilized a macro-econometric dynamic equilibrium growth model of the U.S. economy. This allows us to estimate the resulting changes in investment, exports, industrial production, total employment (and employment in categories such as manufacturing), wages and incomes, federal fiscal conditions, consumption, and overall real GDP growth. We can quantify these changes by comparing a scenario in which policy is changed to a baseline economic projection in which there is no adjustment in policy.

The macro-econometric model[17] embodies major properties of the Neoclassical growth models developed by Robert Solow and incorporates key insights and many theoretical approaches to the business cycle (Keynesian, New Keynesian, Neoclassical, Monetarist, and Supply-side). This structure assures that short-run cyclical movements will converge to a robust long-run equilibrium.

In growth models such as the one utilized in this analysis, the expansion rate of technical progress, the available human capital, and the physical capital stock determine the productive potential of an economy. Both technical progress and the capital stock are governed by investment, which in turn must be in balance with post-tax capital costs, available savings, and the capacity requirements of current spending. The capacity to supply goods and services is tied to a production function combining the basic inputs of labor hours, energy usage, the capital stocks of business equipment and structures, and government infrastructure. The "total factor productivity" of this composite of tangible inputs is driven by expenditures on research and development that produce technological progress.

Consequently, monetary and fiscal policies influence both the short- and long-term characteristics of the U.S. economy through their impacts on national saving and investment. The model of output, prices, and financial conditions is melded with the growth model to present the detailed, short-run dynamics of the economy. In specific goods markets, the interactions of a set of supply and demand relations jointly determine spending, production, and price levels. Typically, the level of inflation-adjusted demand is driven by prices, income, wealth, expectations, and financial conditions.

Corporate Income Tax Rate

International differences in corporate income tax rates are a factor when firms determine where to locate their corporate headquarters, R&D activities, production facilities, and distribution networks. Looking solely at the corporate income tax rate, the United States has become less attractive as a location for investment as other nations in the Organisation for Economic Co-operation and Development (OECD) have slashed rates over the past two decades. The U.S. statutory corporate income tax has remained at roughly 40 percent (the federal rate of 35 percent plus the average state rate of 4.7 percent) for the past 20 years. That tax rate is second-highest among OECD countries today, trailing only Japan. Meantime, the OECD average has fallen from 47 percent in 1981[18] to 26.3 percent in 2009.[19]

Simulation Results

- A reduction in the U.S. corporate income tax rate to match the average of OECD nations would provide a substantial boost to economic growth.
- In the lower-tax scenario, real GDP growth improves by 0.3 percentage point from 2011 to 2013, an average of 0.2 percentage point from 2014 through 2017, and 0.1 percentage point in 2018 and 2019, relative to a baseline projection without a change in policy.
- Real GDP is $375.5 billion, or 2.2 percent, above the baseline projection in 2019.
- Exports respond to the lower corporate tax rate. By 2019, real exports stand at $233.3 billion, or 7.8 percent, above the baseline projection.
- The United States becomes a more attractive location for investment. Real business fixed investment jumps 4.6 percent, or $102.4 billion, above the baseline scenario in 2019.
- Industrial production exceeds the baseline by 3.9 percent in 2019, while total employment increases by 2.13 million (1.4 percent) and manufacturing employment rises by 350,000 (2.7 percent).

Globalization and Location Decisions

When the United States was still a relatively closed economy, roughly prior to 1980, corporate income tax rates were not viewed as a crucial factor in determining the competitiveness of U.S. firms. In an era with few cross-border transactions, higher corporate tax rates were thought to have a slight dampening effect on investment, but no discernible impact on the location of investment.[20] With immobile factors of production, a high U.S. corporate tax rate was seen as being equitable and progressive, since the holders of corporate debt and equity were high-income, wealthier individuals.

Even today, some voters (and thus some members of Congress representing them) advocate higher taxes on both high-income individuals and corporations (even as many European Union nations are reducing corporate tax rates), believing that both actions are justified on the basis of promoting tax fairness.[21] Unfortunately, this position is harming the international competitiveness of U.S. firms, our nation's ability to attract investment, and most regrettably, the prosperity of the U.S. workforce. Contrary to a popular assumption, raising corporate taxes does not necessarily reduce income inequality. Why? Because corporate taxes are another component of the cost of doing business affecting corporations (just like higher electricity prices or employer-provided health-care benefits), and ultimately these costs are passed on to consumers and shareholders. Because manufacturing investment is now highly mobile across borders, U.S. manufacturers and their workers have borne the brunt of this outdated thinking on corporate tax policy.

Tax policy is no longer just a domestic consideration. Today, globalization forces firms to operate a worldwide network of activities to remain competitive. New technological advances have diminished the costs of transportation, telecommunications, and computation, increasing the ease of global information flows. Globalization is expanding the movement of goods, services, capital investment (portfolio and direct), people, ideas, and technology itself. The firms that succeed, whether large or small, will be those that can meet global production standards and tap into a worldwide network.

Information technology has quickened the pace of these changes. In effect, by reducing the cost of communications, IT has opened the door to the globalization of production and capital markets. This trend has spawned new competition, innovation, and quicker diffusion of next-generation technology. One consequence, however, is that firms have become ever more sensitive to differences in the cost of operating in one country versus another—and corporate tax rates are a key part of that accounting.

A review of globalization's growing impact on the U.S. economy is enlightening. As recently as 1960, exports and imports represented slightly less than 7 percent of U.S. gross domestic product. But by 2008, trade in goods and services represented 28.2 percent of real GDP.[22] U.S. multinational corporations (MNCs) now account for two-thirds of the nation's merchandise exports.[23] For policymakers, the growing importance of these firms has crucial implications: If U.S.-based MNCs do not find a favorable tax policy environment here, they will choose to produce more goods abroad and export fewer manufactured goods from the United States, harming employment and incomes.

More important for corporate tax policy, U.S. cross-border investment, both outbound and inbound, has risen from slightly above 1 percent in 1960 to more than 18 percent of real GDP in 2008, hitting $2.4 trillion. The U.S. Treasury Department estimated that in 2007 the aggregate cross-border value of these capital assets reached $26 trillion.

Corporate Taxes and Investment

Corporate tax rates influence businesses' investment decisions by raising the user cost of capital. As the pioneering work of Dale Jorgenson showed, a higher corporate tax increases the "hurdle rate" (the required rate of return for an incremental project to be funded) for a particular capital investment. Thus, through a higher user cost of capital, the demand for capital in the corporate sector is diminished. Under the Jorgenson approach, later adapted by Hall,[24] the cost of capital services is the implicit annual cost to a company of leasing a particular capital asset. The rental cost formulation combines the effects of the cost of financial capital (debt and equity), the corporate tax laws (including applicable tax credits), the physical depreciation of a particular asset, along with its relative purchase price, and the anticipated inflation rate.

Under this specification, investment responds to the *level* of the real cost of capital services, but reacts to both the *level* and the *change* in expected output. A lower corporate tax rate lowers the hurdle rate, increasing the long-run optimal capital investment. However, a lower corporate tax rate would also cause the short-run expected or desired output to rise, spurring a more than proportional initial response in capital investment through this "accelerator" effect as it reacts to the *change* in output.

A high corporate tax rate, which is currently in place in the United States, raises the cost of capital by raising the after-tax rate of return that investors require and the pre-tax return that a firm's capital investment must earn to compensate investors and pay taxes to the government.[25] If the before-tax rate of return is inadequate, investors will allocate their capital to alternative opportunities, and productive investment will be constrained.

In addition, the corporate income tax creates other investment distortions. First, it is part of a "double taxation" of corporate income—dividends paid to owners of equity are taxed *after* corporations pay taxes on income.[26] Since interest expenses are deductible from income, corporations rely more heavily on debt financing and less on equity financing than would be optimal without the corporate tax.

Other domestic distortions are created by a high corporate income tax rate:

- It reduces the incentives to save because the expected after-tax cost of investing is lessened.
- It creates biases in the organization of businesses by discouraging incorporation in favor of forms that are not subject to the tax (such as partnerships and sole proprietorships).[27]
- Since it taxes alternative assets and industries at different effective rates, it shifts economic activity toward more lightly taxed areas.
- More resources are devoted to tax compliance and avoidance planning, leaving fewer resources for productive investment.

International distortions are created as well, and these are magnified in today's global economy. Corporate tax rates may not determine global savings levels, but they will affect where savers in different countries choose to place their investments. Nations with higher corporate taxes will lose investment to lower-tax countries, holding all other location factors constant.

Another particularly onerous feature of the U.S. corporate tax system is that it taxes U.S. multinationals on their worldwide earnings, but most U.S. trading partners take a different approach (raising a crucial implication in the second bullet point below). Most industrialized countries use a territorial system for their MNCs in which the home country exempts all or most of the firm's foreign earnings from home-country taxation.[28]

Among the other international considerations of a high corporate tax rate:

- The efficiency of investment is reduced as businesses allocate capital investment in specific projects across the globe based largely on tax considerations.
- The tax base of relatively high-corporate-tax countries may be eroded further as MNCs attempt to realize profits in low-tax countries and slow or diminish repatriation.
- A high-tax country will curtail the amount of capital available to workers, which tends to reduce their wages.
- Lower foreign direct investment diminishes the opportunities for technology transfer and knowledge spillovers from foreign firms in the host country.

Considering all of these factors together, an economy with lower corporate tax rates will be one with higher levels of domestic investment and a greater accumulation of productive capital. Having more capital stock available per worker augments productivity and improves long-run economic growth, leading to a higher standard of living for workers. Capital-intensive industries, whether producers or users of capital goods, are harmed most severely by non-competitive corporate tax policies. Since manufacturing encompasses both heavy users and producers of capital goods, it is the industry with the most to lose if the United States keeps its outdated corporate tax policy in place.

International Comparisons of Statutory Corporate Income Tax Rates

Most countries have become aware that in a globalized world, firms' investment decisions are highly elastic with respect to differences in corporate tax rates between nations. OECD member nations and many developing nations have been adjusting their corporate tax policies not only to remain attractive for domestic firms but also to effectively compete for foreign direct investment. Recent applied theoretical research has produced a new construct, the Effective Average Tax Rate (EATR), which captures MNCs' investment location decisions quite accurately. The EATR is a weighted average of an adjusted statutory rate and an effective marginal tax rate.[29] Additionally, the location where taxable profits are realized is most affected by the statutory corporate tax rate.[30]

As recently as 1988, the United States had one of the most competitive statutory corporate tax rates in the world. But while other nations have slashed their statutory corporate tax rates, the U.S. has kept them virtually constant.[31]

Consider the case of Germany: In 2000, it had one of the highest corporate tax rates in the world, at 52.4 percent, but that rate now stands at 29.4 percent. Even in France, which is not exactly a bastion of Western-style capitalism, today's statutory corporate tax rate is 32.3 percent, down from 40 percent a decade ago. Since 1994, Italy has reduced its corporate income tax rate by over 20 percentage points; it now stands at 31.4 percent.

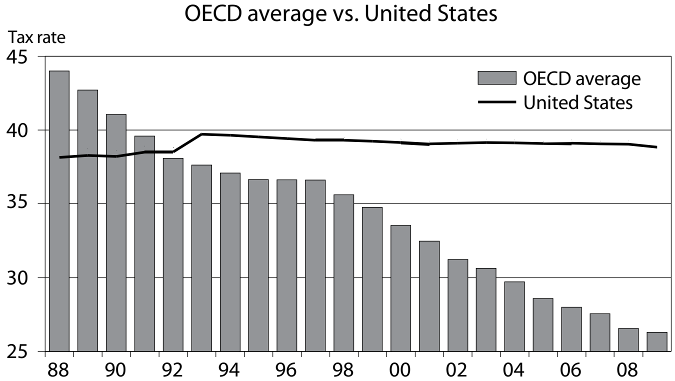
The European Union has seen a flurry of corporate income tax adjustments, and not just among its larger members.[32] For example, the Republic of Ireland has slashed its rate by 27.5 percentage points since 1994; it is now among the lowest in the OECD at 12.5 percent. Other EU countries that have implemented sizable cuts in their corporate tax rates include Poland and the Slovak Republic (21 percentage points), the Czech Republic (19 percentage points), and Hungary (16 percentage points).

Cuts in statutory corporate income tax rates have been prevalent throughout Asia as well. Vietnam reduced its rate by 3 percentage points in 2009 to 25 percent (continuing a downward trend from 35 percent in 1999). Singapore approved a reduction in its corporate tax to 18 percent in 2008 in an attempt to remain competitive with Hong Kong's 16.5 percent. In an ever-growing awareness of cross-border investment sensitivity, even China responded by cutting its rate to 25 percent in 2008.

Many of these statutory corporate tax rate cuts have been accompanied by base-broadening measures and reductions in exclusions (such as less generous depreciation allowances). Nevertheless, the United States now lags behind the competitiveness curve as it relates to corporate tax policy. The graph below shows how the unweighted OECD statutory corporate income tax rate has plummeted, while the U.S. rate has been constant. If it weren't for Japan at 40.7 percent, the United States would have the highest rate among all OECD countries.

Statutory corporate income tax rates

OECD average vs. United States



Sources: OECD, Milken Institute.

Empirical Evidence of the Economic Impacts of Corporate Tax Rates

There is a fairly robust body of economic literature on the impact of corporate taxes on investment. Starting with Jorgenson[33] in 1963, and later Hall and Jorgenson in 1967, an array of noteworthy studies were performed by public finance economists. A small sample of earlier studies[34] includes Summers,[35] Feldstein, Dicks-Mireaux and Poterba,[36] Auerbach,[37] King and Fullerton,[38] Slemrod,[39] and Auerbach and Hassett.[40] In general, this body of literature finds highly significant negative effects on investment stemming from corporate income taxes; however, the size of the impact varies depending on the methodology deployed.

Changes in international corporate tax policies over the past 30 years have provided a rich environment for testing how rate changes affect cross-country economic performance. Econometric studies on a wide variety of outcome measures have been analyzed. Because many OECD countries adjusted corporate tax rates at different times and by different amounts, we can examine a real-world experimental laboratory. One of the most fruitful areas of study has examined the direct relationship between statutory or effective corporate tax rates and **inward foreign direct investment (FDI)**. This body of empirical research has found a robust and significant inverse relationship between corporate tax rates and inward FDI. An important study by Desai, Foley, and Hines[41] provides a powerful measure. They found that a 1-percentage-point increase in the corporate tax rate in a MNC subsidiary's host country reduced long-run capital investment by 3.7 percent.

