ISSUE BRIEF

Progressing to a Fair Carbon Tax

Policy Design Options and Impacts to Households

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Daniel F. Morris and Clayton Munnings

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RESOURCES
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Key Points

- Carbon taxes are likely not as regressive as they are often thought to be.
- Poor households can be compensated for increased prices through effective use of tax revenue.
- Incidence measures based on annual income or only use-side effects may overstate tax regressivity.
- Government programs that index to inflation may contribute to a more progressive tax.
- Tax effects in different parts of the country will be muted.
- Recycling revenue to consumers through direct rebates will be progressive and reach more households, though targeted tax swaps could have similar effects.

Introduction

In his 2013 State of the Union address, President Obama pledged to use his executive authority to reduce greenhouse gas emissions and combat climate change unless Congress resurrected its previous efforts to pass a market-based solution through carbon pricing. Congress, however, remains reticent to revisit cap-and-trade, and a carbon tax appears for the time being to be similarly unpopular.

Carbon pricing is still the most powerful policy option the country can employ to reduce its release into the atmosphere and to decelerate climate change, but it is a distasteful option for many members of Congress. One reason political opposition to carbon pricing continues to be strong is the potential regressive impacts of increased energy and consumer goods prices resulting from additional carbon charges, which functionally operate as a type of energy tax (Hsu 2011).

While conventional political wisdom holds that carbon taxes will punish poor and vulnerable populations, economic

[1] Daniel Morris is a center fellow at the Center for Climate and Electricity Policy at Resources for the Future, morris@rff.org. Munnings is a research assistant at Resources for the Future.

research from past the few decades suggests that is not necessarily the case. Carbon prices, as with all consumptive taxes, generally do have regressive impacts (Metcalf 1999); that regressivity, however, can be overstated by using short-term or non-representative income measures (Poterba 1989) and it can easily be addressed in the design of carbon pricing policies. Well-designed, market-based carbon control policies can, in fact, protect vulnerable classes of citizens.

Previous versions of comprehensive climate legislation in the 111th Congress recognized this and included provisions to help offset carbon price impacts on low-income households. One approach, taken by Waxman–Markey and other cap-and-trade bills, indirectly compensated consumers by keeping their electricity rates low through allowance value allocations to local distribution companies.

Another approach, embodied in the Cantwell–Collins bill, directly compensates consumers through a rebate. Although these two mechanisms likely would have different impacts on the economy, they show that there are multiple options for Congress to buffer vulnerable consumers while properly pricing greenhouse gases.

The challenge then for lawmakers is to better understand the important impacts from carbon pricing on their most vulnerable constituents, so they can craft effective legislation that helps lower greenhouse gas emissions while sheltering consumers. This issue brief aims to explain the complexities of the distributional consequences of carbon pricing, specifically carbon taxes, based on over 20 years of economic research. It highlights major findings from the economic literature and describes the pathways through which US households may be affected by carbon taxes, what considerations are important in determining the regressivity of carbon pricing, what might be experienced by different regions of the country, and how vulnerable populations could be effectively compensated.

Crafting a National Carbon Tax

Proposed bills from the 113th Congress include a carbon tax between $15 and $35 per ton of carbon dioxide, which is within the range of estimates of the social cost of carbon in 2015 established in a 2010 federal study (IWGSCC 2010). Anticipating the kinds of impacts carbon pricing may have on poorer and more vulnerable citizens can help legislators design effective policies to address both greenhouse gas emissions and budgetary concerns.

A national carbon tax would likely be applied to large, domestic greenhouse gas polluters—including power plants, oil refineries, manufacturers, natural gas distributers, and other facilities. Polluters would pay the actual carbon charge for each ton of carbon emitted from their operations. Some portion of the tax will be passed through to consumers, in the form of higher energy prices and more expensive goods and services. Some studies estimate coal companies could pass virtually all compliance costs associated with a carbon price onto consumers, although there is less certainty for oil companies, which could pass on as little as 2 percent of the burden onto consumers or as much as 89 percent (Metcalf et al. 2008).

