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Analysis

Can uncertainty justify overlapping policy instruments to mitigate emissions?

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ABSTRACT

This article constitutes a new contribution to the analysis of overlapping instruments to cover the same emission sources. Using both an analytical and a numerical model, we find that if there is a risk that the carbon price drops to zero and if the political unavailability of a CO_2 tax (at least in the European Union) is taken into account, it can be socially beneficial to implement an additional instrument encouraging the reduction of emissions, for instance a renewable energy subsidy. Our analysis has both a practical and a theoretical purpose. It aims at giving economic insight to policymakers in a context of increased uncertainty concerning the future stringency of the European Emission Trading Scheme. It also gives another rationale for the use of several instruments to cover the same emission sources, and shows the importance of accounting for corner solutions in the definition of the optimal policy mix.

1. Introduction

All countries and regions having implemented climate policies seem to rely on several policy instruments, some of which covering the same emission sources, rather than a single one.[1] In the European Union, CO_2 emissions from the electricity sector are directly or indirectly covered by the EU Emission Trading System (ETS) (Ellerman et al., 2010), by energy-efficiency standards and energy-efficiency labels on electric motors and appliances (UE, 2009), by CO_2 or energy taxes (in some Member States), by energy-efficiency obligations[2] (in some Member States), and by renewable energy power (REP) subsidies, in the form of feed-in tariffs, feed-in premiums or REP portfolio obligations (in virtually all Member States).

This multiplicity of policy instruments is in sharp contrast to the so-called Tinbergen rule (Tinbergen, 1952) requiring in order to achieve a given number of targets that policymakers control an equal number of instruments. Unsurprisingly, this multiplicity has generated criticism by some economists who argue that the policy instruments complementing the EU ETS do not reduce CO_2 emissions (which are capped) but reduce the allowance price on the ETS market and generate costly economic distortions (cf. for instance Böhringer and Keller (2011), Braathen (2007), Fischer and Preonas (2010) or Tol (2010)). Indeed, some abatement options, such as REP sources, are covered by several instruments and benefit from a higher implicit carbon price than others, such as coal-to-gas switch. The mix of instruments promoting the same abatement options is therefore suboptimal, at least in a simple economic model, as it disregards the equimarginal principle and leads to sometime antagonist interactions (Lecuyer and Bibas, 2011).

Yet, the multiplicity of policy instruments has been justified by some other economists, on several grounds. First, and most obviously, other policy targets such as air pollution reduction and security of supply are differently impacted by the various CO_2 abatement options. Second, induced technical change may be higher for some options than for others. For instance, the deployment of photovoltaic panels is likely to induce more technical change than coal-to-gas switch (see Fischer and Newell (2008) for a review). Third, the slow diffusion of clean technology justifies implementing more costly but higher potential options, such as photovoltaic panels, before the cheaper but lower potential options, such as coal-to-gas switch (Vogt-Schilb and Hallegatte, 2011). Fourth, some market failures, regulatory failures or behavioral failures may reduce the economic efficiency of market-based instruments and justify additional policy instruments (Gillingham and Sweeney, 2010). For instance, the landlord–tenant dilemma reduces the efficiency of CO_2 pricing and can justify energy-efficiency standards in rented dwellings

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[1] The unconvinced reader is invited to look at the National Communications to the UNFCCC: http://unfccc.int/national_reports/items/1408.php.

[2] Lees (2012) provides a recent survey of these systems in Europe, while Giraudet et al. (2012) discuss the costs and benefits of these systems.

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(de T'Serclaes and Jollands, 2007), while regulatory failures may lead to a too low carbon price, or prevent governments to commit to a high enough future carbon price (Hoel, 2012).

Our aim is not to discuss these justifications, but to introduce and discuss another rationale: the impact of uncertainty on abatement costs combined to the unavailability of the first-best instrument. It is well known since Weitzman (1974) that under uncertainty, the relative slope of the marginal abatement cost curve and marginal damage of emissions curve (labeled "marginal benefits" in Weitzman's framework) is key to choose between a price instrument (e.g. a CO_2 tax) and a quantity instrument (e.g. a cap-and-trade system, like the EU-ETS). More specifically, in the simplest form of Weitzman's (1974) model, the quantity instrument should be chosen if the marginal damage curve is steeper than the marginal abatement cost curve while the price instrument should be chosen if the marginal abatement cost curve is steeper. If the marginal damage curve is completely flat then a tax (set at the expected marginal damage) is the first-best instrument. In the case of climate change control, most researchers have concluded that on this ground, a tax should be preferred to a cap-and-trade system (e.g. Pizer, 1999). Indeed the marginal damage curve of CO_2 emissions over a few years period is relatively flat because CO_2 is a stock pollutant (Newell and Pizer, 2003). Actually, this argument is even stronger for policies covering only a small part of total emissions, such as the EU ETS; hence, with an uncertain marginal abatement cost curve, an ETS is less efficient than a tax, i.e. it brings a lower expected welfare.

