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Carbon Pricing: Effectiveness and Equity

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ABSTRACT

The 2015 Paris Agreement adopted the goal of limiting the rise in global mean temperature to 1.5–2 °C above pre-industrial levels. Carbon pricing can play a key role in meeting this objective. A cap-and-permit system, or alternatively a carbon tax indexed to a fixed emission-reduction trajectory, not only can spur cost-effective mitigation and cost-reducing innovation, but also, crucially, can ensure that emissions are held to the target level. The carbon prices needed to meet this constraint are likely to be considerably higher, however, than existing prices and conventional measures of the social cost of carbon. This poses issues of distributional equity and political sustainability that can be addressed by universal dividends funded by carbon revenues.

1. Introduction

'The weather,' observed nineteenth century essayist Charles Dudley Warner, 'is a matter about which a great deal is said and very little done.'[1] Today we are doing something *to* the weather, however: we are destabilizing it by emitting large quantities of greenhouse gases into the atmosphere. This, too, is a matter about which a great deal is being said, if still not all that much done.

An important contribution of economists to this conversation has been to make the case for carbon pricing. There are differing views, however, as to the appropriate carbon price, the design of carbon pricing policy, and the best uses of carbon revenues. This essay addresses these issues.

Section 2 reviews the case for carbon pricing. In addition to its instrumental value in providing incentives for cost-effective mitigation and cost-saving innovation, carbon pricing also may have intrinsic value if the policy is designed to advance the principle of universal co-ownership of gifts of nature. In addition, an important feature of carbon pricing that sets it apart from other policies is that the policy can be designed to guarantee fulfillment of emissions targets, such as a trajectory consistent with the Paris Agreement's objective of holding the rise in global mean temperature to 1.5–2 °C above pre-industrial levels.

Section 3 considers the appropriate price for carbon. Currently existing carbon prices generally fall below the 'social cost of carbon' (SCC) calculated from integrated assessment models that prescribe optimal emissions and price trajectories by weighing the benefits of mitigation against its costs. Conventional SCC measures, in turn, generally fall below the carbon prices that are likely to be required to meet the Paris goal. The divergence between the lower SCC and higher Paris-consistent prices reflects the difference between neoclassical efficiency and climate safety as normative criteria for policy making. In the efficiency criterion, economists determine the ends of climate policy. In the safety criterion, economists play a more modest role: they recommend cost-effective means to achieve ends set by climate scientists and international negotiators.

Section 4 turns to practical issues in the implementation of a carbon price. Uncertainty regarding the long-run price elasticity of demand for fossil fuels means that certainty in meeting targets requires that the price be determined by the quantity of emissions. This can be done via either a cap-and-permit system or an adjustable tax rate indexed to the quantity of emissions relative to targets. Implementing the price upstream, where fossil carbon first enters the economy, would minimize administrative costs. A cap-and-permit system does not require that permits be tradeable unless they are issued free of charge rather than auctioned. In the absence of an international agreement on a uniform price, carbon prices will vary across countries, and this variation can have desirable properties.

Section 5 discusses distributional impacts of carbon pricing and how these can be influenced by policy design. In many countries, such as the United States, the incidence of carbon pricing itself is regressive: higher fuel prices hit lower-income households harder than upper-income households as a percentage of their incomes. The magnitude of the fuel price increases required for carbon pricing to be effective in meeting emission targets, coupled with public sensitivity to fuel prices, could jeopardize the political sustainability of the policy. Carbon dividends –

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[1] A version of this quip is often attributed to Mark Twain, with whom Dudley co-authored the novel The Gilded Age: 'Everybody talks about the weather, but nobody does anything about it' (see https://quoteinvestigator.com/2010/04/23/everybody-talks-about-the-weather/).

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equal per capita payments from carbon revenue – can provide a way to address these distributional and political challenges. Section 6 offers some concluding remarks.

2. Why Price Carbon?

In the short run, a carbon price provides an incentive for households, firms, and governments to reduce emissions cost-effectively. In the long run, the prospect of continuing and rising carbon prices also provides an incentive for innovations to lower the cost of cutting emissions. These static and dynamic efficiency effects are independent of the policy's design, as long as the price signal is strong and persistent. Moreover, if designed with these goals in mind, carbon pricing can guarantee that emissions targets are met, and advance the normative principle of universal co-ownership of the gifts of nature.

2.1. Cost-effectiveness

The most widely cited reason for carbon pricing is to promote emissions reduction in a cost-effective fashion. The textbook logic is straightforward: faced with a price on carbon, economic agents will avail themselves of opportunities to abate emissions that are cheaper than paying the price. The marginal cost of abatement varies across techniques. Some options, like the installation of LED lighting or conversion to wind power in favorable locations, are relatively low cost; others, like carbon capture and sequestration at coal-burning plants, would be very expensive. A carbon price gives households, firms, and governments alike an incentive to pick the 'low-hanging fruit' – the most cost-effective ways – to reduce emissions.

