CARBON TAX POLICY:
A Conservative Dialogue on Pro-Growth Opportunities

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— Alex M. Brill, Editor

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Executive Summary

Conservatives generally agree on the need for policies that promote economic growth and improve the efficiency of the economy. When it comes to clean energy and carbon pollution, conservatives must find pro-growth solutions or risk ceding these areas to others. We can't simply disengage on these issues, or our nation's prosperity will suffer. Fortunately, there is momentum among voters to pursue conservative ideas for reducing carbon emissions. This book is intended to be a resource in that endeavor.

Specifically, this book seeks to answer whether a carbon tax – that is, a market-based approach to reducing carbon emissions – offers a pro-growth alternative that is more efficient than the existing regulatory regime. *Carbon Tax Policy: A Conservative Dialogue on Pro-Growth Opportunities* brings together conservative experts to answer practical and theoretical questions about establishing a revenue-neutral carbon tax in the United States. Contributing to the volume are Alan D. Viard and Aparna Mathur, resident scholars at the American Enterprise Institute; John D. Graham, dean of the Indiana University School of Public and Environmental Affairs; Phillip Swagel, a professor of international economic policy at the University of Maryland; Robert J. Carroll, a principal at the professional services firm EY; and Kristen Soltis Anderson, an author and pollster.

In the book's preface, Anderson looks at public opinion, particularly among Republican voters, on climate change and clean energy. She notes that Republicans represent a fast-growing group of Americans concerned about climate change. Just since 2014, belief in global warming among conservative Republicans has increased 19 percentage points. A majority of Republicans support developing and using clean energy in the United States. And voter groups essential to the future of the Republican Party (for example, Millennials and Latinos) favor action on climate change. In other words, there is momentum for the GOP to pursue conservative ideas for reducing carbon emissions.

The rest of the volume presents answers from Carroll, Graham, Mathur, Swagel, and Viard to questions about different aspects of a carbon tax, with each chapter

oriented around a particular theme. **Chapter 1** focuses on existing and proposed carbon-reduction regulations and how a carbon tax could serve as an effective substitute for a regulatory strategy. The primary carbon-reduction regulations currently in effect include Corporate Average Fuel Economy (CAFE) standards, which require certain levels of fuel efficiency in light-, medium-, and heavy-duty vehicles; the Obama administration's Clean Power Plan, which limits power-sector carbon emissions at the state level; the renewable fuel standard, which applies to the amount of renewable fuel that distributors include in transportation fuel; and Appliance and Equipment Efficiency Standards, which require energy efficiency in residential and commercial appliances and equipment.

A better way to achieve the goal of these various programs, contributors argue, is with a carbon tax. This market-based approach would create incentives to reduce carbon emissions instead of relying on government mandates. Leaving carbon abatement decisions to carbon producers is more efficient than having regulators stipulate the abatements because producers are in a better position to choose the least-costly abatements and pursue innovations. A carbon tax also raises revenue that can be used for other purposes, like lowering distortionary taxes such as the corporate income tax. With a carbon tax in place, current burdensome regulations could be repealed.

Chapter 2 examines how a carbon tax would actually work in the United States, from where it should be collected to how the rate should be set. Collecting the tax where energy enters the economy (such as power plants and oil refineries) would be the most efficient because it involves the fewest collection points but ultimately distributes the cost across our energy-driven economy. Regarding the appropriate carbon tax rate, theoretically it should equal the domestic social cost of carbon (that is, the amount of harm that carbon emissions cause to society) if the tax is being imposed unilaterally in the United States alone. In reality, this is difficult to calculate. One proposed way of introducing a carbon tax is to start with a low rate and gradually increase it. The rate obviously affects the amount

of revenue a carbon tax could be expected to generate. A tax of $15 per metric ton, for example, would have yielded more than $100 billion in 2010.

How carbon tax revenue could be used to advance tax reform is addressed in **Chapter 3**. Contributors argue that a carbon tax in the United States should be revenue-neutral – that is, the revenue gained from the tax should be used to reduce other taxes. Should the revenue be used to lower other, highly distortionary taxes, the result could be higher economic activity. One of the most distortionary taxes in the United States is the tax on corporate income, and a popular "tax swap" for a carbon tax is a reduction in the corporate tax rate. A carbon tax of $15 per metric ton in 2010 would have brought in more than half of what the corporate income tax did that year. A carbon tax could also be key to tax reform because it would move the U.S. tax system toward taxing consumption rather than income, which would have positive effects for saving, investment, and wages.

In **Chapter 4**, contributors address questions about the impact of a revenue-neutral carbon tax on economic growth. Of course, how the revenue from a carbon tax is used will in large part determine the growth impact. A corporate rate cut (from 35 percent to 16 percent) funded by a carbon tax, for example, could result in an increase in U.S. economic output of more than 2 percent if paired with the repeal of recent regulations. Other economic impacts to be expected from a carbon tax include higher prices of consumer goods. But per-household GDP is expected to increase under a revenue-neutral carbon tax. For example, it is estimated that annual per-household GDP could increase nearly $3,000 if carbon tax revenues are used to reduce the corporate income tax rate. The economic impact of a carbon tax would also vary considerably by industry as well as by geography. Some assistance for adversely affected workers may be necessary.

Chapter 5 concludes the volume by examining a U.S. carbon tax in a global economy context. One policy option to consider would be a border adjustment to the carbon tax, which would ensure that imports into the

United States face a carbon tax if the source country does not have one. But, should the United States adopt a carbon tax, it would be joining many other countries and regions – including Canada, China, Mexico, and the European Union – in pursuing a price mechanism to curb carbon emissions. Ultimately, by reducing our demand for traditional fossil fuels and increasing our investment in clean-energy sources and our use of renewable energy, a carbon tax could help make the United States more energy independent.

Given the nascent conservative momentum behind some kind of action on carbon reduction, conservative leaders are encouraged to take the opportunity now to explore pro-growth and market-based alternatives to the current regulatory path. The aim of this book is to be a resource for that important work.

Preface: Evolving Voter Views

The sweeping Republican victory in November 2016 means that the Democratic approach to clean energy and emissions reductions will be challenged or replaced in the coming years. Republican control of the White House and both houses of Congress affords conservatives the unique opportunity to implement their own market-oriented vision for clean energy in place of federal regulation and subsidy.

There is a sizable group of voters, including many Republicans, for whom climate change is a pressing concern.

There is a sizable group of voters, including many Republicans, for whom climate change is a pressing concern. Key voter groups like Millennials and Latinos overwhelmingly want to see action on climate change, and to see it soon. Some 63 percent of Hispanics want to see government action on climate change,[1] and a University of Texas survey found that a majority of people under age 35 also want action on the climate.[2] Pew Research Center estimates that among those who say that they care a great deal about climate change, over a quarter of those people are Republicans.[3]

Furthermore, most Republicans do not meet the definition of the label "climate change denier" that is so often used by the media and those on the political left. Research in 2015 for the ClearPath Foundation found that 19 percent of *conservative* Republicans thought that the "climate is changing and human activity is contributing a lot to the change," while only 9 percent felt "that the climate is not really changing." A plurality, 35 percent, acknowledged some limited role that human action may be playing in the changing climate.[4]

The ground on this issue is also potentially moving quickly, as it is conservative Republicans who have exhibited the "largest shift" of any ideological and partisan group

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1. Coral Davenport, "Climate Is Big Issue for Hispanics, and Personal," *The New York Times*, February 9, 2015.
2. University of Texas at Austin, UT Energy Poll, Fall 2016, available at www.utenergypoll.com.
3. Cary Funk and Brian Kennedy, *The Politics of Climate*, Pew Research Center, October 2016, available at www.pewinternet.org/2016/10/04/the-politics-of-climate.
4. ClearPath, Republicans, Clean Energy, and Climate Change Poll, August 24–27, 2015, available at https://assets.clearpath.org/2016/09/clearpath_survey_report.pdf.

since 2014. Belief within that group that "global warming is happening" increased by 19 percentage points in just two years, per researchers at Yale and George Mason.[5]

The good news for those seeking to reduce carbon emissions is that climate change is not the only reason a voter might support a policymaker promoting clean energy or carbon emissions reduction ideas. It is important to recognize that the climate is not the top concern for most Republicans, or even for many voters. But, if clean energy is positioned as an economic issue as opposed to simply an environmental issue, it will have the potential to take on higher priority in the minds of voters. Significantly more voters name economic issues as a very important priority compared with environmental issues.[6] In a pre-election 2016 poll, some 92 percent of voters said that the economy was a very or extremely important issue, compared with only 47 percent who said the same about climate change.[7]

Republicans are less likely to see climate change as an immediate threat, but there is a constituency within the party interested in hearing solutions on the issue. Researchers at Stanford found that about half of Republican voters say they would be more likely to vote for someone who supports fighting climate change.[8] And majorities of conservative Republicans strongly agree that we should accelerate the growth of clean energy for reasons such as cleaner air, economic growth, and less dependence on energy sources in the Middle East.[9] In short, even policymakers who are apprehensive about

About half of Republican voters say they would be more likely to vote for someone who supports fighting climate change. And majorities of conservative Republicans strongly agree that we should accelerate the growth of clean energy.

5. Anthony Leiserowitz, Edward Maibach, Connie Roser-Renouf, Geof Feinberg, and Seth Rosenthal, *Politics and Global Warming, Spring 2016*, Yale University and George Mason University (New Haven, CT: Yale Program on Climate Change Communication, 2016), available at www.eenews.net/assets/2016/04/27/document_cw_01.pdf.

6. Pew Research Center, *2016 Campaign: Strong Interest, Widespread Dissatisfaction*, July 2016, available at www.people-press.org/2016/07/07/2016-campaign-strong-interest-widespread-dissatisfaction.

7. Gallup poll, June 1, 2016, available at www.gallup.com/poll/191960/economy-remains-top-priority-next-president.aspx.

8. Coral Davenport and Marjorie Connelly, "Most Republicans Say They Back Climate Action, Poll Finds," *The New York Times*, January 30, 2015.

9. ClearPath, Republicans, Clean Energy, and Climate Change Poll, August 24–27, 2015.

weighing in on climate change should understand that there are other values – economic growth, disruption of the status quo, American independence – that would lead voters to support other clean-energy strategies in place of the Obama administration's policies.

Republicans, of course, were never enthusiastic supporters of President Obama's approach on energy or environmental issues. For instance, few Republicans favored the federal Clean Power Plan. Seven out of ten (69 percent) voters overall had not heard much about the Clean Power Plan to begin with, with little divide between Republicans and Democrats on awareness. But when the Clean Power Plan was described to voters, most Republicans opposed it (52 percent).[10]

Now, as the Obama administration's approach to curbing emissions is rolled back, conservatives will be asked: What is next? If the Clean Power Plan is the wrong approach, what is the right approach to addressing carbon pollution?

The good news for those hoping to see greater adoption of clean energy and reduction in carbon emissions is that voters of all stripes are broadly supportive of technological innovation that can move us to a cleaner energy future. Some 84 percent of registered voters, including 72 percent of Republicans and 68 percent of conservative Republicans, say they support acting to accelerate the development and use of clean energy in the United States.[11]

There are three key questions that conservatives need to answer when putting forward energy and climate policy. Voters want to know if a policy will have a positive or negative effect on their own financial situation, if a policy is going to choose "winners or losers," and if a policy will work.

The first question voters want answered is: Will this policy hurt the economy or hurt my bottom line? The specter

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10. Voice Of the People and Program for Public Consultation, *Considering the Cost of Clean: Americans on Energy, Air Quality and Climate,* May 2016, available at www.publicconsultation.org/wp-content/uploads/2016/05/Energy-Survey.pdf.

11. ClearPath, Republicans, Clean Energy, and Climate Change Poll, August 24–27, 2015.

of job loss raises concerns with voters when discussing environmental policies. Researchers at the University of Chicago told survey respondents that coal is a major contributor of greenhouse gas emissions and pollutants, and asked if respondents supported federal rules to cut coal consumption. A majority (54 percent) did support the idea at least moderately, but for those who were reminded by the survey interviewer that this policy "also eliminated thousands of jobs," support fell moderately to 45 percent overall.[12]

Polling specifically on a revenue-neutral carbon tax shows majority support from voters overall, but much more division among Republican voters, and a great deal of sensitivity to the use of the revenue from such a policy. Researchers at the University of Michigan specifically asked voters if they supported a revenue-neutral carbon tax, with funds returned to the public via tax rebates; a majority (56 percent) supported the idea, as did 43 percent of Republicans. But using the funds for deficit reduction is opposed by majorities across political parties.[13]

In short, voters want an energy policy that can be framed as both an economy-wide and personal economic win.

Voters want an energy policy that can be framed as both an economy-wide and personal economic win.

The second question voters want answered is: Are we choosing unaccountable winners and losers? Conservatives must figure out how to achieve the goal of boosting clean energy and holding accountable those who pollute without picking winners and losers, and without regulating certain forms of energy out of existence from the top down.

Voters are usually supportive of subsidies for solar and wind power when asked in surveys. Some 58 percent of survey respondents told researchers at the libertarian Reason Foundation that they would support such subsidies,

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12. Energy Policy Institute at the University of Chicago and The Associated Press-NORC Center for Public Affairs Research, Energy and Climate Change in the 2016 Election Poll, August 11–18, 2016, available at www.apnorc.org/projects/Pages/energy-and-climate-change-in-the-2016-election.aspx.