Another important study by Becker, Fuest, and Riedel examined not only the quantity but also the quality of foreign direct investment.[42] On the quantity side, they found that a 1-percentage-point increase in the corporate tax rate decreases the capital stock by 1.2 percent. However, their findings on the quality of FDI proved to be most insightful. The first quality estimate points to a sorting of profitable investment projects away from the home of the parent firm toward affiliates with lower corporate tax rates. They find that a 1-percentage-point decrease in the tax rate differential between the subsidiary's and the parent's corporate tax increases the subsidiary's asset profitability by 0.8 percent. Secondly, they conclude that a higher corporate tax rate has a statistically significant and positive impact on the payroll intensity of corporate production. One specification implies that a 1-percentage-point increase in the corporate tax rate causes the payroll-to-capital ratio to expand by 0.5 percent in the affiliate location. In other words, less-capital-intensive and less-profitable investments are made when corporate taxes are higher.

Other recent studies focus on how corporate rates disproportionately affect **productivity growth** in the economy. One pathway for this effect is through a distortion in relative input factor prices, generally raising the price of capital equipment in relation to that of labor. This will tend to push investment to less-productive sectors, especially in manufacturing.[43] Additional empirical findings show that at both the firm and industry level, corporate taxes have adverse impacts on total factor productivity (TFP) growth. One study shows that a 5-percentage-point reduction in corporate income tax rates boosts average annual productivity growth by 0.4 percent over a 10-year period for firms with productivity at or above the median relative to those below it.[44] Another study examined a panel of data covering 21 industries in 12 OECD countries from 1981 through 2001, revealing a strong negative relationship between corporate tax rates and TFP growth.[45]

The influence of corporate tax rates on **wage growth** has been another area of recent research. One study, based on cohort data from 1979 to 2000, concluded that if the marginal corporate tax rate increases by 1.0 percent, wages decline by 0.7 percent.[46] An important analysis of manufacturing was performed utilizing data captured over 22 years in 72 countries. The empirical results reveal that a 1 percent rise in corporate tax rates is associated with a 1 percent decline in hourly manufacturing earnings.[47] A number of other studies have likewise documented the negative impact of corporate tax rates on wages.

A key area of research in recent years has focused on the link between corporate tax rates and **economic growth**. The main analysis examines the relationship between corporate taxes and GDP per capita growth. Most of these studies find significant impacts of different tax measures, but a large impact stemming from corporate taxes. A key study was performed by Arnold in 2008, using panel data from 21 OECD countries over 35 years. Arnold controls for many other factors affecting growth, such as the accumulation of physical and human capital, but finds that a robust and large negative impact on growth in GDP per capita is attributable to differences in corporate tax rates.[48] Another study examined statutory corporate income tax rates and economic growth across 70 countries from 1970 to 1997.[49] A critical conclusion was that a 10 percent cut in the corporate tax rate was associated with a 1 percent to 2 percent boost in economic growth.

Corporate Income Tax Policy Simulation

In this section, we evaluate the likely economic impacts of reducing the U.S. statutory corporate income tax rate to a level that is more competitive with other industrialized nations. We can quantify these changes by comparing a scenario in which corporate tax rates are reduced to a baseline economic projection in which there is no adjustment in corporate tax policy.

The corporate income tax policy simulation examined the effects of reducing the U.S. statutory rate to the current average of OECD countries. In this scenario, the federal corporate income tax rate was cut by 13 percentage points to 22 percent, with the reduction being phased in over a five-year period. (We assume the average state corporate tax rate of nearly 5 percent remains the same.) The model shows what would happen if the corporate rate is reduced by 5 percentage points in 2010, another 5 percentage points in 2012, and an additional 3 percentage points in 2014.

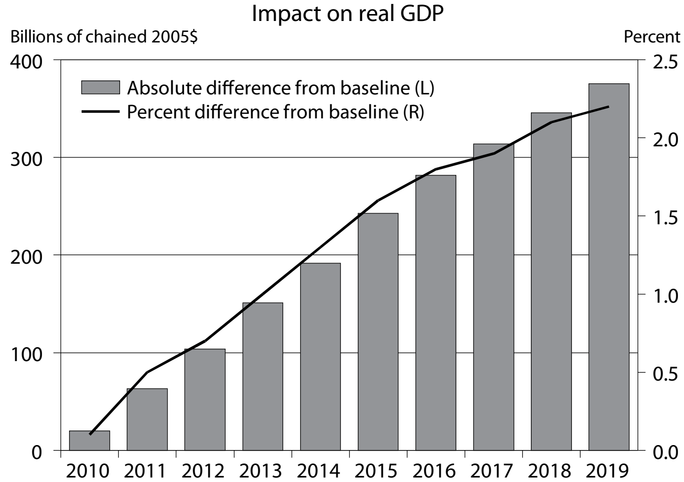
Results

Our results show that a lower corporate tax rate makes the United States a more attractive location for business investment by filtering through a reduction in the user cost of capital. Initially, existing productive capacity in the U.S. is more heavily utilized to fulfill domestic final demand and boost exports. In the current economic climate, with the nation just emerging from the most severe recession since World War II, there are few capacity constraints that would restrict production from rising to meet increased demand. However, the impacts on annual economic growth in 2010 are not as large as in subsequent years, as it would take time for businesses to adjust their investment and production plans.

In the tax-cut scenario, **real GDP** growth improves by 0.3 percentage point relative to the baseline scenario in each year from 2011 through 2013 as the full impacts of rising business investment, exports, production, and employment are felt. Growth in real GDP continues but tapers off to 0.2 percentage point faster than the baseline in 2014 as the response to the 2010 and 2012 cuts in the corporate income tax rate ripples through investment and production decisions. The difference in real GDP growth relative to the baseline rebounds to 0.3 percentage point in 2015 as the impacts from the final installment of the corporate tax cut filter through the economy. Real GDP growth is 0.2 percentage point and 0.1 percentage point greater than the baseline in 2016-2017 and 2018-2019, respectively, as economic growth converges to its new long-term potential growth rate. By 2019, real GDP is higher than the baseline by $375.5 billion, or 2.2 percent.

Corporate income tax policy simulation

Impact on real GDP



Sources: U.S. Bureau of Economic Analysis, Milken Institute.

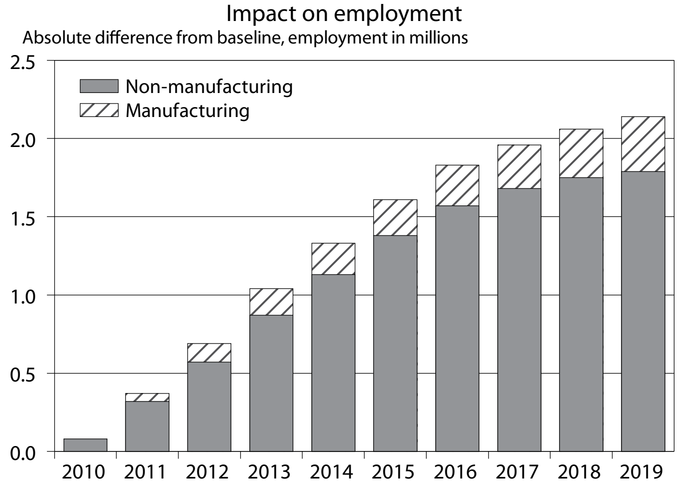
Exports are the first sector that responds to the lower U.S. corporate tax rate. Existing capacity is more heavily utilized as growth in real exports of goods and services rises 0.5 and 1.0 percentage point above the baseline scenario, respectively, in 2010 and 2011. As more capacity is added in 2012 and beyond, annual growth in exports is generally 0.6 to 0.8 percentage point higher than the baseline projection from 2013 through 2019. By 2019, real exports of goods and services stand at $233.3 billion, or 7.8 percent, above the baseline projection. Exports of computer and related equipment, other capital goods, aircraft, and industrial materials show the greatest improvement relative to the baseline. This provides a disproportionate stimulus to manufacturing.

Business fixed investment is the second major sector to respond to the cut in the corporate tax rate. Domestically based firms begin to see the United States as a more attractive location for investment, while foreign direct investment is also enhanced. Initially, investment in capital equipment responds more quickly than structures as new projects are planned and come to fruition. Nevertheless, growth in real business fixed investment improves 0.4 percentage point relative to the baseline scenario in 2010. Annual growth in investment accelerates to 0.9 percentage point greater than the baseline in 2011, then fluctuates between 0.5 and 0.7 percentage point above the baseline from 2012 through 2016. Increases in investment relative to the baseline approach their long-run equilibrium by 2017 and are generally 0.2 percentage point greater each year. We project that real business fixed investment stands at $102.4 billion, or 4.6 percent, above the baseline scenario by 2019. This boost to capital equipment and structures provides a powerful stimulus to manufacturing activity as well.

In response to the simulated corporate tax rate cut, **industrial production** rises as higher exports and investment cause demand for manufactured products, energy, and mining output to increase relative to the baseline projection. The pattern of differences relative to the baseline projection, therefore, is similar to what we see with exports and business investment. By 2019, there is still meaningful annual growth, and overall industrial production exceeds its baseline level by 3.9 percent.

Corporate income tax policy simulation

Impact on employment



Sources: U.S. Bureau of Labor Statistics, Milken Institute.

As manufacturing output expands in our lower-tax-rate scenario, **employment in the manufacturing sector** rises by a commensurate amount. Productivity growth improves relative to the baseline, so manufacturing employment increases at a slightly slower pace. By 2019, manufacturing employment exceeds the baseline projection by 350,000 jobs or 2.7 percent. **Total employment** exceeds the baseline by 2.13 million (1.4 percent) by 2019, when it reaches a steady state rate of advance.

Wages and incomes increase in the lower-tax-rate scenario due to higher employment and manufacturing jobs representing a greater share of overall employment (since manufacturing jobs pay more than the average for all industries). Wage and salary disbursements display average annual growth of 0.6 percentage point greater than the baseline over the 10-year period. Wages and salaries exceed the baseline scenario by $594 billion, or 6.4 percent, in 2019. Real personal income (adjusted for inflation) rises 3.0 percent above the baseline in 2019.

The **federal fiscal impacts** of a corporate tax rate reduction are multifaceted and dynamic with several countervailing forces at work. The principal pathway is through corporate income and the tax collections received by the federal government. Real before-tax corporate profits are higher in the tax-cut scenario than in the baseline scenario due to greater production and sales activity. After-tax corporate profits rise appreciably more than before-tax profits due to the reduction in the tax rate. However, federal corporate tax receipts are not projected to fall as much as the decline in statutory rates would suggest. This is because as the statutory rate declines, the difference between the statutory and the effective rate diminishes. Resources currently devoted to tax avoidance activities would be curtailed.

As the statutory corporate income tax rate is reduced in the three phases assumed in our study, federal income tax collections decline in a step function manner, before higher growth and a reduction in the gap between the effective and statutory rate bring collection back closer to the baseline. By 2019, we project that real before-tax corporate profits exceed the baseline scenario by $59.1 billion, and real after-tax corporate profits surpass the baseline by $151.9 billion. Nominal federal corporate tax receipts fall $120.9 billion relative to the baseline by 2019.

Corporate income tax policy simulation

Summary table

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Statutory corporate income tax rate, decimal fraction											
Adjusted corporate tax level	0.35	0.30	0.30	0.25	0.25	0.22	0.22	0.22	0.22	0.22	0.22
Baseline level	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Difference from baseline											
Absolute	0.00	-0.05	-0.05	-0.10	-0.10	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13
Percent	0.0%	-14.3%	-14.3%	-28.6%	-28.6%	-37.1%	-37.1%	-37.1%	-37.1%	-37.1%	-37.1%
Key impacts											
Ia. Real gross domestic product, US$ billions*											
Adjusted corporate tax level	12,985.5	13,296.7	13,722.7	14,272.8	14,725.9	15,148.1	15,573.7	15,990.4	16,413.8	16,878.9	17,393.2
Baseline level	12,985.5	13,276.9	13,659.5	14,169.2	14,574.8	14,956.6	15,331.1	15,708.7	16,100.1	16,533.3	17,017.7
Difference from baseline											
Absolute	0.0	19.8	63.2	103.7	151.1	191.5	242.7	281.6	313.7	345.6	375.5
Percent	0.0%	0.1%	0.5%	0.7%	1.0%	1.3%	1.6%	1.8%	1.9%	2.1%	2.2%
Ib. Annual real GDP growth											
Adjusted corporate tax level		2.4%	3.2%	4.0%	3.2%	2.9%	2.8%	2.7%	2.6%	2.8%	3.0%
Baseline level		2.2%	2.9%	3.7%	2.9%	2.6%	2.5%	2.5%	2.5%	2.7%	2.9%
Absolute difference from baseline		0.2%	0.3%	0.3%	0.3%	0.2%	0.3%	0.2%	0.2%	0.1%	0.1%
II. Real exports of goods and services, US$ billions*											
Adjusted corporate tax level	1,453.7	1,565.4	1,690.1	1,843.9	2,020.8	2,200.5	2,374.2	2,558.5	2,766.1	2,988.4	3,222.2
Baseline level	1,453.7	1,557.6	1,665.7	1,803.3	1,961.8	2,123.9	2,272.3	2,429.4	2,606.9	2,793.5	2,988.9
Difference from baseline											
Absolute	0.0	7.9	24.4	40.6	58.9	76.7	101.9	129.1	159.2	194.8	233.3
Percent	0.0%	0.5%	1.5%	2.3%	3.0%	3.6%	4.5%	5.3%	6.1%	7.0%	7.8%
III. Real gross private fixed nonresidential investment, US$ billions*											
Adjusted corporate tax level	1,294.1	1,304.7	1,457.0	1,670.4	1,828.3	1,925.2	1,992.7	2,056.3	2,134.6	2,227.5	2,334.6
Baseline level	1,294.1	1,299.1	1,438.2	1,640.7	1,784.1	1,869.4	1,922.7	1,976.3	2,048.3	2,133.3	2,232.2
Difference from baseline											
Absolute	0.0	5.6	18.8	29.7	44.2	55.7	70.0	80.0	86.3	94.2	102.4
Percent	0.0%	0.4%	1.3%	1.8%	2.5%	3.0%	3.6%	4.0%	4.2%	4.4%	4.6%
IVa. Employment–manufacturing, millions											
Adjusted corporate tax level	11.989	11.542	11.759	12.278	12.748	13.001	13.041	12.983	12.942	12.953	12.926
Baseline level	11.989	11.537	11.705	12.155	12.576	12.801	12.812	12.724	12.661	12.644	12.581
Difference from baseline											
Absolute	0.00	0.00	0.05	0.12	0.17	0.20	0.23	0.26	0.28	0.31	0.35
Percent	0.0%	0.0%	0.5%	1.0%	1.4%	1.6%	1.8%	2.0%	2.2%	2.4%	2.7%
IVb. Employment–total nonfarm, millions											
Adjusted corporate tax level	131.894	130.734	133.297	137.024	140.117	142.273	143.957	145.426	146.757	148.149	149.699
Baseline level	131.894	130.648	132.921	136.327	139.074	140.947	142.351	143.598	144.8	146.094	147.567
Difference from baseline											
Absolute	0.00	0.09	0.38	0.70	1.04	1.33	1.61	1.83	1.96	2.06	2.13
Percent	0.0%	0.1%	0.3%	0.5%	0.7%	0.9%	1.1%	1.3%	1.4%	1.4%	1.4%
Other results											
V. Industrial production index, 2002=100											
Difference from baseline											
Absolute	0.0	0.2	0.9	1.6	2.2	2.7	3.2	3.8	4.2	4.7	5.3
Percent	0.0%	0.2%	0.9%	1.4%	1.9%	2.3%	2.7%	3.0%	3.3%	3.6%	3.9%
VI. FY unified budget balance, US$ billions											
Difference from baseline											
Absolute	0.0	-42.1	-28.0	-46.3	-22.2	-29.6	-29.3	-27.4	-46.8	-64.9	-81.3
Percent	0.0%	3.1%	2.6%	5.2%	3.2%	4.2%	3.8%	3.4%	5.5%	7.1%	8.1%

* In chained 2005 dollars

Note: Numbers are rounded. Sources: Federal Reserve Bank, Internal Revenue Service, U.S. Bureau of Economic Analysis, U.S. Bureau of Labor Statistics, U.S. Treasury, Milken Institute.

