Carbon "Tax Swap" Deals: A Review and Critique

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Executive Summary

A growing number of academics and policymakers have recommended a revenue-neutral carbon "tax swap" deal, under which the revenues from a new carbon tax would be used to reduce pre-existing taxes, dollar for dollar. Conservative proponents argue that such a proposal would not only mitigate potential environmental damage down the road, but would provide immediate relief to Americans by reducing the inefficiency of the tax code. By "taxing bads not goods," these conservatives believe, a revenue-neutral carbon tax swap would lead to more economic growth immediately, and would reduce future climate change damages as a bonus. Unfortunately, there are many problems with this conservative claim, including both technical and pragmatic flaws in the position.

Technical Flaws

Even taking the standard textbook framework of the economics of climate change on its own terms, there are four technical problems with the conservative case for a revenue-neutral carbon tax swap:

➔ The best literature on the topic actually argues that a revenue-neutral carbon tax swap would make the tax code *more* inefficient and would *hinder* (conventional) economic growth, because a carbon tax has a narrower base than a conventional income tax. Indeed, some empirical estimates suggest that this "tax interaction effect" is so powerful that, even if carbon emissions caused $50/ton in environmental damages, *the "optimal" carbon tax would be $0* if the revenues were distributed lump-sum back to citizens, and would be only $27/ton *even if the carbon tax revenues were used dollar-for-dollar to reduce other taxes*. This is an initially surprising result, but it is standard in the environmental economics literature and shows that the intuition behind a carbon "tax swap" deal may have things backwards. A carbon tax will likely distort economic behavior more than an income tax raising the same amount of revenue, meaning that even on purely technical grounds a carbon "tax swap" deal is *less* desirable than the standard textbook treatment would suggest.

➔ The "social cost of carbon" is not the proper benchmark to use when calibrating a carbon tax implemented unilaterally by the U.S. government because of the problem of "leakage." That term denotes the probability that carbon-emitting activities in a regulated jurisdiction will be relocated to another, less-regulated jurisdiction. It is incorrect to count a ton of reduced U.S. emissions as providing benefits equal to the "social cost of carbon," if the policy that causes this reduction in U.S. emissions goes hand-in-hand with *increased* emissions elsewhere (such as China). William Nordhaus's respected computer model estimated (in 2007) that if only half of the world's governments implement the "optimal

carbon tax," then the economic cost of achieving a desired environmental objective will increase by 250 percent.

➔ Federal and state governments already have in place many policies that discourage carbon-intensive activities and encourage alternatives. Some of these policies are: gasoline taxes, CAFE standards, special tax advantages and loan guarantees to promote renewable energy use, ethanol mandates, and renewable portfolio standards. Because these government policies already discourage carbon emissions, a new carbon tax should be smaller than proponents typically suggest.

➔ The fourth and final technical objection is that an overly aggressive carbon tax can be a cure worse than the disease. For example, in the 2007 runs of William Nordhaus's "DICE" (Dynamic Integrated Climate-Economy) model, he estimated that a theoretically perfect carbon tax, implemented by all governments around the world and for many decades into the future, would provide net benefits of $3 trillion. In contrast, Nordhaus estimated that had world leaders heeded the recommendations of the famous 2007 Stern Review by implementing a much steeper carbon tax, then the world would be $14 trillion poorer *compared to the baseline case under which governments did nothing to halt climate change*.

Practical Flaws

In addition to the above technical objections, there are four *practical* objections, showing that it is dangerous to rely on the academic framework used by the advocates of a carbon tax:

➔ The promises of "revenue neutrality" are quite hollow, given U.S. history. The best historical precedent is the introduction of the federal income tax in 1913, which was supposed to promote tax efficiency and help poorer Americans by replacing the tariff structure. Yet just five years after implementation, the top income tax rate had gone from 7 percent in 1913 to 77 percent in 1918. Furthermore, the Smoot-Hawley Act in 1930 jacked up tariff rates so significantly that many economists cite it as a major explanation for the severity of the Great Depression. Conservatives who advocate a carbon tax swap in order to reduce the onerous income tax should realize that, originally, *the federal income tax* was supposed to be the relief granted to American taxpayers! Currently, many organizations and specific political proposals tout the benefits of a carbon tax in "reducing the deficit," meaning that its revenues would *not* be fully devoted to providing tax relief.

➔ The regressive nature of a carbon tax will make it very difficult politically to dedicate its revenues to income or other tax reductions. Conservative proponents of a revenue-neutral

"tax swap" deal must realize that they are asking to make the U.S. federal tax code far more regressive—tax rates on wealthy individuals would go down, while electricity and gasoline prices would go up for poor households. The actual history of carbon taxes—including the situation unfolding currently in Australia with its carbon tax—shows that compensatory schemes for the poor are common, meaning that in practice the alleged "efficiency gains" from reforming the tax code may not exist at all.

➔ Any deal using a new carbon tax to offset existing payroll taxes would surely break down quickly, because the two taxes have specific and incompatible purposes. The textbook theory of a carbon tax argues that it should reflect the social cost of carbon, rising steadily over time with atmospheric concentrations of greenhouse gases. In contrast, to fulfill its official purpose, the payroll tax should reflect the changing demographics of Social Security and other social insurance programs. Whatever relationship initially existed between the new carbon tax and the correspondingly reduced payroll tax would soon break down as these underlying factors evolved.

➔ The federal government has ignored the recommendations of academic economists in the design and implementation of most of its other environmental policies. There is little reason to take federal policymakers at their word if they promise to implement a new carbon tax in a way that promotes economic efficiency.

In light of these technical and practical objections, it is clear that the case for a carbon "tax swap" deal is very weak indeed. Conservatives, who normally have a healthy distrust of new initiatives and tax schemes, should be very wary of any such proposal.

I. Introduction

The 2007 Nobel Peace Prize awarded to Al Gore and the Intergovernmental Panel on Climate Change (IPCC) underscored the public's growing awareness of and concern over anthropogenic (man-made) global warming. Many climatologists and other relevant scientists claim that unchecked emissions of greenhouse gases (GHGs) from human activity will lead to significantly rising temperatures, which in turn will spell potentially catastrophic hardship for future generations (IPCC 2007). If this is true, then the economist will recognize what Nicholas Stern, formerly chief economist of the World Bank, described in his famous report to the British government as "the greatest example of market failure we have ever seen" (Stern 2007, p. 1).

With the physical science of global warming so stipulated, the standard reaction of most economists is to recommend a government policy to internalize the externality. The debate has revolved largely around the best mechanism (e.g., "cap-and-trade" versus a carbon tax)

and the appropriate magnitude of the corrective penalty on carbon emissions. Just as Al Gore is associated with "left-wing," "liberal," and "progressive" politics, it has for many years been interventionist economists (e.g., Nordhaus 2008) leading the charge on carbon legislation. Such economists see "market failure" in many guises, and so it was not surprising that they would conclude that the federal government had an important role to play in regulating greenhouse gas emissions.[1]

However, in recent years, more and more self-described conservatives, who generally embrace the free market and are suspicious of taxation and government regulation of business, have come out in favor of a carbon tax, *so long as its revenues are used to reduce pre-existing tax burdens*. Often this "carbon tax swap" is motivated as a way to reduce, dollar-for-dollar, the payroll tax. The newly formed Energy and Enterprise Initiative (E&EI), based at George Mason University (which has a strong contingent of recognized champions of the free market in its economic department), "is a campaign to unleash the power of free enterprise to deliver the fuels of the future."[2] E&EI views its role as *reducing* government intervention in the energy sector, by eliminating subsidies for all energy sources and by attaching "all costs to all fuels." What this means in practice is a government policy (such as a carbon tax) that would cause firms and households to correctly "internalize the externalities" of their carbon emissions.

Some of today's conservatives, such as George Shultz (Golden and Shwartz 2012), support a carbon tax swap because of national security concerns and because they endorse the serious warnings of many climatologists. Others—most notably the famous supply-side economist Arthur Laffer (Wolf 2012)—remain officially agnostic on the dangers inherent in anthropogenic global warming, and instead stress the opportunity to reform the existing disincentives in the tax code. A popular motto among the proponents of a carbon tax swap is: "Tax bads, not goods."

Perhaps the most succinct summary of the conservative case for a carbon tax is the 2008 op-ed in the *New York Times* written by Laffer and South Carolina Republican congressman Bob Inglis. They wrote:

[1] It is typical in this literature to use the shorthand "carbon emissions" for the more accurate "greenhouse gas emissions." Even a so-called "carbon tax" often refers in reality to a tax on greenhouse gas emissions, based on their carbon equivalent (in terms of impact on climate change). But for the sake of brevity and continuity with quoted sources, this paper will generally use the more common term "carbon emissions" rather than "greenhouse gas emissions."

[2] See http://energyandenterprise.com/about/. Another list of conservatives in support of a carbon tax—including the American Enterprise Institute's Kevin Hassett—is available at: http://www.carbontax.org/who-supports/conservatives/.

> Conservatives don't support tax increases that are veiled as "cap and trade" schemes for pollution permits. But offer us a tax swap, and we could become the new [Obama] administration's best allies on climate change.
>
> A climate-change bill withered in Congress this summer [in 2008] because families don't need an enormous, and hidden, tax increase. If the bill's authors had instead proposed a simple carbon tax coupled with an equal, offsetting reduction in income taxes or payroll taxes, a dynamic new energy security policy could have taken root.
>
> . . . As long as national security risks aren't factored into the cost of gasoline and as long as carbon dioxide can be emitted without penalty, oil will continue to have an advantage over emerging fuels in the marketplace, and we'll continue our ruinous addiction to it.
>
> We need to impose a tax on the thing we want less of (carbon dioxide) and reduce taxes on the things we want more of (income and jobs). A carbon tax would attach the national security and environmental costs to carbon-based fuels like oil, causing the market to recognize the price of these negative externalities. . . .
>
> Conservatives do not have to agree that humans are causing climate change to recognize a sensible energy solution. All we need to assume is that burning less fossil fuels would be a good thing. . . .
>
> Yet the costs of reducing carbon emissions are not trivial. . . . It is essential, therefore, that any taxes on carbon emissions be accompanied by equal, pro-growth tax cuts. A carbon tax that isn't accompanied by a reduction in other taxes is a non-starter. Fiscal conservatives would gladly trade a carbon tax for a reduction in payroll or income taxes, but we can't go along with an overall tax increase. (Inglis and Laffer 2008)

In the present paper, we will critique the case for a carbon tax swap, using arguments that should resonate with self-described political conservatives. Some of our objections will be theoretical, working within the standard negative-externality framework, to show that even on its own technical terms, the textbook case for a carbon tax may be significantly overstated. We will also raise practical objections, challenging the basic premises of the carbon "tax swap" proposal, to show that there are significant dangers of "government policy failure" that could dwarf the "market failure" of GHG emissions. We will conclude that conservative proponents of the free market, of all analysts, should be wary indeed of any plan to introduce a new carbon tax in the name of promoting economic growth.

II. Theoretical Problems with a Carbon Tax, Even with Revenue-Neutrality

In this section, we will explore *theoretical* problems with the typical arguments for a carbon tax, even if those arguments are presented in the context of a revenue-neutral tax swap. In other words, in this section, we will concede the general framework of the pro–carbon-tax literature for the sake of argument and show that, *even on its own terms*, the case for a carbon tax is much weaker than its proponents lead the public to believe. (In Section III we will list *practical* problems of implementation, showing that the general framework underlying the carbon tax swap proposals is in fact quite naïve and will very likely yield the opposite results from what its proponents predict.)