Understanding the "tax incidence"—how carbon taxes reverberate through the economy to impact consumers—can help lawmakers and economists better gauge their true effects. Research from the past 20 years on incidence and distributional consequences has predominantly focused on the effects of carbon pricing on household income, though studies have also investigated how it can impact households based on race (Rausch et al. 2011), age (Burtraw et al. 2011), and geography (Burtraw et al. 2009). These studies provide a good understanding of what makes a carbon tax regressive or not, how low-income populations can be protected from negative impacts of the tax, and other useful considerations for implementing a national price on carbon.

How to Think About Carbon Tax Impacts

The first step in understanding the distributional impacts of carbon pricing is to map out the avenues through which price increases reach households. The assumption that only consumers will bear the burden of cost increases make carbon taxes appear to be more regressive than they may be in practice.

Previous economic research has identified at least six distributional impact pathways through which environmental and energy mandates can reach consumers (Fullerton 2008). Taxes can provide more flexibility for regulated parties to reduce pollution, so while the effects of mandates and taxes are not exactly the same, they may lead to similar outcomes for households. Furthermore, not all of these pathways result in regressivity; some may have a greater effect on higher-income households or capital owners. The pathways as described by Fullerton (2008) are:

- **Increased costs to consumers**—Carbon taxes will raise the prices of energy and some goods on which low-income households spend a greater percentage of their income. This is known as a use-side impact. At first glance, this appears to be a regressive outcome, but it may not be the case. Measurements of income (annual versus lifetime) are key to determining the regressivity of impacts on consumers.
- **Lower Production/Increased Factor Costs**—Higher prices on goods from carbon taxes may lead to reduced production in regulated sectors, while simultaneously putting pressure on labor and capital factors to compensate for the costs of cleaner processes. This dynamic, called source-side impacts, could affect households through lower wages, but it could also mean lower returns on capital for wealthy capital owners, which would reduce the overall regressivity of the policy.
- **Value of Scarcity**—Taxes on carbon generate scarcity rents because they restrict output while raising prices. With a tax, those rents manifest as tax revenue that the government captures

and can use to offset negative effects on consumers. The use of tax revenue is integral to understanding distributional impacts.

- **Benefits of Pollution Reduction**—Reductions in carbon pollution will benefit the country as a whole in the form of avoided damages, but some areas will benefit more than others. These benefits can be extremely difficult to measure accurately, so they are typically not included in economic assessments, and we will not address them here. They are, however, a real and important consideration for the effects of a carbon tax.
- **Impacts to Capital**—Just like impacts from GHG pollution will not be the same in every part of the country, neither will the benefits of a carbon tax. Some states or regions may benefit more than others, and if those benefits accrue to capital owners who are already well off, the results could be regressive. Outcomes like this can be reduced by government action to compensate disadvantages populations.
- **Transitional Effects—**If a carbon tax causes a shift away from fossil fuel extraction or some kinds of manufacturing, then workers in those industries will be negatively affected, not only by the immediate loss of employment, but also by the lost value of their developed skills. This is another area where direct government support would be needed to help offsets such losses.

Although these impact pathways will influence the overall outcome of a carbon tax, most existing economic research on distributional impacts has covered costs to consumers, effects on production, and use of tax revenue.

How Does a Carbon Tax Affect Households?

As previously mentioned, studies have confirmed the regressive nature of carbon taxes. Some estimates suggest the income burden from carbon taxes may be as high as 3.5 percent for low-income households, but less than 1 percent for households in the highest income range (Grainger and Kolstad 2010; Mathur and Morris 2012). Recent economic literature, however, suggests that the impact of carbon pricing on households is less regressive than previously suspected, even before utilizing carbon price revenue to compensate households (Hassett et al. 2007; Hassett et al. 2009; Rausch et al. 2009, 2010, 2011; Fullerton et al. 2011). This finding reflects an evolution in academic thinking on carbon pricing incidence and moves away from the idea that carbon pricing is strictly a regressive policy.