However, the impact on the overall federal budget is less than the decline in corporate tax receipts because tax collections on wages and other sources of income would rise in the face of greater economic growth. Our simulation of a reduced corporate income tax rate shows an eventual federal budget deficit that exceeds the baseline scenario by $81.3 billion in 2019, but that is a relatively modest impact compared to the advance in wages and salary disbursements in the economy.

It is possible that federal corporate tax receipts may not fall as much as a standard macroeconomic model might estimate, since the statutory U.S. tax rate is substantially above the revenue-maximizing point on the Laffer curve. Several studies suggest that the revenue-maximizing rate has declined over time, indicating that federal corporate tax collections could improve if rates were cut to an optimizing level.[50]

R&D Tax Credit

As national economies transition to a post-industrial model that is based on intangibles, knowledge-based inputs become critical factors of production that drive sustained economic growth.[51] Today countries with consistently strong economic performance are those with advanced technological infrastructures and efficient innovation mechanisms for production. In a knowledge-based economy, individual income disparities become increasingly influenced by innovation capabilities. Extrapolating this observation to a macro-societal level, innovation becomes progressively important to market development.[52]

In the early twentieth century, Schumpeter's work emphasized the role of innovation in the creation of economic activities and societal progress.[53] Subsequent generations of economists have also acknowledged the importance of innovation in generating economic growth.[54] Contrary to classical economic theories that posit the importance of labor and capital in production, many developing countries with an abundant supply of workers and rising access to capital have not attained the growth rates that were once anticipated. New Growth Theory was introduced to explain the factors behind long-term growth in view of these new dynamics, addressing what Castells argued was the inadequacy of traditional economic thinking to explain some of the behavior exhibited by the post-industrial economy.[55] Under New Growth Theory, increased investments in innovation constitute a key endogenous factor in economic production.[56] Innovation is therefore an important engine of growth in advanced economies today.[57] Now this effect has become more pronounced and is a major subject of analysis in models of sustainable economic growth. Countries must develop innovation-based production to create broad-based economic prosperity.

Simulation Results

- An expanded and permanent R&D tax credit encourages both U.S. and foreign-based firms to channel more R&D activities to the United States, spurring greater productivity and economic growth.
- In the expanded R&D tax credit scenario, real GDP growth improves by 0.2 percentage point on an annual basis from 2011 to 2013, and in 2014 and after, by 0.1 percentage point, relative to a baseline projection without a change in policy.
- After 10 years, real GDP is $206.3 billion, or 1.2 percent, above the baseline projection in 2019.
- Investment responds to the improved U.S. competitive position. Real business fixed investment rises 5.6 percent, or $124.6 billion, above the baseline scenario in 2019.
- Exports, especially technology-related goods and services, experience higher growth in the expanded R&D tax credit scenario. By 2019, real exports stand at $63 billion, or 2.1 percent, above the baseline projection.
- Industrial production exceeds the baseline scenario by 4.4 percent in 2019. Total employment rises by 510,000 jobs (0.4 percent) above the baseline at its peak in 2017, and manufacturing employment jumps by 270,000 jobs (2.1 percent) above the baseline in 2019.

Continuous Research and Development for Sustainable Growth

Sustainable growth is dependent on the ability to create an effective policy framework that can facilitate continuous innovation, among other factors.[58] According to Bell, innovation can be argued to be the result of research and development (R&D) activities.[59] The OECD defines these activities as those that create knowledge or develop new applications of knowledge.[60] At a national level, investments in R&D pave the way for innovation to be transformed into economic growth opportunities.[61]

Given the importance of innovation, one route to sustainable economic growth is the presence and effectiveness of continuous R&D activities. Maintaining this activity at a high level requires a strong national infrastructure—including a viable national policy framework that nurtures R&D on an ongoing basis. This allows firms and entrepreneurs to undertake long-term projects with greater confidence and reduced risks.

Innovation, along with entrepreneurship, involves a lengthy process of research and development—one that inevitably entails risk for firms and industries. There are three main categories of risk (regulatory risk, innovation risk, and monetary risk) that must be overcome in order to create an efficient infrastructure for R&D activities.

Regulatory Risks

It is important to acknowledge that innovation is fleeting. What is groundbreaking today is less so tomorrow, and progressively less so over time.[62] This occurs, at least in part, because the market power accorded to the owners of the innovation is constantly pressured by new players vying for a share of a finite pool of consumers.[63]

In view of this dynamic, patent laws exist to protect these owners from unscrupulous copyright violations. However, regulatory changes may affect the extent of protection, including the length of time owners are protected. Long-term survival therefore depends on continuous innovation. On a macro level, countries and regions alike must be able to generate ongoing momentum for innovation to remain competitive in the global knowledge-based economy.

Innovation Risks

Innovation always carries with it the very real possibility of failure—but failures can sometimes serve as catalysts for greater innovation.[64] They spur further R&D and create opportunities for more sophisticated product and service developments. Some types of innovation, such as medical products, require extended periods of trial and error. Entrepreneurial success may not happen overnight.

Therefore, it is essential for countries and regions to provide a viable policy framework to encourage continuous R&D, and hence continuous innovation, for sustainable growth. Entrepreneurship policies are one way to create an environment that encourages innovation. For example, under the Manufacturing Extension Partnership, organizations were created in every state to consolidate and share best practices among small manufacturing companies, in a bid to develop industry linkages across the supply chains.[65]

Monetary Risks

Research and development activities are typically time-consuming and resource-intensive.[66] They often require substantial capital investment—and returns may not be immediately evident in the short term. Without the right incentives, investors may not have the patience to wait for potential long-term gains.

A number of countries have introduced policies that encourage continued investment in selected high-value industries. Ireland, for example, introduced these measures with an understanding of the extended time required for positive returns on these investments.[67] The country's first Programme for Economic Expansion, in effect from 1958 to 1963, encouraged foreign investment in Irish industries. These and later policies ultimately paid off, but it took decades of development before Ireland's high-tech Celtic Tiger economy took off in the 1990s.

Encouraging Innovation through R&D Tax Credits

Research and development activities are costly, and firms must be able to project long-term benefits to justify these costs. As discussed in the preceding section, there are risks involved in R&D, leading to the possibility of failure and/or an extended wait before a sufficient return on investments can be realized. While U.S. R&D tax credits remain temporary (and technically expired again on December 31, 2009), the majority of other nations have implemented them on a permanent basis, thus providing a firmer commitment to R&D over the long term.

Prior research has shown that lucrative reward systems and regulatory structures influence the level of R&D activities.[68] Tax credits are one way to effectively reduce the costs of conducting R&D. These credits encourage firms to undertake the risks involved and channel more resources into innovation. They have especially been found to stimulate growth in industrial R&D expenditures.[69] Extrapolating this to the national level, the creation of attractive R&D credits can generate broad and sustainable economic growth in the long term.

This argument has been verified by extensive empirical research since the last decade.[70] Not only is it common to find countries introducing tax incentives to support continued investments in R&D, so as to eliminate market failures,[71] but considerable evidence also shows a positive relationship between R&D tax credits and R&D activities.[72]

Reflecting arguments in Romer's endogenous growth model, Russo simulated and compared the impact of various investment tax credits. He showed that investment tax credits for R&D generated the greatest positive change in R&D spending relative to other types of incentives.[73] This finding emphasizes the role R&D tax credits play in stimulating sustainable growth.

Warda examined the tax policies of 27 OECD countries. He found that in 2005, 70 percent of them offered R&D tax incentives (only 50 percent had these policies in place in 1996).[74] Atkinson compared incentives across OECD countries and found that the United States offered the highest R&D tax incentives globally in the late 1980s. By 1996, however, the U.S. trailed Spain, Australia, Canada, Denmark, the Netherlands, and France to occupy the seventh position in terms of R&D tax credits. By 2004, the U.S. had slipped to 16th.[75] Although the United States was the pioneer in implementing the R&D investment tax credit in 1981, most other advanced economies have responded by implementing their own version of this policy in a more aggressive fashion. Based on OECD calculations, the United States now ranks 17th among members on the effective rate of the R&D tax credit. Furthermore, the U.S. has kept the R&D tax credit "temporary" for 29 years. Coupled with the restrictions in

R&D tax credit qualifications in the U.S., many other OECD countries appear to have created a more attractive landscape for innovation and sustainable growth.

Using a sample of 2,785 manufacturing plants in Canada, Berube and Mohnen showed that by taking advantage of existing R&D programs, the plants enjoyed success in product innovation and commercialization. Research and development subsidies were most effective where market failure was the highest.[76] In another study, Klassen, Pittman, and Reed compared the impact of tax incentives on R&D activities among firms in Canada and the United States. Similarities in industries were taken into consideration in the selection of firms for the sample. Based on an empirical analysis of panel data, Canadian firms spent an additional $1.30 for every tax dollar forgone through the country's tax credit system. By contrast, the U.S. system facilitated an additional $2.96 in R&D spending on average.[77]

Further country-level evidence shows that in Australia, R&D tax incentives generated an equal value of R&D per unit of tax expenditures.[78] A study of France showed a triple to quadruple increase in R&D activities through tax credits.[79] Griffith, Redding, and Reenen simulated the effects of proposed R&D tax credits in the U.K. They found that in the long term, the resultant increase in GDP was considerably larger than the costs of the tax credits, while the short-term impact was less evident.[80]

The positive impact of R&D tax credits has been seen not only at the national level but also at the regional and firm levels.[81] The United States is deploying R&D tax credits effectively, but it is not offering them at the same levels as other OECD nations. With incentives in short supply, it is not surprising that cost reduction was found to be a key factor that drives U.S. firms to shift their R&D activities offshore.[82]

Despite the economic importance of R&D tax credits, keeping them temporary in nature restricts firms and entrepreneurs from developing accurate projections on the returns to investing in R&D over a longer time horizon.[83] Because the nature of the investment is long-term, tax policies must similarly take the long view to remove investor uncertainty.

R&D Tax Credit Simulation

We have evaluated the economic stimulus that would be provided by expanding the R&D investment tax credit and making it permanent. We perform this alternative policy simulation by utilizing the same macro-econometric model of the U.S. economy as in the corporate income tax policy simulation. This approach captures the dynamic feedback mechanism created when businesses increase their research and development spending (investment in innovative activities), therefore creating new products and services; enhancing productivity growth; expanding investment in technology-intensive capital equipment; spurring greater exports, production, employment, and incomes; and boosting overall real GDP growth in the economy. We can quantify the effects by comparing a scenario in which the R&D investment tax credit is expanded and made permanent to a baseline economic projection without an adjustment to current policy.

This R&D tax credit policy simulation was developed by increasing the credit to 10 percent—its level prior to the 1986 tax reform legislation—from its current 8 percent level and making it permanent.[84] This represents a 25 percent increase in the R&D tax credit, and our simulation assumes that it takes effect in 2010.

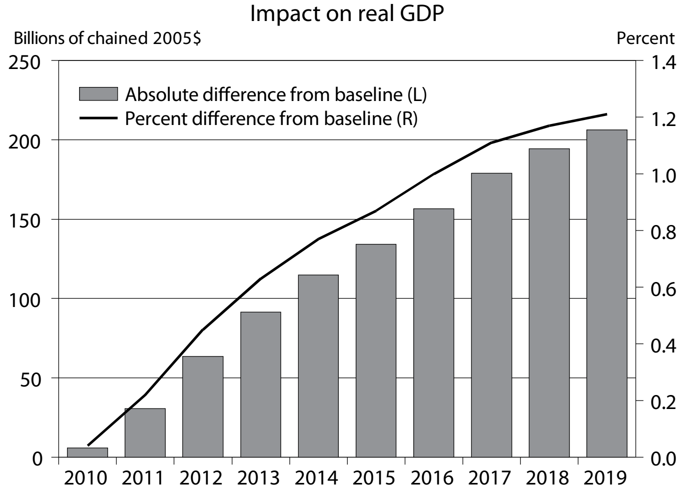
Results

The expanded and permanent R&D tax credit encourages U.S.-based firms to perform more R&D activities in the United States. Additionally, it provides greater incentives for foreign-based multinationals to channel more of their R&D investment to the United States. The resulting stimulus to U.S. economic growth is not immediate, as firms take some time to react to the increased R&D incentives and alter their investment plans.

During the first year of our scenario, research and development by industry increases by a marginal amount, but by the second year (2011) of implementation, we see a meaningful response. This higher growth path is maintained through 2014, before it reaches a long-term equilibrium slightly above the baseline projection. It is important to note that in the macro-econometric model, growth in total factor productivity (not accounted for by any of the factor inputs directly) is largely determined by the stock of R&D capital available in the economy. Additionally, manufacturing industries such as pharmaceuticals, semiconductors, medical equipment, and computers are among the leaders in amounts of research and development funding and relative to sales (R&D intensity).

R&D tax credit permanent and increased by 25 perecent policy simulation

Impact on real GDP



Sources: U.S. Bureau of Economic Analysis, Milken Institute.

With the expanded tax credit, **real research and development spending by industry** improves on an annual basis by 0.5, 1.0, and 0.9 percentage point in 2010, 2011, and 2012, respectively, relative to the baseline projection. After 2012, industry-funded R&D grows approximately 0.2 percentage point faster than the baseline on an annual average basis. By 2019, real R&D spending by industry is 3.8 percent above the baseline. Growth in **real GDP** is 0.2 percentage point above the baseline from 2011 through 2013 as higher investment and gains in exports of capital spur growth, in addition to higher productivity growth. In 2014 and after, real GDP growth in the expanded tax credit scenario is roughly 0.1 percentage point above the baseline. After 10 years, real GDP is above the baseline by 1.2 percent or $206.3 billion. **Productivity growth**, as measured by an index of output per hour in the nonfarm business sector, is nearly 0.1 percentage point greater on average in the years 2010 through 2019 with the expanded tax credit in place, leaving it 1.0 percent above the baseline projection by 2019.