A. A Carbon Tax Applies to Business *Inputs* and Will Likely Cause More (Gross) Inefficiency Than Generic Taxes on Labor or Capital

The first, and most serious, theoretical problem with the entire carbon "tax swap" mindset is that *a carbon tax may cause significantly more economic distortions than a generic tax on labor or capital*. This is a crucial point to make, because some proponents of a carbon tax swap—distinguished economist Arthur Laffer being the most notable example—officially remain agnostic about the level of *environmental damages* from carbon emissions. These proponents of a carbon tax swap lead the public to believe that the harm to the conventional economy from a carbon tax would be no worse (and arguably lower) than the harms coming from existing taxes on income derived from labor, dividends and interest, or capital gains. In this train of argument, the claim (perhaps only implicit) is that the harm to the economy is what it is, but at least a carbon tax will reduce something that is undesirable, while labor and capital taxes reduce things that we want. In the catchy slogan of the pro-carbon-tax community: "Tax bads, not goods."

Indeed, a recent MIT study (Rausch and Reilly 2012) explicitly makes the case that a carbon tax—so long as it were offset by reductions in other taxes—would bestow net economic benefits *even if we ignore* the impact the new carbon tax would have on carbon emissions. In other words, the MIT study claims that increasing taxes on carbon while reducing taxes on labor and/or capital would directly help the conventional economy, *and as a bonus* the future damages from climate change would be lower, because the carbon tax would also mitigate emissions (relative to the business-as-usual trajectory).

This aspect of the MIT study is evident from its very subtitle, which suggests that a carbon tax is a "win-win-win" solution: The authors are claiming that the carbon "tax swap" deal is

good for mitigating climate change, can reduce oil imports, *and* (to make conservatives happy) can render the tax code more efficient and thus promote general economic growth. In other words, they are arguing that even if we completely ignored climate change, such a deal would actually help the conventional economy by implementing a revenue-neutral carbon tax. Here is how Rausch and Reilly themselves describe their results in their concluding summary:

> [W]e find that [the] combination of a carbon tax with general tax cuts improves overall economic performance. **As a result we get other benefits of the carbon tax, reduced emissions and lower oil imports, at no cost.** This surprisingly positive result comes through the tax interaction effect that has been widely studied. By avoiding increases in general income taxes we avoid their drag on the economy, and the avoided drag is actually greater than the direct cost of the carbon tax. The economy thus benefits. (Rausch and Reilly 2012, p. 16, emphasis added)

We have stressed the position of Rausch and Reilly simply because they have made the case explicitly and in a formal paper; others in the pro–carbon-tax-swap community have made similar claims. The irony in all of this is that the "tax interaction effect that has been widely studied"—and which Rausch and Reilly specifically cite on page 2 of their own paper—is generally thought by economists in this area to have the exactly *opposite* impact of what Rausch and Reilly report.

1. The "Tax Interaction Effect"

The pioneers in this literature are Bovenberg and Goulder (1996); this is the paper that the MIT study itself cites when discussing the "tax interaction effect." The irony here is that Bovenberg and Goulder's work actually argued that carbon taxes are *more* harmful to the economy than other taxes. Intuitively, that is obvious when one thinks about it: A standard result in tax analysis is that the *narrower* the tax base, the more distortionary it is for the government to raise a given amount of revenue.

For example, suppose the government wants to raise $10 billion in extra revenue. If it slightly raised the marginal tax rate on personal income in each tax bracket, and for all taxpayers, there would be an increase in what economists call the "deadweight loss" of the IRS code. At the higher marginal rates, every individual in the United States would find it slightly less advantageous to earn income on the margin, and so would have an incentive to reduce earnings and enjoy more leisure. In the aggregate, workers would probably put in fewer total hours, small business owners might start fewer projects, and so forth.

However, suppose instead that the IRS decided to raise the desired $10 billion by raising the marginal tax rate on all brackets *but only for those taxpayers whose Social Security number ended in a "7."* This would mean that the tax base had suddenly been cut by 90 percent, and to wring the desired $10 billion in extra revenue out of the economy, the increase in marginal tax rates on this subgroup of Americans would have to be higher than in the previous scenario. Consequently, the distortions to the economy would be more severe. We would probably see a much larger drop in aggregate work hours, small business start-ups, and so forth. Notice too that *because* the unlucky target group of Americans (those whose Social Security numbers ended in "7") would respond more strongly to the higher marginal tax hikes by cutting back their work hours and other taxable activities, the marginal tax increases themselves would need to be even larger, in order to make sure they still extract the desired $10 billion in new revenue. Thus, shrinking the applicable tax base leads to a harmful feedback effect in which the marginal tax rate must be hiked even higher to compensate for the reduction in economic activity to which it applies.

The above fable illustrates the basic truth that raising an extra $10 billion by a heavy tax imposed on a small group of taxpayers is *more distortionary* than raising $10 billion by a lighter tax applied to a large group of taxpayers. This central insight is the foundation for "flat tax" proposals, in which removing loopholes while lowering marginal rates is supposed to maintain the same revenue to the government while spurring economic growth. The idea is to "broaden the base" to which a given tax is applied, so that its marginal rate can be made as low as possible. The lower the marginal tax rate, the less the tax will distort decisions that individuals and businesses make on the margin, and thus the less the tax code will distort the economy's allocation of resources.

Now, returning to Bovenberg and Goulder, they pointed out that a carbon tax clearly has a *smaller tax base* than more generic taxes on labor or capital. Thus, considering just the impact on the conventional economy, raising a target amount of revenue from a carbon tax is *more distortionary* than raising the same amount of revenue from other taxes currently in the U.S. tax code.

Bovenberg and Goulder went further and showed that the distortions coming from *pre-existing* taxes (such as the personal income tax or payroll tax) could be *amplified* by imposing a new carbon tax, even if the revenues from the carbon tax were used to reduce dollar-for-dollar the rates of the other, pre-existing taxes. This is the "tax interaction effect."

The specific mechanism through which the tax interaction effect can occur is somewhat technical; in the Appendix to this study, we have given more of its details. But, intuitively, Bovenberg and Goulder showed that a new carbon tax can effectively make business inputs more expensive, and so the economic distortions caused by the pre-existing labor and capital taxes become amplified. This leads to the very counterintuitive result that the prior

existence of distortionary taxes *weakens the case* for imposing a revenue-neutral carbon tax.

This is such a startling result that it is worth repeating in different words: Conservative proponents of a revenue-neutral carbon tax swap seem to believe that the *more onerous* the U.S. tax code currently is, the *more helpful* it would be to implement a carbon tax swap. Yet Bovenberg and Goulder's work—the very work cited in the MIT paper discussed above—showed that the opposite is likely the case. In other words, Bovenberg and Goulder showed that the *more* onerous conservatives think the U.S. tax code currently is, the *less* appealing they should find a carbon "tax swap" deal, even if it is revenue neutral. This is because the resulting tax code—with a new carbon tax operating in conjunction with other taxes, albeit at lower marginal rates—will be less efficient than the status quo. Therefore, the revenue-neutral carbon tax will make the economy *less* efficient.

To be clear, Bovenberg and Goulder's work on the tax interaction effect does not by itself *eliminate* the case for a carbon tax. Rather, they simply showed that the prior existence of distortionary taxes likely *weakens* the case for a carbon tax, even if its revenues are used to offset those previously existing taxes. What this means is that conservatives should think carefully before claiming that a carbon "tax swap" deal will "help the economy" and, as a bonus, help the environment. If Bovenberg and Goulder are right, even a revenue-neutral carbon tax will *hurt* the economy (conventionally defined), but could still be justified because of future environmental benefits.

2. Numerical Estimates of the Tax Interaction Effect for U.S. Environmental Taxes

In the previous subsection we laid out the theoretical case for an injurious "tax interaction effect." Here we will provide estimates of *the size* of this effect. In Table 1 below, we reproduce Bovenberg and Goulder's (1994) numerical simulation of the U.S. economy and its tax code, as it stood in the early 1990s. They found that the magnitude of the tax interaction effect is quite severe, leading to much lower "optimal" environmental taxes than the textbook analysis would recommend.

Table 1. Textbook Carbon Tax versus Optimal Carbon Tax, in Presence of Tax Code Distortions ($/ton)

Assumed Marginal Environmental Damages From Carbon Emissions ($/ton)	"Optimal" Textbook Carbon Tax (Ignoring Other Taxes)	Optimal Carbon Tax from Numerical Model, Taking Account of Interactions With Existing U.S. Tax Code (circa early 1990s)	
		Carbon Tax Receipts Distributed Lump-Sum to Citizens	Carbon Tax Receipts Reduce Personal Income Tax
$25	$25	$0	$7
$50	$50	$0	$27
$75	$75	$13	$48
$100	$100	$31	$68

Source: Adapted from Table 2 (appendix) from Bovenberg and Goulder (1994).

The results reported in Table 1 are quite severe, and should give serious pause to those calling for a revenue-neutral carbon tax swap. Because of pre-existing distortions in the U.S. tax code, Bovenberg and Goulder—in the very paper cited by the 2012 MIT study, recall—estimated that if the proceeds from a carbon tax were simply distributed as lump-sum rebate checks to American citizens, then even a $50 "social cost" per ton of carbon emissions would translate into an optimal carbon tax of . . . *zero*. This is because the harm to the economy from the new carbon tax—harm that would be exacerbated by the pre-existing distortions in the tax code—would outweigh the benefits of reduced environmental damages (from carbon emissions). To repeat, Bovenberg and Goulder estimated that instead of the textbook recommendation of a $50 per ton tax on carbon emissions, the tax interaction effect would yield an actual ideal carbon tax of $0 per ton, in the scenario where carbon tax revenues are returned to citizens in the form of lump-sum rebate checks.[3]

[3] Note that the problems of a carbon-tax-with-lump-sum-refunds would also apply to cap-and-trade schemes that send lump-sum dividends to citizens (as opposed to using the auction revenues in order to reduce marginal tax rates).

Now, the intuition of the pro–tax-swap crowd is correct, insofar as it goes. The gross costs of a carbon tax *can* be reduced, if its proceeds are not distributed back to the citizens (or spent by the government), but instead are used to reduce other, distortionary taxes. We see that this intuition is correct by the last column in Table 1. When carbon tax receipts are used to reduce the personal income tax dollar-for-dollar, Bovenberg and Goulder found, it makes sense to levy higher carbon taxes compared to the lump-sum rebate scenario. To continue with our example of a social cost of carbon of $50/ton, we see in Table 1 that the ideal carbon tax is $27. It is greater than $0, to be sure, but it is also a mere 54 percent of the textbook recommendation of a carbon tax of $50/ton. In other words, once we take into account the complex interaction of a new carbon tax with pre-existing (and distortionary) taxes, the optimal carbon tax—even in the best possible case, where all of its receipts are used to offset those other taxes—might fall *by half*.

3. Summary of the Tax Interaction Effect

Contrary to the claims (either implicit or, sometimes, even explicit) of the proponents of a revenue-neutral carbon tax swap, a carbon tax is likely *more distortionary* than a generic tax on labor or capital. A carbon tax is effectively a tax on *certain forms* of energy, and is therefore a tax on a *smaller but sizable fraction* of inputs in virtually all production processes. A new carbon tax, even if its revenues were used to perfectly offset existing taxes on labor, would likely introduce more distortions. This effect is stronger, the greater the original distortions in the tax code.

These considerations do not, by themselves, eliminate the case for a carbon tax. However, they show that the case for a carbon tax is made *weaker* by the distortionary taxes currently levied against labor and capital, not stronger. Proponents for a carbon "tax swap" deal often claim the opposite, but the bulk of the literature comes down against them.

Ultimately the relevance of the tax interaction effect is an empirical matter. Some studies claim that there is indeed a "double dividend," meaning that carbon taxes actually help the economy, even putting aside any environmental benefits. However, intuitively a tax on only certain forms of energy would seem to be more distortionary than a tax on all labor, and indeed most numerical models find that a carbon tax does impose more economic damages per dollar in revenue, compared to other, more traditional taxes. To take an early example in the literature, Bovenberg and Goulder (1994) estimated that even in the presence of a social cost of carbon of $50/ton, the distortions in the U.S. tax code imply a true optimal carbon tax of only $27/ton, virtually cutting in half even the theoretical case for a carbon tax.