Part of the movement within the economic literature is due to changing assumptions that may lead to overestimating the regressivity of carbon pricing. Simplified assumptions about household impacts, including the role of social safety nets and appropriate measurements of incidence, have led to estimates that appear to be less regressive. By adjusting these assumptions to better reflect current economic understanding, more recent studies have produced estimates that suggest regressivity is not guaranteed. In fact, using different measurements of incidence can result in burden estimates for low-income households that are more than a percentage point lower (Grainger and Kolstad 2010; Mathur and Morris 2012).

These changes have helped to build a compelling case that carbon pricing may have a neutral or possibly even progressive effect—even before redistributing tax revenue. Policymakers can hopefully use this information to better appreciate the full implications of a carbon tax and may design future policies to protect vulnerable populations while also striking an acceptable balance between equity and efficiency.

ANNUAL VERSUS LIFETIME INCOME

Researchers have long recognized that excise taxes have regressive effects on households when considering annual income (Pechman 1985). The conventional case for the regressivity of carbon pricing mirrors the economists' arguments for the regressivity of excise taxes. While richer households purchase more goods and therefore pay more excise tax in absolute terms, excise taxes paid ordinarily constitute a larger fraction of a poorer household's budget (Hsu 2011). In relative terms, the tax burden falls disproportionately onto poorer households and when ranking household impacts by annual income, research confirms this regressivity (Metcalf 1999).

But does annual income accurately represent a household's well-being over time? Not necessarily. Some researchers argue that using annual income as a measurement of household well-being overstates the degree of inequality of excise tax burdens, exaggerating the effects of both progressive and regressive taxes (Poterba 1989). This may be the case for a number of reasons. First, the annual income of households follows a predictable path: younger households earn less income as members earn education and first enter the workforce; middle-aged households earn the most income as members' careers mature; and older households earn less income as members retire. Second, annual income can vary significantly year to year. Temporary unemployment, for example, changes income drastically.

An alternative is to represent a households' well-being with lifetime income. Estimating a household's future income, however, is difficult and speculative. Economists use a work-around which posits that only changes in permanent income impact a household's consumption patterns (Friedman 1957), thus annual consumption can be a reasonable proxy for lifetime income. Considering lifetime income makes a notable difference in the estimated regressivity of a carbon tax. Grainger and Kolstad (2009; 2010) find that a carbon price appears two to three times more regressive when measured using annual income, as opposed to annual consumption. Utilizing another proxy for lifetime income, Hassett et al. (2007) and Hassett et al. (2009) find minor regressivity from a carbon tax. Taken together, these studies verify that judging incidence impacts in terms of annual income alone will likely result in an exaggeration of regressivity.

SOURCE-SIDE EFFECTS

Income measurements are not the only consideration that can affect regressivity estimates of carbon taxes. A more robust picture of tax impacts includes not only changes in energy prices, but also changes in the price of goods and services, as well as capital and labor effects. An important assumption in some studies is that producers can completely pass carbon tax burdens on to consumers—in the form of higher energy prices, meaning only use-side effects are accounted for—and that consumers would not reduce consumption of any products (Grainger et al. 2010). Those researchers assumed, in other words, that a carbon tax did not impact producers.

One method that addresses the impact of carbon taxes on product prices is to trace it throughout different sectors of the economy as measured by the federal government[2] and calculate emissions associated with intermediate and final products in each economic sector (Grainger et al. 2010). Researchers can then match price increases to Consumer Expenditure Surveys, which provide annual consumption patterns for different income quintiles in the United States. Many researchers have drawn from this process to analyze the distributional impacts of pollution taxes (Metcalf 1999) and carbon prices (Grainger et al. 2009; Metcalf 2009; Beznoska et al. 2013).

More dynamic approaches allow for producers to alter labor, capital, and pollution in response to the tax and for consumers to change their purchasing behavior. This approach more accurately represents reality by letting consumers substitute away from carbon-intensive goods and provides for a more accurate representation of the impact of carbon pricing on producers (Fullerton et al. 2007).