13. National Surveys on Energy and Environment, "Public Views on a Carbon Tax Depend on the Proposed Use of Revenue," *Issues in Energy and Environmental Policy*, no. 13 (July 2014), available at www.closup.umich.edu/files/ieep-nsee-2014-spring-carbon-tax.pdf.

though for Republicans, that support falls to 46 percent, with another 46 percent opposed.[14] Wind and solar may be popular, but subsidies for these industries divide the political right.

Voters are supportive of boosting clean energy, but those on the right in particular are skeptical of subsidies as an answer, or of government policy that would favor some industries while trying to destroy others.

Voters are supportive of boosting clean energy, but those on the right in particular are skeptical of subsidies as an answer, or of government policy that would favor some industries while trying to destroy others. Creating conditions favorable to clean-energy innovation and allowing the best ideas and companies to thrive would be much more in line with voters' desire to reject cronyism and Washington deciding who gets to be a winner.

But beyond whether a policy idea is sound ideologically and economically, voters also want to know: Will your idea work? While a very slim majority (51 percent) of voters overall – including most liberal and moderate Republicans – say that they think that "restrictions on power plant carbon emissions" can make a big difference to address climate change, support plummets to only 29 percent among conservative Republicans. Other ideas, such as international climate agreements and tougher efficiency standards for cars, are viewed as effective by even fewer people.

However, in the same study, 55 percent of adults, including a whopping 46 percent of conservative Republicans, think that "new technology will solve most problems from climate change," suggesting that while regulation is divisive and viewed as less likely to make real change, unleashing the power of American innovation is something that has much more credibility with this audience.

Furthermore, some 49 percent of conservative Republicans say that "Americans will make major changes to their way of life to address climate change." Already, there is little partisan divide when it comes to individuals being "everyday environmentalists," as Pew has found that "this group of environmentally conscious Americans is comprised

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14. Emily Ekins, "62 Percent Oppose Govt Subsidies to Oil but 58 Percent Favor Subsidies to Wind and Solar Companies," *Reason*, April 17, 2014, available at www.reason.com/poll/2014/04/17/62-oppose-govt-subsidies-to-oil-but-58-f.

of both Republicans (41%) and Democrats (53%) in close proportion to that found in the population as a whole."

Republicans care about the environment and think that technology can allow us to live in new ways that help combat climate change. Ronald Reagan was the first president to call for research into the phenomenon of global warming, something that would surprise even many Republicans today. (Only 25 percent of Republican voters and 17 percent of voters overall name Reagan as the president who took that step.)[15]

Market-oriented ideas to support clean energy and address climate change have the potential to succeed if driven by an optimistic message about the strength of our nation's creativity, imagination, and economic power. Holding polluters accountable and disrupting a culture of cronyism and of choosing winners and losers, while incentivizing good decisions that conserve energy and boost innovation, are things that voters of all kinds, including Republicans, can get behind.

Such a message, backed by sound policy, could gain support from across the political spectrum and offer conservatives an opportunity to effectively capitalize on the current political moment, pursuing policies that can replace the Obama administration's regulations with market-oriented ideas that lead to real, lasting change.

— Kristen Soltis Anderson

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15. *60 Minutes/Vanity Fair* Poll: The Environment, June 16, 2016, available at www.cbsnews.com/news/60-minutes-vanity-fair-poll-the-environment.

Introduction

Historically, conservatives have been strong defenders of environmental conservation, as Republican presidents established the U.S. Forest Service and the Environmental Protection Agency, and signed into law the 1990 amendments to the Clean Air Act. Conservatives have also been the champions of limited government, free markets, and personal freedom as the best path to greater prosperity for our society. Given this lineage, it is important for conservatives to be engaged on the issue of carbon pollution and the economy. This issue is not going away substantively or politically, and conservatives need to provide a viable, meaningful, and market-oriented solution – or the long-run prosperity and health of our great country will suffer.

When it comes to efficient resource allocation, conservatives believe in the power of the free market. Most conservative scholars rightly resist far-reaching regulatory regimes that unduly restrict free enterprise, or yield little or no social benefit while imposing costly burdens on consumers or producers. Likewise, conservatives are generally disinclined toward higher taxes as they enlarge the role of the state versus private initiative, impede the incentive to work and save, or otherwise alter consumer choices.

So what is a free-market approach to dealing with consequences of carbon emissions? In a word: incentives. Specifically, free-market scholars have increasingly gravitated toward a price mechanism to reduce carbon emissions to an appropriate level. One such mechanism is a carbon tax. The purpose of this book is to investigate the validity and consequences of a revenue-neutral tax on carbon emissions in conjunction with the repeal of a broad set of existing carbon regulations.

Carbon Tax Policy: A Conservative Dialogue on Pro-Growth Opportunities draws on the expertise of five prominent scholars with strong conservative bonafides. Alan D. Viard and Aparna Mathur are resident scholars at the American Enterprise Institute. Phillip Swagel, a professor at the University of Maryland, served as assistant secretary for economic policy at the Treasury Department during the George W. Bush administration.

Robert J. Carroll, a principal at EY, was deputy assistant secretary for tax analysis, also during the George W. Bush administration. And John D. Graham, dean of the Indiana University School of Public and Environmental Affairs, was administrator of the Office of Information and Regulatory Affairs from 2001 to 2006.

Structured in an easily accessible question-and-answer format, the book features the authors' complementary perspectives on questions like: How would a carbon tax be a more efficient strategy than existing regulations? If the revenues raised from a carbon tax were used to reduce other, more distortionary taxes, could a carbon tax be pro-growth? How might a carbon tax affect U.S. global competitiveness? While they may differ on the specifics of implementing a carbon tax, the contributors generally agree that a revenue-neutral carbon tax that replaces various existing regulations and reduces other taxes would be a positive step for the U.S. economy.

Starting off the volume is a preface by author and pollster Kristen Soltis Anderson, who offers readers a look at the political landscape and the attitude of Republican voters on climate change, clean energy, and carbon emissions. Among other observations, she says that 63 percent of Hispanics and a majority of people under age 35 want government action on climate change. These voter groups are critical for the long-run viability of Republican candidates. She also highlights the dramatic recent shift among conservative Republicans on this issue, pointing to a 19-percentage-point increase since 2014 in conservatives who agree that "global warming is happening."

The five scholars then delve into the variety of topics related to a carbon tax. Highlights include:

- Alan D. Viard explains the economic theory behind a carbon tax and why it is more efficient than a regulatory strategy. Under a carbon tax, he explains, firms will pursue emission abatements that cost less than the tax but not those costing more. Without the level of detail necessary to identify the least costly abatements, regulators may stipulate abatements that are unnecessarily costly, making regulations a less efficient tool than a tax on carbon.

- John D. Graham looks closely at the current carbon-related regulatory regime. He points out that a national carbon tax would allow the United States to reconsider a number of burdensome regulations – including the Obama administration's Clean Power Plan, the federal renewable fuel standard, Corporate Average Fuel Economy (CAFE) standards, and regional and state-level regulatory programs – while still reducing carbon emissions.
- Phillip Swagel addresses the question of what happens if the United States adopts a carbon tax while other countries do not. He points out that any trade-related disadvantage that would arise from this situation could be mitigated with a border adjustment to the carbon tax. This would impose a tax on imports from countries that do not have a comparable price on carbon.
- Aparna Mathur discusses the best use for carbon tax revenues. A revenue-neutral carbon tax – that is, one where the revenue is used to reduce federal deficits or lower other tax rates – is important for long-term economic growth. With this in mind, Mathur's preferred revenue use is a "tax swap" whereby carbon tax revenues are used to reduce the corporate income tax rate, one of the most distortionary taxes.
- Robert J. Carroll estimates the economic impact of a revenue-neutral U.S. carbon tax, finding that the increase in per-household annual GDP could be as high as $2,940 if the revenue is used to fund a corporate rate reduction. He also argues that a carbon tax could reduce CO_2 emissions by the same amount as a regulatory approach but at a lower cost to the economy.

As this book demonstrates, a carbon tax would be far less economically burdensome than the current patchwork of energy and environmental regulations, and new revenues could be used to reduce other, more distortionary taxes. Together, these changes could reduce the burden on society and enhance economic growth.

The goal of this book is to foster a thoughtful discussion and provide policymakers with additional options to consider as they contemplate structural changes to our tax and regulatory regimes. We won't settle the debate here, but conservative politicians have been too hesitant to engage in these discussions to date. This book is intended to help open a door to that engagement.

— Alex M. Brill

CHAPTER 1

Evaluating the Existing and Proposed Regimes on Carbon Emissions

What are the primary regulations in effect in the U.S. to reduce carbon emissions? What are the economic impacts of these regulations? What do we know about the "hidden tax" embedded in these regulations? Who bears the burden?

Robert J. Carroll:

The United States has pursued CO_2 abatement piecemeal through both new rules and planned tightening of current rules. These rules and regulations typically target specific sectors or types of activities and either mandate the use of specific technologies and processes or otherwise place restrictions on the choices of consumers and producers. As such, they distort the economic decisions of consumers and producers, and encourage activity that, while lowering CO_2 emissions and addressing a public good in the long run, over time result in a reduction in the size of the economy relative to what it would have been otherwise. This, in effect, places a hidden tax on consumers and producers.

The macroeconomic effects of the rule-based CO_2 abatement policies that have been or are scheduled to be put in place since 2013 were estimated using a general equilibrium model of the U.S. economy. If fully phased in, these rule-based CO_2 abatement policies, although reducing CO_2 emissions by nearly 20 percent (relative to the level projected absent these CO_2 abatement policies), are estimated to reduce the size of the U.S. economy by nearly 1 percent, or approximately $1,310 per household annually in the long run. Note that approximately two-thirds to three-quarters of the long-run effect occurs after ten years.

The post-2013 CO_2 abatement reflected in these estimates occurs through the following rule-based policies:

- *Corporate Average Fuel Economy (CAFE) standards.* CAFE standards require that a manufacturer's model year (MY) of vehicles meets a fleet-wide average fuel efficiency level. CAFE standards apply to light-, medium-, and heavy-duty vehicles. The most significant impact of CAFE standards is for light-duty vehicles (i.e., passenger vehicles and light trucks). CAFE standards are set to increase the fuel efficiency of MY2025 light-duty

vehicles to 46.2 miles per gallon (mpg), which is more than double the fleet-wide fuel efficiency across all light-duty vehicles in 2013 of 21.6 mpg.

- *Clean Power Plan (CPP).* The CPP aims to reduce CO_2 emissions in the power sector. It is scheduled to be implemented at the state level starting in 2022, and each state is required to choose one of three approaches: (1) a national emissions rate for each electricity-generating unit (EGU) (in CO_2/MWh), (2) a state-specific emissions rate for the state's overall electricity portfolio (in CO_2/MWh), or (3) state-specific mass-based limits (in CO_2/year).
- *Renewable Fuel Standard (RFS).* The RFS requires that fuel distributors include a specific percentage of renewable fuels in their total sales. The standard is set to increase the required amount of renewable fuels used from 16.55 billion gallons in 2013 to 36 billion gallons by 2022 (a 118 percent increase).
- *Appliance and Equipment Efficiency Standards (AEES).* AEES regulate more than 60 categories of appliances and equipment. The program sets energy efficiency standards for both residential and commercial appliances and equipment to reduce energy consumption. When fully phased in, consumer product energy efficiency standards are estimated to result in total energy savings of 3.29 percent, and commercial and industrial product energy standards in energy savings of 1.02 percent.[1]

1. The Department of Energy (DOE) provides estimates of the energy savings over varying time spans from efficiency standards by type of appliance and equipment. These DOE estimates are scaled relative to the energy use over that time period (as projected by the Energy Information Administration's Annual Energy Outlook 2015) such that the energy savings amounts can be made comparable. These can then be aggregated for appliances ("consumer products") and equipment ("commercial and industrial products") to provide an estimate of the change in energy efficiency from AEES. While an imperfect approach, it is unclear that better data are available to estimate the energy savings and energy efficiency for the various appliances and equipment regulated.

The CPP explicitly targets reduced CO_2 emissions, CAFE standards target reduced fossil fuel consumption through greater fuel e f ciency, the RFS mandates increased renewable fuel usage, and AEES reduce energy consumption through greater energy e f ciency mandates.

EY recently estimated the economic impact of the CPP and the post-2013 tightening of CAFE standards, the RFS, and AEES. The economic impacts were estimated using the EY General Equilibrium Model of the U.S. Economy. This model is designed to capture the major features of the U.S. economy and the key economic decisions of businesses and households a f ected by energy and tax policy. It is similar to models used by the Congressional Budget O f ce (CBO), Environmental Protection Agency, Joint Committee on Taxation (JCT), and Treasury Department to analyze changes in energy and tax policy (see, for example, JCT 2005 and 2014, Carroll et al. 2006, Ross 2009, Jorgenson et al. 2013, and Nishiyama 2013). The eventual reduction in the size of the U.S. economy by nearly 1 percent in the long run, noted above, occurs because consumers and producers are required to use more expensive production processes and purchase more costly products than they would in the absence of the rules and regulations. This, in e f ect, places a hidden tax on consumers and producers.

