

# Chapter 15

## Carbon Pricing

Climate change is the most massive external effect we can consider. It affects everyone, and almost everyone contributes to the externality. As a result, carbon pricing represents the most significant and application of corrective taxation. Because of the size of the correction required - income effects are very significant. In most cases of corrective taxation income effects are small and are therefore usually ignored in the analysis. The level of carbon tax required to be effective carbon is so high that the income effects have macroeconomic implications. There are also important distributional implications. Income a

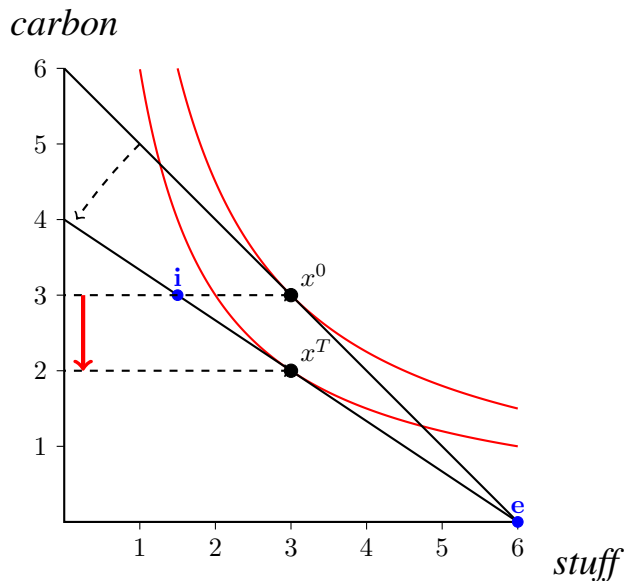


Figure 15.1: The effect of a carbon tax

## 15.1 The basic analysis of income and substitution effects

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Figure 15.1 illustrates the effect of a carbon tax using the indifference curve analysis familiar from intermediate microeconomics. The upper budget line represents the situation without a carbon tax and the lower one represents the budget with a 33% carbon tax.<sup>1</sup>

The indifference curves in the figure are generated by a Cobb-Douglas utility function. They have the property that the share of the budget spent on each good is constant. In this case the fractions are both 0.5. The choice of this utility function explains why  $x^0$  and  $x^T$  are aligned vertically.

In the example the amount of carbon purchased falls from 3 to 2. The tax revenue collected is one third of the original expenditure on carbon.

If demand for carbon were perfectly inelastic – as it might be in the very short run – The lower indifference curve would be tangent to the new budget line at consumption would shift to **i**

If demand were perfectly elastic, demand would shift to **e**. (The indifference curve would have to cross the stuff axis at **e**.)

## 15.2 Revenue Neutrality

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Clearly the effect of a high carbon tax is to lower the utility of the consumer and to withdraw income from circulation. The latter has a multiplied negative effect on GNP at the macro level. These effects are both undesirable and unnecessary.

There are alternative approaches to revenue neutrality

1. The Fee and Dividend scheme proposed by the Green party and others involves revenue neutrality through paying a “carbon dividend” to consumers. The language is intended to help make it clear that the “carbon fee” is not a revenue grab and to make the tax more politically acceptable.

All of the tax revenue is returned to the consumers directly. The process is analogous to actually paying compensating variation. A distinct feature is that the dividend is uniform. Every taxpayer receives the same amount of money, rather than an amount related to their individual spending. The approach is redistributive to some extent, as well as corrective.

This approach relies on widespread spending by the public to promote the transition to a low carbon economy.

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<sup>1</sup>Fossil fuels have been subsidized quite highly. The analysis in this section can be reversed to explore the effect of a subsidy

**Compensating variation (CV)** is a measure of utility change introduced by John Hicks (1939). 'Compensating variation' refers to the amount of additional money an agent would need to reach her initial utility after a change in prices, a change in product quality, or the introduction of new products.

2. The Conservative party of Ontario proposes to achieve revenue neutrality through income tax and corporate tax reductions. The idea is to reduce distortionary taxation in expectation that this will lead to greater investment and economic growth. There is little evidence that this will work. In this case the tax is revenue neutral with respect to the government budget, and somewhat more revenue neutral for households because it returns more of the revenue to higher income people, who spend more on high carbon goods.

It has disadvantages. It will be somewhat more difficult to adjust the tax upward. If the tax works the revenue will fall and income tax will have to be raised again. It is less transparent to the public and therefore does less to make the carbon tax popular, unless accompanied by a monthly check, in which case the inequalities will be very clear.

This approach relies on widespread spending by the wealthier members of the public to promote the transition to a low carbon economy.

3. the Liberal Party of Ontario chooses to divert revenue to selected projects intended to promote climate adaptation. In this case the tax is revenue neutral with respect to the government budget in that revenue is offset by spending. It is not revenue neutral for households. This can be seen as a more 'dirigist' approach. It relies on widespread spending by the government to promote the transition to a low carbon economy.

