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Hidden benefits and dangers of carbon tax

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Abstract

Many scholars argue that revenue from carbon taxes should be used to replace other taxes, such as taxes on capital or labor, in order to minimize economic damage or compensate for the regressive nature of carbon tax. Advocates of this approach argue that the carbon tax could produce a "double dividend," reducing emissions while also increasing GDP by allowing other taxes to be lowered. This paper suggests caution before adopting this approach, for two reasons. First, the scholarly literature systematically understates the benefits of carbon taxes, and overstates their costs, by simply ignoring the possible environmental benefits of carbon taxes. The result is a one-sided scholarship that exaggerates the damage from carbon taxes and should be understood as providing a lower bound for the benefits of the tax, not a rigorous guide to policy. Second, carbon taxes, unlike other taxes, will produce less revenue as technologies improve and cleaner-burning fuels develop. Thus, if carbon taxes replace other taxes, over time the tax base of the state will wither, and the programs those taxes pay for will be threatened. This paper elaborates these claims and then discusses carbon tax policy designs that would take both points into consideration.

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Carbon taxes, like all taxes, raise two sets of design questions. The first set of questions is on how to levy the tax: what the rate should be, on whom it should be levied, and whether there should be any exceptions. The second set of questions is how to spend the revenue, such as whether it should become part of general revenue or should be reserved for dedicated purposes, and if dedicated, then whether it should be dedicated to environmental purposes or other purposes.

There is disagreement on all these questions. On how to levy the tax, the World Bank's Carbon Pricing Leadership Coalition's *Report of the High-Level Commission on Carbon Prices* concluded that achieving the Paris climate targets would require a price on carbon of US $50–100 per ton of CO2 emissions by 2030 [1]. In 2014 William Nordhaus calculated that a price of $7.40 per ton of CO2 would be optimal in terms of balancing costs and benefits of carbon tax [2]. A few years later, however, and in the face of several more years of inaction on carbon tax around the world, Nordhaus concluded that the social costs of carbon are over $30/ton of CO2 [3]. Many studies suggest starting with a lower rate in order to give households and firms time to adjust to the tax and make longer-term changes, and incrementally increasing the rate over time. The theoretical literature is clear that the optimal tax would be a flat tax on carbon that is

levied equally on all sectors, but in practice, it is common for existing carbon taxes to exempt politically influential sectors and/or sectors vulnerable to international competition, even in the most environmentally ambitious countries. Finland and the Netherlands have had a carbon tax since 1990, Sweden and Norway since 1991, and Denmark since 1992. In all of these countries some sectors are hit by the tax and some are exempt, and the affected sectors have changed over time [4]. For example, in Sweden, much higher tax rates in transportation have led to emissions reductions in transportation, but lower rates are levied on oil and natural gas and have thus not led to lower emissions in those sectors [5]; in Norway only about 60% of emissions are taxed, with exemptions being given to the most energy-intensive industries [6, 7].

If there is disagreement on the specific rate and exemptions, there is much more disagreement on how to spend the revenue, and several different approaches have been proposed: merging the revenue with tax revenue from other sources, returning the revenue to households in a lump sum, using the revenue to cut other existing taxes, using the revenue to lessen the regressivity of the carbon tax, using the revenue to subsidize environmentally beneficial technologies or policies, or using the revenue to reduce debt [8].