In particular, CAFE standards require consumers and businesses to purchase more expensive, more fuel-e f cient vehicles. While this policy does reduce the fuel costs of consumers and businesses (by reducing the fuel required per mile traveled), the net e f ect is an overall increase in own-use vehicle transportation costs. Likewise, AEES result in a net increase in appliance and equipment usage costs by requiring consumers and businesses to purchase more expensive, more energy-e f cient appliances and equipment. We do not know how these increases in consumer costs compare to the value of long-term abatement of carbon.

Because the CPP has not yet been implemented, there is considerable uncertainty around how states will choose to comply. Overall, however, consumers and businesses would likely face higher electricity prices under CPP than they would otherwise. This is likely to be the case whether

a relatively e f cient version of the CPP is implemented (via multistate, mass-based trading systems) or a relatively ine f cient version is implemented (via each individual EGU meeting its required national emissions rate).[2] Finally, the RFS mandates that more biofuels be mixed into fuels than would occur in the absence of the RFS and, consequently, increases fuel prices for consumers and businesses.

How do carbon emission regulations affect freedom of choice for producers and consumers? To what extent do they stimulate or discourage innovation?

Carroll:

Policymakers have two broad mechanisms to in f uence the choices of consumers and producers when aiming to reduce CO_2 emissions – namely, (1) a price mechanism and (2) a mandate that sets a speci f c goal for a particular sector or type of economic activity. The price mechanism is exempli f ed by a revenue-neutral carbon tax, which would increase the price of all goods and services proportionate to their emissions of CO_2.[3] Consumers and producers could then take into account all of their individual idiosyncrasies and reduce CO_2 emissions in the most e f cient and cost-e f ective way possible. In contrast, CAFE standards, an example of the mandate approach, require that f eet-wide average fuel e f ciency levels for new vehicles be met. That is, these standards require emissions to be reduced in a speci f c sector of the economy via increased fuel e f ciency and provide less room for consumer and producer choice.

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2. The EY analysis assumes that 50 percent of the power sector is subject to states cooperating in creating a single, multistate cap-and-trade program (relatively e f cient) and 50 percent of the power sector is subject to the national emissions rate option without inter-industry trading (relatively ine f cient). Although not presented here, results were also produced for alternative implementations of the CPP.

3. This analysis assumes a well-designed carbon tax that applies to all goods and services in the economy at a single rate based on their carbon content.

Innovation is one particular margin on which the choices of consumers and producers can operate to reduce CO_2 emissions. As consumers and producers aim to reduce CO_2 emissions, one way they can do so is to invest in research and development to create new technologies and production processes that reduce CO_2 emissions or make it less costly to do so. The flexibility allowed by a revenue-neutral CO_2 price may thus be especially useful in this context given the considerable uncertainty around what future technologies and production processes will be the most cost-effective in abating CO_2 emissions, both in terms of what these technologies and processes will be and where in the economy they will operate.

What is a carbon tax?

Phillip Swagel:

A carbon tax is a price signal meant to affect the behavior of households and businesses so that decisions on spending and investment take into account the consequences of carbon emissions. The goal of moving to a clean-energy economy could be achieved using a carbon tax, but in a way that minimizes the economic costs involved, because market forces rather than the decrees of government officials would determine the changes to achieve the goal. A revenue-neutral carbon tax would use the revenue raised by the tax to lower other taxes. In fact, it is possible that a carbon tax combined with growth-enhancing reductions in other taxes could actually lead to higher economic activity.

A carbon tax acts like a consumption tax weighted by carbon content.

A carbon tax would make items that involve carbon emissions more costly compared with products involving less carbon. In effect, a carbon tax acts like a consumption tax weighted by carbon content; the resulting shift away from carbon-intensive activities would be driven by the decisions of businesses and consumers in response to the carbon tax.

While the precise impacts of the tax on prices and purchasing decisions depend on interactions of supply and demand, on the whole, a carbon tax would lead economic activity to be undertaken in a way that entails lower carbon emissions and greater use of clean-energy fuels. As an

example, a carbon tax would lead utility companies to favor the use of clean-burning natural gas in the generation of electricity over more carbon-laden coal, for which the associated tax would be higher.

Importantly, a carbon tax will also affect business decisions regarding investment and innovation. An electric utility would have an incentive not only to use natural gas rather than a more carbon-intensive fuel, but also to develop new clean-energy technologies, including abatement techniques and ways to capture carbon rather than allowing emissions to go into the atmosphere and affect the earth's climate. In economic terms, the tax will affect not just demand such as customers' use of electricity (and all other items), but also supply – the way in which goods and services are produced.

How could a carbon tax serve as an effective substitute for carbon-related regulations?

Swagel:

In addition to allowing for the benefits of a better tax system, the carbon tax would make unnecessary burdensome regulations that seek to limit carbon emissions. The market-oriented approach of the carbon tax would achieve the aims of such regulations but in a more efficient way than the command-and-control approach in which government officials tell businesses and families what to do. Indeed, a successful carbon tax regime would eliminate the need for such regulations in the future.

At the same time, the carbon tax would facilitate a move to a clean-energy economy. Politically, the combination of a carbon tax and pro-growth tax reform thus allows for progress on both economic aims such as tax reform and market efficiency, and on goals related to climate and energy. And these benefits would come about in a market-oriented way in which businesses and families make the decisions that are best suited for themselves, rather than empowering government officials. A carbon tax is thus a double win: advancing a clean-energy economy while moving forward with pro-growth tax reform that improves the economy.

A carbon tax is a double win: advancing a clean-energy economy while moving forward with pro-growth tax reform that improves the economy.

In the absence of a carbon tax, what carbon-related federal and state regulations are likely in the next ten years, and what might their burdens be?

John D. Graham:

The Obama administration made the regulation of carbon dioxide and other greenhouse gases one of its top domestic policy priorities during the president's second term. Given congressional gridlock, the Environmental Protection Agency (EPA) issued carbon emission regulations directly under the authority granted to it by the Clean Air Act. However, the Trump administration has signaled that it will seek to curtail or eliminate many of these Obama-era regulations that have not yet been finalized or fully implemented.

While new federal carbon regulations are certainly unlikely in the near future, the Trump administration's ability to successfully unwind existing carbon-related regulations will likely hinge on exhaustive judicial review, with the ultimate outcome uncertain. Moreover, the proliferation of carbon-related regulations at the state level is still very possible in the years ahead as the renewables industry gains political power. State regulations often include approaches such as renewable portfolio standards, energy efficiency standards, and renewable tax credits. Enactment of new and stricter regional cap-and-trade programs for greenhouse gases is also a possibility. While the Clean Power Plan is not likely to be kept in place, many states have been developing compliance plans to lower their CO_2 emissions for several years now. Given that cap-and-trade initiatives already exist in ten states, additional states may seek to join these programs over the coming years if they choose to continue pursuing further CO_2 emissions cuts.

It is important to note that some states may begin to consider adopting their own carbon taxes in the absence of a national tax. A proliferation of regional and/or state programs would undermine the efficiency advantages of the national approach and create uncertainty for investors in numerous sectors of the economy.

A final issue to consider when examining the future of carbon-related regulatory affairs is the federal government's inability to commit to a long-term approach. This problem is well documented in the economics literature, and results in a tangible increase in costs for affected industries. The businesses that are most affected by CO_2 regulations, such as industrial manufacturers and power plants, often need to make important production, investment, and abatement decisions that will have consequences that far outlast a single presidential administration. These decisions are made more difficult when firms are tasked with considering the probability that the regulations affecting their decision-making will be changed significantly or done away with by the next administration.

The Trump administration is taking a drastically different approach to carbon regulation than its predecessor. Similarly, the vigor of the Obama administration's approach to carbon regulation bore little resemblance to Bush-era policies. It is possible that whoever succeeds President Trump will reverse course again on the issue. Replacing the current "seesaw" of the carbon regulatory framework with a national carbon tax is a more stable approach that would reduce the burden of regulatory uncertainty. A uniform, nationwide carbon tax that firms can expect to be in place for years to come would be much preferred to the current system plagued by uncertainty and inefficiency.

Replacing the current "seesaw" of the carbon regulatory framework with a national carbon tax is a more stable approach that would reduce the burden of regulatory uncertainty.

Would a price mechanism be more efficient than a regulatory strategy in reducing carbon emissions?

Carroll:

The most efficient way to reduce CO_2 emissions is through a pricing mechanism – such as a carbon tax – that would place a uniform price on emitting CO_2 across the entire economy.[4]

4. Note that in some cases it has been found that a rule-based policy could be less costly than a price mechanism. For example, a recent paper found that a clean-energy standard requiring a minimum share of electricity purchased by electric utilities be from lower CO_2-emitting sources could be less costly than a cap-and-trade system (which is generally equivalent to a carbon tax in computable general equilibrium models) imposed on the power sector. This results from the tax-interaction effect (i.e., inefficiencies

A uniform CO_2 price would leverage the knowledge of consumers and producers to find where it is least costly to reduce emissions, as compared with rule-based approaches that are often less flexible and may mandate more costly ways to reduce CO_2 emissions. The *difference* in efficiency and cost-effectiveness between the current rule-based CO_2 abatement approaches and a pricing mechanism largely depends on how closely the set of rules and regulations mandating reductions mimics the market outcome of a pricing mechanism, such as a uniform carbon price.

It is important to note that, like the current rule-based CO_2 abatement approaches, a pricing mechanism – in isolation – would reduce the overall size of the U.S. economy. To the extent that a carbon tax replaces distortionary regulations, however, there would be a relative increase in economic efficiency and growth. Moreover, a revenue-neutral carbon tax, like the one discussed here, could have a net positive impact on the U.S. economy if the proceeds of the carbon tax are used to reduce taxes or affect other government policies that themselves impose economic costs.

Alan D. Viard:

A carbon tax is more efficient than a regulatory strategy because it ensures that the least costly emission abatements are adopted. Regulators lack the information required to replicate that outcome.

A price mechanism, such as a carbon tax, is more efficient than a regulatory strategy because it ensures that the least costly emission abatements are adopted. Regulators lack the information required to replicate that outcome.

For example, consider a $40 per ton carbon tax. Any emission abatement that costs less than $40 per ton will be undertaken because doing so is cheaper than paying the tax. Any abatement that costs more than $40 per ton will

resulting from the interaction of the price mechanism with the tax system) dominating the inefficiently high level of input demand under the clean-energy standard. (See Goulder, Lawrence, Marc Hafstead, and Roberton Williams III. 2016. "General Equilibrium Impacts of a Federal Clean Energy Standard," *American Economic Journal: Economic Policy* 8(2): 186–218.) The potential greater cost-effectiveness from a rule-based policy over a price mechanism would likely not hold, however, when comparing a rule-based policy on a sector to an economy-wide carbon tax and at higher levels of overall CO_2 emissions abatement. (See, for example, Rausch, Sebastian, and Valerie Karplus. 2014. "Markets versus Regulation: The Efficiency and Distributional Impacts of U.S. Climate Policy Proposals," *The Energy Journal* 35(1).)

not be undertaken because it is cheaper to pay the tax. The same results arise under a cap-and-trade program in which the market price of permits is $40 per ton.

Any alternative way of achieving the same amount of abatement would necessarily be more costly. By definition, such an alternative would involve replacing some of the abatements that the price mechanism induced with an equal amount of abatements that the price mechanism did not induce. Costs would rise as abatements that cost less than $40 per ton were replaced by abatements that cost more than $40 per ton.

Because the price mechanism induces the least-cost abatements, a regulatory program could not do any better. In theory, it could do equally well by mandating exactly the same abatements that the price mechanism induced. In practice, however, regulators could not achieve that outcome. Even if regulators were unaffected by political considerations and steadfastly sought to minimize abatement costs, they would lack the detailed information required to identify the cheapest abatement opportunities. In contrast, the price mechanism does not require any centralized information. Instead, each potential emitter has an incentive to use its information about its own operations to identify any abatements that can be done at a cost lower than the price placed on emissions.

There is one other important difference between the two approaches. A regulatory program prohibits some emissions, but does not require businesses to make any payments for their permissible emissions. In contrast, under a carbon tax, businesses must pay tax on each emission that continues to take place. In the above example, a firm that produces widgets must pay $40 for each ton of carbon dioxide that it continues to emit, payments that would not be made under a regulatory program. Due to this additional cost, the firm produces fewer widgets under the tax than under the regulatory program.

If there were no other taxes in the economy, the additional reduction in widget production would be a further manifestation of the tax's advantage. Because widget production requires carbon dioxide emissions, a reduction in widget output is part of the least-cost way to

reduce emissions. With no other taxes, the output reduction induced by the carbon tax would be appropriate.

In the actual economy, however, existing taxes on work and investment inefficiently reduce the overall level of output. The carbon tax, to a greater extent than the regulatory program, amplifies that preexisting inefficiency by further reducing the overall level of output. If the inefficient output reduction caused by the tax is not offset, it is no longer clear which approach is more efficient.

Fortunately, a solution is readily available. Unlike the regulatory program, the tax raises revenue. Using that revenue to lower the other taxes on work and investment can offset the inefficient reduction in overall output while allowing the carbon tax to shift the composition of output from high-carbon goods to low-carbon goods and otherwise identify the lowest-cost emission abatements. The tax is then more efficient than the regulatory program.

Are there any carbon-related regulations (federal or state) and public subsidies that could be replaced if a national carbon tax is adopted?

Graham:

A properly designed carbon tax is expected to induce firms to reach a socially acceptable level of emissions without further intervention.