In reality, producers cannot fully pass the burden associated with a carbon tax on to consumers. Instead, producers incur a portion of this burden that is determined in part by the underlying elasticities of supply and demand for that producer's goods (Metcalf et al. 2008). A 2007 study estimates that, for a carbon pricing proposal, 87 percent of the tax burden is passed down to consumers, with the remaining 13 percent falling on producers (NCEP 2007). This remainder may reduce returns on producers' investments or lead to reductions in workers' wages (Ramseur et al. 2012). These source-side effects may also negatively impact the well-being of households that draw some income from investments in producers (that is, higher-income households) or earn income from wages paid by producers.

Research employing the dynamic approach described above found that source-side effects largely drive distributional impacts across income groups (Rausch et al. 2009). Specifically, they found that a $15 carbon price increased fuel prices 13 percent and decreased capital rental rates by 0.8

[2] The Bureau of Economic Analysis—part of the US Department of Commerce—regularly publishes input-output tables, which track purchases between all sectors of the economy.

percent and wages by 0.6 percent. While the latter effects seem small, wage and capital make up virtually all of a households income—especially for high-income households. In contrast, energy purchases take up only a fraction of household income, even for low-income households. The source-side effect of carbon pricing, therefore, is highly progressive.

In fact, Rausch et al. finds that the progressivity of source-side effects outweighs the regressivity of use-side effects, leading to a neutral to modestly progressive carbon price impact across all households. Further studies find similar results (Rausch et al. 2010; Rausch et al. 2011), though others find carbon pricing to be slightly regressive when considering source-side effects (Fullerton et al. 2011). The issue remains unsettled.

SOCIAL SAFETY NETS

Until recently, most analyses of the incidence of carbon pricing failed to acknowledge the effect of inflation indexing on households. This effect is potentially important because a carbon price would increase energy prices which, in turn, would boost inflation. The government automatically adjusts most income transferred to households to account for inflation. Including inflation indexing may result in more progressive distributional impacts because transfer payments accrue disproportionately to low-income households.

Government programs that index transfers to inflation buffer recipient households from the full impact of carbon pricing by increasing their total benefit payment. The magnitude of an average household's benefit payment is largely determined by income received from Social Security, which accounts for roughly 90 percent of cash transferred via government programs.[3] In addition, Dinan (2012) identifies Supplemental Nutrition Action Payments (SNAP), formerly named Food Stamps, as a program that might buffer low-income households from the burden of a carbon price. SNAP payments are pegged to food prices and would increase to the extent that a carbon price increased grocery bills. Other indexed programs include those which manage supplementary security, workers' compensation, and veterans' benefits. Benefit payments from all of these programs are adjusted annually to inflation according to the Consumer Price Index. Taken together, these programs index nearly 95 percent of transfer income to inflation (Fullerton et al. 2011).

Low-income households, moreover, receive a disproportionate amount of income from benefit payments. Social Security payments alone constitute an estimated 42 percent of annual household income for the lowest income quintile, partly due to the age of those households. The second lowest and middle annual income quintiles receive 21 percent and 9 percent, respectively, of their income from Social Security payments with the highest two annual income quintiles

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[3] This estimate also includes income from railroad retirement.

receiving less than 5 percent of their income from these payments (Blonz et al. 2012). One study finds that the progressive effect of inflation indexing is strong enough to overcome the regressive impact of increased energy prices, when measuring incidence in terms of annual expenditures (Fullerton et al. 2011).

Blonz et al. (2012) consider additional ways that inflation indexing might influence the distributional burden of carbon pricing. The authors specifically assess the Earned Income Tax Credit (EITC; which provides an annual tax credit to low-income households that participate in the workforce) and the indexation of tax brackets, in addition to accounting for Social Security and veterans' benefit payments. Without accounting for inflation indexing, the authors find that carbon pricing set forth by Waxman–Markey would have increased net costs by 0.25 percent of annual income for the average household in the lowest annual income quintile. This net cost, however, turns into a net gain of 0.13 percent of annual income when the authors account for inflation indexing.