Conventional regulations, somewhat derisively termed 'command-and-control' policies in many economics textbooks, are thought to be less efficient in that they do not necessarily minimize costs per ton of abatement. It is worth noting, however, that economic agents do not always behave as textbook models predict. Studies have reported that often there is scope for emissions reductions at *negative* cost – that is, unexploited opportunities that would be privately profitable even in the absence of a carbon price – arising, for example, from myopia and incomplete information.[2] This is one reason to include complementary instruments in the climate policy mix, rather than relying on price incentives to do the job alone.[3]

2.2. Incentives for Cost-saving Innovation

Marginal abatement costs shift over time. A further rationale for carbon prices is to strengthen incentives for research and development of technologies that will lower the cost of reducing emissions. Experience from past pollution-pricing policies suggest that these dynamic effects can be substantial. In the first decade of the sulfur dioxide cap-and-trade program for power plants in the United States, for example, technological changes occurred so rapidly that marginal abatement costs (and hence permit prices) fell to less than half of what most analysts had predicted (Burtraw, 2000). Similarly, there is evidence that the European Union's Emissions Trading System (EU ETS) for carbon emissions has increased patenting activity in low-carbon technologies (Calel and Dechezleprêtre, 2016).[4]

Of course, not all the returns to investment in research and development are privately appropriable, and this can be expected to cause underinvestment even in the presence of a carbon price. For this reason, complementary public policies are needed to promote cost-saving innovation.[5] Similarly, public investment is needed for public goods that cannot be provided by private-sector responses to the carbon price signal.

2.3. Carbon Pricing to Guarantee Achievement of Emission Targets

The single most compelling reason to include carbon pricing in the climate policy mix is to guarantee that emission reduction targets are met. As discussed in section 4, this can be ensured either by setting an emissions cap and issuing permits up to the quantity allowed by the cap, or by setting a carbon tax with a rate indexed to meeting the targets.

Other instruments can be valuable components of the policy mix, too. For example, feed-in tariffs for electric power and fuel economy standards for automobiles can accelerate innovation in these strategic sectors. Public investment in mass transit can reduce demand for fuel for private transportation. Regulations can advance efficiency and equity by ensuring greater emission reductions in 'hot spots,' locations where hazardous co-pollutants from fossil fuel combustion are concentrated, and by preventing the emergence of new ones.[6]

But the magnitude of impact of other policy instruments on total emissions inevitably will be uncertain. If they prove to be highly effective in reducing demand for fossil fuels, the result will be a lower carbon price; if they turn out to be sufficient on their own to meet emission goals, the carbon price could fall to zero. On the other hand, if impacts of other policies prove to be modest (for example, if energy efficiency investments lead to a substantial 'rebound effect' from increased demand in response to lower unit costs), the carbon price will be higher.[7] There is one, and only one, instrument in the climate policy mix that can guarantee with certainty that emission targets are met: a carbon price *driven by mandated reductions* in the use of fossil fuels.[8] If, for example, a government decides that the Paris goal requires it to cut emissions by 80% over 30 years, it could establish a cap that declines at a constant rate of 5.22%/yr during this period, and let the carbon price be determined by demand for permits as their supply declines accordingly.

2.4. From Open Access to Universal Property

Climate destabilization demonstrates the tragedy of open access (sometimes called 'the tragedy of the commons') at a global scale. Individual economic agents receive the full benefit of fossil fuel consumption but bear only a trivial fraction of its climatic cost, and as a result they make decisions that although privately reasonable are socially tragic. Open access is, by definition, the complete absence of property rights. Conversely, any arrangements that are put in place to prevent the tragedy involve the creation of property rights – in this case, rights to the limited capacity of the biosphere to absorb CO_2 emissions.

Property rights come in many shapes and sizes. These can include rights to use a resource, to exclude others from using it, to set rules for management of the resource, and to transfer these and other rights via inheritance or sale. Together, property rights constitute what legal scholars describe as a 'bundle of sticks.' Not all sticks necessarily are in the same hands, and some may not exist, open access being the extreme case where none exist.[9] Government regulations on carbon emissions

[2] See National Research Council (2010, pp. 69–73) and International Energy Agency (IEA) (2010), pp. 82–83, 529). For cautionary remarks on the measurement of marginal abatement costs, see Kesicki and Ekins (2011) and Murphy and Jaccard (2011).

[3] For discussion of reasons for insensitivity to price signals, see National Research Council (2010, pp. 96–104: 2011, pp. 109–114).

[4] For further discussion, see Baranzini et al. (2017).

[5] On the role of public-sector investment in innovation, see Mazzucato (2013).

[6] For discussion, see Boyce and Pastor (2013).

[7] For varying evidence as to the magnitude of rebound effects, see Gillingham et al. (2016), Wei and Liu (2017) and Friere-González (2017).

[8] Mandated reductions in emissions also provide a safeguard against the 'green paradox' – increased fossil fuel extraction in response to expectations regarding future climate policies – that could result from other policy instruments, including a carbon price not tied to quantity targets (Sinn, 2014; Jensen et al., 2015).

[9] For discussion, see Cole (2002).