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Cash transfers for pro-poor carbon taxes in Latin America and the Caribbean

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Abstract

Carbon taxes are advocated as efficient fiscal and environmental policies, but they have proven difficult to implement. One reason is that carbon taxes can aggravate poverty by increasing prices of basic goods and services such as food, heating, and commuting. Meanwhile, cash transfer programs have been established as some of the most efficient poverty-reducing policies used in developing countries. Here, we quantify how governments can mitigate negative social consequences of carbon taxes by expanding the beneficiary base or the amounts disbursed with existing cash transfer programs. We focus on Latin America and the Caribbean, a region that has pioneered cash transfer programs, which aspires to contribute to climate mitigation, and faces inequality. We find that 30% of carbon revenues could suffice to compensate poor and vulnerable households on average, leaving 70% to fund other political priorities. We also quantify tradeoffs for governments choosing who and how much to compensate.

Introduction

Latin America and the Caribbean (LAC) is facing common challenges in the pathway to sustainable development. Many LAC countries have graduated from low-income status and aspire to join the OECD. And all have made commitments to climate mitigation laid out in the Paris Agreement. Nevertheless, the provision of essential services remains a priority in the region[1–3]. Six percent of Latin Americans lack access to water, eighteen lack sanitation, and five lack a reliable electricity connection[4–6]. In addition, fiscal consolidation and debt reduction are prime concerns[7], leaving little room for governments to maneuver.

Carbon taxes could help fund development priorities and achieve mitigation targets. A carbon tax consistent with the Paris Agreement goals could generate more than 100 billion USD revenue per year in the region, enough to close the water, sanitation, or electricity access gaps[4]. And taxing greenhouse gases would incentivize consumers and firms to reduce fossil fuel and beef consumption, thereby improving health outcomes and reducing emissions of global and local pollutants [8–11].

But carbon taxes have proved difficult to implement globally, as illustrated by the yellow vest movement in France, the *gazolinazo* in Mexico, and the rejection of a carbon tax in Washington.[12,13] One stated reason is their potential adverse near-term social impacts, especially on poor and vulnerable housheolds[14–18]. Indeed, the experience of energy subsidy removal suggests that compensating negatively affected households with complementary policies is one of the keys to make reforms that increase the price of basic goods successful[19–25].

Here, we assess how existing cash transfer programs can be used to mitigate the negative impact of carbon taxes on poor and vulnerable households. Cash transfer programs are one of the most efficient ways for delivering social assistance: they reduce poverty, improve school attendance and health outcomes, encourage savings and investment, foster business creation, increase labor force participation for adults and reduce child work.[26] The region has pioneered their implementation with the Mexican *Progresa* in the mid-nineties. Similar programs are now present in most countries in LAC and reach more than 140 million people, including 48 million beneficiaries of *Bolsa Familia* in Brazil, the largest program in the world[27,28]. But cash transfers are not perfect. In the region, they only reach half of the households living in poverty (they suffer from weak *coverage*), and 40% of the disbursement benefit households who are not poor at all (they are imperfectly *targeted*)[28].

Despite those imperfections, we find that recycling revenues from a carbon tax back to household in cash disbursements would have a *progressive* income effect: households in poorer quintiles would see their real income increase by 5 to 9% on average, while households in richer quintiles would be net contributors. Governments do not need to redistribute all carbon revenues to compensate poor and vulnerable groups. In half the countries we analyze, governments would need to recycle less than 30% of carbon revenues into carbon rebates backed by existing cash transfer programs to make the poorest two quintiles break even, leaving more than 70% of carbon tax receipts to fund other priorities. We also quantify options to maximize the number of households who benefit from the reform across income groups, in the spirit of building coalitions of voters who could support the reform[29], or avoid that poor households who do not currently qualify for cash transfers in the existing programs be left paying the totality of the cost of a carbon price.

Direct and indirect impacts of a carbon tax on consumers

International studies on distributional impacts of carbon taxes or energy subsidy removal have shown that consumers are affected in two ways: directly through cost increase of fossil fuels and electricity, and indirectly through increasing production costs affecting prices of all goods and services[14,18,30]. We start by quantifying the impact of carbon pricing on consumers in 16 LAC countries (Table 1) in two basic steps. We use input-output analysis to assess the direct impacts in terms of costs to households from increasing the price of fossil fuels based on their greenhouse gas (GHG) content, as well as indirect impact through value chains (see Methods in the *Nature Sustainability* version). Our approach provides an upper-bound estimate of the short-term impact of carbon taxes on households, before firms adjust production processes and consumers adapt to new prices. If we used a more sophisticated model with a

representation of how firms and households from different income levels would adjust to a carbon tax over time, our estimate of the total cost to households of a constant carbon tax would presumably be lowered over time and its incidence could change[14]. On the other hand, a meta-analysis of the literature suggest that modeling the response of firms and consumers plays a limited role in determining whether price hikes are regressive or progressive[31]. Our parsimonious and transparent approach is in line with studies from the International Monetary Fund that aim at giving an indication of how governments can improve the social acceptability of energy price hikes[18,32].