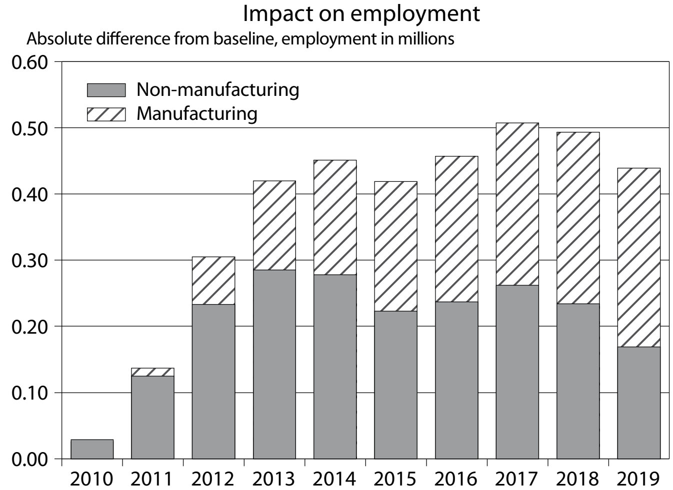
In the expanded R&D tax credit scenario, investment in equipment and structures responds to improved U.S. competitiveness attributable to greater R&D investment and innovation. Higher R&D investment improves the quality of new capital goods and reduces their prices relative to the baseline. As output increases, the need to expand productive capacity provides another dynamic feedback to capital equipment investment. **Real business fixed investment** rises 0.4 percentage point faster than the baseline in 2010, but accelerates by another 1.0 percentage point above the baseline in 2011. In 2012, annual growth in real investment is 0.9 percentage point in excess of the baseline, before tapering off to 0.7 percentage point greater than the baseline in 2013. Growth in investment is around 0.5 percentage point above the baseline during 2014-2017, before diminishing to 0.2 percentage point above it during the last two years of the simulation. By 2019, real investment is 5.6 percent or $124.6 billion above the baseline projection.

With the expanded R&D tax credit, **U.S. exports** experience greater growth as the competitiveness of our information and communication technologies and other technology-intensive capital equipment and products improves relative to that in other advanced industrial economies. The United States gains market share for exports of these goods to both developing and industrialized nations. Higher R&D investment results in better-quality capital equipment and more competitive prices due to productivity enhancements. In the expanded tax credit scenario, real exports of goods and services increase by 0.1 percentage point more than the baseline in 2010, but witness a 0.6 percentage point acceleration in growth above the baseline in 2011 and 2012, before annual growth tapers off to 0.2 percentage point on average thereafter. Real exports stand $63 billion (2.1 percent) above the baseline by 2019.

Manufacturing activity receives a huge boost in the R&D investment tax credit simulation. The two primary sources of stimulus emanate from the large gains in investment in capital equipment and higher merchandise exports. Since much of the growth in exports is concentrated in machinery, equipment, and information and communication technologies, manufacturing is a prime beneficiary. Industrial production increases modestly at first in this scenario, but the annual growth rate rises 0.5, 0.8 and 0.7 percentage point faster in 2011, 2012, and 2013, respectively, relative to the baseline. Growth in industrial production decelerates in 2014 and beyond somewhat relative to the baseline but averages 0.4 percentage point annually. In 2019, industrial production is 4.4 percent above the baseline projection.

R&D tax credit permanent and increased by 25 perecent policy simulation

Impact on employment



Sources: U.S. Bureau of Labor Statistics, Milken Institute.

Policy simulation: R&D tax credit made permanent and increased by 25 percent

Summary table

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Marginal rate of investment tax credit on R&D, decimal fraction											
Expanded R&D tax credit level	0.08	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Baseline level	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Difference from baseline											
Absolute	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Percent	0.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
Real R&D spending funded by industry, US$ billions*											
Expanded R&D tax credit level	223.99	223.09	230.27	242.78	258.81	268.97	278.57	288.01	298.84	310.92	323.54
Baseline level	223.99	222.02	226.79	237.17	251.75	262.06	270.88	279.42	289.18	300.08	311.62
Difference from baseline											
Absolute	0.00	1.07	3.48	5.61	7.06	6.92	7.69	8.58	9.66	10.84	11.92
Percent	0.0%	0.5%	1.5%	2.4%	2.8%	2.6%	2.8%	3.1%	3.3%	3.6%	3.8%
Key impacts											
Ia. Real gross domestic product, US$ billions*											
Expanded R&D tax credit level	12,985.5	13,282.7	13,690.3	14,232.7	14,666.2	15,071.4	15,465.2	15,865.3	16,279.0	16,727.6	17,224.1
Baseline level	12,985.5	13,276.9	13,659.5	14,169.2	14,574.8	14,956.6	15,331.1	15,708.7	16,100.1	16,533.3	17,017.7
Difference from baseline											
Absolute	0.0	5.7	30.7	63.5	91.4	114.8	134.1	156.6	179.0	194.3	206.3
Percent	0.0%	0.0%	0.2%	0.4%	0.6%	0.8%	0.9%	1.0%	1.1%	1.2%	1.2%
Ib. Annual real GDP growth											
Expanded R&D tax credit level		2.3%	3.1%	4.0%	3.0%	2.8%	2.6%	2.6%	2.6%	2.8%	3.0%
Baseline level		2.2%	2.9%	3.7%	2.9%	2.6%	2.5%	2.5%	2.5%	2.7%	2.9%
Absolute difference from baseline		0.0%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%
II. Real exports of goods and services, US$ billions*											
Expanded R&D tax credit level	1,453.7	1,559.1	1,676.9	1,827.0	1,996.2	2,167.3	2,323.4	2,486.3	2,667.7	2,856.2	3,051.9
Baseline level	1,453.7	1,557.6	1,665.7	1,803.3	1,961.8	2,123.9	2,272.3	2,429.4	2,606.9	2,793.5	2,988.9
Difference from baseline											
Absolute	0.0	1.5	11.3	23.8	34.4	43.4	51.1	56.9	60.8	62.7	63.0
Percent	0.0%	0.1%	0.7%	1.3%	1.8%	2.0%	2.2%	2.3%	2.3%	2.2%	2.1%
III. Real gross private fixed nonresidential investment, US$ billions*											
Expanded R&D tax credit level	1,294.1	1,304.4	1,458.2	1,678.5	1,837.2	1,935.7	2,000.6	2,066.7	2,152.0	2,247.9	2,356.8
Baseline level	1,294.1	1,299.1	1,438.2	1,640.7	1,784.1	1,869.4	1,922.7	1,976.3	2,048.3	2,133.3	2,232.2
Difference from baseline											
Absolute	0.0	5.3	19.9	37.8	53.1	66.3	78.0	90.4	103.7	114.6	124.6
Percent	0.0%	0.4%	1.4%	2.3%	3.0%	3.5%	4.1%	4.6%	5.1%	5.4%	5.6%
IVa. Employment–manufacturing, millions											
Expanded R&D tax credit level	11.989	11.534	11.717	12.227	12.711	12.974	13.008	12.944	12.906	12.903	12.851
Baseline level	11.989	11.537	11.705	12.155	12.576	12.801	12.812	12.724	12.661	12.644	12.581
Difference from baseline											
Absolute	0.00	-0.00	0.01	0.07	0.14	0.17	0.20	0.22	0.25	0.26	0.27
Percent	0.0%	-0.0%	0.1%	0.6%	1.1%	1.4%	1.5%	1.7%	1.9%	2.0%	2.1%
IVb. Employment–total nonfarm, millions											
Expanded R&D tax credit level	131.894	130.674	133.058	136.632	139.494	141.398	142.770	144.055	145.307	146.587	148.006
Baseline level	131.894	130.648	132.921	136.327	139.074	140.947	142.351	143.598	144.800	146.094	147.567
Difference from baseline											
Absolute	0.00	0.03	0.14	0.31	0.42	0.45	0.42	0.46	0.51	0.49	0.44
Percent	0.0%	0.0%	0.1%	0.2%	0.3%	0.3%	0.3%	0.3%	0.4%	0.3%	0.3%
Other results											
V. Industrial production index, 2002=100											
Difference from baseline											
Absolute	0.0	0.1	0.6	1.5	2.4	3.1	3.7	4.3	4.9	5.4	6.0
Percent	0.0%	0.1%	0.6%	1.4%	2.1%	2.6%	3.0%	3.4%	3.8%	4.1%	4.4%
VI. FY unified budget balance, US$ billions											
Difference from baseline											
Absolute	0.0	0.7	6.8	23.1	38.8	47.2	47.3	40.3	33.7	28.2	22.7
Percent	0.0%	-0.1%	-0.6%	-2.6%	-5.6%	-6.7%	-6.1%	-5.1%	-4.0%	-3.1%	-2.3%

* In chained 2005 dollars

Note: Numbers are rounded. Sources: Federal Reserve Bank, Internal Revenue Service, National Science Foundation, U.S. Bureau of Economic Analysis, U.S. Bureau of Labor Statistics, U.S. Treasury, Milken Institute.

With the expansion of production in manufacturing, firms respond by adding to their payrolls and increasing investment in workforce training. Manufacturing employment doesn't rise as fast as production due to greater increases in productivity, but substantial gains are experienced in order to meet higher output levels. By 2019, **manufacturing employment** in the expanded R&D tax credit scenario is 270,000 or 2.1 percent above the baseline. Total employment peaks in 2017 at 510,000 jobs (0.4 percent) above the baseline scenario. Manufacturing accounts for 61 percent of the total gain in employment relative to the baseline in 2019.

Real personal income growth averages just over 0.1 percentage point more than the baseline over the 10-year period. By 2019, real personal income is $161.6 billion (1.1 percent) greater than the baseline. The **federal budget deficit** shrinks relative to the baseline projections as economic growth accelerates and improves income tax revenue, outweighing the reduction in the corporate tax receipts caused by the expanded R&D tax credit. By 2019, the federal budget deficit is $22.7 billion lower than in the baseline scenario. Therefore, the expansion in the R&D investment tax credit propels economic growth while improving the nation's fiscal health.

Export Controls

Globalization has ushered in enormous opportunities for exporting countries to take advantage of vast, previously untapped markets. Although the United States generally has open policies in place regarding exports of merchandise, the nation has, for legitimate national security reasons, placed export controls on certain dual-use goods and sensitive technologies that raise concerns about nuclear proliferation, terrorism, or other threats to U.S. national security. While security will always remain paramount, there is growing debate about whether the United States should modernize its export control regime to address 21st-century security and economic realities.

Proponents of modernization argue that the United States would gain through:

- Greater exports of widely available technology to countries around the globe
- Increasing technology exports that build strong linkages with user nations, creating a positive feedback loop
- Maintaining a competitive edge in the world market through multilateral trade agreements rather than unilateral trade agreements

Simulation Results

- Modernizing U.S. export controls on commercially available technology products with some countries would produce higher export growth in the future, particularly in the high-value-added areas in which the United States excels.
- If this policy were implemented in 2010, the most rapid period of export growth (0.2 to 0.3 percentage point on an annual basis) relative to a baseline scenario with no policy change occurs from 2011 through 2016. After that, export growth relative to that in the baseline moderates to 0.1 percent. Real exports are $56.6 billion (1.9 percent) higher than the baseline in 2019.
- Real GDP rises by $64.2 billion (0.4 percent) relative to the baseline projection in 2019.
- Investment activity responds to the higher rate of export growth. Real business fixed investment grows faster than the baseline over the next decade and is $18.7 billion (0.8 percent) above the baseline scenario in 2019.
- In the policy change scenario, industrial production exceeds the baseline by 1.5 percent in 2019, while total employment increases by 340,000 jobs (0.2 percent) and manufacturing employment rises by 160,000 jobs (1.2 percent).

A Brief History of U.S. Export Control Policies

Export controls were established to protect national security and prevent countries of concern from gaining access to sensitive technologies. Restrictions on certain goods and certain countries have been in effect since the beginning of the 20th century. In 1940, Congress gave the president authority to control exports of arms and "militarily significant" goods and technologies. After World War II, U.S. export control policy aimed at national security included "conserving supplies of critical materials, rather than in strategic, ideological, or other terms." [85]

The Export Control Act of 1949 (eventually superseded by the Export Administration Act of 1969) established that export restrictions could be imposed due to a range of national security threats (including regional stability, human rights, anti-terrorism efforts, and non-proliferation of nuclear, missile, chemical, and biological warfare capabilities).[86] The primary objective of the Export Control Act came to focus on delaying improvements in Warsaw Pact (and Chinese) military capabilities that could be accomplished or facilitated through the acquisition of Western technology and end products.[87] This ushered in an era of rewriting the Export Administration Act of 1969 several times before it finally expired in 1989. Today the EAA is in effect through the president's powers under the International Emergency Economic Powers Act (IEEPA).

Selected Components of Export Control Policies at Present

At present, the U.S. Bureau of Industry and Security (BIS) maintains the Commerce Control List (CCL), a list of goods that require a license for export or re-export. This list of sensitive exports includes telecommunications and advanced electronic equipment, precision machine tools, guidance technology, aerospace and jet engine technology, synthetic materials, and specialized manufacturing and testing equipment (including mixers, high-temperature ovens, and heat and vibration stimulators).[88] The main purpose of maintaining this list is to control the availability of sensitive goods and technologies to countries that might pose a threat to national security, increase proliferation and regional instability, or support terrorism.

With this objective in mind, foreign countries are divided into five groups (Country Groups A, B, C, D, and E, with sub-groups) for export purposes. It is possible for the same country to overlap into more than one group.

Country Group B, for example, includes trading partners that are deemed friendly nations.[89] These countries are exempt from license requirement for *certain* CCL goods, but for this group of nations in particular, there is a great deal of room to improve the ease of trade, possibly by creating license-free zones or allowing easier intra-company transfers from branches of firms in unrestricted zones to branches in Country Group B. Falling near the other end of the spectrum is Country Group D-1, a list of countries for which trade is tightly controlled.[90] Approval from the BIS is necessary for all exports to these nations.

One of the main concerns for the United States has always been the risk of nuclear and other arms proliferation. The 1991 Enhanced Proliferation Control Initiative (EPCI) was enacted to control those risks.[91] It denies licenses to certain entities in countries such as Russia, China, Pakistan, India, and Israel.

Licenses to export items controlled for national security purposes are reviewed on a case-by-case basis. The licensing review takes place with the input of the U.S. Commerce and State departments. But applications require cumbersome paperwork, and the process does not easily accommodate advances in technology and any update on dual-use items by other countries.[92] Modernizing license requirements and increasing multilateral trade agreements are possible steps that might be beneficial.