The problem is that these different uses of the revenue respond to different—and potentially conflicting—concerns. Different design features have different consequences for three goals, all of which may be seen as relevant to carbon taxes: economic growth, distributional consequences, and the environment. If the goal is to *minimize economic costs*, many scholars argue the revenue from carbon tax should be used to lower other taxes. For example, [9] argue that because any tax introduces distortion and economic cost, adding a carbon tax on top of existing taxes magnifies the economic cost: "As firms pass CO2 taxes forward into higher energy prices, this drives up product prices in general, thereby depressing the real return to work effort and savings. . .Reducing the buying power (real returns) to capital and labor depresses labor supply and capital accumulation." Therefore, as many scholars argue, the goal should be to minimize the economic damages of carbon tax by cutting other taxes. The most substantial recent study in this vein is [10], which examines several different revenue scenarios, including using the revenue to reduce the deficit or cut taxes on labor or capital, and finds that if the carbon tax is used to cut capital tax rates, it can actually increase GDP (see also [11–14]). Minimizing economic costs and using the revenue to cut capital taxes is also useful politically, to bring on board political actors who might not otherwise be convinced of the need for a carbon tax, because the broader public debate revolves around the perceived economic costs of these policies. British Columbia uses revenue from its carbon tax to fund a reduction in the corporate tax rate and taxes on small businesses, among other uses [15]. Although there are certainly criticisms of the argument that tax cuts for capital lead to significant benefits for the economy (e.g. [16]), a recent review found that "almost all studies agree that recycling the revenue through capital or corporate tax cuts is preferable, from an efficiency perspective, in the long term" [17].

On the other hand, a different goal may be *distributional*. A carbon tax is generally held to be regressive, because lower-income households spend much larger shares of their income on energy costs ([18, 19]. It is not fair for lower-income households to bear a disproportionate share of the burden of climate change mitigation, and therefore—some argue—the revenue from the carbon tax should be returned to low-income households ([20, 18]. The Carbon Pricing Leadership Coalition report is clear that lessening the regressivity of the tax may be necessary to generate political coalitions in its favor. However, some scholars argue that this goal conflicts with the goal to minimize the economic damage from the tax. For example, [18] conclude that a lump sum rebate is the policy that most improves the fortunes of the bottom three quintiles, while "recycling revenue to reduce capital taxes is the most efficient policy, but we

caution that it makes carbon pricing, which is already regressive, even more so." They suggest as a middle option using carbon tax revenues to reduce labor taxes. They worry that "if the rebate policy is viewed as an attempt to reduce inequality, this might introduce a controversial policy sub-plot to an already polarized debate." Moreover, recycling revenue to lower income households could be a selling point for carbon taxes in some circumstances but could be politically unpopular in other cases. The ultimate political consequences are unclear. The Australian carbon tax reserved a significant share of its revenue to be returned as dividends to lower and middle-income households, but this was not enough to overcome the political opposition that eventually saw the tax repealed [15]. Other authors dispute the equity-efficiency tradeoff of carbon tax entirely, finding that economic efficiency and distributional concerns need not always be in conflict [21, 22].

Cost-and-no-benefit analysis

If the goals of economic efficiency and distributional justice are potentially in conflict, at least the literature is aware of these two goals, examines the extent to which they are in conflict, and tries explicitly to reconcile them. But on the question of *environmental benefits*, the literature is surprisingly silent. Because environmental consequences are hard to measure, the peer-reviewed econometric literature assessing the consequences of carbon taxes generally ignores environmental consequences. A World Bank report examined 30 years of scholarship on carbon taxes in peer-reviewed journals and found only a handful that examine their effects on the environment. Even fewer studies attempt to include the environmental benefits in an overarching assessment of the costs and benefits of carbon tax [23].

This is because of the inherent difficulty of modeling climate harms and benefits. Marron and Toder note:

> Carbon dioxide emissions stay in the atmosphere for decades. Their environmental and economic impacts depend nonlinearly on the stock of greenhouse gases, which will depend on future economic developments, domestic climate policies, and policies elsewhere in the world. Estimating the marginal social cost of carbon thus requires complex modeling and assumptions about the trajectory of carbon emissions, climate sensitivity, and the impacts of any climate changes, all of which are uncertain. The cost may depend critically on controversial assumptions, such as what value to place on low-probability, catastrophic outcomes and what discount rate to apply in valuing damages far in the future [19]