We assess the costs of imposing a tax on both CO_2 emissions and non-CO_2 greenhouse gas emissions (methane, nitrous oxide, and F-gases) according to their respective global warming potential. We model a 30$/t$CO_2$-eq carbon tax, a conservative estimate of the price signal consistent with the Paris Agreement temperature targets according to a recent World Bank report[8], but our model is linear and our results can easily be scaled down or up to other carbon tax levels. Table 1 shows that the greatest price increases would happen for natural gas and petroleum products (median increases of +27% and +14%, respectively). Fossil fuels are indeed the commodities with the highest carbon content per dollar. Electricity is the third most impacted item (+9%). Electricity price increase particularly in countries such as Bolivia, Argentina, and Mexico, which generate electricity from a large share of fossil fuels. Public transport would be the fourth most impacted item (+4%), followed by food (+3%). The same carbon price yields different relative price increases across countries because the prices of energy and commodities vary widely across countries, reflecting different cost structures, taxes and subsidies[9].

Price increase from carbon tax, as % of current price	Median	Argentina	Bolivia	Brazil	Chile	Colombia	Costa Rica	Ecuador	El Salvador	Guatemala	Honduras	Mexico	Nicaragua	Panama	Paraguay	Peru	Uruguay
Natural gas	27.3	154.9	111.5	70.6	21.9	73.6	19.4	58.4	20.1	20.1	19.4	50.6	21.0	19.5	90.0	32.7	19.1
Petroleum, gasoline & diesel	13.7	15.6	16.3	13.9	11.3	11.9	11.4	14.3	11.5	15.0	13.5	15.3	14.1	11.8	18.7	9.5	10.7
Electricity	8.6	18.4	25.8	2.0	8.6	4.2	2.2	11.9	5.1	8.7	10.7	15.5	9.0	7.2	0.5	10.8	5.0
Public transport	3.6	3.5	9.1	2.8	2.8	2.8	2.8	4.1	3.6	11.3	5.3	3.6	5.4	9.2	4.4	3.5	2.1
Food	3.1	5.3	13.1	4.7	2.1	3.8	1.8	2.9	1.6	2.4	3.3	2.2	3.8	1.4	7.8	2.1	6.0
Construction incl. materials	1.4	1.6	4.7	0.9	1.0	1.0	0.7	1.7	0.9	1.5	1.5	1.8	2.3	1.8	0.7	1.2	0.6
Water	1.2	1.2	2.1	0.4	0.4	0.2	1.1	6.7	1.8	1.8	4.3	1.7	2.2	0.5	0.9	0.6	0.4
Manufacturing, electronics & machinery	1.1	1.4	6.7	0.6	1.5	0.5	0.4	1.5	1.1	2.0	1.1	0.9	4.5	1.4	0.6	0.8	0.8
Other expenditures	0.6	0.6	3.1	0.4	0.5	0.5	0.2	0.7	0.4	0.8	1.1	0.6	1.8	0.5	0.6	0.6	0.4

Table 1: Impact of a US$30 per ton CO_2-eq on the cost of consumption items, as a percentage of the current price, per item and country.

The second step is to assess, from consumer income and expenditure surveys, the fraction of spending that households devote to each consumption item listed in table 1 and specifically for the wealthiest and poorest quintiles (see below how the income part is used). Figure 1 shows the result for Brazil. Notably, the bottom quintile spends nearly a quarter of its expenditures on food, while the wealthiest quintile spends 13%. The richest quintile spends relatively more on vehicles and fuels than the poorest quintile: 5.0% versus 1.8% in Brazil, as richer households are more likely to own a car. These trends are representative of the situation across the 16 countries of our sample (the supplementary material provides quantifications for each country).