Motivated by concerns surrounding the export of sensitive technologies, the United States has a long history of entering multilateral trade agreements, dating to the establishment of the Coordinating Committee for Multilateral Export Controls (CoCom) in 1949.[93] This was an informal forum associated with NATO to coordinate national export control policies and review potential exports to the Soviet Union and other destinations.

In the mid-1990s, CoCom was replaced by the Wassenaar Arrangement on export controls for conventional arms and dual-use goods and technologies. It is one of the multilateral export control regimes in which the United States participates. Its purpose is to "contribute to regional and international security and stability by promoting transparency and greater responsibility in transfers of conventional arms and dual-use (i.e., those having civilian and military uses) goods and technologies to prevent destabilizing accumulations of those items." [94]

Moreover, the United States has been a member of the Missile Technology Control Regime (MTCR) since its inception in 1987.[95] The focus of the MTCR is to limit proliferation of missiles capable of delivering weapons of mass destruction. Initially, the MTCR consisted of just seven members, but it has now grown to include 34 member countries that have agreed to coordinate their national export controls to stem missile proliferation. At present, the latitude afforded to member countries to exercise their own discretion sometimes undermines the intent of such trade agreements.

Export Controls and Investments in R&D

Proponents of modernization argue that "many current controls (outside of narrowly defined military niches) aimed at protecting national security harm U.S. innovation and competitiveness in global markets, thereby reducing economic prosperity, which is an essential element of U.S. national security."[96] The logic is that if the United States will not supply the desired technology, some other country will.

As other countries trade technologies, a strong bond develops between users and producers.[97] This leads to more R&D spending in both the exporting and the importing nations. As a producer country gains market share for goods and technology, it invests further in R&D and technological innovations. On the other hand, demand for a particular good makes the user country more aware of the need to produce similar goods.[98] This leads to the user country also investing more in R&D. In either case, both parties gain.

If the United States maintains its current export control policies on technology transfer, other countries will jump in and seize the opportunity, reaping the gains from strong export linkages. The end-user nation has not been prevented from receiving the technology in question, and the U.S. eventually sees its technological competitiveness in the world market diminish. Therefore there has been pressure to revise U.S export policies to improve trade performance—and doing so in a way that allows the United States to remain a leader in technological innovation without jeopardizing its national security.

Room to Grow Potential Export Markets: An Example

To see how export controls affect U.S. manufacturers, it is useful to consider China as a specific example, though the issue pertains to many nations. Thirty years ago, China was poor and isolated. But now that it has opened its economy to the outside world, other countries are clamoring to tap the vast potential market it represents. Japan, the Republic of Korea, and European Union countries are taking advantage of U.S. export control policies and increasing their exports to China. As expert testimony before the U.S.-China Economic and Security Review Commission once put it, denying China the import of certain goods from the United States never cost China anything—but the U.S. lost a huge potential market.[99]

Trade value of electronic integrated circuits and micro-assemblies
China and world, 2008

	China's imports		World imports
	Amount (US$ billions)	Share (percent)	Share (percent)
World	**130.8***	**100**	**100****
Leading exporting countries			
United States	7.3	5.6	11.0**
Chinese Taipei	29.5	22.6	10.6
Republic of Korea	23.0	17.6	14.0
Japan	14.2	10.9	8.7
Malaysia	12.9	9.9	1.6
Philippines	12.0	9.2	3.6
Singapore	3.8	2.9	16.7
Thailand	2.8	2.1	1.9
Costa Rica	2.2	1.7	0.3
Hong Kong	1.8	1.4	11.7
Germany	1.3	1.0	3.5

* China's share of world imports was 30.4 percent
** Total world imports were US$430.2 billion.
*** Total U.S. exports were US$41.94 billion.
Sources: International Trade Centre, U.N. Comtrade.

Electronic integrated circuits and micro-assemblies offer just one example of technology products that fall under export control. In 2008, China imported $130.8 billion, or 30.4 percent of all world imports, of these items. The following table shows that China imported most of these products from Taiwan, the Republic of Korea, Japan, and other countries; just 5.6 percent of Chinese imports of these goods were from the United States. Although Japan accounted for 8.7 percent of total world exports of these products, as compared to 11 percent for the United States, its exports to China were nearly double those sold by the United States.

If the United States enacts more focused controls, it can capture a greater share of this potential $130.8 billion Chinese market.

Similar comparisons also hold true for other products in which EU countries are taking advantage of U.S. trade policy by selling to U.S.-restricted countries and increasing their market shares. Since the recipient nations are able to obtain this technology elsewhere, U.S. policy is not effective—it simply prevents American firms from accessing new markets.

Simulation: Modernization of Export Controls on Commercially Available Products

In this alternative policy simulation, we assess the possible economic impacts of modernizing export controls on commercially available technology products for a representative group of countries with windows for increasing exports. While it is certainly in the best interests of the United States to restrict the sale of nuclear and other sensitive military technologies for national security purposes, it is not in our best interest to disallow the export of technology products that are legally available from other advanced and NATO member nations. We provide an estimate of how much U.S. exports to a representative group of nations might increase if reasonable reforms were implemented.[100]

Groups of technology products

Product label	Product code
Nuclear reactors, boilers, machinery, etc.	84
Electrical, electronic equipment	85
Aircraft, spacecraft, and parts thereof	88
Optical, photo, technical, medical, etc. apparatus	90

Sources: International Trade Centre, U.N. Comtrade.

Utilizing data from the International Trade Centre and the United Nations, we calculated the U.S. share of exports of commercially available technology products to this representative group relative to its share of the world markets for those same products. In developing this alternative policy simulation, we assume that a modernization of export controls would narrow the gap between U.S. market share in these nations and its share in the total world market by 50 percent. We evaluate the likely impact of a policy change relative to a baseline economic projection that assumes no alteration in export control policy, utilizing the same macro-econometric model as in the corporate tax rate and R&D investment tax credit simulations.

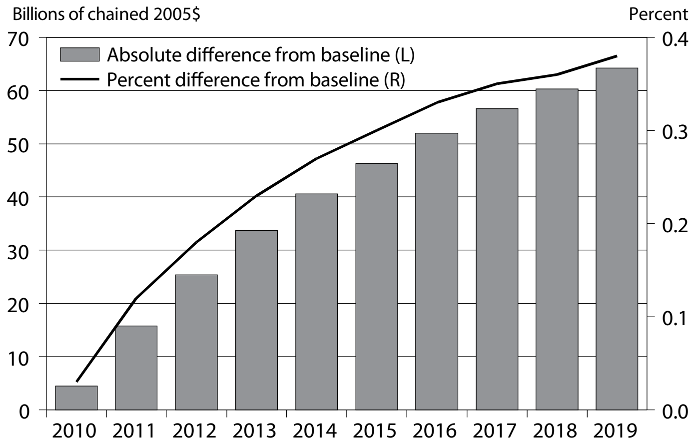
It is important to understand that the trade volumes and values for licensed exports are not the best indicators for determining the impact of modernization on future exports for two reasons. First, many U.S. firms don't bother to submit applications under the Export Administration Act for export licenses because they know they will not be approved or processed in a timely manner. Second, U.S. firms have lost significant business opportunities as other countries have designed out U.S. parts and components due to the nation's export control system.

Results

If export controls on commercially available technology products were modernized in 2010, the most rapid period of U.S. export growth would occur between 2011 and 2016. Our simulation shows that export growth slows relative to a baseline scenario with no policy change after 2016 but still remains on a higher-trajectory path thereafter. Growth in **real exports of goods and services** is 0.2 to 0.3 percentage point higher on an average annual basis relative to the baseline projection through 2016. After 2016, export growth relative to that in the baseline scenario generally moderates to 0.1 percentage point. Real exports of goods and services are $56.6 billion (1.9 percent) higher than in the baseline projection by 2019. The trade balance improves as well, but imports accelerate, reacting to higher U.S. investment and consumption.

Modernizing export controls on commercially available technology products policy simulation

Impact on real GDP

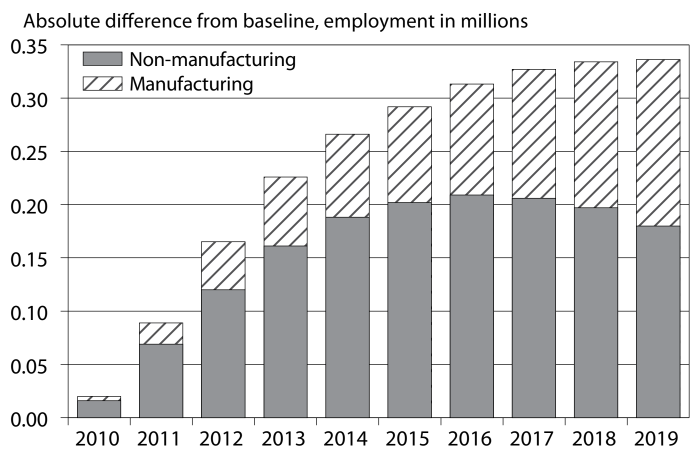


Sources: U.S. Bureau of Economic Analysis, Milken Institute.

In the policy-adjustment scenario, investment activity responds to the higher rate of export growth as additions to capacity become necessary to meet higher production levels. Investment in capital equipment posts the largest gains. **Real business fixed investment** grows annually at slightly less than 0.1 percentage point faster than the baseline level per year over the next decade, and in 2019, is $18.7 billion (0.8 percent) above the baseline projection.

Modernizing export controls on commercially available technology products policy simulation

Impact on employment



Sources: U.S. Bureau of Labor Statistics, Milken Institute.

The manufacturing sector is the primary beneficiary of expanded exports and capital equipment investment if export controls are revised. Industrial production increases 1.5 percent relative to the baseline projection by 2019. Manufacturing adds 160,000 jobs in 2019 relative to the baseline projection. Overall, total employment in the relaxed export control scenario is 340,000 higher than the baseline projection in 2019. Real personal income and **real GDP** rise by $55.2 billion and $64.2 billion, respectively, relative to the baseline in 2019. Additionally, the **federal budget deficit** improves by $15.8 billion in 2019 due to the increased economic activity.

Policy simulation: Modernizing export controls on commercially available technology products

Summary table

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Key impacts											
Ia. Real gross domestic product, US$ billions*											
Modernizing export controls level	12,985.5	13,281.4	13,675.3	14,194.5	14,608.5	14,997.1	15,377.4	15,760.7	16,156.6	16,593.6	17,082.0
Baseline level	12,985.5	13,276.9	13,659.5	14,169.2	14,574.8	14,956.6	15,331.1	15,708.7	16,100.1	16,533.3	17,017.7
Difference from baseline											
Absolute	0.0	4.5	15.8	25.3	33.7	40.6	46.3	52.0	56.6	60.3	64.2
Percent	0.0%	0.0%	0.1%	0.2%	0.2%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%
Ib. Annual real GDP growth											
Modernizing export controls level		2.3%	3.0%	3.8%	2.9%	2.7%	2.5%	2.5%	2.5%	2.7%	2.9%
Baseline level		2.2%	2.9%	3.7%	2.9%	2.6%	2.5%	2.5%	2.5%	2.7%	2.9%
Absolute difference from baseline		0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
II. Real exports of goods and services, US$ billions*											
Modernizing export controls level	1,453.7	1,560.1	1,673.9	1,816.7	1,980.6	2,147.9	2,301.7	2,465.1	2,649.0	2,842.3	3,045.5
Baseline level	1,453.7	1,557.6	1,665.7	1,803.3	1,961.8	2,123.9	2,272.3	2,429.4	2,606.9	2,793.5	2,988.9
Difference from baseline											
Absolute	0.0	2.6	8.2	13.4	18.8	24.0	29.5	35.7	42.1	48.8	56.6
Percent	0.0%	0.2%	0.5%	0.7%	1.0%	1.1%	1.3%	1.5%	1.6%	1.7%	1.9%
III. Real gross private fixed nonresidential investment, US$ billions*											
Modernizing export controls level	1,294.1	1,300.8	1,445.0	1,650.6	1,795.9	1,882.7	1,937.1	1,992.0	2,065.1	2,151.0	2,251.0
Baseline level	1,294.1	1,299.1	1,438.2	1,640.7	1,784.1	1,869.4	1,922.7	1,976.3	2,048.3	2,133.3	2,232.2
Difference from baseline											
Absolute	0.0	1.8	6.8	9.9	11.8	13.3	14.4	15.7	16.8	17.7	18.7
Percent	0.0%	0.1%	0.5%	0.6%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%
IVa. Employment–manufacturing, millions											
Modernizing export controls level	11.989	11.541	11.725	12.200	12.641	12.879	12.902	12.828	12.782	12.781	12.737
Baseline level	11.989	11.537	11.705	12.155	12.576	12.801	12.812	12.724	12.661	12.644	12.581
Difference from baseline											
Absolute	0.00	0.00	0.02	0.05	0.06	0.08	0.09	0.10	0.12	0.14	0.16
Percent	0.0%	0.0%	0.2%	0.4%	0.5%	0.6%	0.7%	0.8%	1.0%	1.1%	1.2%
IVb. Employment–total nonfarm, millions											
Modernizing export controls level	131.894	130.668	133.010	136.492	139.300	141.213	142.643	143.911	145.127	146.428	147.903
Baseline level	131.894	130.648	132.921	136.327	139.074	140.947	142.351	143.598	144.800	146.094	147.567
Difference from baseline											
Absolute	0.00	0.02	0.09	0.16	0.23	0.27	0.29	0.31	0.33	0.33	0.34
Percent	0.0%	0.0%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Other results											
V. Industrial production index, 2002=100											
Difference from baseline											
Absolute	0.0	0.1	0.3	0.6	0.8	0.9	1.1	1.3	1.5	1.8	2.0
Percent	0.0%	0.1%	0.3%	0.5%	0.7%	0.8%	0.9%	1.1%	1.2%	1.3%	1.5%
VI. FY unified budget balance, US$ billions											
Difference from baseline											
Absolute	0.0	0.7	4.6	9.8	14.2	16.6	16.7	15.6	15.4	15.4	15.8
Percent	0.0%	-0.1%	-0.4%	-1.1%	-2.0%	-2.3%	-2.2%	-2.0%	-1.8%	-1.7%	-1.6%

* In chained 2005 dollars

Note: Numbers are rounded. Sources: Federal Reserve Bank, U.S. Bureau of Economic Analysis, U.S. Bureau of Labor Statistics, U.S. Treasury, Milken Institute.

Infrastructure Impacts

As 2010 began, the United States was grappling with a 10 percent unemployment rate, the highest since the early 1980s,[101] coupled with a conservative lending atmosphere [102] and the ongoing migration of jobs overseas. In this environment, government intervention may be necessary to stimulate job growth and to prevent further layoffs.