A properly designed carbon tax, one where price is pegged at the external (social) cost of carbon emissions, is expected to induce firms to reach a socially acceptable level of emissions without further intervention. Thus, enactment of a carbon tax should be linked to a reconsideration of other regulations and public subsidies that are aimed at reducing greenhouse gas emissions.

The EPA's regulation of greenhouse gas emissions under the Clean Air Act should be a prime candidate for deregulation under a national carbon tax. One major EPA action in this context is the Obama administration's Clean Power Plan, which regulates CO_2 emissions from existing power plants on a statewide level in order to reduce emissions by 30 percent from their 2005 levels by 2030. Costs of the plan are estimated to rise to more than $7.3 billion per year by 2030, and additional costs from the distortionary effects of inflexible requirements could push the actual costs of the plan beyond that. Therefore, repeal of the Clean Power

Plan could result in significant savings and could be a good complement to any credible carbon tax proposal.

Additionally, federal subsidies and tax credits for clean-energy technologies should be listed for reconsideration and potential repeal. The intended purpose of these subsidies is to encourage private firms to adopt low-emission technologies. A carbon tax already encourages this action, making additional subsidies redundant. Clean-energy technologies may reduce emissions other than greenhouse gases, but those emissions (for example, those related to smog and soot) are already regulated under other federal and state programs. Federal subsidies for fossil fuels should also be repealed to ensure a level playing field in the energy marketplace.

Another regulation for reconsideration is the federal renewable fuel standard (RFS), which sets floors on the amounts of renewable fuels that must be included in the supply of transportation fuels. The RFS was originally established to reduce U.S. dependence on foreign oil, but that justification has been weakened by the recent surge in U.S. oil and gas production and the diminished market power of OPEC. Advanced renewable fuels such as cellulosic ethanol have been advocated to reduce greenhouse gases, but specific regulations to encourage them are not necessary if a national carbon tax is in effect, since the tax will offer a market incentive for renewable fuels.

Still another set of federal regulations to reconsider is the CAFE standards, which require automakers to achieve average fuel-efficiency standards, where the standards are adjusted based on the size of the vehicle. CAFE standards are now applied to passenger cars, light trucks, and heavy trucks. Like the RFS, CAFE standards were originally adopted to address concerns about U.S. reliance on foreign sources of petroleum. That concern has diminished since the surge of U.S. oil production, the rapid decline in oil imports, and projections that the U.S. may soon become a net exporter of oil. A newer rationale for CAFE standards (as well as EPA's greenhouse gas standards for motor vehicles) is that fewer carbon dioxide emissions from the transport sector will slow the pace of climate change. However, a carbon tax can account for the external cost

of CO_2 emissions from the transport sector and thereby create stronger market demand for fuel-efficient vehicles. The need for further action in the form of mandated efficiency levels for automobiles is lessened. Additionally, sector-based approaches such as CAFE standards are an inefficient means of reducing emissions since the required controls at the emission source have no relationship to damages. In other words, there is no assurance under CAFE that the transport sector of the economy is shouldering an efficient share of the burden in protecting the climate system. A properly designed national carbon tax allocates the burden to various sectors of the economy in proportion to their emissions.

Sector-based approaches such as CAFE standards are an inefficient means of reducing emissions since the required controls at the emission source have no relationship to damages.

A wide range of regional and state-level regulatory programs should also be reconsidered in conjunction with enactment of a national carbon tax. There are regional cap-and-trade programs for carbon dioxide in the northeastern and western states that may not be necessary. Twenty-nine states have mandatory renewable portfolio standards applied to the electricity sector that should be reconsidered. California's renewable fuels standard may no longer be necessary. And the Zero Emission Vehicle (ZEV) program for cars and light trucks in ten states, including California, should be revisited. Although the ZEV program was originally enacted to address smog in Los Angeles and other cities, its primary rationale today is stimulus of technology to curtail greenhouse gas emissions.

It is important for policymakers to consider whether a regulation or subsidy has benefits unrelated to greenhouse gas control that may justify the costs of the intervention. A common argument is that the same source (factory or motor vehicle) that emits greenhouse gases also emits pollutants that cause unhealthy amounts of smog or soot. The national carbon tax only addresses the external (social) cost of the carbon dioxide emissions. In reality, though, federal and state governments already have elaborate programs to control smog and soot, and those programs might be more efficient if they were replaced with a tax on pollutants that contribute to smog and soot.

Are there any carbon-related regulations that still have economic value, even if a national carbon tax is adopted in the United States?

Viard:

It would be preferable, indeed essential, to replace existing regulations and subsidies. With the carbon tax set at the appropriate level, all cost-effective abatements would occur and there would be no reason to seek additional abatements.

The only exceptions are regulations and subsidies that correct other market failures. Notably, subsidies for basic research on clean energy may be justified on the same grounds as subsidies for other types of basic research. Because discoveries about the natural world cannot be patented, the market payoff to basic research may be smaller than the total gain to society, causing too little basic research to be performed. Well-designed government subsidies can help correct this problem.

It would be preferable, indeed essential, to replace existing regulations and subsidies. . . . The only exceptions are regulations and subsidies that correct other market failures.

Carroll:

The most cost-effective approach to CO_2 abatement would generally be through the use of a flexible, broad-based policy instrument that allows CO_2 abatement to be achieved at the lowest marginal cost. Such an instrument would allow the knowledge of consumers and producers to be leveraged to find the lowest-cost emissions abatement opportunities across the entire economy. At the federal level, in comparison to a revenue-neutral carbon tax, rule-based policies would typically be less flexible and be applied to a more narrow segment of CO_2-emitting activities. Rule-based policies often mandate the use of different technologies and processes or otherwise place restrictions on the choices of consumers and producers. At the state level, the issue is further exacerbated because the policy instrument is more narrowly applied to the specific geographic area defined by a state's borders. Notably, to the extent that a rule-based policy comes closer to replicating the outcome of a market-based policy and as rule-based policies incorporate pricing mechanisms, the relative benefit of a market-based policy over a rule-based policy is lessened.

Graham:

While the adoption of a national carbon tax in the United States would render a number of other regulations ine f cient or redundant, there are some climate-related policies that should be retained even if a carbon tax is implemented.

Federal funding for research and development of new energy technologies (for example, both low-carbon energy sources and carbon capture and storage systems) is one policy that should be left in place alongside a carbon tax. Knowledge spillovers associated with technological advancements realized from research make it di f cult for private f rms to capture the full value of any research they produce. As a result, private f rms will hesitate to invest their limited resources into the development of innovative technologies and will naturally undersupply research. At the same time, a carbon tax provides an incentive for f rms to move toward cleaner technologies, resulting in a gap between the demand for cleaner technologies and the supply of research and development into producing such technologies. Federal appropriations for clean-energy research can help to resolve this discrepancy.

A carbon tax provides an incentive for firms to move toward cleaner technologies, resulting in a gap between the demand for cleaner technologies and the supply of research and development into producing such technologies.

Another policy to consider retaining with a carbon tax is the Energy Star certi fcation program. The merits of state and federal energy e f ciency mandates are greatly weakened in the presence of a carbon tax, as e f ciency improvements would already be incentivized as a result of the tax. However, even in the absence of a carbon tax, economists generally f nd that energy e f ciency mandates are extremely distortionary and advocate for their repeal or transition into information-only approaches. The Energy Star program provides consumers with information about which products have relatively higher levels of energy e f ciency compared with other substitute products so that consumers are able to make informed decisions. As the Energy Star program points consumers toward energy-e f cient products, the resultant rising demand will cause f rms to innovate and produce products with increasingly higher e f ciency levels. The alternative approach of allowing direct e f ciency mandates to remain in place leaves little

incentive for frms to improve energy e f ciency once they have reached the level mandated by law.

One fnal policy to keep in place with a carbon tax is the mandatory reporting of CO_2 emissions by private frms to the EPA. While the reporting of a frm's emissions would no longer be necessary for the purpose of comparing against regulatory standards or benchmarks, it would be absolutely necessary to monitor CO_2 emissions for the purpose of determining an individual frm's carbon tax burden. There is an argument to be made that since the tax itself would presumably be administered by the Internal Revenue Service (IRS), the EPA could scale back its mandatory reporting requirements and leave that responsibility to the IRS. However, since the EPA already has the infrastructure in place for mandatory reporting and has developed means for verifying that emissions information submitted by sources is indeed accurate, it may make sense for the EPA to continue the monitoring and reporting aspect of the carbon tax and report the data to the IRS.

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CHAPTER 2

How Would a Carbon Tax Work?

How is a carbon tax different from cap-and-trade and would a carbon tax be preferable?

Viard:

Under simple assumptions, a carbon tax is economically equivalent to a cap-and-trade program in which the government sells all of the permits at auction. Adding real-world uncertainties suggests, however, that the carbon tax is superior to such a program. Moreover, a carbon tax is far superior to a cap-and-trade program that follows the commonly proposed approach of giving away the permits to frms that emitted carbon dioxide in the past.

To see the potential equivalence of a carbon tax to a cap-and-trade program with auction, consider a $40 per ton carbon tax that results in 10,000 tons being emitted, raising $400,000 of revenue. Now, consider a cap-and-trade program in which 10,000 tons of permits are sold at auction. It is easy to confrm that the market-clearing price of permits is $40 per ton. At that permit price, frms will undertake all abatements that can be done at a cost of less than $40 per ton and no other abatements. Because those are exactly the same abatements that were done under the $40 carbon tax, which resulted in 10,000 tons of emissions, a cap-and-trade program with a $40 permit price also results in 10,000 tons of emissions. Therefore, $40 is the market-clearing price when 10,000 tons of permits are offered for sale, which means that the government raises $400,000 from auctioning the permits. So far, the carbon tax and the cap-and-trade program are equivalent, resulting in the same emissions and revenue.

If abatement costs are uncertain, the cap-and-trade program faces problems that do not arise under the carbon tax.

If abatement costs are uncertain, however, the cap-and-trade program faces problems that do not arise under the carbon tax. Suppose that the damage to society from carbon dioxide emissions is $40 per ton. If the government imposes a $40 per ton carbon tax, it can rest assured that only those emissions that would cost more than $40 per ton to abate will take place and need not know in advance how many emissions fall into that category. With a cap-and-trade program, however, the government must estimate the amount of emissions that will occur at a $40 price. If the government estimates that 10,000 tons will be emitted, it

sells 10,000 tons of permits. But, abatement may turn out to be more costly than the government thinks, so that more than 10,000 tons of emissions would occur at a $40 price. In that case, restricting the supply of permits to 10,000 tons drives the permit price above $40, causing abatements that are unwarranted based on the $40 social harm. On the other hand, abatement may turn out to be less costly than the government thinks, so that fewer than 10,000 tons of emissions would occur at a $40 price. In that case, providing 10,000 tons of permits drives the permit price below $40, causing emissions to occur that should have been abated based on the $40 social harm.

Similarly, if the government keeps the quantity of permits stable, but abatement costs vary from year to year, permit prices will fuctuate from year to year, even if the social damage from carbon dioxide emissions remains unchanged. Too many emissions will occur in years in which emissions could have been cheaply abated and too few emissions will occur in years in which abatements were costly.

Both the carbon tax and the cap-and-trade program must cope with uncertainty about the social harm from carbon dioxide emissions. But, the cap-and-trade program faces additional unnecessary problems due to uncertainty about abatement costs.

The government can alleviate the cap-and-trade program's problems by setting a price foor and a price ceiling. If the price threatens to fall below the foor, the government buys back permits at the foor price; if the price threatens to rise above the ceiling, the government issues extra permits and sells them at the ceiling price. If both the foor and the ceiling are set at $40, the price is locked in at $40, similar to the carbon tax. Similarly, the government can smooth annual fuctuations in permit prices by allowing frms to move permits between years; frms may be allowed to bank current permits for future use and borrow future permits for current use. These measures should be used if a cap-and-trade program is adopted, but such complications are unnecessary under a carbon tax.

A bigger problem with cap-and-trade is the strong political pressure to give the permits away to firms based on their past carbon dioxide emissions.

A bigger problem with cap-and-trade, however, is the strong political pressure to give the permits away to frms based on their past carbon dioxide emissions. The good news about such a giveaway is that it does not weaken incentives to abate emissions; even if a frm receives free permits, it still has an incentive to undertake abatements that cost less than the permit price because such abatements enable it to sell its free permits to other frms.

The bad news is that a cap-and-trade program with permit giveaway cannot offset the inefficient reduction in overall economic output discussed above. The cap-and-trade program still raises the marginal cost of producing additional widgets; because widget production requires carbon dioxide emissions, producing each additional widget requires frms to buy permits or forgo sales of permits. The resulting reduction in widget output amplifes the inefficient output reduction caused by existing taxes on work and investment. If permits are auctioned, the problem can be corrected by using the auction proceeds to reduce existing taxes on work and investment. With permit giveaway, however, there are no auction proceeds to use for this purpose. Moreover, because the permit giveaway is based on past emissions, it does not lower the cost of new production and therefore does not boost output.

A cap-and-trade program with permit giveaway is economically equivalent to imposing a carbon tax and using the tax revenue to make cash grants to past emitters. But no carbon tax proposal features such grants, while many cap-and-trade proposals feature permit giveaways. That difference gives the carbon tax a major advantage.