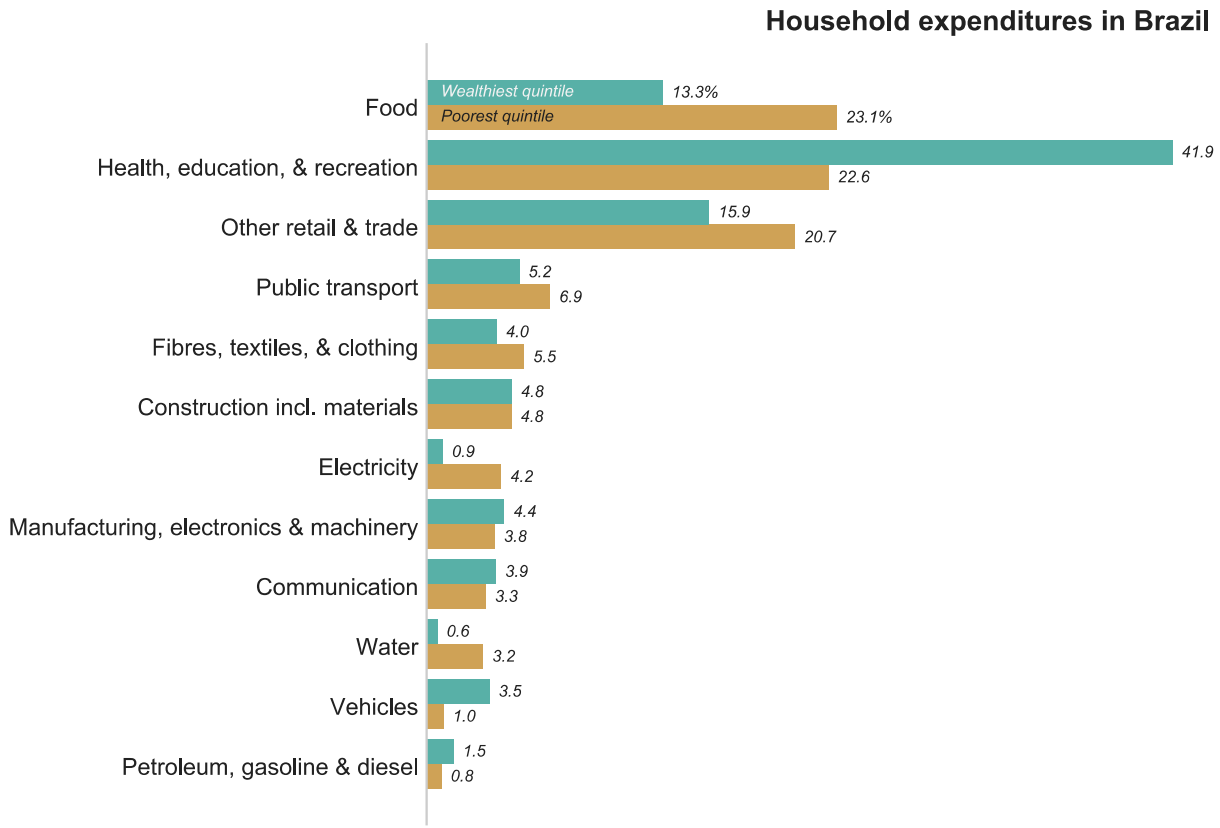

Figure 1: Household expenditures per consumption item, as a fraction of total household expenditure, for the poorest and wealthiest quintiles in Brazil.

From household expenditure data and the price increases in household goods and services, we assess the total (direct and indirect) impact of the carbon tax on households, before any redistribution. In average, the indirect impacts of carbon taxes on food, public transportation, and electricity turn out to cost households more than the direct impacts on fossil fuels. Across all countries and quintiles, the cost of non-CO_2 greenhouse gases emissions from food, and the cost of CO_2 emissions from public transport and electricity represent respectively 42%, 10% and 5% of the total cost of the carbon tax. The preponderant role of food price hikes comes from the fact that while food prices are not dramatically affected by a carbon tax (Table 1), food represents an important share of consumers expenses in the region (Figure 1 and SI). The case of Brazil, pictured in Figure 2, shows the importance of the price of food, public transport, and liquid fuels. Electricity and natural gas are negligible here as Brazil mostly relies on hydroelectricity and natural gas is not commonly used for heating there (see supplementary material for country results). The direct impact on fossil fuels matters relatively more for richer households, because they are more likely to own private vehicles than poorer households.