B. Estimates of the "Social Cost of Carbon" Do Not Model the Situation the U.S. Government Actually Faces

In Section A above, we took estimates of the "social cost of carbon" (SCC) at face value, and showed that once we account for pre-existing distortions in the U.S. tax code, the optimal "second-best" level of a carbon tax could be significantly lower than the SCC.

In this section, we make a distinct but related point: *Estimates of the SCC in the climate change literature do NOT correctly model the situation that the U.S. government actually faces*. Consequently, it is *incorrect even on theoretical grounds* for the U.S. government to levy a carbon tax equal to the latest, best guess of the SCC. To reiterate, this incorrect use of the SCC is a completely distinct argument from the argument concerning second-best tax interaction described in Section A, and constitutes an independent problem with the typical case for a carbon tax.

1. The Social Cost of Carbon and the Problem of "Leakage"

The argument in this section of the paper revolves around the problem of *leakage*, which refers to the migration of carbon emissions from a more-regulated jurisdiction into an area with weaker regulation. We can motivate our discussion by quoting from the (pro–carbon-tax) discussion found in a July 4, 2012, *New York Times* op-ed by environmental economist Yoram Bauman and law professor Shi-Ling Hsu. They wrote:

> On Sunday, the best climate policy in the world got even better: British Columbia's carbon tax — a tax on the carbon content of all fossil fuels burned in the province — increased from $25 to $30 per metric ton of carbon dioxide, making it more expensive to pollute.
>
> This was good news not only for the environment but for nearly everyone who pays taxes in British Columbia, because the carbon tax is used to reduce taxes for individuals and businesses. . . .
>
> The only bad news is that this is the last increase scheduled in British Columbia. In our view, the reason is simple: the province is waiting for the rest of North America to catch up so that its tax system will not become unbalanced or put energy-intensive industries at a competitive disadvantage.
>
> . . . . Substituting a carbon tax for some of our current taxes — on payroll, on investment, on businesses and on workers — is a no-brainer. Why tax good things when you can tax bad things, like emissions? The idea has support from economists across the political spectrum, from Arthur B. Laffer and N.

> Gregory Mankiw on the right to Peter Orszag and Joseph E. Stiglitz on the left. That's because economists know that a carbon tax swap can reduce the economic drag created by our current tax system and increase long-run growth by nudging the economy away from consumption and borrowing and toward saving and investment.
>
> Of course, carbon taxes also lower carbon emissions. Economic theory suggests that putting a price on pollution reduces emissions more affordably and more effectively than any other measure. . . . British Columbia's carbon tax is only four years old, but preliminary data show that greenhouse gas emissions are down 4.5 percent even as population and gross domestic product have been growing. Sales of motor gasoline have fallen by 2 percent since 2007, compared with a 5 percent increase for Canada as a whole. . . .
>
> A carbon tax makes sense whether you are a Republican or a Democrat, a climate change skeptic or a believer, a conservative or a conservationist (or both). We can move past the partisan fireworks over global warming by turning British Columbia's carbon tax into a made-in-America solution. (Bauman and Hsu 2012)

The Bauman and Hsu piece contains a few problems. For example, when they claim that British Columbia's carbon tax is "good news . . . for nearly everyone who pays taxes in British Columbia," they are simply assuming away all of the problems discussed in Section A above. In other words, BC's carbon tax is more likely *bad news* for the taxpayers in the province, because (as we have already seen) a carbon tax is probably far more destructive economically than other taxes that raise the same total revenue.

By the same token, when Bauman and Hsu conclude that a "carbon tax makes sense whether you are . . . a climate change skeptic or a believer," again they are on shaky ground. To repeat, the best evidence suggests that a carbon tax is *more harmful* to the economy than other types of taxes. Therefore, to justify the imposition of a new carbon tax—even if its revenues are used to reduce other types of taxes, dollar for dollar—there must be some auxiliary benefit in terms of avoided future climate change damages. Therefore, if someone is a climate change skeptic, then he or she should *not* think that a carbon tax "makes sense."

But let us put these objections aside and focus on the opening of the Bauman/Hsu op-ed, where they claim that British Columbia's "best climate policy in the world got even better," because of increasing its carbon tax from $25 to $30 per metric ton of emissions. Although they do not spell it out in their article, presumably Bauman and Hsu think that the actual

social cost of carbon is *at least* $30 per metric ton.[4] In this case, Bauman and Hsu could understandably believe that British Columbia's carbon tax hike is causing everyone within the BC jurisdiction to operate closer to the economically optimum behavior.

Unfortunately, this analysis is wrong and relies on a faulty application of the standard environmental welfare analysis. The definition of the social cost of carbon (SCC) is that it is the present discounted value (PDV) of the future damages that will result from one additional unit of carbon emissions.[5] Yet this definition implicitly assumes that there is a fixed baseline of carbon emissions, against which to compare a marginal increase. In other words, considerations of the marginal impact of one more unit of carbon emissions only makes sense *if we hold everyone else's emission behavior constant.*

The underlined clause is crucial if we wish to tailor government policy responses to the textbook analysis. Because of the phenomenon of leakage, *it is not true* that a small government should impose a carbon tax equal to the worldwide SCC as defined above. This is not because there are "limits" to the textbook analysis, but rather that economists such as Bauman are *misapplying* the framework when they overlook this complication.

To put it simply: Even if the SCC, as defined above, were (say) $50/ton, it does not follow that the optimal response *by the government of British Columbia acting on the margin* is to impose a carbon tax of $50/ton. This is because *the rest of the world's carbon emissions will increase* in response to a unilateral change in policy from the government of British Columbia, as people (on net) move out of British Columbia and (especially) as economic activity is re-located to lower-tax jurisdictions. Therefore, on the margin the *benefits* of a unilateral British Columbia carbon tax (measured in terms of reduced worldwide carbon emissions and therefore reduced worldwide future damages from climate change) will be *much lower* than a naïve reliance on the standard SCC would indicate. Because the marginal benefits of its unilateral carbon tax are much lower than the SCC reported in the literature, the optimal carbon tax—the one that equates marginal social benefits with marginal social costs—should be much lower than the SCC, as well.

[4] When looking at actual estimates of the social cost of carbon (and associated carbon taxes), it is important to keep the units in mind. Some writers and policy proposals quote the social cost of carbon in dollars per (metric) ton of *carbon dioxide*, whereas others quote it in dollars per ton of carbon. The former calculation will give a lower figure, because (intuitively) a ton of CO_2 is diluting the carbon it contains with the presence of oxygen.

[5] To take just one example, the 2010 White House Technical Support Document to Executive Order 12866 states, "The 'social cost of carbon' (SCC) is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year" (p. 2). Although this definition does not directly use the phrase "present discounted value," its table of estimates of the SCC contains columns indicating various discount rates, with the corresponding SCC going up when the discount rate is reduced. It is thus clear that the SCC involves taking the present value of future damages (discounted at various possible rates).

2. An Extreme Illustration of the Problem of Leakage As It Relates to Optimal Carbon Taxes

An extreme illustration will help to clarify the argument of this section. Rather than looking at the entire Canadian province of British Columbia, suppose instead that we consider just *one town* in British Columbia, with a population of (say) 10,000 people. Convinced of the urgency of the climate change problem, the government of this town imposes a carbon tax of $1,000/ton and enforces it with draconian severity. What would be the consequences?

It is obvious that in this extreme scenario, virtually all businesses and individuals would within a few years have *left* the small town in question, and moved to other jurisdictions with lower (or even non-existent) carbon taxes. Total global emissions of greenhouse gases may have been lower for a few years during the transition process, but the atmospheric concentration of CO_2 in (say) the year 2050 would be virtually identical to the concentration it *would have been* in the absence of the draconian carbon tax. To be clear, the reason for this result is *not* that 10,000 people cannot do much in the grand scheme of things. Rather, we are saying *these 10,000 people will ultimately emit almost as much carbon anyway* once they leave the jurisdiction.

In fact, much of the "leakage" of carbon emissions from our hypothetical town would be almost immediate. The day the new $1,000 carbon tax went into effect, virtually all businesses in our hypothetical town would shut down; it would be impossible for them to stay profitable in the face of such an onerous tax. Thus, the competitors of these businesses would have more market share to exploit, and they would expand their operations accordingly. The only real drop in global economic activity would be that attributed to the few people still living in the town itself, who would have seen a sharp and catastrophic plunge in their living standards. Thus, the draconian carbon tax would not actually reduce carbon emissions very much on the margin, and so the actual social benefits of the new tax (levied only in the jurisdiction of a single town) would be far lower than a naïve application of the textbook framework would at first suggest.

3. Leakage Underscores Two Separate Externalities Due to Carbon Emissions, One Negative But One Positive

To repeat, the phenomenon of leakage does not overturn the textbook framework for handling climate change but instead *complicates* the analysis. What analysts often overlook is that a typical act of carbon emission actually contains *two* externalities—one negative, the other positive—that are relevant in a discussion of climate change.

For example, consider the operator of an oil well. When he brings one more barrel of crude to the surface and sells it, the standard environmental economist will run the numbers to assess the increment in total social costs (reckoned in discounted present value terms) from the release of the carbon content of one additional barrel of oil. This is the negative externality associated with pumping and selling one additional barrel of crude oil, and it is what everyone in the field associates with the SCC and the implied optimal tax.

Yet in reality, there is a *second* effect flowing from our operator's activity, and this is actually a *positive* externality. By pumping and selling one additional barrel of crude, the operator of the oil well has *slightly lowered worldwide crude oil prices*. This provides a *disincentive* for other oil producers to pump and sell barrels of crude today, and in that respect *reduces* total carbon emissions from the rest of the world. When these two forces—the negative and positive externalities—are considered jointly, the net marginal effect of the oil operator's behavior is less significant than the standard SCC measurement would suggest.

In the context of a *uniformly enforced, global carbon tax*, these complications can be safely ignored, because they effectively "cancel out" among the potential carbon emitters, who are all facing the same carbon tax penalty. But if we are considering a carbon tax that is applied to only a *subset* of potential carbon emitters, then the two types of externalities *cannot* be ignored, lest we incorrectly calculate the actual social marginal costs and marginal benefits of the regulated emitter's behavior. If we ignore the problem of leakage, then we will *overestimate* the true social cost of additional emissions in the regulated jurisdiction, and consequently the introduction of a carbon tax calibrated to the global SCC will be too high, *even on the terms of the textbook analysis*. Even if one believes that the problem of global climate change should be addressed with a global carbon tax, it does not follow that regional governments should implement the same policy unilaterally.

4. Numerical Estimates of the Significance of Leakage

Above we have laid out the theoretical problems with using estimates of the global SCC to calibrate a *regional* carbon tax. In this subsection we will provide some numerical estimates of the actual significance of this issue.

Caron et al. (2012) analyzed the cap-and-trade program in the state of California. They summarized their results as follows:

> We estimate the impact of California's cap-and-trade program on the leakage of emissions to other regions using a calibrated general equilibrium model. Sub-national policies can lead to high leakage rates as state economies are generally closely connected to other economies, including integration of

> electricity markets. Measures that will prevent leakage from California's cap-and-trade program include requiring permits to be surrendered for emissions embodied in imported electricity and legislation banning "resource shuffling." **Under a cap-and-trade policy without measures to reduce leakage, the price of emission permits is $12 per ton of CO_2 and emissions in other regions increase by 46% of the reduction in emissions in California.** When imported electricity is included in the program and **resource shuffling is banned, the carbon price is $65,** there is negative leakage to regions exporting electricity to California, positive leakage to other regions and the overall leakage rate is 2%. We conclude that although there is potential for large increases in emissions elsewhere due to California's cap-and-trade policy, **enforcement of requirements for imported electricity will be effective at curtailing leakage.** (Caron et al. 2012, emphasis added)

Free-market conservatives who have applauded a revenue-neutral carbon tax should take note of the passages we have highlighted in the excerpt above. In the absence of other restrictions on commerce, a simple implementation of a cap-and-trade program in California—which does not set a marginal penalty on carbon emissions, but instead caps the total amount of permissible emissions in the state—would lead to an emission price ($12/ton) below what many analysts believe is the global social cost of carbon (SCC). The explanation for this result is that faced with higher costs of operation *and* with no other regulations on their activities, electricity providers in California would simply curtail production in-state, and turn to importing (cheaper) electricity produced in other U.S. states where California's cap-and-trade program did not apply. This mechanism explains why 46 percent of the drop in California emissions would be offset by increased emissions in other regions. Thus, we see that Bauman and Hsu's casual description of British Columbia's $30 carbon tax as "the best climate policy in the world" was quite dubious, even on their own terms.

