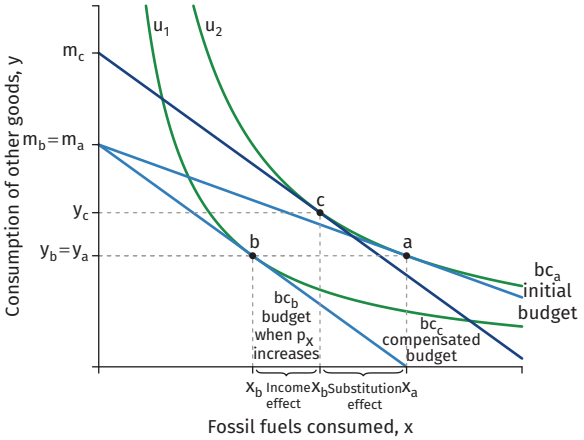
**› EXAMPLE** In their 2017 op-ed (opinion editorial) in *the New York Times* three economists made "A conservative case for climate action," proposing the carbon tax and citizen's dividend that we analyze here. They included Martin Feldstein and Gregory Mankiw, chief economic advisers to US Presidents Ronald Reagan and George W. Bush, respectively.[5]

## Reducing carbon emissions by imposing the tax

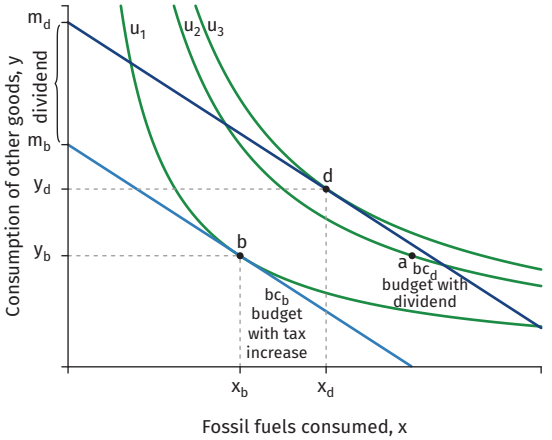
In Figure 7.17, the fossil fuel consumption ($x$) of a citizen is plotted on the horizontal axis, and the consumption of other goods measured in some currency is plotted on the vertical axis ($y$). Before the tax, a citizen is at point **a** in Figure 7.17 where the marginal rate of substitution equals the marginal rate of transformation, which is the existing price of fossil fuels, $p_a$. At **a**, the citizen has a utility of $u_2$ on the corresponding indifference curve.

The government then imposes a tax on fossil fuels. The tax increases the price of fossil fuels. With the increase in the price from $p_a$ to $p_b$ due to the tax, the citizen's budget constraint becomes *steeper*. It pivots inward round its $y$-axis intercept because the amount of the budget itself is unaffected, but the price has *increased*. So $bc_b$ is the *new* budget constraint. As before, the citizen now maximizes her utility now consuming at point **b** where her marginal rate of substitution equals the new marginal rate of transformation, $p_b$. At **b** the constrained utility maximum, the citizen has decreased her consumption of fossil fuels from $x_a$ to $x_b$, consistent with the policy goals of the tax to *decrease* consumption of fossil fuels.

**Figure 7.17 Carbon tax with dividend.** A citizen decides on consumption of fossil fuels ($x$) and other goods ($y$). Prior to the introduction of the carbon tax the citizen's budget is $m_a$ and the budget constraint is the line labeled $bc_a$, with slope $-p_a$. The utility-maximizing bundle is on the budget constraint at point **a** where the citizen's indifference curve $u_2$ is tangent to the budget constraint. A carbon tax increases the price from $p_a$ to $p_b$ steepening the budget constraint. The result, shown in panel (a), is that the budget constraint pivots inward. The effect of the price change—a reduction in fossil fuel consumption from $x_a$ to $x_b$—is the sum of the income and substitution effects. In panel (b) the citizen's dividend increases the household's budget so the budget constraint shifts outward and has a vertical intercept (the budget itself) $m_d > m_b$. The indifference curves shown here are based on a Cobb–Douglas utility function with $\alpha = 0.5$.




(a) Substitution and income effects of the price increase




(b) Second income effect due to citizen dividend

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Setting aside the value that the citizen places on the overall mitigation of the climate-change crisis, the policy has lowered her utility because she is on a lower indifference curve, $u_1 < u_2$.