As Table 1 shows, this beneficial trend holds for the lowest three annual income quintiles. The top two annual income quintiles, on the other hand, incur a relatively minor net cost of .05 percent of annual income as they pay a larger share of taxes covering the EITC and Social Security and veterans' benefit payments. Accounting for the impact of the EITC and indexation of tax brackets further bolsters the progressivity of inflation indexing.

Table 1. Household Burden by Annual Income Quintile Under Waxman-Markey

Income Quintile	Average Household Income	Before Accounting for Inflation Indexing	After Accounting for Inflation Indexing	Net Effect of Inflation Indexing
1	11,610	0.25	-0.13	-.38
2	26,842	1.08	0.89	-.20
3	44,074	1.03	1.00	-.03
4	68,620	0.88	0.93	.05
5	140,280	0.53	0.58	.05

Note: Adapted from Blonz et al. (2012). Burdens are reported as percentages of annual income.

Dinan (2012) calculates that accounting for inflation indexing reduces the estimated burden of the lowest and second lowest income quintiles by $40 and $50, respectively. For the lowest income quintile, this translates into a burden reduction of 0.2 percent of annual income—a change from 2.5 percent to 2.3 percent of annual income. For higher income quintiles, the burden reduction is less dramatic with virtually no change in burden for the highest income quintile. Therefore, Dinan (2012) confirms the progressivity of inflation indexing.

Although accounting for inflation indexing given a certain carbon pricing policy may result in a progressive estimate of incidence for the lowest-income quintile overall, this does not mean that all low-income households are protected. In fact, approximately one-third of the lowest-income quintile receives no transfer payments (Fullerton et al. 2011). While amendments to the tax code—for example, an extension of the EITC—could reach some households not receiving transfer payments, a full one-sixth of households in this quintile receive no income or transfer payments.

In an attempt to maximize the number of low-income households buffered by the regressive impacts of carbon pricing, one study suggests a two-pronged approach that combines an expansion of the EITC with rebates through existing Electronic Benefit Transfer systems that already provide aid to low-income households at the state level. This combined approach would help buffer the vast majority of households in the lowest annual income quintile from the regressive impacts of carbon pricing (Greenstein et al. 2008).

Regional Carbon Tax Effects

Just as carbon tax impacts will not be felt equally by different income groups, different regions of the country will not receive the same price signals. The existing economic models cannot deliver reliable estimates about household impacts in specific cities or congressional districts. There are, however, clear patterns that one might see from a national carbon tax in terms of price increases in different regions of the country.