Moreover, as Weitzman (2016) notes, a carbon tax lends itself more readily to international cooperation than cap-and-trade. It would be essentially impossible to reach agreement on a global allocation of permits or to sustain a system under which some countries would make large payments to other countries to buy permits. It is much easier to imagine an agreement under which countries impose a uniform carbon tax, with each country retaining the revenue raised by its tax, although such an agreement would still be quite difficult to reach and implement.

How should a carbon tax be administered?

Swagel:

Administrative efficiency suggests collecting a carbon tax from as few sources as possible, generally where energy enters the economy (the so-called upstream stage of the production process). Around 80 percent of U.S. emissions would be covered by collecting the tax from a small number of sources – only around 2,300 – including power plants (the largest U.S. emitters of carbon) and energy-related industries such as oil refineries. The impact of the tax would then be reflected throughout the economy, since all aspects of economic life involve the use of some energy source. Unlike a sales tax, cash register receipts would not show the carbon tax – the levy would be embedded in prices rather than displayed separately. Other climate-related emissions such as methane could be included in the regime, with the tax being levied per ton of CO_2-equivalent.

Around 80 percent of U.S. emissions would be covered by collecting the tax from a small number of sources – only around 2,300 – including power plants (the largest U.S. emitters of carbon) and energy-related industries such as oil refineries.

A host of detailed decisions are involved in administering a carbon tax. The initial amount of the tax and its path over time must be determined, including the circumstances under which the path will be adjusted (such as developments in technology or scientific understanding). Such flexibility must be set against the benefits of a stable carbon tax regime that provides certainty to businesses looking to adapt their activities and undertake potentially long-horizon investments in new technologies.

Viard:

In principle, a carbon tax is a tax on the emission of carbon dioxide and other greenhouse gases. Because every household and business in the country emits greenhouse gases, however, it would not be administratively feasible to directly tax all emissions. Even if small emitters were exempted, which would undermine the tax's environmental objectives, the number of taxpayers would still be impractically large. Fortunately, there is no need to collect the tax at the point of emission, as the tax imposes the same price increase on the final user, regardless of the stage of production at which it is collected.

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Calder (2015) and Horowitz et al. (2017, 4-10) examine the possible approaches. Most greenhouse gas emissions result from the combustion of fossil fuels. Under an upstream collection approach, petroleum could be taxed when refined, coal could be taxed when mined, and natural gas could be taxed when processed; imports of all three fuels would also be taxed at the point of import. Under a midstream collection approach, fuels could be taxed when sold to electric-generating facilities or to industrial users. Midstream collection would involve more tax fliers, but would be less likely to impose tax on fuels ultimately used in ways that did not result in greenhouse gas emissions. Some greenhouse gas emissions result from the production of cement, iron, steel, lime, and ammonia and a few other industrial processes; the firms engaged in those processes could be taxed directly on their emissions.

What are the factors that should determine the carbon tax rate? Should it be constant or adjusted over time?

Viard:

If the United States imposes a unilateral carbon tax, the tax should equal the domestic social cost of carbon, the dollar value of the harm suffered by Americans from the emission of carbon dioxide. Unilateral emission abatement serves the national interests of the American people – the appropriate goal of U.S. policy – only if the abatement costs incurred by Americans are smaller than the harm that Americans suffer from the emissions. Under a comprehensive international climate change agreement, however, it would be efficient for all countries to impose taxes equal to the global social cost of carbon, the total harm suffered by everyone in the world from the emission of carbon dioxide. Weitzman (2016) argues that, if an international agreement is ever reached, it is likely to feature a uniform carbon tax imposed at a rate close to the global social cost. Viard (2014, 7) notes that available estimates suggest that the U.S. domestic social cost is no more than one-tenth of the global social cost.

The carbon tax should change as the social cost of carbon changes. Most estimates show the social cost will rise in real terms over time as the stock of greenhouse gases in the atmosphere increases.

The carbon tax should change as the social cost of carbon changes.

Many carbon tax proposals set the initial value of the tax below the social cost of carbon and increase it over several years. Although that approach may enhance the tax's political feasibility, there is no economic reason for such a phase-in; it is e f cient to tax all emissions at their social cost, regardless of how soon they occur after the tax is adopted. To be sure, frms and households may not immediately be able to fully adjust their behavior in response to the tax. Nevertheless, setting the tax equal to the social cost is appropriate because it induces frms and households to undertake all abatements that, taking into account the di f culties of rapid adjustment, can be done more cheaply than the social cost.

The presence of other taxes has little e fect on the appropriate level of the carbon tax. Kaplow (2008, 213-216) describes simple assumptions under which the government should set environmental taxes equal to social harm, regardless of what the rest of the tax system looks like, provided that the government makes suitable adjustments to the other taxes in response to the introduction of the carbon tax.

In principle, the carbon tax should be set somewhat below the social cost of carbon if the revenue will be used unwisely, or somewhat above the social cost of carbon if the revenue will be used to correct preexisting f aws in the f scal system. In practice, such considerations are unlikely to be important because the adoption of the carbon tax would not alter the political forces that produced the existing f scal system. For example, some have argued that the carbon tax should be set above the social cost of carbon on the premise that the revenue will be disproportionately used to reduce the economically harmful corporate income tax. Because the adoption of a carbon tax would not alter the political forces that produced the corporate income tax, however, it would be unlikely to induce a signif cant sustainable shift away from corporate income taxation that could not otherwise have been achieved.

Aparna Mathur:

The rationale for taxing carbon is that it is a negative externality, which means that it entails damage to others, referred to as the social cost of carbon. An optimal carbon tax would be set equal at any point in time to the present value of the sum of marginal social damages caused by carbon or greenhouse gas emissions over many future periods. However, it is unclear exactly what that value should be because a comprehensive estimate of climate damage that takes into account all the physical, ecological, and economic impacts of climate change is limited by the lack of precise information on these outcomes. Even so, the EPA (2015) provides a range of estimates for the social cost of carbon, from a low of $14 to a high of $138 per metric ton.

Given the uncertainty around the precise estimate, it is improbable that when policymakers announce a carbon tax, they would pick a value that is exactly the equilibrium level of tax that would allow emissions to be reduced to the desired amount. Nor is it likely to be true that the marginal damages are constant over time. Therefore, in practice, the adoption of a tax would lead to certain changes in emissions that would then allow policymakers to figure out how to adjust the tax over time to reach the desired goal.

The question then becomes whether we should start off with a high carbon tax and bring it down over time as emissions adjust, or whether we should start low and phase it in. Williams (2012) uses a stylized theoretical model and comes up with a slightly counterintuitive result: Start off at a high level of tax and then as emissions reduce over time, lower the level of the tax as well. This is because when firms have capital adjustment costs, having a high tax encourages them to make those investments in clean technologies early on, which then allows them to achieve lower emissions at later times. However, as discussed by Holland (2012) in response to Williams (2012), the carbon tax falling over time rests on the assumption that the atmospheric concentration of carbon falls over time. If, in fact, the growth of the atmospheric concentration of carbon is merely slowed, then the marginal social damage is still increasing (albeit at a slower pace), which would call for an increasing carbon tax over time.

Other considerations might also move us toward a more gradual phase-in of a carbon tax. First, it would allow firms more time to adjust to the policy, thereby reducing costs. This could be important for distributional reasons since typically firms would try to pass on the costs to consumers in the form of higher prices, and it is lower-income households who are most affected by the higher prices. Second, if regulatory agencies have limited capacity for monitoring and enforcement that can only be increased gradually over time, then phasing-in by initially covering only a few polluters and then widening over time might make sense. This was the case with the U.S. sulfur dioxide trading program, which initially covered only a few polluters but then expanded to cover more pollution sources.

A more gradual phase-in of a carbon tax . . . would allow firms more time to adjust to the policy, thereby reducing costs.

How much revenue might be raised from a carbon tax in the U.S.?

Carroll:

One advantage of a carbon tax in comparison with the current rule-based CO_2 abatement approach is that it raises revenue that can then be used for other purposes. As shown in Table 1, EY recently estimated that a $20 per ton carbon tax could raise $930 billion over the ten-year budget window, while a $40 per ton tax would raise $1,590 billion, and a $60 per ton tax would raise $2,070 billion. To put these numbers in context, the CBO and JCT estimate that the ten-year costs of the state and local tax deduction and home mortgage interest deduction are each approximately

Table 1: Estimated ten-year revenue raised by an economy-wide carbon tax

Carbon Tax Rate	Revenue 2017–2026 *Billions of dollars*
$20/ton	$930
$30/ton	$1,290
$40/ton	$1,590
$50/ton	$1,850
$60/ton	$2,070

Note: The revenue cost of the various carbon taxes is estimated using a micro- and macro-dynamic model (EY GE Model).
Source: EY analysis.

$870 billion. In addition, the CBO and JCT estimate that the total ten-year cost of eliminating the estate and gift tax, preserving the research and development credit, replacing the gas tax, and preserving the child tax credit is around $1,060 billion.

Mathur:

With the social cost of carbon ranging in value from $14 to $138 per metric ton (EPA 2015), it is likely that a carbon tax would be set somewhere within that range as well. In my own (static) analysis (Mathur and Morris 2014), I estimate that a $15 per metric ton tax rate in 2010 would have generated revenues of $102.3 billion in 2010. A CBO analysis from 2013 similarly finds that a $25 tax rate would result in revenues of over a trillion dollars during the first decade. Using a dynamic, general-equilibrium, overlapping generations model developed at Resources for the Future, authors Carbone et al. (2014) find that a tax rate of $20–$50 per ton (in 2012 $) could potentially raise $160 billion–$360 billion in gross revenues per year. These are not insignificant amounts given the size of the federal deficit in 2016 ($587 billion).

Ultimately, the revenues from a carbon tax will depend on the level of the tax and how it is designed, which sectors and industries it covers, and whether some revenues will be used to offset burdens on lower-income households. Moreover, it will depend on the use of different types of fossil fuels. For instance, the electricity sector is a big user of coal and is likely to be responsible for a large share of carbon tax revenues. However, if there is a shift toward natural gas as a result of lower natural gas prices, or if people simply have less demand for electricity, this could affect carbon tax revenues. In a 2012 paper for Resources for the Future, Palmer et al. show that under a carbon tax of $25 per ton in 2020, revenues from the electricity sector can vary roughly 18 percent and revenues for the economy as a whole can vary 7 percent. Continuous increases in tax rates could in fact lead to falling tax revenues over time as the tax base erodes and there is a switch to renewables and nuclear.

It is also important to keep in mind that carbon tax revenues could potentially be used to reduce other distortionary taxes, such as corporate or personal income taxes, which could have beneficial effects on economic growth and raise the trajectory of federal revenues even more.

Carbon tax revenues could potentially be used to reduce other distortionary taxes, such as corporate or personal income taxes, which could have beneficial effects on economic growth.

If a carbon tax were adopted, would it be better to preserve or repeal existing tax expenditures for energy production and conservation? Which, if any, would be appropriate to preserve?

Mathur:

A carbon tax would allow us to eliminate most if not all tax expenditures since it would simultaneously achieve a reduction in greenhouse gases and a shift toward renewables or cleaner fuels. By eliminating tax credits such as wind, solar, percentage depletion, expensing by extractive industries, and accelerated amortization of geological and geophysical expenses in oil and gas, the federal government would save billions of dollars. At the same time, a carbon tax could by itself be a significant revenue source. Perhaps the only tax expenditures that might be worth keeping are those related to research and development. Federal funding for basic research and development would remain important under a carbon tax because those activities would be underfunded by market participants alone.

Energy-related tax expenditures accounted for 42 percent (about $12.4 billion) of the total value of direct financial interventions and subsidies in energy markets in 2013 (Energy Information Administration 2015). Many of the energy-related tax expenditures are inefficient and result in possibly adverse environmental impacts. Examples of these include the percentage depletion allowance and the provision to allow extractive industries to expense their exploration and development costs (see Hanson and Sandalow 2006). As a result of these provisions, companies are often encouraged to engage in these activities because these are essentially subsidizing their cost of production. Since many industries operate in ecologically sensitive

Energy-related tax expenditures accounted for 42 percent (about $12.4 billion) of the total value of direct financial interventions and subsidies in energy markets in 2013.

regions, this can result in groundwater contamination and other environmental impacts on mining sites.

Similarly, the SUV deduction encourages the purchase of heavy-duty vehicles that are more polluting and use more oil than smaller cars. In recent testimony, Gilbert Metcalf (2014) highlights the case of the $0.50 per gallon alternative fuels mixture credit. This credit was intended to encourage the addition of biodiesel and biomass-based fuels to petroleum to reduce petroleum use but had the perverse effect of raising the demand for diesel fuel in order to make the biofuel eligible for the credit. Other examples include the use of tax expenditures to promote more efficient electrical appliances. Lower operating costs for energy-consuming home appliances like HVAC systems encourage customers to use those appliances more frequently (Rorke 2013).

A bigger problem with the use of these policies is that they are often politically motivated to favor certain industries. This lends a certain amount of uncertainty to the long-run viability of these provisions. As political preferences change, there may be demands for dropping certain credits or not renewing others. This affects the ability of firms to plan their investments for the future and creates uncertainty in policies. For instance, the two-year authorization cycle for renewable electricity production tax credits has resulted in great uncertainty in the wind industry and boom-and-bust cycles that raise the cost of renewable energy investment (Metcalf 2014).