Yet the excerpt from Caron et al. is even more revealing. Precisely because of this problem of leakage, the authors of this study were *not* content to consider merely a cap-and-trade program. Instead, they modeled the effects of the California state government imposing *more* regulations on the energy sector, namely, placing a tariff on electricity imported from outside the state and banning "resource shuffling." By introducing these additional, top-down interventions in the economy, the authors were able to bolster the potency of a state-level cap-and-trade program, because now—by cracking down on "leakage" so that it is only 2 percent—they found the price of permits rising from $12 to $65/ton, a more than fivefold increase. As this example illustrates, free-market conservatives should be aware that, even on theoretical grounds, the so-called "market solutions" of a carbon tax or cap-and-trade program may not address the problems of climate change in the eyes of those

most alarmed, making command-and-control regulations necessary to contain unintended consequences.

Naturally, the estimates of leakage emanating from *national* carbon policies are lower than those associated with subnational policies. Caron and his co-authors themselves summarized the literature by reporting that "[g]eneral equilibrium assessments of leakage from federal policies commonly estimate leakage rates between 10% and 30%" (Caron et al. 2012, p. 2). Distinguished economist William Nordhaus, one of the pioneers of the economics of climate change—and himself a vocal proponent of carbon taxes—provided his own analysis of the importance of a worldwide policy:

> Our modeling results point to the importance of near-universal participation in programs to reduce greenhouse gases. Because of the structure of the costs of abatement, with marginal costs being very low for the initial reductions but rising sharply for higher reductions, there are substantial excess costs if the preponderance of sectors and countries are not fully included. **We preliminarily estimate that a participation rate of 50 percent, as compared to 100 percent, will impose an abatement-cost penalty of 250 percent. Even with the participation of the top 15 countries and regions, consisting of three-quarters of world emissions, we estimate that the cost penalty is about 70 percent.** (Nordhaus 2008, p. 19, emphasis added)

In the passage quoted above, Nordhaus was saying that if only half of the world (weighted by current emission levels) is subject to the optimal carbon tax regime, then *the sacrifice in welfare (measured in money) necessary to achieve a given environmental objective* will be 250 percent higher, relative to the cost under a regime of worldwide participation.[6] For the truly interesting case, where large, carbon-intensive economies such as China and India never sign on to a carbon policy but allow unrestricted emissions growth over the coming decades, Nordhaus offered no estimates of the cost penalty.

5. Summary of Misapplications of the Social Cost of Carbon Due to Leakage

Even if we concede the framework of serious potential damages from unrestricted carbon emissions, and embrace the standard textbook solution of a corrective carbon tax,

[6] Note that Nordhaus was *not* saying that the "optimal carbon tax" in the participating countries needs to be 250 percent higher, relative to the full participation scenario. Rather, he was saying that the worldwide economic costs necessary to achieve a given environmental objective—such as limiting global temperature increases to 2 degrees Celsius—will be 2.5 times greater, if only half of the global emitters are subject to the carbon tax necessary to achieve this objective.

nonetheless it is a misapplication of the theory to conclude that the optimal tax *levied by the U.S. government* (let alone smaller governments) should equal the current, best estimate of the social cost of carbon.

If advocates of a carbon tax wish to argue that "U.S. leadership" is needed on the issue, they may do so, but they cannot simply ignore the issue of *marginal analysis* when it comes to tax policy. To simply assume that the "optimal carbon tax" at the U.S. level is equal to the social cost of carbon, implicitly requires the dual assumptions that (a) no other governments in the world will levy carbon taxes if the U.S. federal government fails to do so, and (b) *all* other governments in the world will levy an *identical* carbon tax if the U.S. government does so. These are self-evidently false assumptions. The burden of proof is on the proponents of a U.S. carbon tax to spell out their (typically implicit) models for international diplomacy and trade negotiations that would justify their current approach of assuming that the optimal U.S. carbon tax should equal the social cost of carbon as estimated in the academic literature.

As with the tax-interaction effect discussed in Section A of this paper, so too with the leakage effect discussed here in Section B: The optimal carbon tax levied at the U.S. federal level is *lower* than what a naïve estimate of the social cost of carbon would suggest. In the case of the tax-interaction effect, the explanation was that the economic costs of a given carbon tax were higher than the standard analysis indicated, meaning that efficiency required a *reduction* in the optimal carbon tax. In the present case, considerations of leakage show that the *benefits* of a given carbon tax (applied in the United States) are *lower* than the standard analysis would indicate, meaning that efficiency again requires a reduction in the optimal carbon tax.

C. An Optimal Carbon Tax Must Take into Account Pre-Existing Penalties on Carbon and Advantages for Carbon Substitutes

There is a third problem with setting a carbon tax equal to the estimated social cost of carbon, even if we continue to operate within the basic textbook framework. In addition to the tax-interaction effect and the possibility of leakage, the third problem is that the U.S. and other governments *already* impose numerous policies that penalize carbon emissions and subsidize carbon substitutes. Writing in 1992, economist Roy Cordato explained this issue:

> Justification of new [carbon] taxes must also explain why existing taxes on fossil fuels and other supply restrictions are not enough. The point of any tax on social-cost generating activities is not to reduce the social costs to zero, but to achieve the price-output combination that would result if the offending parties were actually bearing the costs and there were no other

> distortions in the economy. To show merely that some social costs are still present is not proof that more taxes are needed. Throughout the world there is extensive taxation of the use of fossil fuels. Taxes on gasoline range from 28 percent of the retail sale price in the U.S. to as high as 75 and 77 percent in Italy and France respectively. In addition, the U.S. government restricts exploration and drilling for oil in both Alaska and off-shore along both coasts. These taxes and restrictions cause supplies to be lower and prices to be higher than they would be in their absence. (Cordato 1992, p. 9)

There are other government policies besides the ones Cordato singled out. For example, vehicle mileage ("CAFE") standards at the federal level have been (partially) justified in terms of their effect on carbon emissions, and the same goes for state-level mandates on renewable electricity generation. The Energy Information Administration, when calculating the "levelized costs" of electricity production from various sources, assumes that coal-fired plants would face the equivalent of a $15/ton of carbon dioxide tax if future regulations required them to adopt carbon control and sequestration (CCS) technology.[7]

The government does not merely penalize carbon-intensive energy sources, however, but also actively subsidizes alternatives. For example, the generous Production Tax Credit (PTC) for wind and other qualifying energy sources, as well as the Department of Energy's loan guarantees and outright grants to renewables projects, all have the effect of tilting energy production away from carbon-intensive sources. The federal government, it is true, offers implicit subsidies for fossil fuels as well, but Institute for Energy Research analyses of EIA data show that, on a BTU basis, far more support is given to so-called alternative energy sources. For example, focusing on subsidies to electricity production, in Fiscal Year 2010, the federal government gave $775.64 per megawatt-hour to solar power, $56.29 to wind, and only 64 *cents* to natural gas, petroleum liquids, and coal (Institute for Energy Research 2011).

Much of the climate policy literature focuses on the superior efficiency of a carbon tax or a cap-and-trade program versus "command and control" regulations such as fuel economy standards or Renewable Energy Standards. (See, e.g., Karplus et al. 2012, and Rausch and Mowers 2012.) However, in this section we are making the *opposite* point, that the "optimal carbon tax"—given the pre-existing mandates, taxes, and subsidies that penalize carbon emissions—is lower than it otherwise would be. Thus, even within the textbook framework, U.S. policymakers should not simply levy a carbon tax calibrated to the estimated social cost of carbon, unless they first remove all of the other implicit penalties levied on carbon-intensive activities.

[7] See the discussion in the Annual Energy Outlook 2012. Available at: http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.

D. A Carbon Tax Set Too High Can Be a Cure Far Worse Than the "Disease"

Above, we have listed three independent, theoretical reasons to think that the advocates of a carbon tax (even in the context of a revenue-neutral tax swap) may be calibrating their recommendations to a tax rate that is far too high. In this final section of Part II, we will show just how dangerous this potential overshooting could be, using the 2007 results from William Nordhaus's DICE model of the global economy and climate system.[8]

DICE-2007 contains simulations not just of the baseline scenario (no controls) and of the optimal carbon-tax scenarios, but of many other policies as well. The results show that the dangers from an overly ambitious and/or inefficiently structured policy can swamp the potential benefits of a perfectly calibrated and efficiently targeted one (i.e., the optimal carbon tax scenario). As Table 2 indicates, Nordhaus's optimal plan yields net benefits of some $3 trillion (consisting of $5 trillion in reduced climatic damages and $2 trillion of abatement costs). Yet some of the other popular proposals have abatement costs that exceed their benefits. The worst is Gore's 2007 proposal to reduce CO_2 emissions 90 percent by 2050; DICE-2007 estimated this plan would make the world more than $21 trillion poorer than if there were no controls on carbon.

[8] The analysis in this section is reproduced from the same description given in Murphy (2009).

Table 2. William Nordhaus' DICE Model's Relative Benefits of Different Climate Policies (trillions of 2005 US $)

Climate Policy	PDV Difference from Baseline	PDV of Environmental Damages	PDV of Abatement Costs	Sum of Damages and Costs
No controls baseline	0.00	22.55	0.04	22.59
Optimal carbon tax	+3.07	17.31	2.20	19.52
Limit CO_2 to 560 ppm	+2.67	15.97	3.95	19.92
Kyoto with US	+0.63	21.38	0.58	21.96
Kyoto without US	+0.10	22.43	0.07	22.49
Carbon tax using *Stern Review* discount rate	-14.18	9.02	27.74	36.77
Limit temp. to 1.5°C	-14.44	9.95	27.08	37.03
Limit CO_2 to 420 ppm	-14.60	9.95	27.24	37.19
Gore's 90% emissions cut	-21.36	10.05	33.90	43.96

Source: Adapted from Nordhaus (2008, p. 89).

Some comments on Table 2 are in order. Nordhaus's optimal carbon tax is the best policy for two related reasons: first, it is calibrated to balance marginal abatement costs against marginal benefits from avoided climatic damage; and second, it uses a very flexible tool (namely, time-varying penalties on carbon use, that is, an adjustable carbon tax) that can be perfectly correlated (in the DICE model, at least) with the level of damages inflicted on the world. In contrast, the Gore proposal is disastrous because it fails on both counts. First, its ambitious reductions in environmental damage are achieved at a price that exceeds the benefits. Second, by choosing a somewhat arbitrary and blunt tool (namely, a reduction in emissions by a certain date), this aggressive containment of environmental damages is achieved at a higher cost than necessary. For example, if Gore had instead proposed to limit CO_2 concentrations to 1.5 times their preindustrial value (i.e., 420 ppm), then abatement costs *and* environmental damages would both be lower than what his own plan would achieve.

However, even if we stick with a straight-up carbon tax—which (generally speaking) has the desirable property of achieving given environmental objectives in the least-cost manner—a carbon tax rate set *too high* can still be far worse than the business-as-usual

baseline. In particular, Nordhaus's simulations show that if governments around the world had been foolish enough to implement an aggressive carbon tax based on the perspective of the famous Stern Review (Stern 2007), then the world would be some $14 trillion poorer (measured in present-value terms from today's perspective) *compared to its fate if NO carbon tax were implemented at all*. Moreover, to put this number in perspective, Nordhaus estimates that the textbook, perfectly enforced worldwide optimal carbon tax would yield net benefits of only some $3 trillion relative to the business-as-usual baseline.