## Is the tax fair?

All citizens will have lower utility, but the effect will differ by levels of income. In the U.S., the percentage reduction in *real income* imposed by the carbon tax will be *larger* among poorer households. This is because, as Figure 7.18 shows:

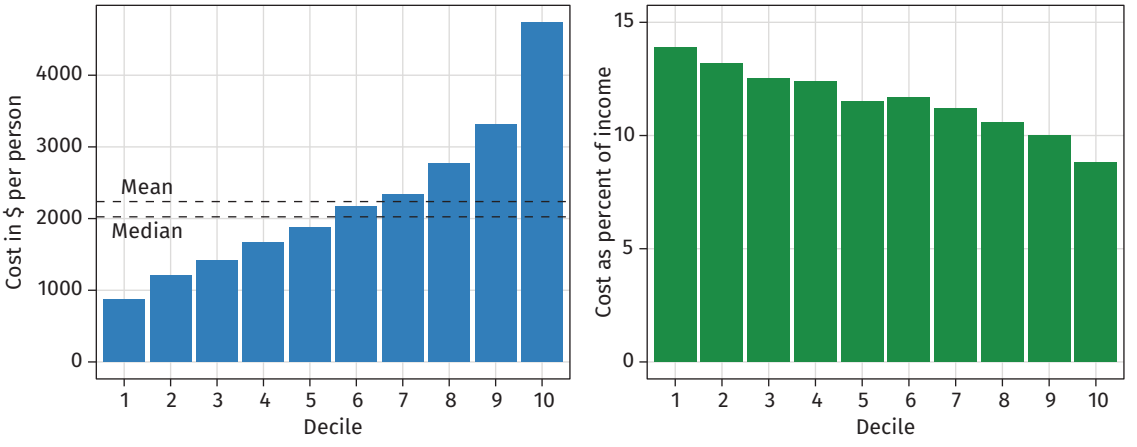
- while (panel (a)) higher-income people spend much more than lower-income households on carbon costs (think about air travel, heating, and air-conditioning large houses);
- expenditure on carbon costs *as a fraction of their total expenditure* is greater for lower-income households (panel (b)).

As a result, high-income people will pay more of the tax than low-income people, but the tax will lower the real income of poor people by a larger percentage than will be the case for higher-income people. In the US the carbon tax is regressive, meaning that the amount paid as a fraction of a household's income is greater for lower-income households. This is where the citizen's dividend comes in.

✓ **FACT CHECK** Using detailed data on household expenditures economists Anders Fremstad and Mark Paul calculated that a tax of $50 per ton of $CO_2$, the revenues of which were distributed equally to all citizen households would raise the real income of 56 percent of US households and 84 percent of households with incomes less than the average income.[6]

**Figure 7.18 Dividend distribution and carbon costs.** The left-hand figure shows the absolute amount spent on carbon for each of the ten household income deciles (1 is poorest, 10 is richest). The right-hand figure shows the proportion of household expenditure on carbon by for the ten income deciles.

Source: Fremstad and Paul (2019) using data from the Energy Information Agency, the Bureau of Economic Analysis, and the Bureau of Labor Statistics.




(a) Average carbon costs per person by income decile

(b) Average proportion of expenditure on carbon by income decile

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## Increasing income and ensuring fairness through a citizen's dividend

To see how the citizen's dividend alters the result, return to Figure 7.17 (b). As in panel (a), the citizen is at point **b** with lower utility than before the tax. But now suppose the total carbon tax revenues collected are divided equally and distributed to each household, raising the budget of each from $m_b$ to $m_d$. This is the citizen's dividend. As you can see, the effect of the dividend is to shift upwards the budget constraint by the same amount.

With the higher income, the citizen maximizes her utility at point **d**. For the citizen we have modeled, the dividend ($m^d - m^b$) is large relative to her previous budget.

The result is an increase in consumption of other goods, so that her level of utility is higher than it was before the tax, that is, comparing points **d** and **a**, $u_3 > u_2$. At **d**, they have higher consumption of other goods ($y_d > y_b$) and they consume a lower level of fossil fuels than they did previously, but greater than before the dividend ($x_a > x_d > x_b$). With the greater consumption of other goods, the citizen has higher utility and they obtain utility of $u_3 > u_1$.

All citizens receive *the same* dividend but higher-income households will pay a larger share of the tax from which the dividend is funded (because their carbon consumption is greater). As a result, lower-income households would pay *less* in taxes (which are proportional to the cost of the carbon they consume) than they receive in the citizen's dividend which is proportional to the mean carbon costs consumed.

Thus, in the US (and other higher-income countries) the carbon tax alone is **regressive**, but the carbon tax and the citizen's dividend taken together is **progressive**. The case we modeled in Figure 7.17 illustrates the increase in disposable income and utility of a poorer-than-average citizen.

## International differences

In some countries, however, the picture is reversed, with poor people spending a small fraction of their budget on carbon-related consumption and wealthy families spending a larger share. The data in Figure 7.19 for Mexico show exactly this, at least for motor fuels. As with carbon costs as a whole, the US data (in the left panels) show that the fraction of the

**REGRESSIVE POLICIES** A system of taxes and transfers or other policies that increase disposable income inequality is regressive.

**PROGRESSIVE POLICIES** A system of taxes and transfers or other policies that reduce disposable income inequality is called progressive.