If the purpose of energy policy is to reduce our reliance on traditional fossil fuels and thereby reduce greenhouse gas emissions, this could be more efficiently achieved through a carbon tax. A carbon tax would address the negative externality that arises from the combustion of fossil fuels, encourage firms to shift away from polluting activities, and thereby spur investments in cleaner technologies.

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CHAPTER 3

Carbon Tax and Tax Reform

How could a carbon tax facilitate fundamental reform of the tax code?

Swagel:

A carbon tax enables tax reform both practically and politically. A variety of carbon tax proposals would generate revenues of around $100 billion per year over the first decade, and then more in subsequent years. There would be many claimants on such a large stream of money, but an efficient use would be to reduce other taxes in a way that offsets the impacts of the carbon tax on the overall economy. A wide range of research indicates that the positive impacts of pro-growth tax reform in an amount that could be funded by carbon tax revenues has the potential to result in a net *increase* in overall income – that is, the combination of a carbon tax and growth-oriented reductions in other taxes could have a net economic *benefit* rather than a cost. In this way, a carbon tax would not lead to more spending and a larger government, but instead to a tax system that raises the revenue needed for vital public functions such as national defense in the most efficient way.

The carbon tax can be seen as a form of pro-growth tax reform that moves toward consumption taxation, with a carbon inflection.

The carbon tax can thus be seen as a form of pro-growth tax reform that moves toward consumption taxation, with a carbon inflection. This change to a tax on consumption rather than income would reduce the current bias in the U.S. tax system against saving and investment. This bias comes about because the returns from saving are taxed twice: first when the funds for saving are generated as income earned through wages, and then a second time when the returns on those funds are earned from investment. In contrast, income used for consumption is taxed only once, when the wages are earned. This feature of the tax code imparts a bias against saving and investment that reduces both. Importantly, a pro-growth tax reform that reduces taxes on capital – that is, on saving and investment – would also lead to higher wages over time. This is because the tax reform would lead to a higher capital stock, which improves the productivities of workers (for example, a worker is more productive with a mechanical excavator than with a shovel – more capital improves worker productivity). Over time, wages rise with productivity: Workers who are more

productive earn more. Ultimately, then, benefts of lower taxes on saving and investment will accrue to workers through higher wages. And all will benef t from the stronger economy brought about by pro-growth tax reform.

How should the revenue from a carbon tax be used?

Viard:

A signifcant part of the revenue should be used to reduce marginal tax rates, thereby offsetting the output reduction that the carbon tax would otherwise cause. If other taxes and spending are adjusted in ways that leave the distribution of the fscal burden across income groups roughly unchanged, then work disincentives would also be roughly unchanged.

It would be desirable to use some of the carbon tax revenue to lower taxes that penalize investment, particularly corporate income taxes. Marron and Toder (2015) discuss options for corporate tax reduction. As discussed above, however, the political forces that produced the corporate income tax must shift if carbon tax revenues are to be adopted as an offset to a corporate tax rate cut.

What would be your preferred "tax swap" for a carbon tax? By how much could other taxes be reduced with the revenue from a carbon tax?

Swagel:

Reductions in U.S. capital taxes would have the largest impact in terms of increasing economic growth. This is because taxes on capital income afect saving and investment. A tax on capital reduces the return to investment, which in turn reduces the incentive for people to save. A tax swap focused on reform of capital taxes would thus lead to increased investment and a larger capital stock over time, which in turn means higher productivity for workers and more output. Over time, wages rise with productivity, so a tax reform that fosters increased investment will also lead to larger paychecks.

Taxes on dividends, capital gains, and on corporate income are the most salient forms of capital taxes in the United States (the estate tax is also a tax on capital because

Research on a variety of proposals for a carbon tax suggests that using most of the revenues from a carbon tax would allow for a reduction in the corporate income tax of enough to offset the impacts of the carbon tax on economy-wide income (that is, on overall GDP).

it is levied on the savings of families). Research on a variety of proposals for a carbon tax suggests that using most of the revenues from a carbon tax would allow for a reduction in the corporate income tax of enough to offset the impacts of the carbon tax on economy-wide income (that is, on overall GDP). By itself, the carbon tax will impose some economic costs: After all, it is meant to affect behavior and raise prices of carbon-intensive goods and services. A tax swap that involves lower capital taxes would raise incomes, thereby offsetting the economic impacts of the carbon tax, possibly by enough to result in net income gains.

Reductions in other taxes would have lesser impacts in terms of fostering stronger growth and offsetting the impacts of the carbon tax. Lower income taxes or labor taxes provide for considerably less pro-growth improvement than reforms to capital taxes. To be sure, using the revenues from a carbon tax to lower income tax rates or payroll taxes would improve incentives for work and thereby increase output. But the pro-growth impact of capital tax reform is considerably larger, reflecting the larger distortions imposed by taxes that reduce saving and investment. The worse impact of capital taxes reflects their long-lived effect in reducing the capital stock, thereby lowering output for years into the future.

A swap involving a carbon tax would also need to strike a balance between pro-growth tax policy and distributional considerations. Devoting around 15 percent of the revenue from the carbon tax to distributional purposes such as targeted relief for low-income families would offset the impacts on the bottom 20 percent of households. This allows for most of the revenues to be devoted to pro-growth tax policy that increases overall incomes. The distributional implications of this tax swap would then differ in the near term during which the benefits would accrue to the owners of capital and over time as increased productivity translates into higher wages.

Mathur:

Revenues from a carbon tax could be used to reduce other distortionary taxes such as corporate income taxes or personal income taxes. My preferred tax swap would be

a carbon tax–corporate tax swap. A number of scholars have examined such "tax swaps." Although the studies use different tools and arrive at different conclusions about how much of the macroeconomic cost of a carbon tax can be mitigated, it is clear that reducing existing tax distortions can be an important way to lower its overall burdens. Analyzing the impact of policy that yields a 15 percent cut in emissions, the CBO estimated that the hit to GDP could be reduced by more than half if the government lowered corporate income taxes rather than provided lump-sum rebates to households or to give the allowances away (Elmendorf 2009). Metcalf (2007) also suggests that linking a carbon tax to a capital income tax reduction could be efficiency-enhancing. Parry and Bento (2000) find that efficiency gains are particularly large when revenue recycling lowers taxes that favor some kinds of consumption (such as housing or health insurance) over others. Feldstein (2006) argues that the distortions from the tax system are greater than most people realize, resulting in costs of about $0.76 for every dollar the federal government raises. Some recent modeling evidence suggests that carbon tax swaps could improve welfare and/or economic growth, irrespective of the environmental benefits.

In my research (Mathur and Morris 2014), I find that a carbon tax of $15 per metric ton could have raised $102.3 billion in 2010. In 2010, the U.S. corporate income tax raised $191.4 billion, while the personal income tax brought in $898.5 billion. By these measures, a carbon tax of $15 per metric ton would replace slightly more than half of corporate income tax revenues or 11.4 percent of personal income tax revenues. In practice, those shares would evolve over time as carbon tax revenues and other revenues evolve at different rates.

A carbon tax of $15 per metric ton would replace slightly more than half of corporate income tax revenues or 11.4 percent of personal income tax revenues.

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CHAPTER 4

Economic Growth and Impacts of a Carbon Tax

How might a revenue-neutral carbon tax affect U.S. economic growth and employment?

Carroll:

The economic impact of a revenue-neutral carbon tax (i.e., one in which the revenue raised is used to fund another tax policy change or an offsetting change in government spending in the case of a budget-neutral change) depends critically on how the revenue is used. Some uses may produce additional benefits by either reducing preexisting distortions arising from, for example, high tax rates or promoting economic activity with other societal benefits.

To the extent that a revenue-neutral carbon tax reduces an existing tax that is more distortionary, it can produce a net benefit to the overall U.S. economy.

To the extent that a revenue-neutral carbon tax reduces an existing tax that is more distortionary, it can produce a net benefit to the overall U.S. economy. Generally, taxes on capital income are the most distortionary, followed by taxes on labor income and consumption. The economic impact of any particular tax policy proposal, however, is an empirical question that must be analyzed in detail.

EY recently estimated the economic impact of a revenue-neutral carbon tax. In the analysis, the carbon tax rate is set to reduce CO_2 emissions by the same amount as the set of post-2013 rule-based policies – that is, a reduction in long-run carbon emissions by 20 percent. Three scenarios for using the revenue from the carbon tax are analyzed (see Table 2): (1) a reduced corporate income tax rate (from 35 percent to 16 percent in the long run); (2) an across-the-board, proportional reduction in individual income tax rates (top rate from 39.6 percent to 37.1 percent in the long run); and (3) a household rebate ($1,380 per household annually in the long run).[1]

The corporate income tax reduction is a reduction in taxes on the return to investment (specifically, the return to equity-financed investment in the corporate sector), which would encourage more capital investment and contribute to higher labor productivity and, ultimately, higher real wages and living standards. The across-the-board, proportional

1. Using the proceeds to reduce the deficit is similar in many respects to the funding mechanisms here, from the perspective that deficit spending must eventually be paid for with future higher taxes or lower future government spending.

Table 2: Economic impact of revenue-neutral, emissions-equivalent carbon tax implemented instead of regulatory CO_2 control path

	2016–20	2021–25	2026–30	2031–35	Long run
CO_2 emissions change in all scenarios	–16.0%	–19.0%	–19.6%	–19.7%	–19.6%
Corporate income tax rate reduction					
GDP change	0.7%	1.5%	1.8%	1.9%	2.1%
GDP change per household (2016 $)	$950	$2,070	$2,570	$2,690	$2,940
Corporate income tax rate (from 35%)	19.9%	17.5%	16.8%	16.6%	16.2%
Across-the-board, proportional individual income tax rate reduction					
GDP change	0.5%	1.0%	1.2%	1.3%	1.4%
GDP change per household (2016 $)	$780	$1,450	$1,740	$1,820	$1,950
Top individual income tax rate (from 39.6%)	37.6%	37.2%	37.1%	37.1%	37.1%
Household rebate					
GDP change	0.2%	0.4%	0.5%	0.5%	0.6%
GDP change per household (2016 $)	$220	$570	$720	$760	$820
Rebate per household (2016 $)	$1,130	$1,340	$1,380	$1,390	$1,380

Note: Economic impacts are presented as the five-year average over the time period denoted. All rule-based policies modeled include only the impacts of post-2013 expansion or implementation. The results presented in this table assume that the CPP is implemented as 50 percent national emissions rate and 50 percent mass based. The long run is defined as when the U.S. economy has fully adjusted to the economic effect of the policy. Figures are rounded.
Source: EY analysis.

reduction in individual income tax rates reduces both labor and capital taxes, which would increase the after-tax reward to work, possibly resulting in higher real wages, hours worked, or other labor market impacts, and increase the after-tax return for savings and investment through the lower investor-level taxes on dividends, capital gains, and interest income and lower pass-through income taxes. The household rebate would not reduce any preexisting distortionary taxes, but would increase household incomes.

Income tax reductions

The EY analysis finds that there are significant economic benefits from a revenue-neutral, emissions-equivalent carbon tax when income tax rates are reduced. In particular, if the revenues were used to reduce the statutory U.S. corporate income tax rate, the U.S. economy would be 2.1 percent larger ($2,940 per household) after the economy fully adjusts relative to the fully phased-in 2013 rule-based CO_2 abatement regime. Likewise, if carbon tax revenues were used to fund an across-the-board, proportional reduction in individual income tax rates, the U.S. economy is estimated to increase by 1.4 percent ($1,950 per household) relative to the fully phased-in post-2013 expansion of the rule-based CO_2 abatement policies in 2013 and after.

If the revenues were used to reduce the statutory U.S. corporate income tax rate, the U.S. economy would be 2.1 percent larger ($2,940 per household) after the economy fully adjusts.

Rebates

The EY analysis also finds that a revenue-neutral, emissions-equivalent carbon tax where revenues are rebated to households – that is, which does not improve economic efficiency via the reduction in distortionary taxes – would increase GDP by 0.6 percent ($820 per household) relative to the fully phased-in post-2013 rule-based CO_2 abatement regime in the long run. Because this use of proceeds does not improve efficiency through reductions in distortionary tax rates it, in effect, isolates the benefit of leveraging the knowledge of consumers and producers in choosing where CO_2 emissions should be reduced.

Mathur:

The design of a carbon tax and the use of revenues in a manner that promotes economic growth could lead to large positive impacts on growth and employment in the long run.

The long-run effect on economic growth would largely be driven by the use of revenues. If revenues were used to reduce federal deficits, this could potentially improve economic growth since higher federal deficits lead to lower economic growth (CBO 2013). At the same time, if carbon tax revenues were used to reduce other distortionary taxes such as corporate income taxes, then the effect on economic growth is likely to be positive. Corporate income taxes are one of the most distortionary taxes since they affect a firm's incentives to invest. My research with Kevin Hassett shows

that higher corporate taxes lead to lower worker wages (Hassett and Mathur 2015). Work by economists Marc Hafstead et al. (2016) shows that in a dynamic setting using an overlapping generations model, the benefit of using a carbon tax–corporate tax swap more than offsets the cost of a carbon tax. A range of studies finds that the efficiency costs are lowest when we cut corporate income taxes as opposed to personal income taxes or lump-sum rebates (Marron et al. 2015). Other options that could potentially result in higher economic growth involve spending on infrastructure, research and development, and other productive activities (Marron and Morris 2016).