With this in mind, we set out to determine the potential effects of various infrastructure investments on the job market, choosing 10 projects for study. The selected projects are high-impact investments in both high-growth and traditional industries that provide high-paying jobs, offering the most advantageous platform for sustainable development. All 10 projects fall under the broad themes of public safety, competitive transportation, and energy security, which is particularly crucial for the United States. The Energy Information Administration projects that U.S. energy demand will increase by 5.6 percent in the next 10 years, while demand from export giants like China is projected to increase by 37.6 percent. With such great demand, scarcity coupled with competition will push prices higher.[103] Energy security will be a key factor in achieving continued economic prosperity for Americans.

The 10 projects are also "public goods"—transportation projects, a smart electric grid—that require government intervention because consumers cannot fully bear the true cost of consumption. While critics of federal funding contend that it crowds out private investment, federal intervention can help nascent technologies mature, allowing them to become viable enough to attract private investment on their own. Federal investment in riskier ventures such as renewable energy and nuclear power also tells investors that policymakers are committed to a technology that may require government subsidies or help with land acquisitions in order to be competitive and ameliorate financial risk. In addition, public funding can send the markets a strong signal of political support that could eventually lead to less restrictive permitting and licensing and to new tax incentives, price guarantees, and non-pecuniary backing that attract even more private investment.

The current investments in these 10 projects will produce high job growth in both the short and long term, which is reflected in our analysis of employment and output, aimed at determining the total impact on an industry. Ongoing infrastructure funding could go a long way toward providing energy security and an efficient transportation network that facilitates trade and public safety.

Background and Methodology

Infrastructure investment can have significant impacts on economic vitality, creating opportunities for existing businesses while incentivizing new firms and entrepreneurs. Whether creating economic linkages across regions through construction of new highways and bridges or decreasing energy costs by deploying more energy-efficient technologies, infrastructure investments are critical to economic development and the nation's ability to compete in the 21st century.

Typically, infrastructure development involves at least two phases: a project's construction and its design and planning, normally captured within research and development services. Construction is divided into three main categories: construction of buildings, heavy and civil engineering construction, and specialty trade contractors. Building construction includes residential and nonresidential construction of projects such as single-family homes, factories, and office high-rises. Heavy and civil engineering construction encompasses initiatives such as highways and utility systems. Finally, specialty trade contractors handle painting, electrical work, or other specific construction activities that usually are subcontracted through general contractors.

While many of the infrastructure projects we will discuss involve some type of construction, it is important to note how they differ. Variations in the requirements of the underlying production process are reflected in the many subsectors of heavy and civil engineering construction.[104] Similarly, subsectors within specialty trade contractors represent unique areas of specialization. The types of machinery and equipment used can also differ substantially across subsectors. In addition, the skills required and the wages paid can vary significantly depending on the type of construction involved. For example, skilled underwater engineers are likely to be paid much more than a drywall installer working on a single-family home.

To capture the extent of an industry's economic impact, the Bureau of Economic Analysis (BEA) assigns unique coefficients, known as multipliers, to specific industries. Derived from the BEA's RIMS II, economic multipliers shed light on inter-industry relationships.[105, 106] More specifically, they help illustrate how investments made in one sector can immediately stimulate related sectors. Multipliers enable us to quantify how an industry's employment, earnings, and output ripple through other economic sectors. For instance, the building of new dams can have significant implications for various manufacturing components and can lead to increased economic activity across a number of other sectors. In this section, we will use those multipliers to examine how specific infrastructure investments will benefit various sectors of the U.S. economy, both directly and indirectly.

In determining which multipliers to use, we examined program descriptions for the 10 projects to determine the primary nature of the work involved. Multipliers were then applied to the proposed investment funding amounts, which were based on recent funding allocation and industry knowledge.[107] The proposed investment funding was derived from various sources—congressional reports, industry analysts, academia, the National Association of Manufacturers (NAM), and the Milken Institute. This funding also reflects various incentives and public-private partnerships.

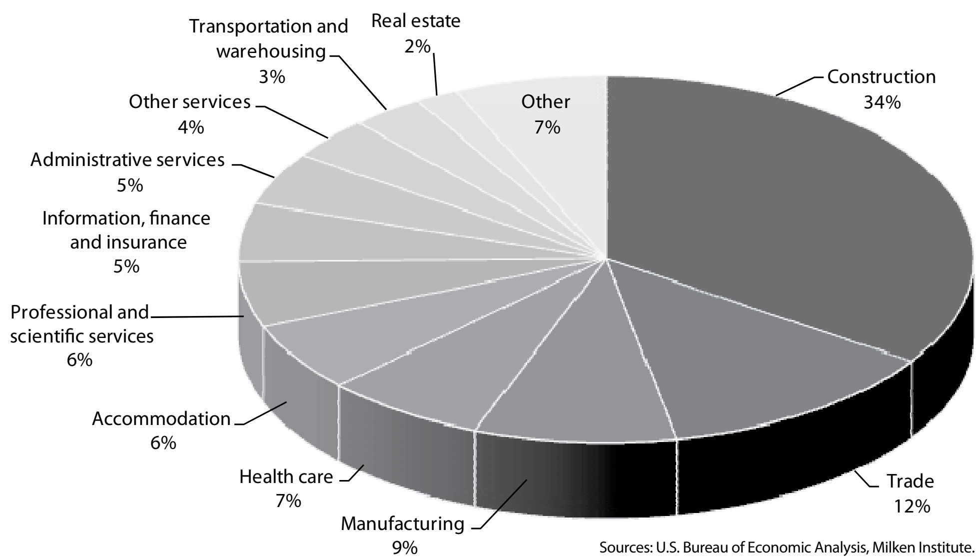
The proposed investments mentioned in this section draw from a mixture of industry estimates and legislation currently being discussed. The 10 projects studied serve as a basis for dialogue on the economic impact of new funding, using recent funding allocations as a model for how new investments might be distributed.[108] We feel this framework best represents how new injections would be invested. Although realistically, new funding may not go to the exact same programs as in the past, the allocation and end use should be the same. It is the information on end use and program type that is inputted into our model. The Milken Institute collected these proposals and analyzed their economic impact on an individual project basis so that policymakers can make informed decisions about where to allocate resources.

Certain infrastructure projects, such as building a smart grid or constructing inland waterways, require an extensive production infrastructure and a large proportion of highly skilled and specialized labor. With this need comes demand for supply-related goods and services. The cumulative employment and earnings generated by all this tightly interconnected activity ripples throughout the economy. Spending by engineers, contractors, and researchers boosts the income of business professionals, restaurant workers, retail clerks, and real estate agents, who then plow that extra income back into the local economy. Through these greater purchases of goods and services, wealth is created and sustained.

The following pie chart shows the distribution of jobs required to support a $1 million investment in the construction sector. While the primary or direct impact would occur in the construction sector, the economic ripple effects mean that 9 percent of the total impact would be created in manufacturing industries and 6 percent in professional and scientific services. These jobs, unlike some of the construction-related occupations, could become permanent, providing the potential for longer-term sustainability and enabling many parts of the country to expand their technology base.

Economic activity generated by construction

Distribution of jobs across all sectors



Sources: U.S. Bureau of Economic Analysis, Milken Institute.

In summary, our analysis uses the following key assumptions:

- These 10 projects were chosen because they affect energy security or involve infrastructure upgrades and expansion, which create the type of high-value jobs that bolster the economy.
- The report analyzes the impact of additional proposed investments using a framework based on recent funding allocations and industry knowledge.
- The proposed investment funding was derived from various sources, including congressional reports, industry analysts, academia, the National Association of Manufacturers (NAM), and the Milken Institute. These funds also reflect various incentives and public-private partnerships. These new investments would be in addition to recent funding.
- Proposed investment funding is computed over a three-year period to focus on near-term job creation and economic impacts.
- The Milken Institute uses the Regional Input-Output Modeling System (RIMS II) from the Bureau of Economic Activity (BEA) to compute the economic and employment impact of the allotted and proposed investments. For example, highway expansion mainly involves construction, so the BEA multiplier for construction was applied to those funding amounts. Indirect employment effects

capture byproducts such as manufacturing, the wholesale and retail trade, and a broad array of material suppliers.

- Program descriptions from the federal government and trade groups provided the classification details used in the application of BEA multipliers.

- The model assumes that proposed funding will follow the same allocation priorities as recently passed legislation. The assumption is that each agency recognizes and prioritizes allocation funding based on need. We then base our multiplier application on those funded programs to gain insight into broader effects of the 10 projects.

Projects and Impacts

The proposed investments we studied amount to $425.6 billion across all 10 projects. Highway and transit projects account for just over half the total investment pool. Investments in broadband infrastructure and onshore and offshore oil exploration account for the next-largest investment amounts.

All the projects combined will create more than 3.4 million construction- and R&D-related jobs, which will generate an estimated $147 billion in earnings. Accounting for ripple effects across other sectors, the total impact will be more than 10.6 million jobs, $420 billion in earnings, and approximately $1.4 trillion in output. Because these impacts will likely be spread across a three-year period, the average annual increase would be 3.5 million jobs and $468 billion in output.

Given that the U.S. economy has lost more than 7.2 million jobs since December 2007, these investments would provide immediate relief and help restore the national employment base in the short term.

Summary of economic impacts by project
(2010–2012)

Project	Proposed investment amounts (US$B)	Direct impact on employment (# of jobs)	Direct impact on earnings (US$B)	Total impact on employment (# of jobs)	Total impact on earnings (US$B)	Total impact on output (US$B)
Highway and transit system	225.0	2,106,914	85.8	6,189,480	238.2	775.4
Broadband infrastructure	55.0	293,736	15.1	1,048,064	43.9	158.3
Onshore exploration and development/offshore drilling	46.5	194,844	9.9	896,185	38.8	145.0
Drinking water and wastewater infrastructure	30.0	280,922	11.4	825,264	31.8	103.4
Smart grid	24.0	219,578	9.1	649,627	25.1	82.0
Nuclear energy	15.0	139,145	6.1	397,271	15.6	48.7
Renewables (solar, wind, biofuels)	14.5	115,874	4.8	337,558	13.1	44.3
NextGen air traffic control	10.4	30,631	2.7	181,921	8.9	32.1
Inland waterways	2.6	23,951	1.1	67,100	2.7	8.1
Clean coal technology	2.55	24,018	1.1	66,127	2.6	7.9
Total of all projects	**425.6**	**3,429,612**	**147.1**	**10,658,597**	**420.6**	**1,405.3**

Note: Total economic impact is an accumulated statistic over the three-year period. For example, total employment translates to an annual average of 3.5 million jobs.

Average output per employee stemming from the total impacts from all projects amounts to about $132,000. By way of comparison, output per employee in 2009 across all non-farm sectors was slightly more than $108,000.[109] The additional output per employee generated through these infrastructure projects reflects the valuable nature of such activity, the quality of the jobs that would be generated, and the incremental wealth that would be created. Average wages across these projects would amount to $43,000 annually—substantially more than the current average annual wage of $30,500 across all private, service-providing sectors.[110]

In addition, for every dollar invested in these projects, an additional $2.30[111] would be generated across all sectors.

Because most of the investments would be injected directly into the construction industry, some of the direct impacts may be short-lived as the initial investment dries up. But the indirect impacts would provide other sectors with a tremendous boost. In fact, of the 3.5 million jobs created per year, 9.2 percent or 327,100 of them would be in manufacturing. Manufacturing, services, and trade, all of which support various construction activities, would have the opportunity to capitalize on the investments. Support from the private sector could sustain these jobs over the long run and perhaps until the next innovation cycle.

Highway and Transit

Investing in transportation infrastructure is vitally important: It boosts commerce, increases public safety, and enhances quality of life across the socioeconomic spectrum. But its contributions are broad and difficult to quantify, making infrastructure investment a public good that calls for government intervention. Public infrastructure requires federal support specifically because it is capital intensive and because transportation systems cannot be financially supported by states and cities alone.

Recognizing that, Congress created the Highway Trust Fund in 1956, using federal fuel taxes to help build and maintain the Interstate Highway System. However, the system is antiquated and not easily adaptable to the changes in demand and technology.[112] For example, the technology responsible for the growth in hybrid car sales[113] will distort the road usage data that is gathered to justify funding the Highway Trust Fund. Add to that the fact that more than 20 percent of the nation's bridges are rated structurally deficient and functionally obsolete and it is clear that a better funding solution is imperative.[114]

There is also interest in extending federal assistance to improve the surface transportation network.[115] Improvements to the freight and passenger rail infrastructure, for example, would increase accessibility to various markets and could revitalize certain areas while offering an environmentally conscious option akin to car-pool lanes. Continued funding of the federal Transportation Investment Generating Economic Recovery (TIGER) grant[116] for such issues as bridge construction, port infrastructure investments, and passenger and freight rail projects has also been brought before key congressional decisionmakers.[117]

A proposed $225 billion investment as part of a multi-year surface transportation authorization is under consideration, with the majority of the funds allocated for construction.[118] The direct impacts of that investment would total more than 2.1 million construction-related jobs and almost $86 billion in earnings. When the broader economic ripple effects are considered, the total impact will be nearly 6.2 million jobs and more than $238 billion in earnings and $775 billion in output. That is, for every $1 billion invested in highway and transit, more than 27,400 jobs are created across all sectors. Assuming the impacts of a $225 billion investment occur over a three-year period, the average increase would be about 2 million jobs per year.

Economic impacts of highway and transit investment
(2010–2012)

Project	Proposed investment amounts (US$B)	Direct impact on employment (# of jobs)	Direct impact on earnings (US$B)	Total impact on employment (# of jobs)	Total impact on earnings (US$B)	Total impact on output (US$B)
Federal Highway Administration	165.8	1,552,938	63.2	4,562,066	175.6	571.6
Federal Transit Administration	50.7	474,352	19.3	1,393,504	53.6	174.6
Surface transportation network	8.5	79,623	3.2	233,910	9.0	29.3
Total highway and transit system	**225.0**	**2,106,914**	**85.8**	**6,189,480**	**238.2**	**775.4**

Note: Total economic impact is an accumulated statistic over the three-year period. For example, total employment translates to an annual average of 2,060,000 jobs.

Contractors would require various raw materials such as asphalt, cement, and metals as well as the production of commercial and industrial equipment, boosting economic activity in such sectors as manufacturing, trade, and mining. Specialty trades and various engineering occupations would also benefit.

From 2007 to 2009, the subsector of highway and bridge construction lost 46,000 jobs—over 13 percent of its employment base. A boost in infrastructure spending would help revitalize the industry and create additional economic benefits across the nation. Additionally, highway and transit investments would decrease transportation costs, lead to improved productivity among businesses, and better link regional economies across the nation.

Inland Waterways

Inland waterways are part of the nation's infrastructure for moving goods, and they require federal assistance for maintainance and improvements. They encompass over 8,200 miles of major river systems[119] that connect the Gulf of Mexico with the agriculturally rich Midwest and manufacturing hubs in the Southeast and the Great Lakes. Current projects include development in the Pacific Northwest; however, the Mississippi River system and its tributaries are the busiest and most expansive network of lock-and-dam infrastructure.[120] Inland waterway projects under construction or almost ready to begin construction will require approximately $7 billion to complete.[121] The U.S. Army Corps of Engineers is responsible for constructing, modernizing, and maintaining these waterways.