To repeat the point we made earlier, William Nordhaus is a pioneer and world expert in the economics of climate change. He is one of the most vocal proponents of a carbon tax (though others in the field believe he underestimates the optimal tax rate). It is very significant, then, that his own modeling results (at least as calibrated in 2007) show that the net damages from a carbon tax calibrated to a very popular policy proposal (the Stern Review) are more than *four times* as large as the greatest benefits that could even theoretically be derived from a perfect carbon tax.

In concluding this section of our report, it is fitting to quote from the National Academy of Sciences, which stated in 1992: "Uncertainty cannot be ignored in responding to greenhouse warming. Errors of doing too much can be as consequential as errors of doing too little; the error of trying to solve the wrong problem is as likely as the error of failing to act" (National Academy of Sciences 1992, p. 194).

III. Practical Problems with a Revenue-Neutral Carbon Tax Swap

In Part II of this paper, we reviewed three independent, theoretical reasons that a carbon tax (even if implemented in a revenue-neutral fashion) might be imposed at too high a level, if policymakers relied on the conventional treatment in the pro-tax literature. Moreover, we then relied on modeling results from an advocate of carbon taxes to show the potential dangers in an overly aggressive tax rate. Yet throughout Part II, we conceded the basic textbook framework of the carbon tax advocates, in order to critique their proposal on its own terms.

In this third part of the paper, we go further and challenge the very premises of the carbon "tax swap" advocates. We will see that in additional to the theoretical problems discussed in Part II, there are several practical or "real-world" problems with the proposals for a revenue-neutral carbon tax swap.

A. Promises of "Revenue-Neutrality" Are Naïve in Light of the Historical Record

The most obvious practical objection to the proposals for a carbon tax swap is simple: Even if the carbon tax revenues are initially devoted 100 percent to reducing the burden of other taxes, it would be quite naïve to trust the government to honor this deal forever. It is far more likely that during the next fiscal crisis, the government would raise payroll, income, and/or other tax rates, while keeping the new carbon tax in place. Over time, we would likely see an increase in the amount of tax receipts (relative to GDP), and a *more* inefficient tax structure.

This cynicism is grounded in U.S. history. The most obvious parallel to today's calls for a carbon tax swap is the introduction of (our modern) federal income tax in 1913. The campaign for this tax (which ultimately required a Constitutional Amendment) was eerily similar to many of the arguments today in support of a carbon tax swap.

In the first place, the proponents of a federal income tax (and inheritance tax) touted it as a method of raising revenue so that tariffs could be reduced. In this way, the new tax system would (allegedly) be more equitable, because it could be targeted at the wealthy, whereas tariffs disproportionately hurt the poor. One of the authors of the Revenue Act of 1913, Oscar Underwood, declared it should be "a means of redressing in some measure the unequal tax burdens which result from the practice of basing the Federal income entirely upon customs and internal revenue duties."[9]

In the words of New York State Senator Robert F. Wagner: "[U]nlike our high Republican tariff, this [income tax] is a tax on plenty instead of necessity" that "will lighten the burdens of the poor" (Weisman 2002, p. 256). Congressman Cordell Hull, who worked for years to introduce a federal income tax, said: "I have no disposition to tax wealth unnecessarily or unjustly," but "I do believe that the wealth of the country should bear its just share of the burden of taxation and that it should not be permitted to shirk that duty" (Weisman 2002, p. 274). During debates on the House floor, Hull disagreed with critics who said a federal income tax would encourage more federal spending.

> Hull argued that the opposite was the case. The [income] tax, he declared, would encourage budget restraint because lawmakers would recognize they were spending money directly taxed from Americans. As for the graduated rates, he repeated the basic argument that citizens should support the state proportionate to their income, which was in effect protected by the state.

[9] Oscar Underwood quotation taken from http://www.unz.org/Pub/Outlook-1913may10-00058.

> Quoting Prime Minister David Lloyd George in England, who called the tax the "center and sheet anchor" of the British financial system, Hull went over the British experience example by example, especially its adoption of the principle of withholding, known as "stoppage at the source." One advantage of this system, he noted, was that it would reduce taxpayers' annoyance over having to pay tax directly themselves. (Weisman 2002, p. 277)

In addition to its virtues of reducing the tax burden on the middle and lower classes, as well inducing restraint in federal spending (!), proponents of the income tax swap deal even claimed it would benefit the environment:

> [Senator Robert La Follette] and others advanced a new argument as well, that free trade [made possible by tariff reductions in conjunction with an income tax] was good for the environment because imports would reduce American exploitation of natural resources by the oil, coal, lumber, iron and lead industries. (Weisman 2002, p. 222)

At the time, many Americans perceived the danger in the new federal income tax. To take but two examples from the press, the Philadelphia *Ledger* editorialized:

> If Congress is to exempt the great mass who have the power to expend the money, and grant that vast majority the power to mulct the wealthy or the well-to-do, the majority will rest under the liveliest temptation to erect a system which means confiscation, and to indulge in a wanton license of profligacy.

The Wall Street Journal, commenting on what was, at the time, a great magnification of federal power, remarked:

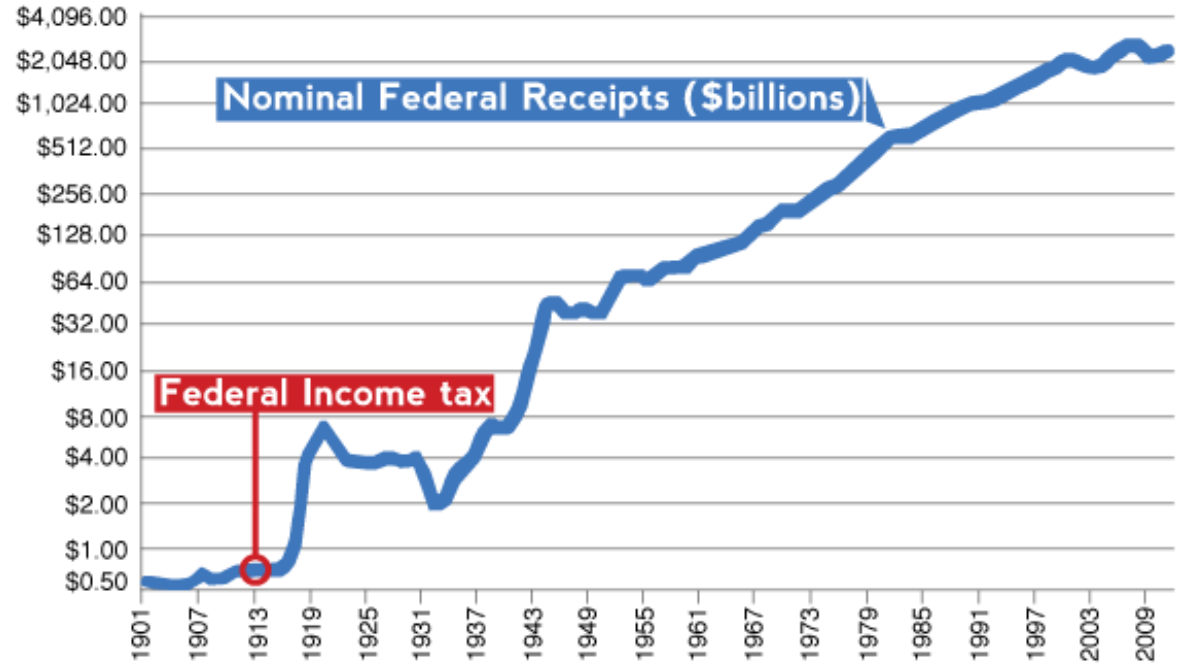
> Under the plan of "collecting at the source," an employee in receipt of a salary in excess of $3,500 a year has to make a statement . . . of all his taxable private means, of his wife's private means, and of the means of every member of his family constituting his household. The inquisitorial power, which is so offensive a part of any such measure, is, in fact, handed on. No self-respecting employee would dream of making such a statement at present, and his wife might constitutionally object; while no decent employer would ask for such information from an employee sufficiently trusted to be in receipt of a taxable salary.[10]

[10] Quotations from the Philadelphia *Ledger* and the *Wall Street Journal* obtained from: http://www.unz.org/Pub/Outlook-1913may10-00058.

With the benefit of hindsight, it is obvious that the proponents of the 1913 income tax swap deal were woefully mistaken in their predictions. Although there was tariff reduction in the short term, most economists would now agree that the Smoot-Hawley Act of 1930—which drastically increased tariff rates—was disastrous, and arguably one of the chief causes of the Great Depression. Far from constraining federal spending, the income tax (and the new Federal Reserve System) introduced in 1913 soon fostered a massive increase in federal receipts, necessary to help defray the expenses of World War I.

Figure 1.

Nominal Federal Tax Receipts, FY 1901-2011
(semi-logarithmic scale)

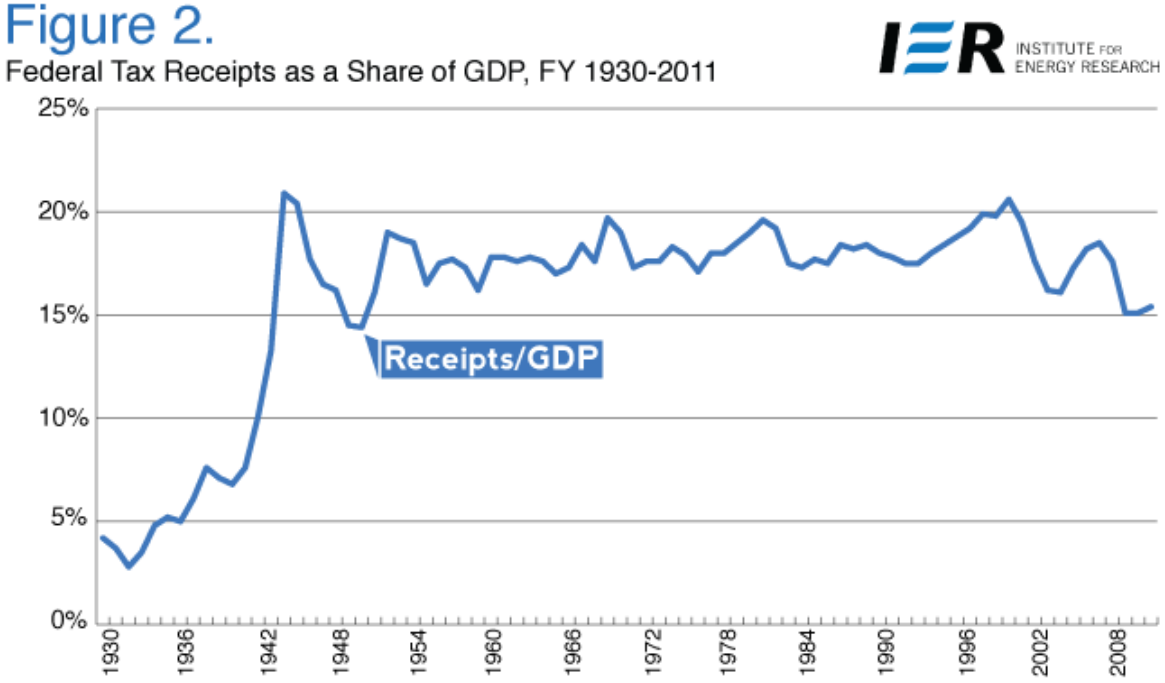


Source: Office of Management and Budget (OMB) available at: http://research.stlouisfed.org/fred2/categories/5

Although it is difficult to obtain consistent GDP data going back to 1913, we can look at the information in Figure 1 and Figure 2 and be quite confident that the federal government ended up absorbing a much larger share of total resources, soon after the income tax swap deal in 1913.