As a result, the estimates of environmental costs are wildly different, with a mean of $196 per metric ton of carbon but a standard deviation of $322. Examining the social costs of carbon has become more common in governmental cost-benefit analyses in the U.S. over the last decade, because a court case in 2008 concluded that governmental analysts could not assume that carbon emissions reductions have no value [24, 25]. Nevertheless, this literature generally ends with a wide range of measurements and an acknowledgment of uncertainty, since there are parameters that will forever remain outside the bounds of any attempt at calculation, such as the actions of future governments, and parameters that do not generate any consensus, such as the discount rate. Tol, in a metareview of these studies, concludes that "estimates of the social cost of carbon or the Pigouvian tax are highly uncertain and are very sensitive to the researcher's assumptions about people's attitudes toward the distant future, faraway lands, and remote probabilities" [26]. Governmental calculations have seen drastic revisions, ranging from $-10 to over $100, and changing from one year to the next the conclusion of the benefits of particular policies ([24, 27]. Pindyck argues that the conclusions of these models are almost

entirely a function of an arbitrarily chosen discount rate, and that these exercises "create a perception of knowledge and precision that is illusory, and can fool policy-makers into thinking that the forecasts the models generate have some kind of scientific legitimacy" [26].

Because of this uncertainty, rather than attempt to model the environmental benefits of carbon tax, most cost-benefit analyses of carbon tax take the approach of beginning with a specific emissions reduction target and determining only what is the most cost-effective way of reaching it, a goal which demands less information and therefore affords more certainty [19]. While this approach is sensible given the uncertainties and political controversies surrounding the measurement of environmental harm, it leaves the literature disproportionately oriented to economic costs, and silent on the possible environmental benefits of carbon tax: "Since existing empirical studies on carbon tax do not account for the benefits of mitigating climate change, the common findings are carbon taxes cause the economy to shrink . . . While the magnitude of carbon tax varies significantly [depending on] how the carbon tax revenue is recycled to the economy, the direction of impact is always negative, with few exceptions" [23].

For example, one study argues "Substituting carbon taxes for other sources of revenue or using the proceeds to reduce deficits or finance expenditures are the keys to integration of carbon taxes with proposals for fiscal reform" [11]. But the authors do not assess whether using the revenue to facilitate the development of alternative energy would result in more or less abatement of carbon emissions, examining only how cuts in tax rates or returning the revenue in a lump sum would affect abatement. And they do not include the environmental benefits in their conclusion: "We focus on the market consequences of the carbon tax and recycling policies. We do not consider the avoided damages and climate benefits that would accompany such policies". Similarly, another study argues for using carbon tax revenues to reduce capital taxation [10]. The authors find that the carbon tax reduces CO2 emissions, but they do not include the benefits of this reduction in assessing the costs and benefits of the tax, and they do not assess whether using the revenue for environmental purposes could lead to greater reductions in CO2 emissions. Because the environmental benefits are out of the equation, these authors ignore the question of whether using carbon tax revenue for environmental purposes would lead to even greater emissions abatement and thus to even greater overall benefit.

As Nemet, Holloway, and Meier write, because these benefits are not considered in economic studies "the focus on cost minimization—rather than comparison of benefits and costs—diminishes the role of benefits in general"[28]. They note that targets for abatement levels are specified exogenously and treated as given in many carbon tax studies, and thus "the marginal damages of climate change do not influence choices among policy options" and "The resulting marginalization of climatic benefits has had the effect of excluding quantitative representation of benefits in general."

Perhaps most striking is that the focus on quantifiable costs leads these scholars to criticize the policies that may be precisely the ones to have the most environmental benefits. For example, the success of carbon tax in the Nordic countries has been attributed to their use of carbon tax revenue to subsidize research and development into clear energy technologies. One study cites "compelling technological contingences or breakthroughs. . .a continued phase out of nuclear power; a rapid ramping up of onshore and offshore wind energy; a spectacular diffusion of electric vehicles; a massive increase in bioenergy production; and the commercialization of industrial scale carbon capture and storage" as the relevant factors in explaining the energy transition in the Nordic countries [29]. Other authors emphasize the development of substitute fuels as a primary factor in the reduction of climate emissions [4, 30]. Using carbon tax revenue to subsidize research and development into clean energy technologies could thus be a means of accelerating technological innovation that gives firms the ability to reduce carbon emissions [31]. As Liscow and Karpilow argue, because innovations are non-linear and

can build over time in a "snowballing" fashion, "To address social harms like climate change, government policy should encourage innovation in targeted areas" [32], giving clean energy technologies a "big push" that would fundamentally alter the trajectory of innovation.