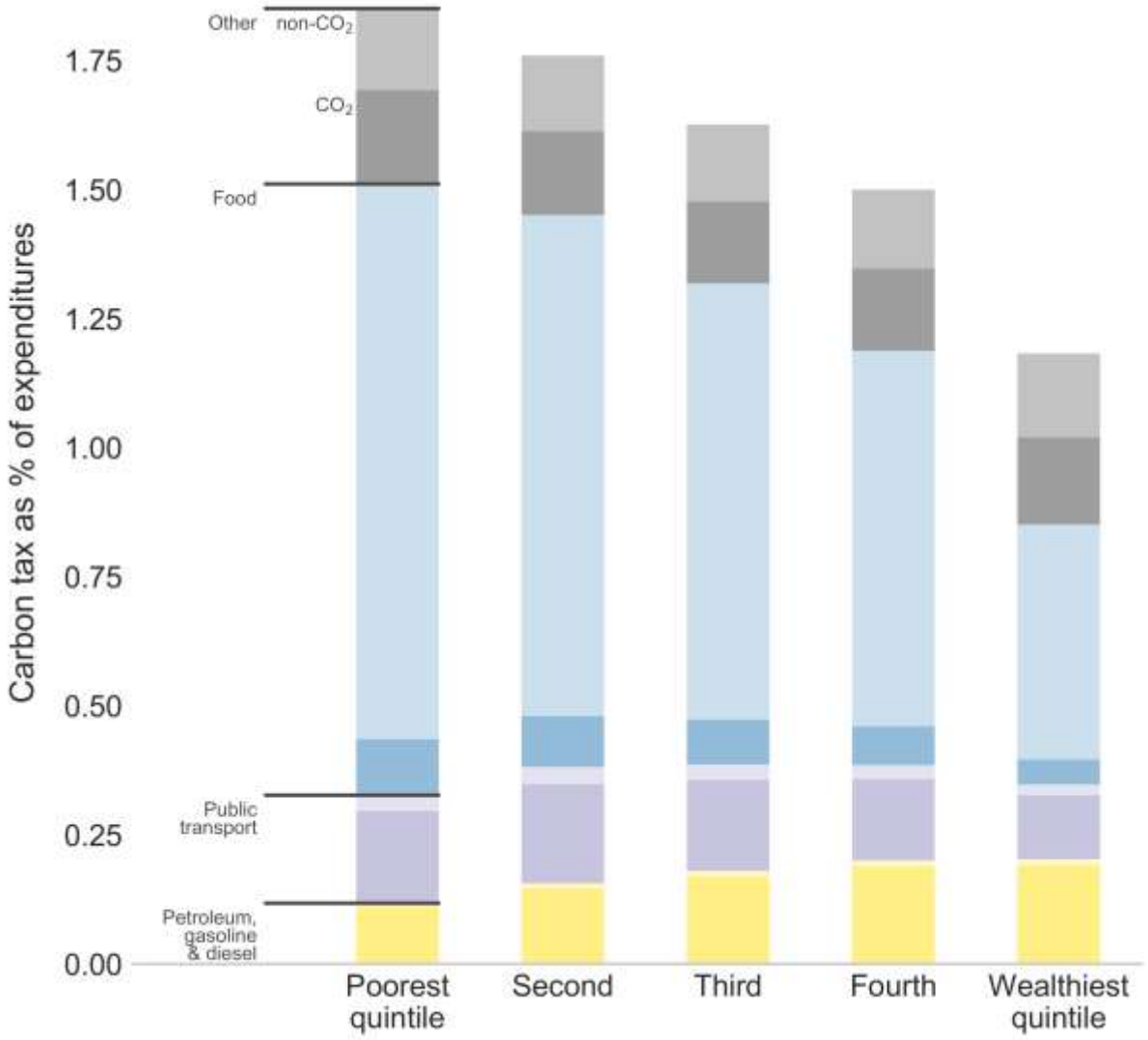

Figure 2: Impacts of a 30$ per ton CO_2-eq carbon tax in Brazil, per consumption item and per expenditure quintile.

In most countries (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, Paraguay, and Uruguay), the combined direct and indirect cost of a carbon tax is regressive – in other words, the poorest quintiles pay a larger cost, relative to their total expenditure, than the richest quintiles, given that the larger share of food, public transport and electricity in the poorest households' budget in these countries. In Bolivia, the cost to the poorest quintile is more than 10% of their total expenditures due to poor households' high spending on food (52%) and high emissions of other GHGs from food production. In Ecuador and El Salvador, the tax is progressive, but still costs the poorest quintile 2.5% and 1.2% of total expenditures, respectively.