Figure 2.

Federal Tax Receipts as a Share of GDP, FY 1930-2011



Sources: http://www.whitehouse.gov/omb/budget/Historicals
and http://www.presidency.ucsb.edu/data/budget.php.

But perhaps the biggest warning of all comes from an analysis of the *initial* federal income tax code in 1913—which brought howls of protest from some quarters, as we documented above—with the income tax code a mere five years later, at the peak of U.S. involvement in World War I.

Table 3. U.S. Federal Income Tax Code, 1913 vs. 1918

Federal Income Tax Code in 1913	
Bracket	Rate
$0 - $20,000	1.0%
$20,000 - $50,000	2.0%
$50,000 - $75,000	3.0%
$75,000 - $100,000	4.0%
$100,000 - $250,000	5.0%
$250,000 - $500,000	6.0%
$500,000 and above	7.0%

Federal Income Tax Code in 1918	
Bracket	Rate
$0 - $4,000	6.0%
$4,000 - $5,000	12.0%
$5,000 - $6,000	13.0%
$6,000 - $8,000	14.0%
$8,000 - $10,000	15.0%
$10,000 - $12,000	16.0%
$12,000 - $14,000	17.0%
$14,000 - $16,000	18.0%
$16,000 - $18,000	19.0%
$18,000 - $20,000	20.0%
$20,000 - $22,000	21.0%
$22,000 - $24,000	22.0%
$24,000 - $26,000	23.0%
$26,000 - $28,000	24.0%
$28,000 - $30,000	25.0%
$30,000 - $32,000	26.0%
$32,000 - $34,000	27.0%
$34,000 - $36,000	28.0%
$36,000 - $38,000	29.0%
$38,000 - $40,000	30.0%
$40,000 - $42,000	31.0%
$42,000 - $44,000	32.0%
$44,000 - $46,000	33.0%
$46,000 - $48,000	34.0%
$48,000 - $50,000	35.0%
$50,000 - $52,000	36.0%
$52,000 - $54,000	37.0%
$54,000 - $56,000	38.0%
$56,000 - $58,000	39.0%
$58,000 - $60,000	40.0%
$60,000 - $62,000	41.0%
$62,000 - $64,000	42.0%
$64,000 - $66,000	43.0%
$66,000 - $68,000	44.0%
$68,000 - $70,000	45.0%
$70,000 - $72,000	46.0%
$72,000 - $74,000	47.0%
$74,000 - $76,000	48.0%
$76,000 - $78,000	49.0%
$78,000 - $80,000	50.0%
$80,000 - $82,000	51.0%
$82,000 - $84,000	52.0%
$84,000 - $86,000	53.0%
$86,000 - $88,000	54.0%
$88,000 - $90,000	55.0%
$90,000 - $92,000	56.0%
$92,000 - $94,000	57.0%
$94,000 - $96,000	58.0%
$96,000 - $98,000	59.0%
$98,000 - $100,000	60.0%
$100,000 - $150,000	64.0%
$150,000 - $200,000	68.0%
$200,000 - $300,000	72.0%
$300,000 - $500,000	75.0%
$500,000 - $1,000,000	76.0%
$1,000,000 and above	77.0%

Source: Tax Foundation. Available at: http://taxfoundation.org/article/us-federal-individual-income-tax-rates-history-1913-2011-nominal-and-inflation-adjusted-brackets.

It is probably an understatement to say that if the American people had had any idea in 1913 of what lay in store for them a mere five years later, they never would have acquiesced in the introduction of the federal income tax. Far from an efficient, revenue-neutral switch to a tax falling more lightly on the poor, the move placed a powerful new tool in the hands of the government. Over time, rich and poor alike saw a massive increase in their overall federal tax burdens. Rather than making the tax code more efficient, the 1913 innovation put in place the very apparatus that today's political conservatives seek to rollback.

Some might argue that our analysis is unfair, because of the emergency presented by World War I. Yet in today's context, there are fiscal "emergencies" looming on the horizon. The latest forecasts from the Congressional Budget Office project a federal debt-to-GDP ratio exceeding 90 percent by 2021 if the government postpones difficult decisions, as it typically has done in the past.[11] Virtually all analysts agree that, in the coming decades, the federal government will have to scale back its spending growth and increase the total tax burden. By placing a new carbon tax in its arsenal, conservatives would surely end up tilting the balance toward tax hikes rather than spending restraint. Indeed, a September 2012 Congressional Research Service (CRS) report lauds the ability of a new carbon tax to reduce the deficit by $1.2 trillion over ten years (Ramseur et al. 2012). The carbon tax proposed by Rep. Jim McDermott in August 2012 calls for an enormous tax (up to $525/ton by 2024) with one-quarter of the revenues explicitly devoted to "deficit reduction."[12] It is very naïve to believe the revenues from a new carbon tax would be devoted to dollar-for-dollar reductions in other taxes.

B. A Carbon Tax Is Regressive, Making Efficient Tax Recycling Politically Unlikely

A carbon tax, by its very nature, will raise energy, food, and other consumer prices, impacting lower-income households far more than upper-income households. Consequently, it will be very unlikely politically to get the type of tax swap deal that would most appeal to supply-side reformers. Rather than using carbon tax receipts to fund across-the-board reductions in personal income tax rates, for example, in reality a bipartisan deal will almost certainly involve targeted tax breaks—if not actual federal expenditures—to help poorer citizens shoulder the burden of the carbon tax.

[11] The text refers to the June 2012 CBO Long-Term Fiscal Outlook's "Alternative Fiscal Scenario."

[12] See "McDermott's Carbon Tax Bill Is Worst of All Possible Worlds." Available at: http://www.productsandpower.org/2012/10/24/mcdermotts-carbon-tax-bill-is-worst-of-all-possible-worlds/.

To see a real-world example, consider the 2008 Canadian federal election, in which the Liberal Party proposed a national carbon tax that would begin at $10/ton and rise $10 each year to a maximum of $40/ton. As described by Merkley et al. (2012), to build political support the Liberal Party agreed to use the projected carbon tax revenue to:

> - Cut the bottom tax bracket 10 percent, from 15 percent to 13.5 percent and cut the middle-class tax rates from 22 percent to 21 percent and 26 percent to 25 percent.
> - Cut corporate tax from 15 percent to 14 percent . . . and cut the small-business tax rate by 1 percent. . . .
> - Increase the Northern Residents Deduction to $7,000 from $6,000 and introduce a green rural credit to compensate rural residents for higher energy costs.
> - Introduce the Liberal 30-50 plan to cut poverty by 30 percent and child poverty by 50 percent within five years by introducing a universal child-tax benefit of $350 and a $1,850 refundable employment credit, by enriching the Working Income Tax Benefit and by making the Disability Tax Credit refundable. (Merkley et al. 2012, pp. 20-21)

Recall the severe economic costs of a carbon tax discussed in Section A of Part I, *even when the revenues were fully recycled to reduce personal income tax rates*. In reality, such theoretical estimates—unflattering though they were to a carbon tax swap—were actually far too generous. In practice, carbon tax revenues will not be used to reduce dollar-for-dollar the most economically inefficient taxes currently in the federal code. In the first place, the federal government will surely collect *more* total revenue once the carbon tax is introduced, but secondly, even the "recycled" receipts will be used at least partially in relatively inefficient ways, such as giving tax breaks to poorer citizens who will suffer disproportionately from higher energy and food prices. The current proposals in Australia—to ease the burden on families from its carbon tax—illustrate this point perfectly. The "relief" measures in Australia are hardly optimal from a supply-side perspective.[13]

Such concentration of carbon tax receipts on the poor might be fairer or more desirable in the eyes of many Americans—indeed, this is why a political deal will surely involve such features. Nonetheless, these complications will reduce the ability of carbon tax receipts to offset the inefficiencies due to the existing tax code. In other words, the theoretical

[13] See http://www.couriermail.com.au/money/money-matters/lump-sum-to-ease-carbon-tax-pain/story-fn3hskur-1226321137229.

limitations of a carbon "tax swap" deal, analyzed in Part II of this paper, actually *understate* just how bad a new carbon tax would be for the economy, if we neglect the potential environmental benefits.

For those advocating a carbon tax because of concern over global climate change, these types of considerations may be negligible. However, free-market conservatives who tout a new carbon tax as a vehicle for making the tax code more efficient and thereby promoting economic growth need to take the regressive nature of a carbon tax into account when imagining realistic budget agreements.

C. Any Carbon/Payroll Tax Swap Will Break Down Almost Immediately

Besides the general problems raised above in Sections A and B of Part III, there is a more specific flaw with the popular proposals to use a new carbon tax to reduce *payroll* tax rates: Both a carbon tax and the payroll tax have their own associated logic, making it difficult to define what a long-term tax swap would look like even in theory, let alone in political practice. Specifically, the optimal carbon tax as dictated by economic theory should rise over time in accordance with the social cost of carbon, while the payroll tax should fluctuate based on demographics and the promised benefits of Social Security, Medicare, and other federal social insurance programs.

According to the Social Security Trustees Report released in April 2012,[14] if we disregard interest on the "Trust Fund" holdings and look just at incoming worker and employer contributions compared to outgoing benefit payments, then the Social Security program has been in cash-flow deficit since 2010 (the first time this had happened since 1983), and this deficit is expected never to close for the entire 75-year forecast period going forward. Even if we include the interest earnings on the accumulated Trust Fund, Social Security will begin running annual deficits by 2020. At that time, annual incoming worker and employer contributions, plus interest earned on the Trust Fund, will fall short of outgoing benefit payments. Consequently the Social Security administrators will need to draw down the Trust Fund assets, which will be fully exhausted by 2033. Thus, depending on the treatment given to the Social Security "Trust Fund," it is correct to say that Social Security as currently configured either broke down in 2010, will break down in 2020, or will break down in 2033.

[14] The figures relating to Social Security and Medicare come from the Trustees Report Summary available at: http://www.ssa.gov/oact/TRSUM/index.html, as well as the full report on Medicare available at: http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/Downloads/TR2012.pdf.

From a unified budgetary perspective (disregarding IOUs issued by the Treasury to other parts of the U.S. government), the latest Trustees Report estimates that, over the next 75 years, the Hospital Insurance (HI), Supplemental Medical Insurance (SMI), and Old Age, Survivors, and Disability Insurance (OASDI) programs—constituting what the public knows as Medicare and Social Security—will have a massive shortfall in anticipated payroll contributions relative to expected beneficiary payments. The present discounted value of these combined shortfalls is a staggering $38.6 trillion.[15]

Given these grim actuarial realities, it is almost inevitable that there will eventually be large payroll tax increases, coupled with benefit reductions (perhaps in the form of postponed retirement). Thus, when today's proponents of a carbon tax swap speak of payroll tax cuts, this will not necessarily translate into a future with lower payroll tax rates relative to today. At best, the carbon tax receipts of the future may mitigate the *hike in payroll tax rates* that would otherwise occur. But it is also quite likely that new carbon tax receipts will be used to (at least partially) mitigate the reduction in benefits that would otherwise occur, meaning the claims of "revenue neutrality" will almost certainly be violated.

D. Previous Federal Efforts to Fight Climate Change Have Been Grossly Inefficient

Underlying the conservative arguments for a carbon "tax swap" deal is the notion that, although taxes in general hurt economic growth, in the case of a carbon tax it "moves us in the right direction" and yields environmental benefits, however controversial and hard to quantify they might be in certain quarters. Yet just as the belief in revenue neutrality is naïve, on this score too, history belies such faith in the government. Its past efforts—explicitly justified in the name of fighting climate change—have been grossly inefficient in achieving their stated goals, as even the progressive proponents of carbon policies will often admit.

Besides the taxpayer losses and outright corruption plaguing the Department of Energy's loan guarantee program for renewables (Murphy 2012a), consider the EPA's light-duty vehicle greenhouse gas emissions (GHG) and corporate average fuel economy (CAFE) standards, formally proposed on December 1, 2011. To understand the full significance of this particular example, we first need to provide the context of the legal history.