But Timilsina [23] notes that when carbon tax revenues are used to subsidize renewable electricity and efficiency improvements, the existing models, which are not equipped to consider the environmental benefits, show only economic costs, because the policy is only "recycling the revenue from one distortionary policy (i.e., carbon tax) to finance another distortionary policy (i.e., clean technology subsidy)." The policies most likely to lead to the development and adoption of substitute cleaner-burning fuels are precisely the ones that are deemed too distortionary by the existing models, because their benefits—particularly the nonlinear benefits of rapid technology improvement—are not visible in the models.

The motivations behind decisions to leave out environmental benefits are understandable given the impossibility of calculating them, but the result is a scholarship that thoroughly explores the costs of carbon taxes to economic growth but is unable to consider the possible benefits to the environment. This leads to policy suggestions that may not be the most effective in reducing carbon emissions.

The new starve the beast

If the literature on carbon tax misses hidden benefits of carbon tax, it also misses a hidden danger: the carbon tax generates revenue only if individuals or firms are paying the tax, that is, if they are emitting carbon. To the extent that they are able to bypass the tax by substituting to lower-carbon substitutes—or to the extent that lower-carbon emitting firms drive out higher carbon-emitting firms—revenues from the tax fall. If those revenues have been used to substitute for other taxes, when revenues fall the programs funded with those revenues come under threat.

One study, for example, in analyzing the effect of carbon taxes in Canadian provinces, assumes fixed elasticities of response of fuel use to carbon taxes [33]. But given the immense research and development infrastructure that has been generated around environmental technologies, this assumption of fixed elasticities is questionable, and it may be necessary to model also the elasticity of the elasticity—that is, it may become much easier to improve energy efficiency or substitute renewable fuels than it is now. For example, the price per watt of solar photovoltaic cells has dropped from over $70 in 1977, to under 70 cents today. That kind of nonlinear development in technology is common in the rapidly developing green technology sector, but it is not incorporated in the current models. Indeed, the most ambitious countries have aimed to become 100% free of fossil fuel, and in the Nordic countries 63% of electricity already comes from renewable energy [34; see also 30].

Consider McKibbin et al.'s argument for using carbon tax revenues to reduce capital taxation: "In that case, investment rises, employment and wages rise, and overall GDP is significantly above its baseline through year 25" [10]. But what happens when one introduces nonlinear technological development, of the kind seen in the development of solar energy, into the model? The environmental benefits would of course be dramatic, but the revenues from the carbon tax would fall, because these newer technologies emit less carbon and thus generate less tax revenue. If capital taxes or other taxes have been cut, then the programs that were supported by the carbon tax revenue can only be financed through deficits, through new taxes, or through cuts in spending, none of which are included in the optimistic model about economic benefits. These developments may reduce some of those economic benefits. Stern and Stiglitz [1] argue that this would only happen over the very long run, but it is hard to be confident of this prediction given the rapid development of clean energy technologies.

In a sense, using carbon tax revenue to replace other tax revenue pits the goal of reducing environmental emissions against the goal of preserving revenue for government programs, because efforts to reduce carbon emissions will starve the government of funds. Of course, taxes could always be raised in the future if and when this problem arises, and Gillis [35] suggests tax cuts are often reversed or undone in subtle ways. However, in the American context, cutting taxes has become an important electoral tool, and politicians therefore have an incentive to spotlight and campaign against tax increases, making maintenance of tax revenue more difficult than in other countries [36]. Carbon taxes could thus become a new means of reducing the size of government by changing the default situation to one of declining tax revenues.

One strategy to mitigate this problem would be to incrementally raise the price of carbon emissions to keep government revenue fixed. For example, one study notes that the Swiss carbon tax "establishes a clear link between the rate and pre-defined quantitative reduction targets of CO2 emissions. In case reduction targets are not achieved an increase in the CO2 levy rate is triggered" [30]. Similar policies could be adopted to preserve government revenue, although these would make the carbon tax tougher to implement politically. Some scholars worry that policymakers will in fact privilege the preservation of revenue over the reduction of carbon emissions, keeping carbon emissions high in order to keep revenue high ([37, 28]). A strategy to avoid this would be to avoid using the revenue for general government purposes altogether.