Yet, in the EU, a meaningful CO_2 tax is out of reach because fiscal decisions are made under the unanimity rule, while a cap-and-trade system has been adopted thanks to the qualified majority rule which applies to environmental matters (Convery, 2009). Another main reason why cap-and-trade was chosen was for political economy reason in order to be able to alleviate opposition of e.g. electricity producers by means of free allocation of emission permits (Boemare and Quirion, 2002).[3]

The fact that the EU ETS is not optimal is illustrated by its history since its introduction in 2005, which shows how volatile the carbon price can be: it dropped to virtually zero in 2007 because allowance allocation in phase I was too generous (Ellerman and Buchner, 2008), recovered up to more than €30/t CO_2 because allocation in phase II was tighter and dropped again sharply in 2009 following the economic crisis, down to €3/t CO_2 in April 2013. While economists disagree over the marginal damage of CO_2 emissions, commonly called the "social cost of carbon" (Perrissin Fabert et al., 2012), they would presumably agree that such a price evolution is inefficient: in some periods, the carbon price has prompted relatively expensive abatement options (up to €30/t CO_2) while in other periods, cheaper abatement options have not been implemented. This potentially provides a rationale for correcting the ETS and/or for complementing it. Among the proposed corrections is the introduction of a price cap and a price floor. Since this proposal has been widely debated (e.g. Hourcade and Ghersi, 2002), we will not address it in this paper.

Conversely, to our knowledge only two papers have addressed the role of uncertainty on abatement costs on the effectiveness of multiple instruments. Mandell (2008) find that under some conditions, it is more efficient to regulate a part of emissions by a cap-and-trade program and the rest by an emission tax, than to use a single instrument. Admittedly, under such a mixed regulation, the marginal abatement cost differs across emission sources, which is inefficient, but the emission volume is generally closer to the ex post optimum than under a single instrument: following an increase in the marginal abatement cost, the tax yields too high an emission level while the cap-and-trade system yields a level which is too low, so these inefficiencies partly cancel out.

The other paper is by Hoel (2012, Section 9) who studies the opportunity to subsidize REP in case of an uncertain future carbon tax. He studies the case of scientific uncertainty (damages caused by climate change are uncertain) and political uncertainty (the current government knows that there might be a different government in the future, and that this government may have a different valuation of emissions). He shows that scientific uncertainty justifies a subsidy to REP if REP producers are risk-averse. Under political uncertainty, results are more complex. If the current government expects the future government to have a lower valuation of emission reductions than itself, this tends to make the optimal subsidy positive. Hoel (2012) studies the impact of uncertainty, but only when the subsidy is combined to a tax, not when it is combined to an ETS — which is what the present article focuses on.

While we also address the role of uncertainty concerning abatement costs on the effectiveness of multiple instruments, our focus is on whether it makes sense to use several instruments to cover the same emission sources and not to cover different sources, as in Mandell's article Mandell (2008). More precisely, we assume that the EU cannot implement a CO_2 tax because of the above-mentioned unanimity rule but can implement an ETS. However some CO_2 abatement options (for illustration, REP) can be incentivized by a price instrument (in this case, a subsidy to REP, e.g. a feed-in tariff). In our model, without uncertainty on the energy demand level (and hence on abatement costs) or if uncertainty is low enough, using the REP subsidy in addition to the ETS is not cost-efficient because there is no reason to give a higher subsidy to REP than to other abatement options. However we find that this uncertainty provides a rationale for using the REP subsidy in addition to the ETS, if it is large enough to entail a risk of a nil carbon price.[4] Even though the first-best policy would be a CO_2 tax, when the latter is unavailable, using both a REP subsidy and an ETS may provide a higher expected welfare than using an ETS alone.

We demonstrate this result using three approaches. Section 2 presents the intuition in a graphical way. Section 3 develops an analytical model and presents some key analytical results based on the same intuition. Section 4 further completes the model and presents a numerical application on the European electricity sector. Section 5 concludes.

2. The Possibility of a Nil Carbon Price: Justification and Implications for Instrument Choice

This section presents our main conclusion in an intuitive and graphical way. We study the possibility of a nil carbon price, unaccounted in Weitzman's seminal Prices vs. Quantities paper (Weitzman, 1974) or in the related literature, on optimal policy instrument choice. We show that using a REP subsidy in addition to the ETS improves expected welfare in so far as uncertainty on the demand level is large enough to entail a possibility of a nil carbon price, i.e. if there is a possibility that demand for GHG quotas turns out to be so low, compared to its expected value, that the ETS cap becomes non-binding.

Before introducing the intuition, let us give some elements justifying the possibility of a nil carbon price, in the light of the experience with cap-and-trade systems. An allowance price dropping to zero in an ETS is not unrealistic at all, and happened in some of the most well-known ETS worldwide. In the EU ETS, the carbon price dropped to zero at the end of the first period (in 2007). It would have done so in the second period (2008–2012) again without the possibility to bank allowances for the next period (2013–2020) and the likelihood of a political intervention to sustain the price. In the Regional Greenhouse Gas Initiative (RGGI), which covers power plant CO_2 emissions from North-Eastern US states, phase one carbon emissions fell 33% below cap (Point carbon, 2012). Consequently, the price remained at the auction reserve

[3] The ETS was also implemented as part of a long-term strategy aiming at setting clear targets for investors. As a market instrument, it also brings value as a coordination tool for investment efforts across a large range of sectors or parts of sectors.

[4] Since we use an expected welfare maximization model with a subjective probability distribution, we do not distinguish between risk and uncertainty.