In 1999, certain environmental groups petitioned EPA arguing that the agency had the authority to regulate greenhouse gases from motor vehicles under the Clean Air Act. After

[15] See Table V.F2 of the Trustees report on Medicare, available at: http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/Downloads/TR2012.pdf.

EPA refused to act in this capacity, the environmental groups (along with a few states) sued EPA and eventually the case ended up at the Supreme Court as *Massachusetts v. EPA*, 549 U.S. 497 (2007).[16] The question in the case was whether EPA had the authority to regulate greenhouse gas under the Clean Air Act. The Supreme Court found that EPA indeed has the authority to regulate greenhouse gas emissions from motor vehicles, and the fuel economy regulations are the result of this ruling.

In order to justify the policy on a cost/benefit basis, EPA argued that mandated mileage increases would benefit consumers through saving them money on fuel costs. Thus, EPA had to assume a "market failure" (in this case, consumer inability to properly tradeoff vehicle price versus future fuel expenses) besides a simple negative externality. This was no small part of their case, either: Depending on the parameter values, anywhere from 56 to 73 percent of EPA's claimed net benefits from the new rule derived from consumer irrationality.

More incredible, EPA and other proponents of the rule claimed it would help contain damages from climate change. Yet here is EPA's own analysis of the benefits on this criterion:

> The results of this analysis [of the proposed rules on light-duty vehicles] demonstrate that relative to the reference case, projected atmospheric CO_2 concentrations are estimated by 2100 to be reduced by 3.29 to 3.68 part per million by volume (ppmv), global mean temperature is estimated to be reduced by 0.0076 to 0.0184 °C, and sea-level rise is projected to be reduced by approximately 0.074–0.166 cm, based on a range of climate sensitivities.

Any self-described conservative should be quite alarmed when the U.S. federal government proposes to override consumer choices in the marketplace in the present, in order to limit global temperature increases by *at most* 18 one-thousandths of a degree Celsius, almost nine decades in the future. Against this ephemeral and far-distant benefit, EPA's analysis estimates that vehicle buyers will see increased costs in the year 2030 alone of $36 billion from the new standards (Murphy 2012b).

To reinforce our earlier discussion of the Supreme Court ruling: The reason the EPA presumably had the authority to issue greenhouse gas regulations in the first place was because of the potential threat to human welfare vis-à-vis anthropogenic (man-made) climate change. When the EPA's own analysis predicts that the regulations in question will reduce global temperature by 18 one-thousandths of a degree Celsius, almost nine decades

[16] See http://www.supremecourt.gov/opinions/boundvolumes/549bv.pdf.

in the future, and in exchange for billions of dollars in higher costs that will occur much sooner, conservatives should take notice.

To be clear, the proposition that U.S. government programs to combat climate change have been inefficient is not something unique to climate "skeptics" or to political conservatives. Indeed, the progressive *proponents* of climate change legislation often seek a carbon tax (or a comprehensive and transparent cap-and-trade program) precisely because these "market-based" solutions will achieve environmental benefits at much lower cost than existing federal policies. (For two recent examples see Karplus et al. 2012, and Rausch and Mowers 2012.)

From our perspective, the dismal record of the U.S. government in implementing efficient climate change policies is hardly evidence *in favor* of a massive new carbon tax (or cap-and-trade program). On the contrary, it is evidence that such a new program will be *abused* in the political process, and will not be tailored to the recommendations of climate scientists and environmental economists. Such abuse could take the form of exempting favored constituencies from the scheme, setting the carbon tax rate in line with fiscal needs rather than climate objectives, and/or using carbon tax receipts to fund inefficient yet politically powerful groups, such as producers in "clean energy" sectors who, in principle, should not need federal support in the presence of a well-designed carbon tax.

Lastly, the problem is not merely that government is always a blunt instrument and that its rough edges must be tolerated as a fact of life. No, when it comes to environmental policies, the federal government is *particularly* innocent of rational cost/benefit considerations. For example, consider a 1995 article published in the journal *Risk Analysis* that was a non-ideological survey of various "life-saving interventions and their cost-effectiveness." As the authors explained:

> We gathered information on the cost-effectiveness of life-saving interventions in the United States from publicly available economic analyses. "Life-saving interventions" were defined as any behavioral and/or technological strategy that reduces the probability of premature death among a specified target population. We defined cost-effectiveness as the net resource costs of an intervention per year of life saved. (Tengs et al. 1995, p. 369)

Although the authors studied various interventions in the private sector, they also provided results for a few agencies of the federal government. Table 4 below summarizes their findings.

Table 4. Median Cost Per Life-Year Saved for Government Regulations By Agency (as of 1994)

Government Agency	Median Cost of Proposed Regulations Per Life-Year Saved	Agency Proposals For Which Data Available
Federal Aviation Administration (FAA)	$23,000	4
Consumer Product Safety Commission	$68,000	11
National Highway Traffic Safety Administration (NHTSA)	$78,000	31
Occupational Safety and Health Administration (OSHA)	$88,000	16
Environmental Protection Agency (EPA)	$7,600,000	89

Source: Tengs et al. (1995), p. 371

As Table 4 indicates, the EPA's proposed interventions were grossly more expensive (per life-years saved) than the interventions proposed by other government agencies (at least as of the economic analyses available in 1994). Furthermore, the large figure of $7.6 million isn't driven by a few outliers: That was the *median* figure for 89 EPA interventions studied.

In summary, political conservatives who are generally wary of government intervention in the marketplace should be particularly suspicious of federal programs that will directly affect the entire energy sector, in the name of fighting climate change. If past history is a guide, it would be astonishing if such measures were implemented with careful attention to cost-effectiveness, even if we fully embrace the standard arguments of a carbon negative externality.[17]

[17] Another illustration of this political reality is the composition of the cap-and-trade bills that have been proposed. The 2003 McCain-Lieberman proposal was a mere 58 pages. (See http://www.gpo.gov/fdsys/pkg/BILLS-108s139is/pdf/BILLS-108s139is.pdf.) Yet a few years later, the final version of the Waxman-Markey cap-and-trade bill was a whopping 1,428 pages. (See http://www.instituteforenergyresearch.org/pdf/Other_Half_of_Waxman-Markey--FINAL.pdf) Clearly there were many side-deals and political compromises in the bill as it evolved, which would not pass muster with environmental and tax economists designing an "ideal" mechanism according to

IV. Conclusion

Conservative proponents of a revenue-neutral carbon tax swap argue that such a proposal would not only mitigate potential environmental damage down the road, but would provide immediate relief to Americans by reducing the inefficiency of the tax code. By "taxing bads not goods," they think that a revenue-neutral carbon tax swap would lead to more economic growth as conventionally defined, and would reduce future climate change damages as a bonus. Unfortunately, there are many problems with this conservative claim, including both technical and pragmatic flaws.

On the technical side, there are four main problems. First, the best literature on the topic actually argues that a revenue-neutral carbon tax swap would make the tax code *more* inefficient, and would *hinder* (conventional) economic growth. Indeed, some empirical estimates suggest that this effect is so powerful, that the "optimal" carbon tax should actually be cut roughly *in half* to mitigate the damage to the economy.

The second technical objection is that the "social cost of carbon" is not the proper benchmark to use when calibrating a carbon tax implemented unilaterally by the United States government (as opposed to a *worldwide uniform carbon tax* implemented by all governments). The literature refers to this as the problem of "leakage," which means that the carbon-emitting activities in a regulated jurisdiction can be relocated to another, less-regulated jurisdiction. Intuitively, it is not correct—even on theoretical grounds—to count a ton of reduced U.S. emissions as providing benefits equal to the "social cost of carbon," if the policy that causes this reduction in U.S. emissions goes hand-in-hand with *increased* emissions elsewhere (such as China). The ability of U.S. policymakers to affect the trajectory of *global* carbon emissions is very constrained, yet many textbook analyses overlook this important complication and assume that national or even smaller units of government should set their carbon tax rates equal to the best estimate of the "social cost of carbon."

The third technical objection is that the U.S. (and state) governments already have in place many policies that discourage carbon-intensive activities and encourage alternatives. Some of these policies are gasoline taxes, CAFE standards, special tax advantages and loan guarantees to promote renewable energy use, ethanol mandates, and renewable portfolio standards. Because these government policies already discourage carbon emissions, a new carbon tax—even on theoretical grounds—should not be calibrated to the textbook "social

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textbook theory. Any carbon "tax swap" deal that actually became law would undoubtedly itself contain many deviations from what its academic proponents really wanted.

cost of carbon" magnitude, but rather should be smaller. Although proponents of a carbon tax may discuss these other policies, they often do so only to show why a carbon tax would achieve emission cuts more efficiently. The proponents rarely explain that these pre-existing policies *reduce* the theoretical justification of a new carbon tax.

The fourth and final technical objection is that state-of-the-art models show that an overly aggressive carbon tax can be a cure worse than the disease. For example, in the 2007 runs of William Nordhaus's "DICE" model, he estimated that a theoretically perfect carbon tax, implemented by all governments around the world and for many decades into the future, would provide net benefits (reckoned in the present, using a suitable discount rate) of some $3 trillion. In contrast, Nordhaus estimated that had world leaders heeded the recommendations of the famous Stern Review report by implementing a carbon tax much steeper than what Nordhaus desired, then the world would be $14 trillion poorer *compared to the baseline case where governments did nothing to halt climate change*. Thus, not only would this aggressive carbon tax make the world collectively worse off (because its economic damage would swamp the environmental gains), but the net damage would be more than four times as large as the net benefits from the best possible carbon policy. Nordhaus's results show the incredible importance of "getting the numbers right," because overshooting with the carbon tax can be so devastating.

In addition to the above technical objections—which take the textbook case for a carbon tax at face value—we have in this study also described four *practical* objections, showing that it is dangerous to rely on the academic framework used by the advocates of a carbon tax.

The first practical objection is that the promises of "revenue neutrality" are quite hollow, given U.S. history. The best historical precedent is the introduction of the federal income tax in 1913, which was supposed to promote tax efficiency and help poorer Americans by replacing the tariff structure with a fairer tax that could be concentrated on the wealthy. Yet just a few years later, during World War I, the new federal income tax was used to extract wealth from taxpayers in amounts that would have seemed inconceivable when the new tax was passed. (Specifically, the top tax rate went from 7 percent in 1913 to 77 percent in 1918.) Furthermore, the Smoot-Hawley Act in 1930 jacked up tariff rates so significantly that many economists cite it as a major explanation for the severity of the Great Depression. Conservative whose propose a carbon tax swap to reduce the onerous income tax should realize that, originally, *the federal income tax* was supposed to be relief granted to American taxpayers!

The second practical objection is that the regressive nature of a carbon tax will make it very difficult politically to dedicate its revenues to income or other tax reduction. Conservative proponents of a revenue-neutral "tax swap" deal must realize that they are asking to make

the U.S. federal tax code far more regressive—tax rates on wealthy individuals would go down, while electricity and gasoline prices would go up for poor households. In practice, if policymakers impose a large new carbon tax, they will surely need to provide *some* relief to the groups most injured by rising energy prices. The actual history of carbon taxes shows that such compensatory schemes are common. In practice, the alleged "efficiency gains" from reforming the tax code may not exist at all.

The third practical objection is that any deal using a new carbon tax to offset existing payroll taxes would surely break down quickly, because the two taxes have precise but incompatible purposes. Specifically, a textbook carbon tax should reflect the social cost of carbon, rising steadily over time with atmospheric concentrations of greenhouse gases. In contrast, the payroll tax should reflect the changing demographics of Social Security and other social insurance programs. Whatever relationship initially existed between the new carbon tax and the correspondingly reduced payroll tax would soon break down as these underlying factors evolved.