Policy implications

In *Cents and Sensibility*, Morton Schapiro tells the story of a World Bank report that evaluated a World Health Organization program to counteract river blindness in Africa. The WHO considered the program highly successful, as there was progress in stamping out the disease in 90% of the areas covered by the program, without going over budget. But when the World Bank tried to analyze the success of the program using traditional economic principles of cost-benefit analysis, the result was inconclusive. Schapiro writes: "If you count value in economic terms—changes in earnings discounted back to the present—the answer is, alas, not all that much [value generated] in areas with high unemployment and low educational achievement" [38]. Because the beneficiaries could not be expected to be particularly productive in economic terms, the economic benefits were not as large as they would be for those in contexts where the beneficiaries could be expected to earn more. The authors of the report noted "there are humanitarian benefits associated with reducing the blindness and suffering" but "these benefits are inherently unmeasurable, and we will not account for them here." The benefits of curing blindness for large numbers of people simply do not enter the cost-benefit analysis.

In a way, this hesitation to tread where one's methods do not go can be seen as admirable modesty. If the mandate is to measure the calculable benefits of a program, then clearly things that are not calculable are outside of one's remit, and one should not try to force them into calculability. These calculations are best thought of as exercises, designed to shed light on some issues but not to provide a wholesale judgment on programs.

The problem arises when policymakers make decisions based on these partial analyses as if they were complete analyses. This behavior, too, is understandable: policymakers who care about evidence and analysis and rigor (which does not constitute the entirety of the population of policymakers) will gravitate toward studies that claim to provide it and may let themselves be guided by such studies. But if scholars are unwilling to consider incalculable benefits, policymakers who pay attention to scholars will be making decisions based on overestimations of costs and underestimations of benefits.

This phenomenon seems to be occurring today with the study of carbon tax. Decision-makers should be wary of relying on the economic scholarship for this reason.

Simply pointing out the insufficiency of these approaches, however, does not give us alternative principles for policy analysis and selection. Thus, rather than completely ignoring cost-benefit calculations, a better principle is that we should always examine cost-benefit calculations with an eye toward whether the unmeasurable factors are symmetrical or asymmetrical. If both costs and benefits have equal degrees of difficulty of measurement, cost-benefit analysis cannot be a guide to action. However, where, as in this case, there is a strong tendency for unmeasurable factors to be in one direction—the calculation of benefits—cost-benefit analysis can be a guide to action if it is taken as providing a lower bound. Despite the difficulties of measurement, the implications for policy in this case are clear: carbon tax is a more promising policy than cost-benefit calculations would lead us to believe. More precise measurement is not necessary to reach that conclusion.

But if there are unmeasurable benefits to carbon tax, there is also a hidden danger. If carbon taxes are substituted for other taxes, then the tax base of the state becomes dependent on the revenue from carbon taxes continuing. If that revenue declines—as it surely must, given the rapid development of alternative energy and energy efficiency technologies, which will make it easier for firms and individuals to reduce carbon emissions and therefore no longer need to pay the tax—then the tax base of the state declines.

Of course, there will be many who would celebrate the decline of the tax base and the pressure it puts on government to reduce spending. However, voters who are concerned about climate change and would be willing to support a carbon tax tend to be on the progressive part of the political spectrum. It cannot be assumed that they will be sanguine about a shrinking tax base. If carbon tax is to avoid losing support among such voters, a general principle is that it should not lead to an unintentional weakening of state capacity in future.

In the absence of the ability to measure and take into account environmental benefits, policy proposals cannot be made by drawing on precise measurements, but rather by drawing on general principles. The general principle to avoid unintentionally weakening state capacity gives us one way to evaluate various policy proposals for the use of carbon tax revenue.