The cost of non-CO2 emissions constitutes a significant share of the total cost of the carbon tax on consumers, and a significant driver of the regressively of our modeled taxes. Taxing only carbon emissions from fossil fuel without compensation would be progressive in most countries, in line with previous results (supplementary Excel file)[14]. This difference matters for real-life implementation: many

carbon tax proposals focus on taxing the carbon content of fossil fuel energy as a first step, as doing can be easier than taxing non-CO2 emissions from agriculture.

Using carbon revenues for cash transfers

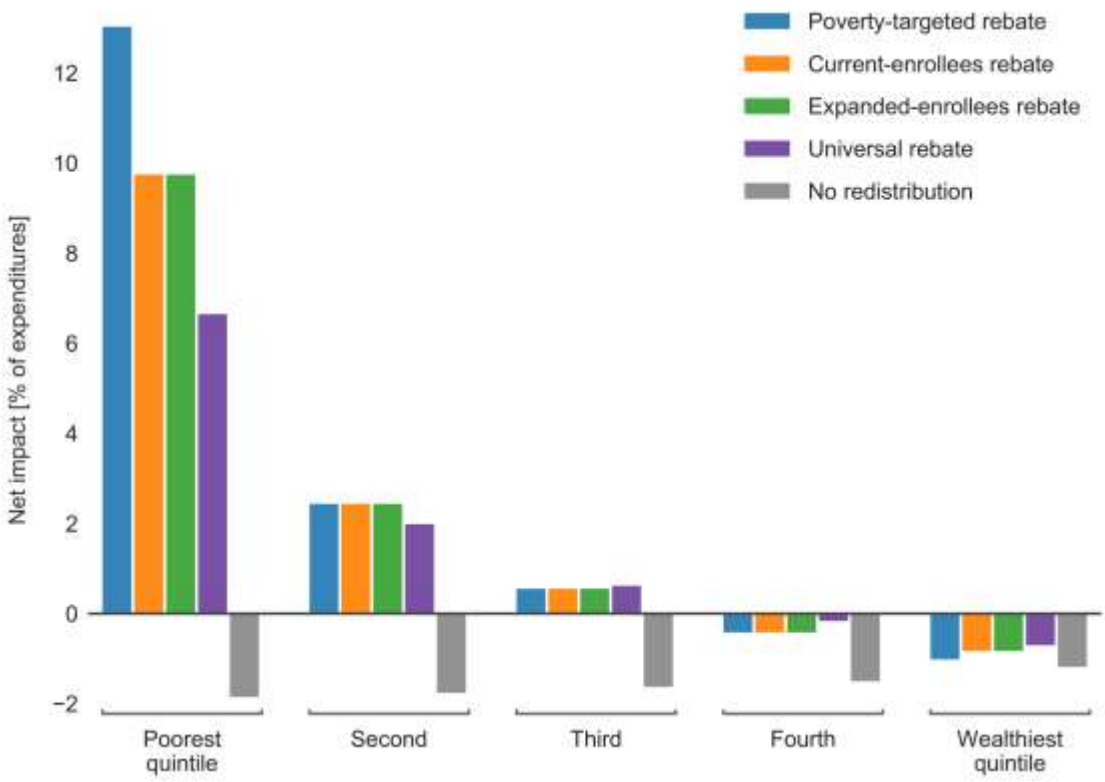

Figure 3: Net impact of a 30$/$CO_2$-eq tax coupled with alternatives for fully redistributing carbon revenues in Brazil. Note: Universal rebate: carbon revenues are distributed evenly to all households. Current-enrollees: carbon revenues are shared evenly among households currently enrolled in cash transfer programs. Expanded-enrollees: carbon revenues are shared evenly among a list of enrollees that includes 25% more households in each quintile than the current cash transfer programs. Poverty-targeted: carbon revenues are shared evenly among a list of enrollees that excludes 50% of top-quintile households and includes the same number of bottom-quintile households.

Whether regressive or progressive, carbon taxes adversely impact poor and vulnerable households, undermining social development objectives and potentially reducing support for reforms[15,17,24,33–37]. The academic literature has established that adequately redistributing carbon revenues can make carbon pricing progressive[15,30,38,39], and may enhance public support for carbon taxes[15,34,36].There are two main options to redistribute revenues. One is to reduce other existing taxes, which may come with the additional benefits of improving economic efficiency, especially in countries where the informal sector and tax evasion are substantial issues [15,40–43]. The other is to increase spending, particularly using either cash or in-kind transfers, such as vouchers for food or energy services or subsidized public transport. Here, we focus on cash transfers. Indeed, it is not clear whether poor people in developing countries pay enough taxes to make cutting taxes an effective compensation mechanism. Moreover, the data we use do not allow investigating this question. Finally, the experience from subsidy removal suggests that governments that reinforce social transfers as part of a reform package are more likely to succeed in increasing prices[16,19–21,23,25].