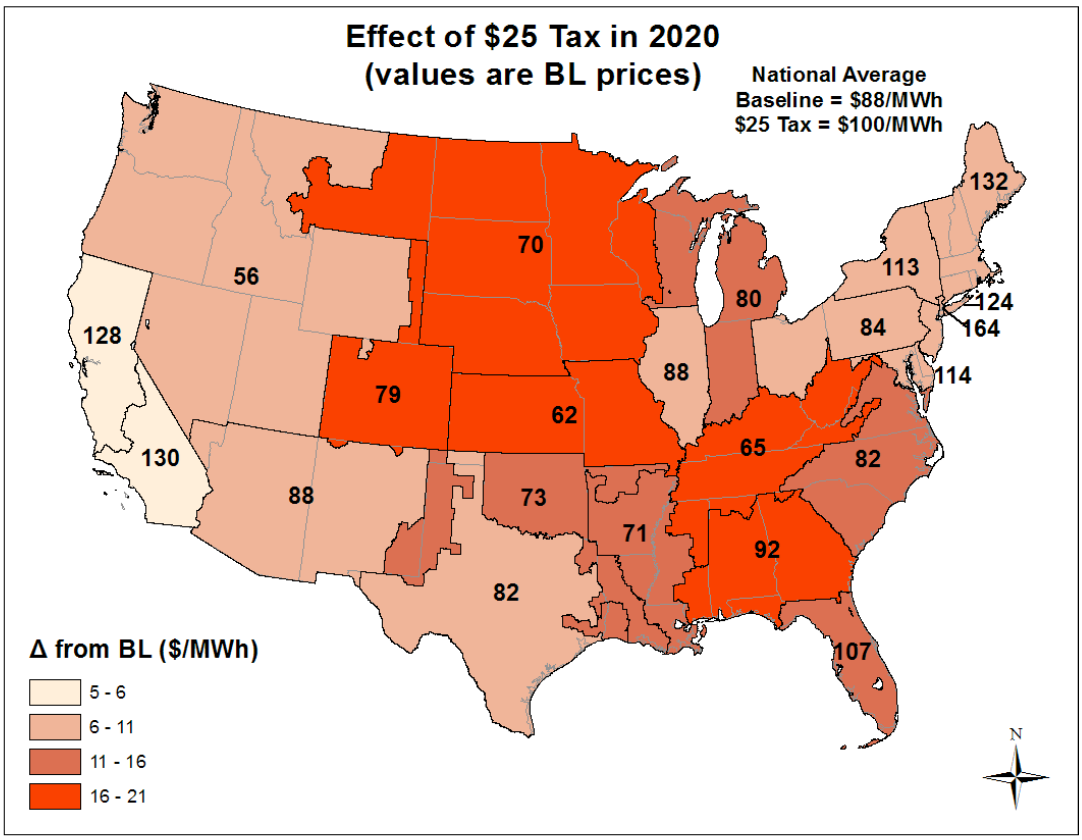
The electricity sector will most prominently show regional disparities in price increases. Modeling of cap-and-trade policies from the Energy Information Agency show that the electricity sector will account for about 70 percent of emissions reductions through 2030, even though it is responsible for around 40 percent of actual GHG emissions. Areas of the country that depend more on fossil-fuel rich fuels for electricity production will see greater price increases than areas that utilize renewable sources or nuclear power. Those regions, however, currently pay less in electricity prices, so the carbon tax will result in a price flattening across the nation.

Palmer et al. (2012) find this pattern to be the case for electricity prices. They find that a carbon tax of $25 raises national electricity prices by an average of 12 percent, but that the increase could be as little as 4 percent in southern California or as much as roughly 33 percent in Missouri, Kansas, and most of Appalachia. Their findings, presented in Figure 1 below, represent the average household in each region and do not show the differences between states within a single region.

It is important to note that while areas in the Midwest and Appalachia experience a notable increase in electricity prices, they still have some of the cheapest electricity in the country. Additionally, households in these regions may spend less money on electricity than other regions and more on other energy inputs like gasoline or heating oil.

It may be the case that a carbon tax has similar effects on household income in different regions even though it has heterogeneous effects on energy prices. For instance, Mathur and Morris (2012) find that the tax burden for average households cluster around 1.5 percent of annual income. This is despite the fact that areas like the Upper Midwest and Appalachia spend more money on gasoline, whereas New England spends more money on home heating oil. These findings are similar to a previous study that found the differences between regions were smaller than anticipated (Hassett et al. 2009). Both of these studies find that while direct energy consumption of specific fuels varies by region, overall direct energy consumption of all types (electricity, gasoline, heating oil, natural gas) is such that the carbon tax does not significantly disadvantage households in any specific region.

Figure 1. Retail Electricity Prices in 2020 by Region



Source: Palmer et al. 2012.

Other studies look at regional impacts of carbon pricing, in the form of cap and trade, beyond the average household. Burtraw et al. (2009) also find there is not much difference in welfare impacts for the average household on a regional basis (less than one percent of income), but low-income households in California and Texas may experience welfare losses of greater than three percent. Another study that looks across age demographics finds very minor differences between household income effects in separate regions, and that the results are also small when considering the age of the households (Blonz et al. 2011). Overall, current economic research shows that regional effects from carbon taxes are not excessively heterogeneous and that all parts of the country will experience roughly similar income and welfare impacts.