A direct impact on the economy would be through higher costs of production because a carbon tax would essentially raise the prices of fossil fuels such as oil, coal, and natural gas. Since these fuels are inputs in the production of nearly all other goods consumed in the economy, this would end up raising the prices of consumer goods. A carbon tax is regressive, which means that the burden as a share of household income would be larger for poorer households. Firms adjusting to these cost increases could also pass on higher costs to workers in the form of lower wages. If wages did go down, or prices went up, this could potentially have negative impacts on economic growth as workers' incentive to supply labor, and spending on consumption goods by households, is likely to go down. At the same time, industries that bear the burden of a carbon tax most intensively, such as those reliant on coal, would presumably either reduce output or employment or both, which would again have negative growth consequences. The negative short-run effect on employment of a carbon tax could be mitigated if workers moved to newer industries that relied on cleaner technologies when they were displaced from traditional, fossil fuel–reliant industries.

Who would bear the burden of a carbon tax and how best would the impacts be measured? Will a carbon tax have a larger impact among certain types of households or in certain regions?

Mathur:

The burden of a carbon tax would largely fall on lower-income households. Since lower-income households generally spend more on energy as a share of total income, their expenditures on these items as a share of income will go up much more than for higher-income households. This is what makes a carbon tax regressive. It is important to remember, however, that while much of the discussion surrounding a carbon tax focuses on the direct impact of the tax on energy prices, the prices of all other consumption goods increase as well, since a tax affects the prices of all fossil fuels containing carbon. My research shows that prices of everyday items such as food, shoes, clothing, etc. increase with a carbon tax. Therefore, we need to consider both direct energy expenditures as well as indirect energy expenditures when considering the burden of a carbon tax. In general, I find that the direct burden of a carbon tax is regressive, while the indirect burden is more evenly distributed.

The [geographic] variation in the total carbon tax burden is not as pronounced as one might expect.

When it comes to the burden across regions, again I find that while the direct burden varies a lot, the indirect burden is more evenly distributed. As a result, the variation in the total carbon tax burden is not as pronounced as one might expect. In my paper (Mathur and Morris 2014), to measure the geographic burden of the tax (had it been imposed in 2010), I group households by region and measure their average tax rate using weighted averages of the tax burdens. The tax burden as a share of household income varies around 1.5 percent, and the degree of variation across regions is modest. The maximum difference in the average rate across regions is just 0.45 percentage points. This is remarkable considering the variation in weather conditions, driving patterns, and other factors across the regions. The bulk of the variation across regions in carbon tax payments arises from the direct portion of the tax. The underlying data reveal that the relatively high regional burden for

the East South and East North Central regions is due to the higher consumption of gasoline per household in that region relative to others. By itself, this would have led to much larger burdens of the carbon tax on consumers in this region. However, consumption of other direct energy goods such as natural gas, electricity, and home heating oil are relatively low in that region. Such differences substantially even out the burden across regions. For instance, gas consumption is highest in the East North Central region, electricity is highest in the West South Central region, and home heating oil is highest in New England. There is little variation in the indirect burden across regions. This suggests that consumers in different regions of the country buy similar mixes of non-energy commodities.[2]

What would be the net impact on households of a revenue-neutral carbon tax in place of existing regulations?

Carroll:

EY recently estimated the economic impact of expansion of the rule-based CO_2 abatement policies in 2013 and after, compared with a market-based alternative in the form of a revenue-neutral, emissions-equivalent carbon tax. EY finds that, relative to the expansion of the rule-based policies, a carbon tax would reduce CO_2 emissions by the same amount at a lower cost, adding up to 2.1 percent of GDP in the long run, depending on the use of carbon tax proceeds.

As displayed in Figure 1, replacing the proposed expansion in rule-based policies with a revenue-neutral carbon tax amounts to a significant increase in per-household GDP. Specifically, annual per-household GDP is estimated to increase by $2,940 if carbon tax revenues

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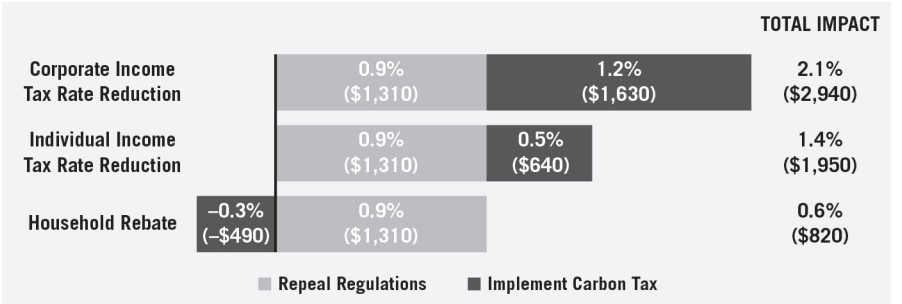
2. One caveat to these results is, of course, that when working with national household-level data such as the Consumer Expenditure Survey, on which much of this analysis is based, we are unable to identify the types of industries that workers are employed in. So when we classify workers as belonging to a certain income group, there might still be significant variation within the group, with some workers more affected by carbon pricing and others less so, if they are employed in industries that are heavily reliant on traditional fossil fuels.

are used to reduce the corporate income tax rate; $1,950 if carbon tax revenues are used to fund an across-the-board, proportional individual income tax rate reduction; and $820 if carbon tax revenues are rebated to households (calculated as the estimated change in GDP divided by the number of households).

Figure 1. Long-run change in annual per-household GDP from revenue-neutral, emissions-equivalent carbon tax if implemented instead of fully phased-in post-2013 rule-based CO_2 abatement regime, by use of carbon tax proceeds



Note: The fully phased-in post-2013 rule-based CO_2 abatement regime refers to the regulatory expansion that occurred during the 2013–2016 period. Economic impacts are scaled to the size of the 2016 U.S. economy. The long run is defined as when the U.S. economy has fully adjusted to the economic shock of the policy. Approximately two-thirds to three-quarters of the long-run effect occurs after ten years.
Source: EY analysis.

Mathur:

In general, the use of lump-sum rebates and tax swaps faces the trade-off of efficiency versus equity. While tax swaps that reduce distortionary taxes are appealing because they encourage economic growth, they don't improve equity. On the other hand, lump-sum rebates are equitable but not efficiency enhancing since they largely have no growth impacts. Analyzing the impact of a tax swap policy that would offset about 50 percent of corporate tax revenues or alternatively about 11 percent of personal tax revenues, I find (Mathur and Morris 2014) the effect of a carbon tax on households depends to a large extent on what we believe about the incidence of any type of tax on workers. When we use the revenues to offset the burden of personal income taxes, the benefits will largely go to the workers through

their wage income, since the incidence of personal income taxes is 100 percent on workers. However, since wage income is concentrated in upper-income households, this means that a large share of the revenues would essentially be used to help higher-income households. This means that with this type of tax swap, the policy is still regressive but much less so than with a carbon tax and no rebate or tax swap. If, instead, we used the revenues to offset corporate income taxes, the tax swap would again benefit all households but with a larger benefit to higher-income households since they receive the majority share of capital incomes. This would also be regressive but again better than a policy with no tax swap or no rebate.

The policy that would more directly help offset the burden on low-income households would be a lump-sum rebate. If the amount of the rebate were the same across households or if it were specifically available only to low-income households, then such a policy would be more beneficial to lower-income households and offset the regressivity in the tax code. Some proposals to use carbon tax revenues to expand means-tested programs or expand refundable credits like the Earned Income Tax Credit aim to do exactly that. While these would do little for economic growth, they would be justified on equitable grounds.

Put another way, the most economically efficient recycling benefits poor households (who pay very little in taxes) proportionately less than rich households (who pay much more in taxes). Thus, there is an intrinsic trade-off between optimizing the macroeconomic effects of the tax reform and making it distributionally neutral or progressive.

To what extent would workers in existing industries be displaced by a carbon tax? How should policymakers mitigate these effects?

Mathur:

If a carbon tax is put in place, it is very likely that workers in certain industries, such as those relying on coal, will be hit hard by the tax. This could lead to employment losses and also output losses as industries adjust to the tax. However,

it is also important to point out that over the last five years, coal producers have been suffering a loss in market value that has already resulted in significant job losses. This is not simply a consequence of environmental regulations but also a byproduct of competition from low-cost natural gas, generated through fracking technology. This is also true of the oil industry, with the price of oil declining and reducing profitability over the last few years. These industries have already shed jobs significantly. And these losses are likely to continue if we have a carbon tax.

Therefore, a policy to help workers in these industries is warranted. Some have suggested a policy similar to Trade Adjustment Assistance, which helps displaced workers through a combination of wage subsidies, health insurance, job training, and relocation assistance. Some have also suggested guaranteeing new clean-energy jobs to younger workers who are displaced from traditional industries. Another option would be to keep aside some funds from a carbon tax for coal workers displaced by a carbon tax policy (Morris 2016).

While direct employment losses in carbon-intensive industries are likely in the short run, some authors suggest that investments in clean energy could create more jobs in the long run than would be displaced (Pollin and Callaci 2016). A carbon tax could be useful in this regard because it would create an incentive for energy-related innovation and R&D into new technologies, which would boost clean-energy employment.

Swagel:

Industries that involve especially carbon-intensive activities would be relatively more affected than others, as would the regions and workers associated with those industries. Electricity generation in the Midwest, for example, tends to rely on coal-fired generators more than utilities do in other parts of the country. Emissions and pollution would fall the most in these areas as the carbon tax leads to changes in electricity generation – whether through a shift away from coal or to the development and use of clean coal technology such as carbon sequestration. But prices would rise as well. Similarly, firms that make things that are carbon intensive

in their production or usage likewise would be relatively more affected – again, by design. Cement production, for example, is relatively carbon intensive, so the tax would affect not just the cement industry, but also construction. These impacts would be offset by the pro-growth impacts of a tax swap that lowers the tax bias against saving and investment. That is, some costs would go up – of cement and fuel – but other costs would go down, and the people and businesses who are the ultimate customers of cement and fuel would have higher incomes. On net, the impact of the carbon tax and pro-growth tax reform could be positive.

The policy will be most effective in both bringing about pro-growth tax reform and in achieving the goal of fostering a clean-energy economy if these sector-specific changes are allowed to take place rather than slowed through sector-specific subsidies that effectively undo the incentive effects of the carbon tax. Workers affected by sectoral change should be supported – just as workers today affected by technological change (including global competition amplified by technological change) should be supported as they improve their skills and adjust to the evolving economy. These adjustments will be meaningful for families and regions. The overall impact will be positive, providing resources with which to help those most negatively affected without seeking to undo the incentives created by the carbon tax.

Which companies and industries are favorable to a carbon tax? Which are most affected?

Swagel:

The leaders of companies in a wide range of industries in the United States have expressed support for a nationwide mechanism for carbon pricing or are already using an internal carbon pricing system in their operations, including major corporations, utilities, and trade associations. This support includes advocating for carbon pricing legislation, using an internal carbon pricing system, issuing a statement in support of a carbon tax, signing the World Bank Carbon Pricing statement, or recommending advancing carbon

pricing at the Vatican Global Forum. Among the supporters or users of a carbon price are large companies in the energy sector, which would be most directly affected by a carbon tax, including BP, ConocoPhillips, ExxonMobil, Occidental Petroleum, and Shell. Also supporting a carbon price are many companies that either generate electricity, such as American Electric Power, NRG Energy, PG&E, and PSEG, or that use electricity intensively in their operations or in the products they sell, including Alcoa, Dow Chemical, General Electric, and General Motors. These are but a few of the many others within the Fortune 500 list of the largest U.S. corporations that are on record in favor of a carbon price.

Support from companies that would be most affected by a carbon price can be seen as reflecting both broad awareness that a carbon price is a necessary policy component of a move to a clean-energy economy, and a narrower sense of business judgment that an economy-wide price would be the best such approach for the companies involved (in addition to being the best approach for the overall economy).

Industries that rely on especially carbon-intensive production methodologies would be most affected by the tax, even while the ultimate impact depends on the complex interaction of supply and demand within the U.S. and global economies, and on the development of future technologies. For example, implementation of a carbon tax will provide incentives for the development of new technologies that reduce carbon emissions or sequester carbon rather than allowing the emissions to persist in the atmosphere and contribute to climate change. The long-lasting impacts of the carbon tax on particular industries are thus difficult to predict – an activity that today looks to be affected especially by the carbon tax might be transformed in the future by innovations fostered by it.

Implementation of a carbon tax will provide incentives for the development of new technologies that reduce carbon emissions or sequester carbon.

A similar thought process applies to the ultimate impact of the carbon tax on consumers. In the United States, coal-fired power plants are especially large contributors to carbon emissions. A carbon tax would be expected to increase the price of electricity generated by coal, but also provide an incentive for increased exploration and

production of fuels that are less carbon-intensive, such as natural gas. The carbon tax likewise would encourage utility companies that rely on coal to generate electricity to shift instead to natural gas. This increased demand in turn would be expected to lead to increased production of natural gas, eventually reducing prices through this supply response. The impact of a carbon tax would also lead to a shift toward clean energy, which would further result in increased use of energy-e f cient technologies such as solar panels, wind turbines, and smart meters. The ultimate impacts thus could involve smaller cost increments than would be expected by looking at the carbon tax alone. For this investment response to occur, it is especially important for the rules of the carbon scheme to be set and followed into the future.