Construction and maintenance of dams and waterways for freight transportation have historically been neglected and underfunded. The Corps of Engineers has a $60 billion project backlog.[122] In addition to hampering trade by limiting cargo size and freight passage,[123] underinvestment in public works has had major public safety ramifications, often negatively amplifying natural disasters, as was the case with the levees that failed during Hurricane Katrina in 2005.

The direct impacts of a $2.6 billion investment would consist of nearly 24,000 construction- and R&D-related jobs and $1.1 billion in earnings. Ripple effects increase the total impacts to more than 67,000 jobs, $2.7 billion in earnings, and $8.1 billion in output. In other words, every $1 billion invested in inland waterways creates more than 25,800 jobs across all sectors. Assuming that the impacts of the total proposed investment occur over three years, the average annual increase would be about 22,300 jobs.

Economic impacts of inland waterway investment
(2010–2012)

Program	Proposed investment amounts (US$B)	Direct impact on employment (# of jobs)	Direct impact on earnings (US$B)	Total impact on employment (# of jobs)	Total impact on earnings (US$B)	Total impact on output (US$B)
U.S. Army Corps of Engineers Civil Works Program	2.01	18,550	0.84	52,068	2.1	6.3
Mississippi River and tributaries account	0.19	1,734	0.07	5,094	0.2	0.6
Maritime Administration	0.05	462	0.02	1,358	0.1	0.2
"Corps of Engineers (environmental restoration and flood protection, etc.)"	0.35	3,205	0.16	8,580	0.3	1.0
Total inland waterways	**2.6**	**23,951**	**1.1**	**67,100**	**2.7**	**8.1**

Note: Total economic impact is an accumulated statistic over the three-year period. For example, total employment translates to an annual average of 22,300 jobs.

Renewable Energy

Renewable energy (including wind, solar, biomass, hydroelectric, biofuels, and geothermal) represents just 7 percent of the total U.S. energy portfolio[124] despite a dramatic surge in biofuel and wind energy production from 2000 to 2007 (roughly 300 percent and 500 percent, respectively).[125] The issue now is to increase production volume to commercially viable, meaningful levels and connect this new generation to the current transmission system. Both hurdles require government assistance in the form of R&D funding for basic research, production subsidies, capital backing for infrastructure, or price guarantees.

While the world has expanded its renewable energy portfolio, the United States has lagged behind, but the investment focus has now turned inward as domestic consumer preferences and carbon tracking gain traction. Our technology is ready to seize this opportunity as semiconductors and imaging technology cross over almost seamlessly into fields like solar photovoltaic construction.[126] This wave can help revitalize the economy, converting stagnant high-tech industries previously focused on defense work into growth fields focused on clean tech.

Presently, Senator Jeff Bingaman (D-NM) is working to craft energy legislation that would not only increase Department of Energy project funding by $8 billion but would also double applied energy research to $6.5 billion. Of this $14.5 billion investment, nearly one-third is expected to go toward construction. Another third would likely go toward R&D, with the remainder spent in various manufacturing industries. The direct impacts would total nearly 116,000 jobs related to construction, R&D, and manufacturing and $4.8 billion in earnings. The economic ripple effects increase the total impacts to more than 337,000 jobs, $13.1 billion in earnings, and $44.3 billion in output. So for every $1 billion invested in renewables, nearly 23,300 jobs are created across all sectors. If the impacts of the total proposed investment occur over three years, the average annual growth would be approximately 112,500 jobs per year.

Construction of alternative energy structures that can generate and transmit wind and solar power has a higher economic impact than construction in general. Building power and communication lines and related structures requires skilled, high-value labor from various specialty occupations, and those architects and engineers require additional services and assistance, creating yet more jobs.

From 2007 to 2009, the subsector of power and communication lines construction lost nearly 19,000 jobs, or 13 percent of its job base. During that same period, the industry as a whole lost more than 1.3 million jobs—a drop of nearly 18 percent. Investing in renewable energy could help lessen our reliance on traditional forms of energy and create hundreds of thousands of "green" jobs in the process.

Economic impacts of renewable energy investment

(2010–2012)

Program	Proposed investment amounts (US$M)	Direct impact on employment (# of jobs)	Direct impact on earnings (US$M)	Total impact on employment (# of jobs)	Total impact on earnings (US$M)	Total impact on output (US$M)
"Modify Integrated Biorefinery Solicitation Program for pilot and demonstration-scale ciorefineries"	353.4	3309	134.8	9722	374	1218
Commercial-scale biorefinery projects	129.9	1217	49.6	3575	138	448
Fundamental research in key program areas	79.2	888	33.0	1976	71	211
Management and oversight (EE program direction)	59.4	899	24.9	1816	56	165
Advanced building systems	72.0	654	32.4	1751	71	205
"Residential buildings (Building America, Builders' Challenge, and existing home retrofits)"	50.5	567	21.1	1262	45	135
"National accounts acceleration in support of the Commercial Buildings Initiative"	38.6	362	14.7	1063	41	133
Buildings and appliance market transformation	53.6	502	20.4	1474	57	185
Solid state lighting	36.1	405	15.1	901	32	96
Community renewable energy deployment	16.3	182	6.8	406	15	43
Integrated biorefinery research expansion	10.0	91	4.5	242	10	28
Renewable energy and supporting site infrastructure	64.4	585	29.0	1566	64	183
Lab call for facilities and equipment	77.8	706	35.0	1891	77	221
NWTC upgrades	7.4	67	3.3	180	7	21
Enhance and accelerate FEMP service functions to the federal government	12.6	114	5.6	305	12	36
Energy, water and emissions reporting and tracking system	4.1	46	1.7	101	4	11
Geothermal demonstrations	102.2	928	46.0	2483	101	290
EGS technology R&D	57.5	522	25.9	1398	57	163
Validation of innovative exploration technologies	73.7	826	30.7	1839	66	197
National geothermal database, resource assessment and classification system	21.6	203	8.3	595	23	75
Ground source heat pumps	37.0	105	5.6	652	28	120
Enabling fuel cell market transformation	31.9	299	12.2	878	34	110
"Combined Heat and Power (CHP), District Energy Systems, waste heat recovery implementation, and deployment of efficient industrial equipment"	114.7	163	16.3	1169	57	259
Improved energy efficiency for information and communication technology	36.1	328	16.2	878	36	103
Industrial assessment centers and plant best practices	7.4	83	3.1	185	7	20
"Advanced Materials RD&D in support of EERE needs to advanceclean energy technologies and energy-intensive process R&D"	36.0	404	15.0	898	32	96
EE Conservation Block Grant Program	2,364.9	26527	986.1	59047	2127	6318
Weatherization Assistance Program	3,695.2	34602	1409.3	101651	3912	12735
State Energy Program	2,291.0	6519	347.7	40404	1727	7425
EE appliance rebate programs	221.7	631	33.7	3910	167	719
Weatherization Innovation Pilot Program	18.5	207	7.7	461	17	49
Concentrating solar power	18.9	172	8.5	460	19	54
PV systems development	37.4	340	16.8	910	37	106
High-penetration solar deployment	29.8	270	13.4	724	29	85
Wind energy technology R&D and testing	10.3	94	4.6	251	10	29
Battery manufacturing	1,478.1	3522	190.3	20687	892	4079
Transportation electrification	295.6	2768	112.7	8132	313	1019
Clean Cities AFV Grant Program	221.7	2076	84.6	6099	235	764
Commercial vehicle integration (SuperTruck) and advanced combustion engine R&D	83.4	935	34.8	2082	75	223
Investigation of intermediate ethanol blends, optimization of E-85 engines, and development of transportation infrastructure	14.7	138	5.6	405	16	51
Wind turbine drivetrain testing facility	33.2	310	12.6	912	35	114
Large wind turbine blade testing facility	18.4	173	7.0	507	20	63
Wind energy consortia between institutions of higher learning and industry	17.5	197	7.3	438	16	47
Hydroelectric Facility Modernization Program	23.5	220	9.0	647	25	81
DOE Innovative Technology Loan Guarantee Program	1,485.5	16663	619.4	37090	1336	3969
Job training for high-growth fields (green industries)	557.1	5056	250.5	13536	551	1583
Total renewables (solar, wind, biofuels)	**14,500.0**	**115,874**	**4,773**	**337,558**	**13,073**	**44,286**

Note: Total economic impact is an accumulated statistic over the three-year period. For example, total employment translates to an annual average of 112,500 jobs.

Smart Grid

A smart grid is a coordinated network that controls the flow of electricity, matching the type of need with the correct premium in order to curtail demand and incentivize customers to waste less during peak usage periods. It involves overseeing transmission and distribution grids and modernizing infrastructure. Globally, governments and companies are expected to invest $200 billion in smart-grid technologies from 2008 to 2015.[127]

The Electric Power Research Institute estimates the total bill for U.S. smart-grid construction over the next two decades at $165 billion—roughly $8 billion annually. Of the proposed $24 billion investment that falls within our three-year window, 94 percent would go toward construction, with the remaining to be spent in the planning and design phase. The direct impacts include more than 219,000 jobs in construction, R&D, and manufacturing, and nearly $9.1 billion in earnings. The ripple effects bring the total impacts to almost 650,000 jobs, $25.1 billion in earnings, and $82 billion in output. For every $1 billion invested in the smart grid, more than 27,000 jobs are created across all sectors. Assuming a three-year span, the average increase generated by the total proposed investment would be about 216,500 jobs per year.

Construction of smart-grid infrastructure would yield higher economic benefits than the typical construction project. As with renewable energy, construction of smart-grid structures would require highly skilled labor from various architectural and engineering occupations.

A $24 billion investment in smart-grid technology will quickly revitalize employment in construction—where more than 1.3 million jobs were lost from 2007 to 2009—and R&D-related fields.

Economic impacts of smart-grid investment
(2010–2012)

Program	Proposed investment amounts (US$M)	Direct impact on employment (# of jobs)	Direct impact on earnings (US$M)	Total impact on employment (# of jobs)	Total impact on earnings (US$M)	Total impact on output (US$M)
Grant: Local Energy Assurance Planning Initiative	3.9	35	1.8	94.9	3.9	11.1
Grant: Science: Small Business Innovation Research Phase I	13.8	125	6.2	334.3	13.6	39.1
"Grant: Enhancing State Government Energy Assurance Capabilities and Planning for Smart Grid Resiliency (noncompetitive formula grants)"	14.9	135	6.7	361.4	14.7	42.3
"Grant: State Electricity Regulators Assistance (noncompetitive formula grants)"	17.1	155	7.7	415.6	16.9	48.6
"Grant: Resource Assessment and Interconnection-Level Transmission Analysis and Planning"	22.3	202	10.0	542.0	22.1	63.4
Grant: Workforce training for the electric power sector	53.5	486	24.1	1,300.9	53.0	152.1
Grant: Request for Information: Advanced Research Projects Agency - Energy (Round II)	148.7	1,350	67	3,614	147	423
Grant: Advanced research projects agency - Energy	148.7	1,350	67	3,614	147	423
Grant: Smart-grid demonstrations	228.7	2,075	103	5,556	226	650
Treasury: Advanced Energy Manufacturing Tax Credit (48 C)	855.1	3,035	178	15,030	670	2,655
Grant: Smart Grid Investment Grant Program	1264.1	11,837	482	34,774	1,338	4,357
"Loan Guarantee: 1703: Innovative Energy Efficiency, Renewable Energy and Advanced Transmission and Distribution Technologies (2009)"	3160.2	29,592	1,205	86,934	3346	10,891
Loan Guarantee: 1705: Advanced Transmission and Distribution Technologies	18,069.0	169,199	6,891	497,057	19,130	62,273
Total smart grid	**24,000**	**219,578**	**9,050**	**649,627**	**25,128**	**82,027**

Note: Total economic impact is an accumulated statistic over the three-year period. For example, total employment translates to an annual average of 216,500 jobs.

Nuclear Energy

Nuclear energy has been a reliable power source for many developed countries.[128] Currently, 5.9 percent of the world's electricity is derived from nuclear plants.[129] In 2008, the United States produced 8.5 quadrillion Btu, or about 21 percent of the nation's electricity, from nuclear power. The electric power sector is the nation's largest consumer of energy (40.1 percent), followed by transportation (27.8 percent), industrial (20.6 percent), and residential/commercial (10.8 percent).[130]

Nuclear energy prices are more stable than those of other sources and cheaper than coal, natural gas, and biomass.[131] Also, safety has improved significantly since the Three Mile Island nuclear accident in 1979, when equipment malfunctions and worker errors led to a partial meltdown at the Pennsylvania plant.[132] However, building a nuclear plant requires huge fixed costs up front for infrastructure as well as long-term political support. Warming-up costs also make this technology inflexible to being turned on and off intermittently. Regulatory turbulence or delays in approval during plant construction can cause labor costs to mushroom and add a hefty premium to construction.[133] But with the nation's population growth and its need for cleaner energy alternatives, nuclear is a viable option that would address clean energy, energy security, and the creation of high-value manufacturing and construction jobs that are immune to outsourcing.[134]

The Clean Energy Act of 2009, S. 2776, introduced by Senators Lamar Alexander (R-TN) and Jim Webb (D-VA), proposes roughly $100 billion in investment over the next 20 years for nuclear production, or "mini-Manhattan Projects." Using our model to frame this investment, of the proposed $15 billion in investments that would occur in the next three years, 95 percent is expected to go toward construction, with the remainder spent in the planning and design phase.

The direct impacts will consist of more than 139,000 construction-related jobs, which will produce $6.0 billion in earnings. Accounting for the ripple effects, the total impacts will result in more than 397,000 jobs, $15.5 billion in earnings, and $48.8 billion in output. Every $1 billion invested in nuclear energy creates more than 26,400 jobs across all sectors. Assuming the impacts of a $15 billion investment would occur over three years, the average annual increase would be approximately 132,000 jobs.

Nuclear power plant construction typically involves a higher concentration of high-skilled labor, drawing on specialty contractors, architects, and engineers. Again, projects that support higher-than-average wages help create wealth and contribute to more economic activity.