Offsetting the Burden on Poor Households

Although a carbon tax may be less regressive than it appears at first blush, it still is potentially more burdensome to poor households than to wealthier households. The direct and indirect burdens of the tax, however, are only part of the story. No discussion of this topic is complete without including how the revenues generated from the tax should be used. Disproportionate burdens on low-income households can be alleviated by directing some portion of carbon tax revenues to them, through direct rebates or swaps to reduce other, more distortionary taxes. Recent research suggests that it would take 11 to 12 percent of revenues from a $15 to $28 carbon tax to offset the impacts to the poorest 20 percent of households (Dinan 2012; Mathur and Morris 2012). The use of revenues from the carbon tax is critical in determining the progressivity of the tax, and could in some cases possibly lead to increased regressivity. There are a number of ways to recycle revenue from carbon pricing back to consumers.

DIRECT REBATES

One of the most straightforward options to offset regressivity is to cut households a check from carbon tax revenue and send it back to them directly. This approach would benefit all households, though not necessarily equally, depending on the size of the rebate. The distributional mechanism central to the Cantwell–Collins cap-and-trade bill in the 111th Congress was a lump sum rebate delivered back to households. As a result, most of the analysis of this mechanism was done in a cap-and-trade context, though the effects for a carbon tax would be similar. Research suggests that while direct rebates to households do benefit all households, they have a progressive effect—they most benefit the lowest 20 percent of households, especially if the rebates are subject to marginal income taxes (Burtraw et al. 2009).

When compared to targeted programs to protect low-income households, lump sum rebates may also improve the overall economic efficiency of the policy because they will not overcompensate those households, which could lead to more energy use and, in turn, lead to higher abatement costs (Rausch et al., 2009). Additionally, wealthier households are more likely to save and invest a portion of their rebate, possibly improving economic efficiency even more. Other forms of rebates, such as income and payroll tax rebates, would be on net progressive and could help expand the number of eligible households that actually receive the rebates, although they would include some increase administrative costs (Dinan 2012).

TAX SWAPS

Another way to directly offset household income losses is to swap carbon tax revenue with existing distortionary taxes. The tax swap approach would compensate households for income lost to the carbon tax by reducing income and payroll taxes, which may enhance economic efficiency, depending on the distortionary tax being offset. Tax swaps involve important tradeoffs, however. Increased economic efficiency may come at the detriment of equity concerns. If lawmakers are most concerned about protecting low-income households, then they need to ensure they offset specific taxes that will benefit those households.

For example, research indicates that a proportional reduction in income taxes with carbon tax revenue would most benefit the highest income brackets and make the policy more regressive overall. Targeted income tax reductions would mute this effect, but it would not help those households that do not make enough to pay income taxes; at least one estimate shows only 30 percent of the poorest households would benefit from an income tax reduction (Dinan 2012). Similarly, using carbon tax revenue to reduce corporate tax rates would initially benefit owners of corporate stock, which are mostly high-income households. Over time, benefits would eventually accrue to wage earners, but the overall benefits to low-income households from offsetting taxes on capital would likely be minimal, and it would be far less than the positive impacts to higher earning households (Mathur and Morris 2012).

This dynamic could mean that a carbon tax looks more regressive after a tax swap because even though the burden of the tax would be reduced across the board, higher-income households receive more benefits. There also is no guarantee that a single tax swap will reach all vulnerable households because not all of them are subject to income or payroll taxes, nor do they benefit from corporate taxes. Targeting specific programs designed to assist low-income households like the EITC as described in the previous section may result in a more progressive carbon tax, though at some cost to efficiency.

Conclusion

Distributional impacts from carbon pricing remain a serious concern for legislators investigating the possible benefit from assigning a price to carbon dioxide emissions. A carbon price in the form of a tax can indeed have disproportionate effects on poorer households, but regressivity is by no means guaranteed. When accounting for how households anticipate their spending over time and the long-term effects on capital investment and operations, a carbon tax begins to appear more progressive than conventional wisdom has previously suggested. Additionally, different parts of the country do not appear to be unequally exposed to negative impacts from the carbon tax. This does not mean, however, that lower-income households are unaffected. They will use a greater proportion of their income to compensate for higher energy and commodity prices. Luckily, there exist many options for Congress to help those poorer citizens, through direct rebates or tax swaps. By utilizing mechanisms that take equity concerns into consideration, policymakers can design an effective solution that balances economic efficiency with the welfare of the nation's most vulnerable.

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