We first analyze a simple redistribution scheme often mentioned in the literature and policy proposals[19,44,45]: the creation of a new *universal carbon rebate*. This policy redistributes all carbon revenues to all households, on a per capita basis. Iran and India have implemented such a scheme to compensate the impacts of subsidy removal[15]. Figure 3 shows our simulations of this policy for Brazil. The three bottom quintiles would be net beneficiaries, while the top two quintiles would be net contributors. In all 16 countries of the sample, recycling carbon revenues into a universal rebate would ensure bottom quintiles benefit from the reform. Across countries, the median impact on the poorest quintile is 4.7% of total expenses; 0.6% on the third quintile, and -0.9% on the richest quintile (Supplementary Materials).

Another approach to redistributing carbon revenues may be to leverage existing conditional and unconditional cash transfer programs, incrementally improving the established enrollment and delivery mechanisms[46]. We use income information from the household surveys to analyze three ways to do so.

One option is to rebate carbon revenues evenly to all households currently enrolled in cash transfer programs (*current-enrollees rebate* in Figure 3). In all the countries except Honduras and Paraguay, the two bottom quintiles would benefit from a current-enrollee rebate. Except in Honduras and Paraguay, existing cash transfers programs are more likely to reach poorer households than richer households. Rebating carbon revenues only to current enrolees thus tends to make bottom quintiles better off than rebating to all households. (In Argentina and Bolivia, current enrolment is flat, and the impact of both schemes is similar). Across all countries in our sample, the median impact on poorest quintile of the current-enrolees rebate is 8.8% of expenditures, versus 4.7%, for the universal rebate.

In Argentina, Chile, Panama, and Paraguay, our surveys do not discriminate cash transfers from other government transfers. For these four countries, we analysed a rebate to beneficiaries of all transfers from the government. It turns out that noncash government transfers tend to benefit richer households more than poorer households (this is true across the 16 countries). Indeed, those transfers include contributory pensions, unemployment benefits and health insurance that, by design, benefit richer households with formal jobs more than poorer households with informal or no jobs[47].[47] In all countries, rebating carbon revenues to beneficiaries of all government transfers would benefit bottom quintiles less than using a universal rebate or a rebate to enrolees of current cash transfer programs.

Another option to leverage established social protection systems is to expand the beneficiary base. Rather than assuming that governments can implement carbon rebates perfectly targeted to the households most affected by carbon taxes, we investigate incremental improvements from the existing situation. For instance, most of the cash transfers in the region are conditional cash transfers, with one popular condition being school attendance[27,28]. Carbon rebates could leverage existing registries of beneficiaries, without applying some of the conditionalities. As an example, we model an *expanded-enrollees rebate* that would share carbon revenues to a list of beneficiaries that includes 25% more households than those currently receiving transfers in all quintiles (e.g., 50% enrollment increases to 62.5%). Looking at the average effect by quintile, we find that the expanded-enrollees rebate performs similarly to the current-enrollees rebate (Figure 3). Indeed, the two schemes distribute the same total value to each quintile by design.

At the household level, however, increasing the number of beneficiaries matters. Rebating carbon revenues from an unchanged beneficiary base leaves out the consumers who are currently not benefitting from any cash transfer program, resulting in many poor consumers having to cover the full

cost of the carbon tax. On the other hand, expanding the number of beneficiaries reduces the resources available per beneficiary. To shed light on this issue, we compute the fraction of individuals within each quintile that are net beneficiaries from each simulated reform.