**Dirigisme** or dirigism (from French diriger, meaning 'to direct') is an economic system where the state exerts a strong directive influence over investment. It designates a capitalist economy in which the state plays a strong directive role, as opposed to a merely regulatory one.

### 15.2.1 A Carbon Dividend and Compensating Variation

Following the proposal of the **Citizens Climate Lobby** and the Green Party, let us examine the effect of a transfer that will restore the average consumer to the original indifference curve while retaining the change in price induced by the carbon tax. It is easy to see that the required com-

*carbon*

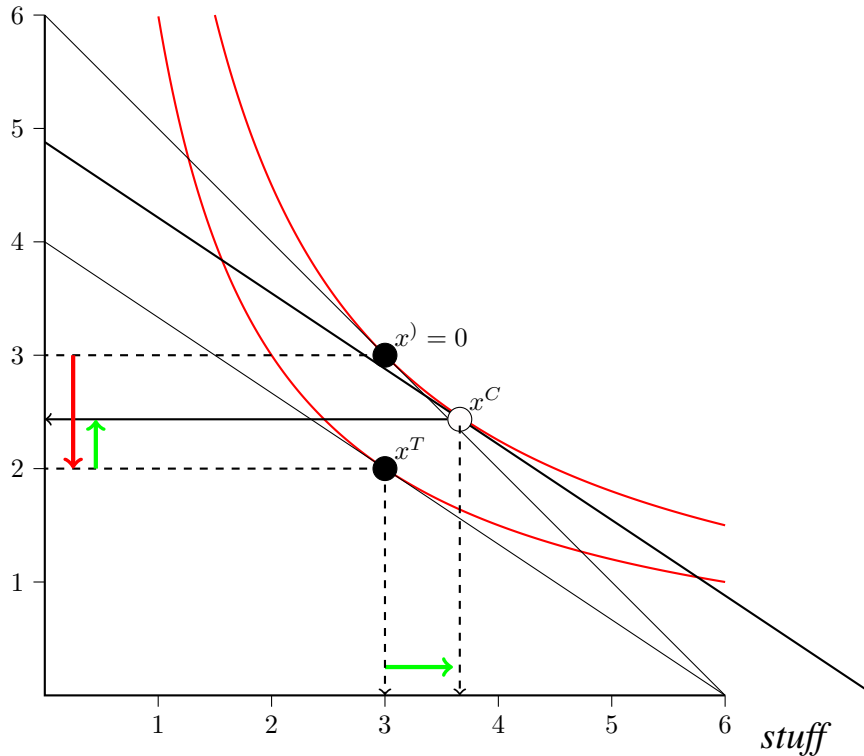


Figure 15.2: The carbon dividend as a compensating variation

pensation is slightly smaller than the tax revenue in this case. This is because of the convexity of the indifference curves.

With compensation, the consumer moves to  $x^C$ . The shift along the indifference curve is a substitution effect. It consists of a reduction in carbon and an increase in other stuff. The move from  $x^C$  to  $x^T$  is the income effect of the tax, which reduce the consumption of both carbon and stuff.

Some of the dividend is spent on more carbon, undoing part of the effect of the carbon tax but also increasing the revenue collected. With many goods, carbon forms a smaller part of the budget, so this rebound

will be smaller.

## 15.3 Distributional effects

The analysis above deals with the representative individual. people differ in tastes and in income, however.

### 15.3.1 differing tastes

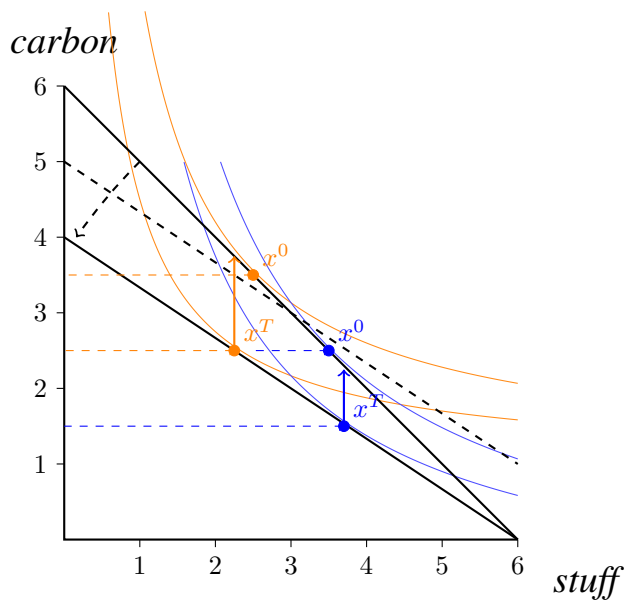


Figure 15.3: The unequal effect of a carbon tax and uniform dividend with different preferences

In Figure 15.3 The orange indifference curve reveals a higher preference for carbon than do the green. the taxes collected are indicated by the length of the coloured vertical arrows. The equal dividend results in the dashed budget line. The carbon lover ends up slightly worse off and the carbon hater slightly better off than where they started with an equal dividend.