(1) Using the revenue to cut other existing taxes

The discussion in the paper argues against this approach, because revenues from carbon tax are destined to—indeed, intended to—decline. In fact, this is the main approach that should *not* be adopted according to the principles suggested in this paper. For example, a popular suggestion is to reduce taxes on labor to lessen the regressivity of carbon tax. However, taxes on labor such as payroll taxes fund highly popular programs, including Social Security and Medicare in the U.S., and other welfare programs in other countries. Pinning these programs on a revenue base that is destined to shrink is a stealth politics of shrinking the welfare state.

(2) Merging the revenue with tax revenue from other sources

Similarly, if the revenue from carbon tax has been merged into general revenue, general revenues will eventually decline. While they would be declining from a higher base given the addition of the carbon tax revenue, and asymptotically to the same level as before, the danger is that necessary programs will come to depend on carbon tax revenue and will eventually be threatened as revenues decline. If carbon tax revenues are not clearly distinguished from other revenue sources, there will be no structural ability for policymakers to protect necessary programs from what is in fact a temporary tax base.

(3) Using the revenue to reduce debt

Using carbon tax revenue to reduce debt is a plausible use of the revenue. In an ideal scenario, by the time carbon tax revenues start to decline, significant headway will have been

made in eliminating or substantially reducing debt, leading to benefits for the economy. The temporary nature of carbon tax revenues is not a disadvantage in this case because they will have contributed to reduction in the stock of debt. They can be seen as transitional revenues with a temporally limited purpose, lowering levels of debt. This may not be the best use of carbon tax revenue, however, if interest rates remain low. This approach also seems to be unpopular with the American public [39].

(4) Using the revenue to lessen the regressivity of the carbon tax

Carbon tax revenue could be used to carve out exemptions to the carbon tax for lower-income households. This does not violate the principle of preserving state capacity, and because the decline of carbon tax revenue implies that the costs the tax inflicts are declining, the exemptions become less necessary as revenue declines. However, this approach lowers incentives for emissions reductions among households who have been given exemptions.

(5) Returning the revenue to households in a lump sum

For that reason, it may be better to collect the revenue without exemptions, and then return it to lower-income households, or to all households, as "carbon dividends." Returning it to lower income households would lessen regressivity, while returning it to all households would increase the proposal's popularity. As carbon tax revenue declines, these dividends would decline, but no other aspect of state capacity would be threatened. Many have argued that this approach would be the one most likely to generate broad political support among the public [17], and [40] show that even a universal dividend not targeted to the poor would disproportionately benefit the poor, because the wealthy produce more carbon emissions and would pay more of the tax.

(6) Using the revenue to subsidize environmentally beneficial technologies or policies

Finally, one strategy would be to implement carbon tax but use the revenues to promote the growth of energy efficiency and alternative energy technologies. In Denmark, which boasts perhaps the most successful carbon tax, 40% of tax revenue was used in ways that led to the promotion of clean energy technology [31]. Polls find this use of carbon tax revenue to be the most popular among the American public, even generating majority support among Republicans [39, 41]. There are several concerns to consider in designing such a policy: if not designed carefully, policies to promote green technology can end up benefiting the wealthy [42]; not all governments have been as successful as Denmark in using carbon revenue for productive clean energy purposes [35]; and clean energy technologies can be funded through measures other than carbon tax. Nevertheless, if designed carefully such a policy could help to reach climate goals that cannot be reached directly through carbon tax. For example, there are some areas where individuals or businesses may be unable to reduce carbon emissions because cleaner-burning fuels are not available; carbon tax revenue could be used for research and development in such areas [8]. Industries exposed to trade may also require government assistance to reduce emissions [43].

This paper thus argues for ways that policymaking can be informed by evidence but not led astray by the false precision of cost-benefit estimates. As this discussion shows, even without precise measurements, we can develop principles that can lead us to favor carbon taxes, but to reject the option of using carbon tax revenues to reduce other taxes, and to be wary of merging carbon tax revenue into general revenue, the first two of the six options above. While options three and four respect the principle of integrity of the tax base, they have other disadvantages.

The last two options combined—carbon dividends plus funding for green technology—could produce an emissions reduction policy that generates public support, follows the advice of economists, takes into account the hidden as well as visible benefits of carbon tax, and also

responds to the basic principle suggested here: don't use a temporary source of revenue to make permanent changes in the tax code.

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