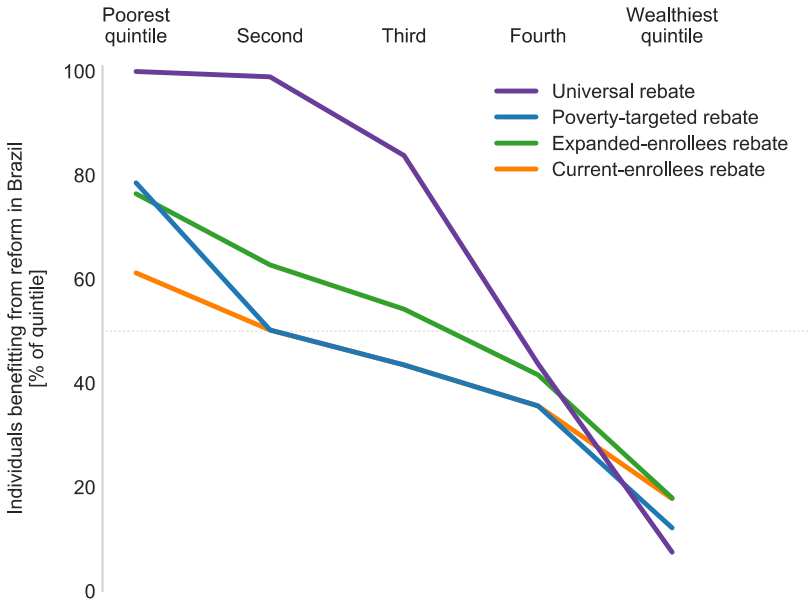

Figure 4: Fraction of households in each quintile experiencing a net benefit from the combined carbon tax and rebate schemes in Brazil

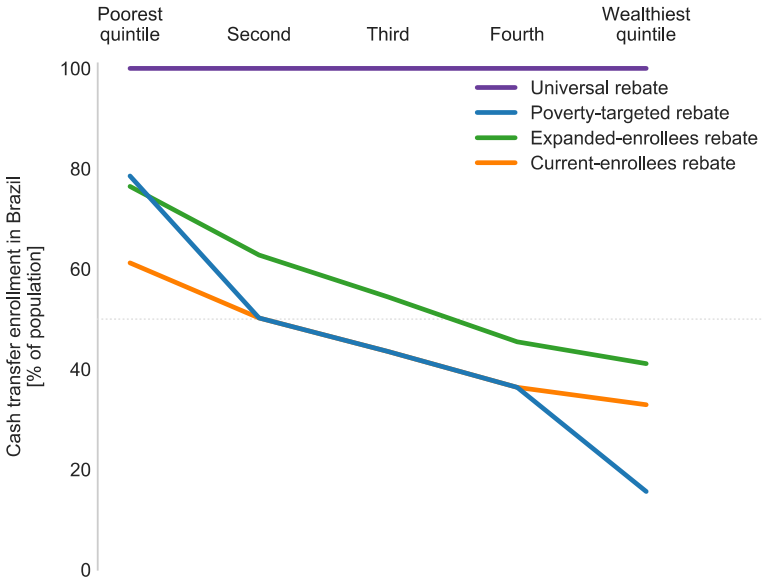

Figure 5 Coverage of simulated carbon rebate programs, in Brazil.

In Brazil, 61% of individuals in the bottom quintile would be net beneficiaries of a carbon tax combined with the current-enrollees rebate (Figure 4, orange line). This corresponds to all current beneficiaries

from cash transfers (Figure 5). At the other end of the income distribution, 33% of Brazilians in the highest quintile are recipients of cash transfers, but only half of them (18% of the quintile) would be net beneficiaries of the current-enrollees scheme. Indeed, richer household tend to spend more money (in absolute terms) on the carbon tax than poorer households, while the rebate gives the same amount to all beneficiaries by design. Poorer recipients thus tend to receive more than what they pay in carbon taxes. The expanded enrollees-scheme performs even better in this metric: in Brazil, almost 80% of the bottom quintile would be net beneficiaries (green line). Over countries, the expanded-enrollees rebate results on 61% (median) of bottom-quintile households to be net beneficiaries.

Because existing cash transfers do not perfectly target poor households, registries of beneficiaries are an imperfect base to design compensation mechanisms. In the last policy simulation, we quantify the impact of skewing the list of beneficiaries in favor of poor households (*poverty-targeted rebate*). In this scheme, carbon revenues are shared evenly among a list of enrollees that starts from the beneficiaries of current cash transfer programs, excluding 50% of top-quintile households, and including the same number of bottom-quintile households. Across the sample, the median coverage of the poverty-targeted rebate among the bottom quintile is 59% (from 55% median coverage of existing cash transfers).