### 15.3.2 differing incomes

**Reading:** Lutz Sager (2017) Income inequality and carbon consumption: evidence from environmental Engel curves. Centre for Climate Change Economics and Policy Working paper 319

The analysis for differing incomes is fairly simple if we assume that tastes are independent of income. Using the same Cobb-Douglas preferences we can use the fact that budget shares are constant. This implies that the bundle chosen by a rich person is simply a multiple of the bundle for a poor person. (Cobb-Douglas preferences are homothetic, to use a technical term). In this special case a person who earns 10 times the income will pay 10 times the tax.

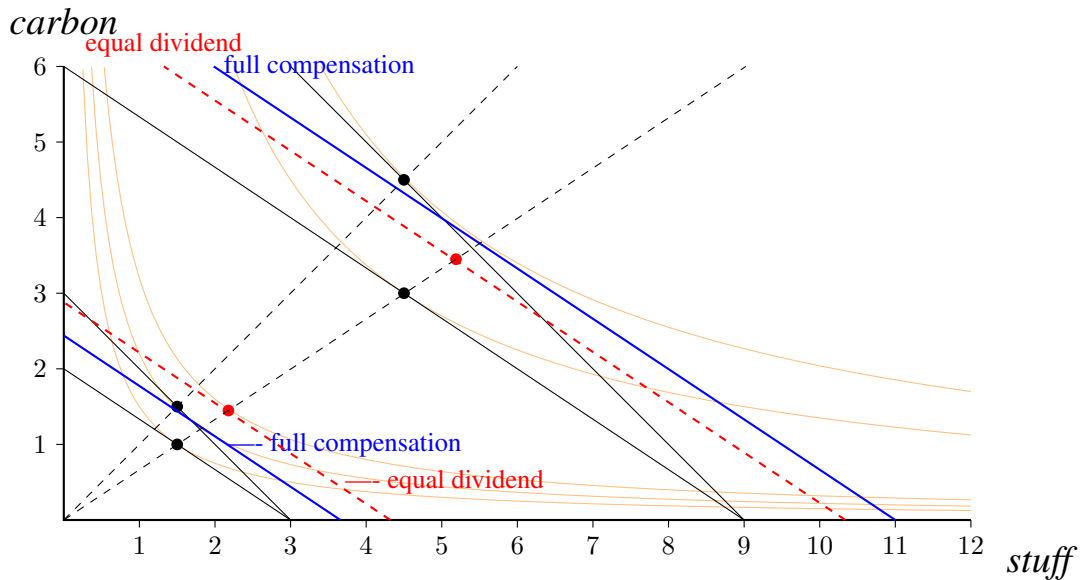


Figure 15.4: Equal dividend with incomes that differ by a factor of 3

If the compensation were in proportion to the tax paid, a person with 10 times the income would also receive 10 times the compensation. The fee and dividend approach that appears to have the widest support, however, proposes a **uniform** dividend. Rich and poor would receive the same compensating transfer.

Imagine a community with one rich person and ten poor. Let the rich person have with 10 times the income of a poor person. Total tax revenue would be, say 20. The dividend would be  $20/11$ . The poor would get back 1.818, or 82% more than they pay and the rich would get only 20% of their tax back.

It is clear that that rich people actually consume more carbon on average. The 10% of households with the highest incomes had an average carbon footprint of 59.4 metric tons of CO<sub>2</sub> per household in 2009. The 10% of households with the lowest incomes had a carbon footprint of

18.1 metric tons. On the other hand, research by Lutz Sage however, shows that in the USA poorer households actually spend a larger **proportion** of their income than better-off households on carbon-intensive products and services, such as fossil-fuel-based energy. (Based on modelling of BCs carbon tax, the top 1% of households had emissions three times the average, and almost six times the emissions of households in the bottom decile.)

Using Sage's numbers, assuming a tax of \$100/metric tonne, The poor households pay \$1810 and the rich pay \$5940. There would be a \$2065 transfer from a household in the richest 10% to a household in the poorest 10%.

Models show that more than half of the US population gains from a carbon tax with a 100% uniform dividend.

Notice that a larger tax payment for the rich is necessary to achieve the substitution required. If we believe that the marginal social utility of income is declining, we may not be concerned that the wealthier person is not fully compensated

## 15.4 Summary

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Climate change is a classic market failure due to an external effect.

1. As an externality, climate change is distinguished primarily by the fact that the externality has a universal effect and generation is highly distributed.
2. The level of corrective taxation required is high
3. as a result, income effects matter greatly - and have macroeconomic consequences.
4. There is wide agreement that some form of revenue neutrality is desirable for both political and economic reasons
5. There are alternative approaches to revenue neutrality
6. With varying tastes, those who consume more carbon pay more but are unlikely to be fully compensated under any revenue neutral scheme
7. With varying income, the fee and dividend approach involves a larger transfer from rich to poor than income tax or corporate tax reduction.