Economic impacts of nuclear energy investment

(2010–2012)

Program	Proposed investment amounts (US$M)	Direct impact on employment (# of jobs)	Direct impact on earnings (US$M)	Total impact on employment (# of jobs)	Total impact on earnings (US$M)	Total impact on output (US$M)
PHENIX Silicon Vertex MIE full funding (RHIC at BNL)	0.6	5	0.26	14	0.6	1.6
PHENIX Forward Vertex Detector MIE full funding (RHIC at BNL)	4.6	42	2.07	112	4.6	13.1
Enhanced AIP funding at NP user facilities	57.5	522	25.86	1,398	56.9	163.4
Enhanced utilization of Isotope facilities	23.0	209	10.35	559	22.8	65.4
TJNAF infrastructure investments	23.0	209	10.35	559	22.8	65.4
Nuclear Data Program Initiative	4.5	41	2.01	109	4.4	12.7
Lattice quantum chromodynamics computing	11.4	104	5.14	278	11.3	32.5
Nuclear science workforce	44.7	406	20.11	1,087	44.2	127.1
R&D on alternative isotope production techniques	10.6	96	4.78	258	10.5	30.2
DIII-D facility upgrades	27.0	245	12.13	742	28.6	93.0
Alcator C-Mod facility upgrades (MIT)	11.4	107	4.35	314	12.1	39.3
NSTX facility upgrades	16.2	152	6.17	445	17.1	55.8
Enhanced operation of major fusion facilities	11.3	102	5.07	274	11.2	32.0
PPPL GPP	11.5	108	4.39	316	12.2	39.6
High energy density laboratory plasma, Matter in Extreme Conditions (MEC) instrument project	45.9	417	20.66	1,116	45.5	130.6
High energy density laboratory plasma, NDCX-II	25.3	230	11.38	615	25.0	71.9
"Infrastructure improvements for Innovative Confinement Concepts (ICC) experiments"	11.2	105	4.27	308	11.9	38.6
Plasma science centers	22.3	250	9.30	557	20.1	59.6
Infrastructure improvements for general plasma science user facilities	8.9	84	3.41	246	9.5	30.8
SLI construction	249.7	2,338	95.23	6,869	264.4	860.6
General plant project funding across all SC laboratories	206.1	1,930	78.59	5,668	218.2	710.2
OSTI technology infrastructure	3.7	34	1.40	101	3.9	12.7
Energy Sciences Fellowships and Early Career Awards	224.3	2,036	100.88	5,451	221.9	637.4
SBIR/STTR	133.0	1,207	59.79	3,231	131.6	377.8
Management and oversight (SC program direction)	9.2	103	3.84	230	8.3	24.6
Office of Environmental Management (DOE) - 70% CN	9,662.1	90,477	3,685.04	265,794	10,229.3	33,299.6
Office of Environmental Management (DOE) - 30% RD/oper.	4,140.9	37,587	1,862.11	100,620	4,097.0	11,766.4
Office of Environmental Management (DOE)	13,803.1	128,064	5,547	366,414	14,326	45,066
Total nuclear energy	**15,000**	**139,145**	**6,049**	**397,271**	**15,546**	**48,792**

Note: Total economic impact is an accumulated statistic over the three-year period. For example, total employment translates to an annual average of 132,400 jobs.

Clean Coal Technology

Generating over 50 percent of electric power, coal continues to be a primary energy source for the United States despite claims that renewables are the next frontier.[135] Federal investment in clean coal technology takes into account the public goods issue of carbon emissions and air pollution, and it supports carbon capture and sequestration technology.

Analysts at the American Coalition for Clean Coal Electricity recently estimated that deploying a cost-effective, near zero-emissions coal technology would cost as much as $17 billion from 2006 to 2025.

In the next three years, that proposed investment would be $2.6 billion, nearly 70 percent of which would likely go to planning and design and the remainder to construction projects. The direct effects would consist of over 24,000 R&D and construction jobs and $1.1 billion in earnings. Accounting for the broader economic ripple effects, the total impacts will be more than 66,000 jobs, $2.6 billion in earnings, and nearly $8 billion in output. So every $1 billion invested in clean coal technology creates 26,000 jobs across all sectors. Over three years, an annual average of about 22,000 jobs would be created.

Economic impacts of clean coal technology investment

(2010–2012)

Program	Proposed investment amounts (US$B)	Direct impact on employment (# of jobs)	Direct impact on earnings (US$B)	Total impact on employment (# of jobs)	Total impact on earnings (US$B)	Total impact on output (US$B)
Carbon capture and storage	0.8	7,023	0.3	20,632	0.8	2.6
Industrial carbon capture and storage applications	1.1	10,333	0.5	27,661	1.1	3.2
Expand and extend Clean Coal Power Initiative Round III	0.6	5,446	0.3	14,579	0.6	1.7
Geologic sequestration site characterization	0.04	331	0.016	886	0.04	0.10
Geologic sequestration training and research grant program	0.015	136	0.007	364	0.01	0.04
Program direction - Fossil Energy (FE)	0.008	68	0.003	182	0.01	0.02
"Innovative Materials and Processes for Advanced Carbon Capture Technology, IMPACCT (DOE's ARPA)"	0.1	681	0.034	1,822	0.1	0.2
Total clean coal technology	**2.6**	**24,018**	**1.1**	**66,127**	**2.6**	**7.9**

Note: Total economic impact is an accumulated statistic over the three-year period. For example, total employment translates to an annual average of 22,000 jobs.

Much of the planning and design phase would involve architectural and engineering services as well as energy-related consulting. These professionals generally have extensive engineering backgrounds and/or degrees of specialization, and command above-average wages.

Offshore Drilling and Onshore Exploration and Development, Including Oil Shale

The United States seeks to enhance its energy security through offshore drilling within its territory and domestic shale exploration. The latter has been helped significantly by a new technology called “hydraulic fracturing,” which injects high-pressure liquids into shale formations, fracturing reservoirs in order to release natural gas deposits caught in rock. Large deposits of rich organic shale in Utah, Texas, and the Appalachian area are currently being developed. An estimated 237.7 trillion cubic feet of natural gas and 21.3 billion barrels of oil are situated in the United States.[136]

In the current policy climate, exploration is often hindered by state and federal regulations. A conservative investment of $46.5 billion in the exploration and development of oil and gas wells, mine shafts, and offshore construction would be a step toward an energy security initiative that embraces policy investment and incentives.[137] The potential employment and output effects are staggering.

The entire $46.5 billion investment would go toward drilling oil and gas wells. The direct impacts will consist of almost 195,000 oil- and gas-related jobs and $9.9 billion in earnings. Including the ripple effects, the total impacts would be more than 896,000 jobs, $38.8 billion in earnings, and nearly $145 billion in output. For every $1 billion investment in onshore exploration and development and offshore drilling, more than 19,200 jobs are created across all sectors. If the impacts occurred over three years, the average increase generated by the proposed investment would be approximately 298,700 jobs each year.

Economic impacts of onshore exploration/offshore drilling investment
(2010–2012)

Program	Proposed investment amounts (US$B)	Direct impact on employment (# of jobs)	Direct impact on earnings (US$B)	Total impact on employment (# of jobs)	Total impact on earnings (US$B)	Total impact on output (US$B)
Onshore exploration and development/offshore drilling*	46.5	194,844	9.9	896,185	38.8	145.0
Onshore exploration and development/offshore drilling	**46.5**	**194,844**	**9.9**	**896,185**	**38.8**	**145.0**

* Investment amount based on historical trends (additional funds have yet to be proposed).
Note: Total economic impact is an accumulated statistic over the three-year period. For example, total employment translates to an annual average of 298,700 jobs.

Occupations in the industry consist mainly of contractors specializing in drilling. While the direct impact of 195,000 jobs seems low, given the invested amount, the indirect impacts of drilling activities are among the highest. For every job created within the subsector, an additional 3.5 jobs are created in other sectors. Other support activities for oil and gas operation may also benefit, and increased demand for related professional and businesses services may be created.

Broadband

The National Broadband Plan under consideration at the Federal Communications Commission estimates that it would take $20 billion to bring Internet speeds to 0.768–3 Mbps and an additional $35 billion to upgrade to the next rung of 3-10 Mbps. The project would affect an estimated 10 million to 16 million American consumers by expanding fiber optic cables and increasing capacity.

Increasing accessibility and speed to this level has many possible beneficial impacts across a wide spectrum of the population, but it is vitally important to rural areas. Broadband would generate more economic opportunities. Additional broadband funding would provide construction jobs and allow companies based in those regions to expand globally, creating more jobs through use of the network. Remote areas, with their competitive labor costs, could successfully vie for new call centers, for example. But federal support is necessary to increase broadband deployment to rural areas because the cost of building the physical infrastructure is the primary reason there is currently such limited capacity.[138]

Based on our model's framework, nearly one-third of the proposed $55.5 billion investment would likely go toward construction, with the remainder spent on telecommunications services. The direct impacts are estimated at more than 293,000 construction- and telecommunications-related jobs and nearly $15.1 billion in earnings. Ripple effects bring the total impacts to more than 1 million jobs, nearly $44 billion in earnings, and $158.3 billion in output. For every $1 billion investment in broadband, more than 19,000 jobs are created across all sectors. Assuming the impacts would occur over three years, the average annual increase in jobs created by the proposed investment would be approximately 349,300.

Economic impacts of broadband investment

(2010–2012)

Program	Proposed investment amounts (US$B)	Direct impact on employment (# of jobs)	Direct impact on earnings (US$B)	Total impact on employment (# of jobs)	Total impact on earnings (US$B)	Total impact on output (US$B)
National Telecommunications and Information Administration	34.2	114,660	7.6	509,159	22.9	88.9
Dept. of Agriculture's Rural Utilities Service	18.2	170,538	6.9	500,988	19.3	62.8
NTIA/FCC	2.5	8,539	0.6	37,916	1.7	6.6
Total broadband infrastructure	**55.5**	**293,736**	**15.1**	**1,048,064**	**43.9**	**158.3**

Note: Total economic impact is an accumulated statistic over the three-year period. For example, total employment translates to an annual average of 349,300 jobs.

While the installation of equipment and structures draws on the construction sector, the operation, maintenance and transmission of such services rests with the telecommunications sector and its major players. The installation of complex technology components and services requires a heavier concentration of knowledge-based workers, so wages are typically higher than average.

In the long run, broadband investments will lead to increased forms of productivity among businesses, improving speed and connectivity across the nation.

NextGen Air Transportation System

The proposed Next Generation Air Transportation System (NextGen) seeks to transform the nation's existing ground-based technology for air-traffic control to a more flexible satellite-based technology that will modernize air safety, reduce environmental impacts, ease user access to the National Airspace System, and increase capacity and efficiency.[139] NextGen consists of programs that help with flight and flow management, aeronautical information management, and weather data dissemination.[140] While much of this involves retraining personnel, new manufacturing of more advanced systems and parts will also be required, as will construction at airports. Some aspects of NextGen are being rolled out incrementally at present, but the full benefits of NextGen are not expected to fully accrue until 2025. Deploying more advanced technology more quickly would not only have positive economic ramifications but would also improve overall public safety.

Economic impacts of NextGen investment
(2010–2012)

Program	Proposed investment amounts (US$B)	Direct impact on employment (# of jobs)	Direct impact on earnings (US$B)	Total impact on employment (# of jobs)	Total impact on earnings (US$B)	Total impact on output (US$B)
Next Generation Air Transportation System (NextGen)	10.4	30,631	2.7	181,921	8.9	32.1
Total NextGen	**10.4**	**30,631**	**2.7**	**181,921**	**8.9**	**32.1**

Note: Total economic impact is an accumulated statistic over the three-year period. For example, total employment translates to an annual average of 60,600 jobs.

A proposed $10.4 billion investment would likely be allocated across the aerospace product and parts manufacturing. Investment would stream from an anticipated jobs bill in the Senate, a Federal Aviation Administration reauthorization, and fiscal year 2010 appropriations to the FAA. The direct impacts would be more than 30,000 aerospace manufacturing-related jobs and $2.7 billion in earnings. With ripple effects, the total impacts would result in almost 182,000 jobs, $8.9 billion in earnings, and nearly $32.1 billion in output. Every $1 billion investment in NextGen creates nearly 17,500 jobs across all sectors. The proposed investment would generate approximately 60,600 jobs annually over three years.

The direct impact would be immediately felt in aerospace product and parts manufacturing. The industry tends to employ a higher concentration of high-skilled labor and pays above-average wages. A job created within the aerospace and parts manufacturing industry, on average, can create six additional jobs in other sectors. The industry relies on an extensive value chain that stimulates many other manufacturing industries.

Drinking and Wastewater Infrastructure

Clean drinking water is basically a public safety issue. The American Recovery and Reinvestment Act (ARRA) puts $4 billion into the Clean Water State Revolving Fund program, which finances high-priority wastewater infrastructure projects and loans to help municipalities, communities, farmers, homeowners, small businesses, and nonprofit organizations oversee nonpoint source pollution control and watershed and estuary management.[141] An additional $2 billion has been diverted to a Drinking Water State Revolving Fund program that installs, upgrades, or replaces the nation's water system infrastructure.[142] Aging facilities are a contamination threat to public health.

The Environmental Protection Agency (EPA) estimates a potential gap in infrastructure investment of $150 billion to $400 billion over the next decade. Using these EPA statistics, the U.S. Government Accountability Office has funded research on how to address this shortfall and close the margin by $10 billion annually.[143] In the next three years, $30 billion would be required.

Nearly half of the proposed $30 billion investment would be allocated for construction, with the remainder spent in the planning and design phase. The direct impacts would consist of more than 280,000 construction- and R&D-related jobs and $11.4 billion in earnings. With ripple effects, the total impacts will result in more than 825,000 jobs, $31.8 billion in earnings, and over $103 billion in output. For every $1 billion invested in drinking water infrastructure, over 27,500 jobs are created across all sectors. Over three years, the proposed $30 billion investment would generate approximately 275,000 jobs annually.

Economic impacts of drinking water and wastewater infrastructure investment
(2010–2012)

Program	Proposed investment amounts (US$B)	Direct impact on employment (# of jobs)	Direct impact on earnings (US$B)	Total impact on employment (# of jobs)	Total impact on earnings (US$B)	Total impact on output (US$B)
Clean Water State Revolving Loan Fund - I	14.8	138,727	5.7	407,538	15.7	51.1
Safe Drinking Water Act State Revolving Fund - I	7.4	69,363	2.8	203,769	7.8	25.5
Clean Water State Revolving Loan Fund - II	3.7	34,682	1.4	101,884	3.9	12.8
Safe Drinking Water Act State Revolving Fund - II	3.7	34,682	1.4	101,884	3.9	12.8
Bureau of Reclamation - improve drinking water	0.4	3,468	0.1	10,188	0.4	1.3
Total drinking water and wastewater infrastructure	**30.0**	**280,922**	**11.4**	**825,264**	**31.8**	**103.4**

Note: Total economic impact is an accumulated statistic over the three-year period. For example, total employment translates to an annual average of 275,000 jobs.

Construction of water lines, sewer lines, and related structures in the subsector would benefit most directly. The subsector lost nearly 36,000 jobs from 2007 to 2009, a decline of 17 percent. Investment injected directly into this particular area can have huge economic and socioeconomic benefits.

Projects can vary from the creation of sewer and water distribution lines to the construction of new water treatment facilities. The work involves skilled labor and relies heavily on various R&D services, such as architectural and engineering services, where wages are substantially higher than the industry average.

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