Figure 3 shows that in Brazil, the poverty-targeted rebate would, as expected, have a more progressive impact than both the current-enrollees and the expand-enrollees schemes, when measured at the quintile level. The poverty-targeted scheme also results in more households from the bottom quintile benefiting than the other schemes in eight countries (Argentina, Bolivia, Brazil, Chile, Honduras, Nicaragua, Panama, and Paraguay; Figures 3, 4 and SI). In the other eight (Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Peru, and Uruguay), expanding enrollment performs better for households in the bottom quintile. The difference boils down to current enrollment patterns. In countries where enrollment decreases strongly with income (such as Colombia) expanding coverage across the board is more effective, while in countries where enrollment in current cash transfer programs is flat over expenditure groups (e.g. Bolivia) or even increases with income (e.g. Honduras), improving the targeting tends to be more effective.

If the objective is to maximize the number of poor and vulnerable households who benefit from the reform, recycling carbon revenues in a universal rebate is the preferred option. Over 90% of households in the bottom three quintiles would benefit. But creating a universal rebate from scratch could be challenging. If governments need to start from existing programs, improving their coverage is an effective option. Ideally, the expansions of existing cash transfer could target poor households. But governments could face difficulties in doing that, technically to identify and reach poor households[28], or politically to enact reforms that do not benefit middle-class and well-off voters[29]. Our simulations of an expanded-enrollee rebate show that tolerating the inclusion of richer households would not necessarily jeopardize the effectiveness of the scheme.

Using existing or improved cash transfers programs to compensate vulnerable households

Cost to reimburse bottom 40% (as % of total carbon revenue)	Median	Argentina	Bolivia	Brazil	Chile	Colombia	Costa Rica	Ecuador	El Salvador	Guatemala	Honduras	Mexico	Nicaragua	Panama	Paraguay	Peru	Uruguay
Perfect compensation	16	20	19	14	16	15	14	17	17	15	11	16	15	13	20	18	18
Poverty-targeted rebate	25	40	40	24	30	22	21	25	22	24	36	24	27	23	64	22	36
Expanded-enrollees rebate	27	50	50	28	38	23	22	26	22	27	77	25	32	27	133	23	41
Current-enrollees rebate	27	50	50	28	38	23	22	26	22	27	76	25	32	27	129	23	38
Universal rebate	39	49	48	34	39	38	36	42	42	37	28	39	37	32	51	45	46

Table 2: Fraction of carbon revenue required to make the bottom 40% break even using different policy packages, per country.

Finally, if the purpose of the governments is to make poor and vulnerable household groups break even while maximizing the fraction of carbon revenues used to fund other development programs or pay back national debt, they may not need to recycle all the proceeds of carbon taxes into improving existing cash transfers. Table 2 reports the fraction of revenue required to compensate the two bottom quintiles for their carbon costs, using the recycling schemes analyzed in this paper.

In Brazil, for example, the poorest 40% pays 14% of the total carbon tax. A perfect redistribution mechanism starting from the bottom of the income distribution would need to spend 14% of total revenue from a carbon tax to compensate these two quintiles (first line of table 2). However, an ideal redistribution scheme would require detailed knowledge of each household's expenditures schemes. Other systems based on existing cash transfer program registries or universal redistribution could easier to implement but would be more expensive (table 2).

To compensate the two bottom quintiles for the carbon tax by issuing a carbon rebate to all current enrollees of social protection schemes, the Brazilian government would need to spend two times the amount required in a perfectly targeted scheme—that is, 28% of total carbon tax revenues. If the government started by reducing targeting imperfections in existing social protection schemes, reducing coverage of rich households by 50% and improving coverage of poor households, then the fraction of tax revenue needed would drop to 24%. The government could also simply redistribute 34% of carbon revenues into a universal rebate evenly shared among all households.

As a caveat, in addition to compensating poor and vulnerable households, making sure that a majority of consumers benefit from the reform might be needed to ensure political feasibility.[17,29] Table 34 in the supplementary material shows that among the redistribution schemes we modelled, only the universal rebate can consistently transform at least 60% of consumers into winners. Further research could investigate what fraction of carbon revenues would need to be recycled into a well-selected combination of cash transfers, in kind transfers, and tax rebates to ensure that both poor households and most households across income groups benefit from reforms.

Should governments compensate consumers for the impact of a carbon tax? Some authors consider that all taxes are takings of private property compensable by the government[48], while others consider compensation to provide perverse incentives and thus being detrimental[49]. Beyond normative views,

international experience suggests that any government project to implement carbon taxes without a plan to compensate, at least partially, affected households is unsustainable[16,17,19,23]. Our work provides insights on how cash transfer programs can contribute to such a compensation, while leaving most fiscal resources available to fund other priorities.

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