Some energy companies have already responded to the likelihood that there will be future restrictions on carbon emissions by increasing their investment in exploration and production of low-carbon fuels such as natural gas or renewables such as solar and wind power. A carbon tax that provides a clear and long-lasting price signal would further this shift. Importantly, the carbon tax by itself provides the necessary incentive: Intrusive regulations that dictate to frms and industries the particular ways in which they are to reduce emissions would not be necessary, so long as the carbon price is su f ciently high. There would be no need to tell power companies which technology to use to abate emissions – the carbon tax would give them a clear fnancial incentive to fgure out how to do this. The same thought process applies broadly. Airline ticket prices would re f ect the impact of air travel on carbon emissions, thereby feeding back into the decisions of consumers and businesses contemplating travel. The government would not need to provide fnancial subsidies for commercially viable innovation – the tax on carbon would provide the requisite incentive. In this way, the carbon tax would allow for the dismantling of costly and ine f cient regulatory approaches to reducing carbon emissions.

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CHAPTER 5

U.S. Carbon Tax in a Global Economy

What can we learn from other countries employing carbon taxes or similar strategies?

Swagel:

The U.S. would not be the first country to levy a carbon tax. Many other countries and regions have instituted carbon taxes or other types of price signals on emissions, such as a cap-and-trade regime. The Canadian province of British Columbia has imposed a tax since 2008 on the carbon in fuel, and has used the revenue to reduce other taxes, especially corporate taxes. The carbon tax has risen over time from $5 (Canadian) in 2008 to $30 in 2013 and thereafter (equal to $22 US in late 2016), resulting in emission reductions even while the economy of British Columbia has grown faster than that of Canada as a whole. In 2016, Canada announced its intention to establish a nationwide carbon tax, with the federal government collecting the tax and returning the proceeds to the provinces.

The European Union (EU) put in place an emissions-trading scheme in 2005 that covers around half of EU carbon emissions by requiring large emitters such as power plants and factories to acquire permits. The experience of the EU effort illustrates the potential and pitfalls of a cap-and-trade approach to a price signal on carbon. In addition to allowances given to firms for their baseline emissions, such a large amount of additional carbon permits have been given away that the price of purchasing needed permits has been lower than expected, including zero at times. While putting the scheme into place might provide valuable lessons, the low price suggests that the cap on emissions is too loose.

Many other countries impose taxes on energy products with the aim of offsetting the social cost of carbon.

Many other countries impose taxes on energy products with the aim of offsetting the social cost of carbon. France, for example, introduced a tax in 2014 on gasoline, fuel oil, and coal – fuels not covered by the EU carbon scheme since electricity in France is generated with nuclear power. Denmark, Ireland, and Sweden similarly tax fuels not covered by the EU-wide trading scheme, while Norway (which is not an EU member) has its own emissions-trading scheme on electricity and a fuel tax based on carbon content. Mexico, Costa Rica, and Chile all either have or are set to impose carbon taxes.

China, the world's largest source of carbon emissions, announced in 2015 that it intended to put in place a nationwide system for pricing carbon in 2017 that will involve a cap-and-trade regime.

Would a carbon tax disadvantage the U.S. globally? How can this be dealt with?

Swagel:

Climate change is intrinsically a global problem, and a complete response to the challenge requires a global approach. Imposing a carbon tax in the United States but not in some other countries that are important U.S. trade partners has the potential to put American firms at a disadvantage since they would be affected by the tax regime but some of their global competitors would not. The impacts would be most significant in activities that are relatively carbon-intensive, such as energy products and production of items such as cement or aluminum that are either energy-intensive or have high emissions. A tax by itself in the United States might lead to changes in the global balance of industries, with carbon-intensive activities shifting to countries without a carbon price.

Fortunately, it is possible to mitigate these issues by applying a border adjustment to the carbon tax. A border-adjusted tax is imposed on imports from countries without a carbon price regime, and rebates the carbon tax to U.S. exports to such countries. A border adjustment would effectively level the playing field between U.S. and foreign competitors, ensuring that imports into the U.S. market face a carbon tax even if the source country does not have a carbon tax, and that U.S. exports are not disadvantaged.

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Theoretically, global coordination of carbon regimes would be useful. Broadening the coverage of the carbon regime would allow for greater efficiency in that a lower (and thus less distortionary) tax rate applied globally (to a large tax base) would be able to achieve the desired reduction of emissions. Coordination would further provide an incentive for countries outside the regime to join, particularly if a border adjustment is imposed by which imports from countries that do not impose a carbon tax are subject to the tax.

Viard:

Because climate change is a global problem caused by greenhouse gas emissions throughout the world, it would be best for a carbon tax to be imposed on an internationally coordinated basis. The unilateral adoption of a carbon tax by the United States would pose challenges, although not necessarily the ones emphasized in popular discussion.

A unilateral carbon tax would not undermine the overall trade competitiveness of the United States and would have little effect on the overall trade balance. To be sure, the carbon tax would make production in the United States more costly (unless it was accompanied by offsetting reductions in other taxes on domestic production), and those higher production costs would reduce exports and increase imports if there was no change in the international value of the dollar. However, the dollar would weaken against other currencies, which would boost exports and reduce imports, counteracting any change in overall competitiveness.

That conclusion reflects the fundamental conclusion of the economic theory of trade. Regardless of its overall level of production costs, a country is always competitive in the goods in which it has a comparative advantage.

Despite the carbon tax's lack of impact on the economy's overall competitiveness, it would have significant effects on the competitiveness of specific industries. The carbon tax would sharply increase production costs for industries with high-carbon production processes, but would have little effect on the costs of industries with low-carbon production processes. As discussed above, the dollar would weaken to the extent necessary to restore overall trade balance. That weakening would be too small to offset the initial loss of competitiveness for high-carbon industries and would be larger than needed to offset the initial loss of competitiveness for low-carbon industries. The combination of the carbon tax and the weaker dollar would impair the United States' comparative advantage in high-carbon industries and would strengthen its comparative advantage in low-carbon industries. Exports would fall and imports would rise for high-carbon goods; exports would rise and imports would fall for low-carbon goods.

This shift of comparative advantage and change in trade patterns would be desirable if greenhouse gases had the same geographical effects as conventional pollutants. Because those pollutants generally inflict their harms within national borders, the country's environment is protected by reducing domestic emissions. Although reducing the consumption of high-pollution goods is one way to reduce domestic emissions, importing high-pollution goods from abroad or curtailing the production of high-pollution goods for export may be cheaper ways to achieve that goal. A tax on domestic emissions causes firms and households to choose the cheapest ways to reduce domestic emissions, including export reductions and import increases.

Because greenhouse gas emissions abroad are as harmful to Americans as emissions at home, however, increasing imports and reducing exports of high-carbon goods does nothing to protect Americans from climate change. The reduced domestic emissions are merely replaced by foreign emissions, an outcome referred to as "leakage." Indeed, if foreign production processes are more carbon-intensive than production processes in the United States, shifting production abroad may even increase worldwide emissions.

Leakage under a unilateral carbon tax can be combatted by providing output subsidies to trade-sensitive industries in the form of rebates. For example, suppose that each widget produced in the United States causes one less widget to be produced abroad (due to a reduction in imports or an increase in exports) and that each widget produced abroad results in one ton of carbon dioxide being emitted. If the unilateral U.S. carbon tax is $4 per ton, U.S. widget firms should receive a rebate of $4 per widget produced. The carbon tax would still give the firms an incentive to minimize emissions in their production processes, but the rebate would negate any incentive to shift production abroad.

Of course, the most effective response to climate change would be an international agreement in which all countries impose a carbon tax equal to the global social cost of carbon, which would ensure coordinated action and remove the possibility of leakage.

Should a carbon tax be border-adjustable? If so, how?

Swagel:

Border-adjusted taxes would be a natural way to ensure that U.S. firms compete on a level playing field in the global economy once a carbon tax is in place in the United States. With border adjustment, the U.S. carbon tax would be collected on imports into the United States from countries without a carbon price scheme of their own, while U.S. exports to such countries would have their carbon tax rebated. All items sold within the United States would thus face a carbon tax – both imports and domestic production – and U.S.-produced items sold in countries without a carbon tax would not be disadvantaged by the U.S. carbon regime.

There is a trade-off involved in terms of the abatement of carbon emissions, since the border adjustment for exports means that the scope of the carbon price is reduced, thereby achieving less in terms of the incentive to move to a clean-energy economy than in the situation in which the carbon tax applies to exports. On the other hand, the border adjustment effectively imposes the U.S. tax on some of the production of countries without their own price on carbon. Without border adjustment, a carbon tax only in the United States could inadvertently increase global carbon emissions if production of carbon-intensive items shifted from the United States to other countries without a carbon tax, and especially if production techniques in these other locations resulted in greater carbon emissions. This possibility would be especially worrisome if the absence of a level playing field leads production to shift to locations in which electricity is generated through burning carbon-intensive fuels such as coal. The border adjustment is thus vital for avoiding or at least reducing such unintended distortions that might otherwise occur if U.S. firms face the carbon tax while those in others countries did not.

Border adjustments are routinely applied by countries with a value-added tax (VAT). Indeed, this border adjustment is why tourists can apply for a rebate of their VAT when leaving European countries – the goods they purchase and take back home are exports for which the VAT is rebated.

It would be relatively straightforward to implement a border-adjusted carbon tax on fuels and other items for which the carbon content can be readily calculated and the appropriate carbon tax imposed. Importantly, the border adjustment for fuels would mean that the same tax is imposed on domestic products and on imports. This treatment is required under U.S. trade obligations to ensure that the U.S. tax system treats products sold by other countries equally with domestic items.

Complications arise in implementing a border adjustment for the carbon tax imposed on products in which carbon emissions are involved in production but vary considerably across countries or even between production facilities within a country. As an example, the aluminum produced in one plant in the United States will have a different amount of carbon associated with it than the aluminum produced in a different U.S. facility – the variation in carbon content would reflect both differences in production techniques across plants and variations in carbon emissions involved with the generation of electricity in different parts of the country (some utilities might burn coal, while others use natural gas, a fuel with less carbon emissions).

Taking into account foreign products adds a further dimension of complexity. It would be an immense administrative burden to calculate the carbon emissions associated with all products imported into the United States. The aluminum produced in one smelter in China might involve considerably different carbon emissions than the aluminum from another Chinese smelter – let alone comparing against aluminum from yet another country. Moreover, U.S. trade obligations require that any such border adjustments apply equally across U.S. products and imports rather than varying for individual items based on location and production characteristics. That is, a tax on Chinese aluminum must apply equally to U.S.-made aluminum. A way to satisfy this requirement would be to calculate a single carbon tax for each item traded internationally and apply that amount to both U.S. and foreign items. In this example, all aluminum would

have a certain carbon tax applied, whether domestic or imported. This would provide only an approximation in terms of ensuring a level playing field, since the carbon tax will be too high for some products that are relatively clean and too low for others that involve relatively more carbon emissions. Even so, this sort of rough justice ensures that the carbon tax applies evenly to traded items, and in a way that reduces the possible competitive disadvantage that would otherwise result if U.S. firms paid a carbon tax but their foreign competitors did not.

Implementing a border adjustment will require many such administrative decisions, as well as negotiations with U.S. trade partners to ensure that the tax is allowed under international trade agreements. But such a mechanism could go far in reducing potential disadvantages in the global marketplace for U.S. industries that would otherwise be most affected by the carbon tax.

Would a border adjustment for a U.S. carbon tax make it more likely for other countries to follow suit?

Swagel:

A further advantage of a border-adjusted carbon tax is that the United States would in effect collect and keep revenue from a carbon tax that other countries would have received if they had their own regime. Consider the case of exports from China to the United States. With a border adjustment, if China does not have a carbon pricing regime and the United States does, then Chinese products sold in the United States would still face a carbon tax, but in this case it would be the U.S. carbon tax, and the United States would collect the revenue. If China had its own carbon tax, it instead would collect the revenue. The border adjustment in effect provides an incentive for countries to institute their own carbon tax to avoid losing some revenue. The incentive is only partial, of course, since countries would have to impose carbon taxes on both their exports and their domestic consumption. In the example above, China would not be allowed under international trade rules to collect a carbon tax on exports alone. A country in which the

domestic market is considerably larger than exports might thus still forgo the revenue from the carbon tax rather than imposing its own.

Would a carbon tax help make America more energy independent?

Mathur:

In the long run, if we are able to shift away from traditional fossil fuels, reduce our demand for oil and coal, and depend more on renewable energy both in production and consumption, we will achieve some level of self-reliance to the extent that our demand for energy can be supplied from within the country. In 2005, the United States was importing 60 percent of its oil. Today, as a result of the increase in shale gas and oil production, as well as a decline in consumption, imports have declined to 24 percent, according to the Energy Information Administration (2016). Energy independence would require a more aggressive decline in imports and consumption than we have been witnessing, and a carbon tax could push us in that direction by causing a switch toward cleaner fuels.

However, we will still not be completely protected from what is happening in global energy markets since the price of energy is ultimately determined in these markets. What that will mean is that as resources get depleted and the price of oil goes up, the less we rely on it, the better of we are. A carbon tax can get us there by helping businesses and individuals to reduce their consumption and production of items that rely heavily on coal and oil, and instead invest in clean-energy sources.

Energy independence would require a more aggressive decline in imports and consumption than we have been witnessing, and a carbon tax could push us in that direction by causing a switch toward cleaner fuels.

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