The fourth and final practical objection is that the federal government has shown in its numerous other environmental policies that it can be grossly inefficient, completely ignoring what economic theory would recommend as the proper way to address a given environmental problem. There is little reason to take federal policymakers at their word if they promise to implement a new carbon tax in a way that promotes economic efficiency.

In light of these technical and practical objections, it is clear that the case for a carbon "tax swap" deal is very weak indeed. Conservatives, who normally have a healthy distrust of new initiatives and tax schemes, should be very wary of any such proposal.

V. Technical Appendix on the "Tax Interaction Effect"

One of the central arguments of the present paper is that the "tax interaction effect," as laid out in the *American Economic Review* by Bovenberg and Goulder (1996), probably implies that a carbon tax imposes *more* direct economic costs than the taxes it would offset. Bovenberg and Goulder realized that because a new carbon tax would change factor prices, it might interact with a pre-existing suite of taxes on labor and capital in such a way as to *amplify* their distortions. This outcome can occur even if the new carbon tax is an appropriately scaled Pigovian tax,[18] and even if the revenues from the new carbon tax are used dollar-for-dollar to reduce the pre-existing (and distortionary) taxes on labor and capital.

These insights led Bovenberg and Goulder to what is, at first blush, a very counterintuitive conclusion: The more distortionary the pre-existing tax code from an efficiency standpoint—the more deadweight losses it imposes on the economy in order to raise a given amount of revenue for the government—then the *weaker* is the case for implementing a revenue-neutral carbon tax swap. This claim is the exact *opposite* of what conservative champions of a carbon tax swap believe; they think that the current, onerous U.S. tax code is a good reason to implement a Pigovian carbon tax, so long as it is revenue neutral, *in addition* to whatever environmental benefits it might deliver.

In this appendix, we will try to explain Bovenberg and Goulder's surprising result. However, their explanations can be somewhat technical, and will perhaps resonate only with professional economists. First, here is Goulder explaining their work in general terms:

> Over the last three decades in the United States and other nations, there has been a significant increase in the use of economic analysis to guide the design and evaluation of environmental policies. Economic analysis has played a key role in the evaluation of "green tax reform"—the reorienting of the tax system to concentrate taxes more on "bads" like pollution and less on "goods" like labor effort or capital formation (saving and investment). . . .
>
> Much of my research focuses on these sorts of environmental policy issues. I often use a general equilibrium framework, an approach that considers how environmental policies affect not only the targeted firms or industries but the

[18] A Pigovian tax is named in honor of economist A.C. Pigou (1920), who formalized the current "textbook" framework for dealing with negative externalities such as anthropogenic climate change.

rest of the economy as well. **General equilibrium analysis yields dramatically different results from what one would obtain from partial equilibrium, or sector-specific, analyses. In realistic, "second-best" economies with pre-existing distortionary taxes, such as income and sales taxes, the differences are striking. In some cases, policies that appear to improve efficiency in a partial equilibrium analysis emerge as reducing efficiency when researchers account for second-best, general equilibrium interactions**. . . .

Environmental Tax Reform and the "Double Dividend"

Green tax reform usually involves substituting environmentally motivated ("green") taxes for existing distortionary ones, for instance income and sales taxes. One highly debated green tax reform is the introduction of a revenue-neutral carbon tax: levying taxes on fossil fuels according to their carbon content and using the additional tax revenues to finance reductions in income tax rates. . . .

The possibility of using green tax revenues to finance cuts in marginal rates of existing distortionary taxes is also attractive in terms of efficiency. This has prompted speculation as to whether the revenue-neutral substitution of environmental taxes for other taxes might offer a "double dividend": not only improving the environment but also reducing the overall cost of the tax system.

If the second "dividend" obtains, then the gross costs (that is, the costs apart from environmental benefits) of the reform are zero or negative. Proponents of revenue-neutral green tax reforms would welcome this result, since it implies that policymakers must only establish that there are positive benefits to the environment from the reforms in order to justify them on efficiency grounds. This is especially important in regards to the carbon tax, given the vast uncertainties about the magnitudes of the environmental benefits (the avoided damages from climate change) that this policy generates.

A First Glimpse

Does the double dividend indeed arise? Using revenues from green taxes to finance cuts in distortionary taxes does avoid some of the distortions that these pre-existing taxes would generate otherwise. This implies an efficiency benefit, which is termed the "revenue-recycling effect." Because of the positive revenue-recycling effect, the costs of a green tax reform will be lower when the revenues from such a tax are used to finance cuts in

distortionary taxes than when the revenues are returned to the economy in a lump-sum fashion. . . . However, this simply means that the costs of the former policy are lower than the costs of the latter policy; it does not mean that those costs are negative, which is the requirement for the second dividend to occur.

Are the costs of the green tax negative? Over the last decade, many researchers have addressed this question. The simplest analytical models suggest that the answer is no. These models point out that green taxes usually are a relatively inefficient way to raise revenue: the economic cost of raising a dollar through green taxes tends to be higher than that of raising a dollar through ordinary income taxes. Intuitively, that is because green taxes have a much narrower base than income taxes. They focus on individual commodities (such as fossil fuels) or on emissions from particular industries. As a result, they tend to imply larger "distortions" in markets for intermediate inputs, for consumer goods, and for labor and capital. **Hence, swapping a green tax for part of the income tax augments the (nonenvironmental) distortions of the tax system, and there is an economic cost of this revenue-neutral tax reform.**

A Closer Look

Separating out three components of the overall cost of a green tax reform makes it easier to understand the requirements for obtaining the [double] dividend. The first component is the "primary cost" of the environmental tax, that is the direct cost to the regulated sector associated with changes in production methods or installation of pollution-abatement equipment required to reduce pollution. The second component, which emerges in a general equilibrium analysis, is the revenue-recycling effect. As mentioned earlier, this component serves to lower the costs of the reform. The third component is an additional general equilibrium impact called the "tax-interaction effect," which can be explained as follows: to the extent that environmental taxes raise producers' costs, they imply higher prices of commodities. This effectively reduces the real returns to factors—a given nominal wage payment or given nominal distribution of profits has less purchasing power. **When there are pre-existing taxes on these factors, the environmental tax functions like an increase in factor taxes, compounding the distortions in factor markets from prior taxes. This adverse impact on factor markets is the tax-interaction effect.**

To get the double dividend, the (cost-reducing) revenue-recycling effect

> would have to outweigh both the primary cost and the (costly) tax-interaction effect. **Under neutral conditions, theoretical models indicate that the revenue-recycling effect is not strong enough to do this—the double dividend does not arise. Under these same circumstances, the revenue-recycling effect is weaker than the tax-interaction effect.** Thus, the gross costs are not only positive but also turn out to be higher than they would be in a world without prior distortionary taxes, and thus without the revenue-recycling and tax-interaction effects. This reflects the fact that environmental taxes are implicit factor taxes that expand pre-existing distortions in factor markets.
>
> Still, there are some circumstances under which the double dividend can arise. Although the initial theoretical analyses tended to reject the double dividend, a second wave of models offered more scope for the double dividend by acknowledging additional potential channels for beneficial efficiency impacts from green taxes. . . .
>
> The presence or absence of the double dividend thus depends on the nature of the prior tax system and on how environmental tax revenues are recycled. Empirical conditions are important. This does not mean that the double dividend is as likely to occur as not, however. The narrow base of green taxes constitutes an inherent efficiency handicap. The impact of the green tax reform on pre-existing inefficiencies in the tax system could offset this handicap, but it also could add to it. Numerical general equilibrium models aim to realistically incorporate the pre-existing inefficiencies of the tax system and to gauge how green taxes alter these inefficiencies. **Although results vary, the bulk of existing research tends to indicate that even when revenues are recycled in ways conducive to a double dividend, the beneficial efficiency impact is not large enough to overcome the inherent handicap, and the double dividend does not arise.** (Goulder 2000, emphasis added, footnotes removed)

We have included a fairly lengthy quotation above, but Goulder's explanation is critical to properly evaluate the current carbon tax swap proposals. Goulder is explaining that both the simplest theoretical models, *and* the bulk of numerical simulations, find that the presence of pre-existing (distortionary) taxes *weakens* the case for a carbon tax, rather than strengthening it, as its proponents believe.

In Bovenberg and Goulder (1994) we see a more specific explanation of this surprising result. After deriving a theoretical relationship showing that the optimal carbon tax is

inversely related to the "marginal cost of public funds" (MCPF),[19] here is how Bovenberg and Goulder explained this counterintuitive finding:

> The inverse relationship between the MCPF [marginal cost of public funds] and the optimal environmental tax may seem surprising since revenues from the environmental tax can be used to reduce distortionary taxes. However, the crucial consideration here is how the *presence* (as opposed to [the] reduction) of distortionary taxes in the economy influences the costs of environmental taxes. The connection can be understood as follows. **Abstracting from their environmental benefits, environmental taxes are more costly than alternative distortionary taxes. In particular, a tax on dirty intermediate inputs is more costly than a tax on net output. . . . This is the case because . . . the pollution tax "distorts" the input mix into production. In this way, environmental taxes involve an excess cost over other distortionary taxes such as labor taxes,** and this excess cost rises with the MCPF. . . . Hence, the higher the MCPF, the higher the environmental benefits need to be to offset the excess costs of environmental taxes. The optimal pollution tax balances the social opportunity cost of additional tax revenue against the social benefit from reduced pollution. A higher MCPF means that the social opportunity cost of revenue is larger; hence the social benefits from pollution reduction have to be greater to justify a given environmental tax. (Bovenberg and Goulder 1994, p. 4, emphasis added.)

Thus we see a point that is rarely, if ever, mentioned in the popular discussions: A carbon tax is actually *more* distortionary than taxes on labor. This is obvious, when we consider standard results from tax analysis. In general, imposing a revenue-neutral tax on a smaller base will lead to greater "deadweight losses" or inefficiencies; the government will cause more harm to the economy in order to extract a given amount of revenue. This effect will be more pronounced, the greater the initial inefficiency in the tax code.

In conclusion, Bovenberg and Goulder's pioneering work showed the theoretical possibility (and empirical likelihood) that the case for a revenue-carbon tax is *weaker* once we take into account the prior existence of distortionary taxes on labor and capital. The proponents

[19] The marginal cost of public funds (MCPF) is defined as "the ratio of the marginal value of public revenue to the marginal utility of private income" (Bovenberg and Goulder 1994, p. 3). It is a proxy for how inefficient or distortionary the tax code is—prior to the introduction of a Pigovian tax, such as a carbon tax—because it indicates the deadweight loss to the community from transferring an additional dollar of tax receipts away from the private sector and into the government's coffers.

of a carbon tax swap understandably focus on the obvious fact that—*other things equal*—a tax on labor or capital is less onerous, if its marginal rate is lowered because of offsetting carbon tax revenues. However, Bovenberg and Goulder pointed out that other things are *not* equal. The new carbon tax will exist side-by-side with the pre-existing taxes on labor and capital. Because the carbon tax will change factor prices, it can actually amplify the distortions emanating from the pre-existing taxes, even though they are now at a lower marginal rate.

Once this subtle possibility is taken into account, it is theoretically possible (and many economists in this literature believe empirically likely) that the "optimal" carbon tax—all things considered—is actually lower than the standard Pigovian analysis would suggest. This is because the net benefits of the textbook Pigovian tax are partially offset by the increased distortion of the revised tax code. Thus, since the marginal cost of imposing the new carbon tax (even if in a revenue-neutral manner) is lower due to the tax interaction effect, the truly "optimal" carbon tax is *lower* than the Pigovian analysis suggests.

Furthermore, if the tax interaction effect occurs in this manner, then *any* carbon tax—even if revenue-neutral—will actually impose more deadweight losses on the economy, causing a reduction in economic efficiency, if we neglect the environmental benefits. The imposition of the carbon tax could still be justified overall, by taking these environmental benefits into account, but it is not correct for conservative proponents to claim that a carbon tax will make the tax code less onerous or that it will be a "win-win" outcome.

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