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Designing an EU energy and climate policy portfolio for 2030: Implications of overlapping regulation under different levels of electricity demand

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HIGHLIGHTS

- A minimum renewable quota that is added to an existing emissions trading system causes excess costs.
- Excess costs depend on electricity demand and are highest when electricity demand is low.
- Excess costs can reach up to 1.2 Billion Euro annually in the European Union in 2030.
- CO_2 prices are more sensitive to changes in electricity demand if combined with minimum renewable quota.

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ABSTRACT

The European Union's current climate and energy policy has to operate under an ex ante unforeseen economic crisis. As a consequence prices for carbon emission allowances in the EU Emissions Trading System collapsed. However, this price collapse may be amplified by the interaction of a carbon emission cap with supplementary policy targets such as minimum shares for renewables in the power sector. The static interaction between climate and renewable policies has been discussed extensively. This paper extends this debate by analysing the efficiency and effectiveness of a policy portfolio containing a cap and trade scheme and a target for a minimum renewable share in different states of aggregate electricity demand. Making use of a simple partial equilibrium model of the power sector we identify an asymmetric interaction of emissions trading and renewable quotas with respect to different states of aggregate electricity demand. The results imply that unintended consequences of the policy interaction may be particularly severe and costly when aggregate electricity demand is low and that carbon prices are more sensitive to changes in economic activity if they are applied in combination with renewable energy targets. Our analysis of the policy interaction focuses on the EU, yet the conclusions may also be of relevance for fast growing emerging economies like China.

1. Introduction

Emissions trading is key to climate policy in an increasing number of countries. The primary example is the European Union's Emissions Trading System (EU ETS). Launched in 2005, it was the first large carbon emissions trading scheme in the world. Thus, it is also an unprecedented grand scale policy experiment that provides lessons to learn for the design of subsequent emissions trading systems in other countries and regions as well as about the policy environment they have to operate in. A first major assessment and adjustment of EU's climate policy targets for 2020 – based on the three main pillars of a 20% reduction in greenhouse gas (GHG) emissions, a 20% share of renewables in EU energy production, and a 20% reduction in energy consumption – has been initiated by the European Commission (2013) with the publication of the Green Paper on the EU 2030 climate and energy policy. Herein the Commission asks which targets for 2030 would be most effective and whether there have been "inconsistencies in the current 2020 targets".

The question of inconsistencies in the current 2020 targets has been discussed by economists before. Böhringer and Rosendahl (2010) study the interaction of climate and renewable policy targets. They show that adding a minimum renewable share target

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to an existing ETS in the power sector unintentionally promotes production by the dirtiest power generation technology. The additional renewables reduce the abatement pressure on the carbon-emitting technologies and cause a reduction in the price of emission allowances. This benefits in particular the most emission-intensive producers.

The stringency of a given policy target also depends on aggregate energy demand, which is determined, inter alia, by levels of economic activity and government policies (International Energy Agency, 2013, p. 171). Different climate policy instruments, which constrain emissions in different ways, respond differently to changes in economic activity. On the one hand, Fischer and Springborn (2011) and Heutel (2012) show how emission intensity targets and emissions trading allow for flexibility in meeting climate policy goals if aggregate demand is changing. But on the other hand, the low carbon prices during an economic downturn may reduce low carbon investments and the dynamic efficiency of the ETS. Regardless of the drawn conclusion, it is clear that changes in electricity demand, driven by changes in economic activity, affect the performance of climate policy instruments.

So far, the two issues have been discussed in isolation of each other. It is the aim of this paper to contribute to the literature on the interaction of climate and renewable policy by discussing how the intensity of the interactions is linked to the level of electricity demand. We focus on the interaction of a cap and trade scheme with a target for a minimum renewable share as implemented in the EU. Our research is guided by the intuition that climate policy instruments may interact asymmetrically depending on the level of electricity demand. In order to illustrate our reasoning, we employ a highly stylised model of the European power sector. In our model carbon emissions can be reduced by three abatement options. One is a relatively cheap fuel switch from coal to gas. The other two, which are more expensive, are a replacement of carbon emitting power generation capacities with non-emitting nuclear energy or renewables. For the European case, this assumption is quite reasonable, as it is in line with projections for future electricity generation costs calculated for the European Commission by Capros et al. (2009).[1]

By means of a comparative static analysis, we aim to shed light onto the efficiency of the combined targets. If demand for electricity is low, then emissions are low and a fuel switch is sufficient to stay below the cap of the ETS. However, if the ETS is combined with a minimum renewable share target, abatement efforts are forced towards the more expensive use of renewables. Put differently, the minimum renewable share target becomes particularly binding if electricity demand is low. As a side effect, comparatively more energy will be produced with the dirtiest technology when emissions trading and a renewable share target coexist, compared to a single emissions trading scheme. Reversely, if demand for electricity is high, the minimum renewable share target becomes less binding, as energy production by renewables becomes more and more necessary to stay below the emissions cap. If electricity demand is even very high, the renewable share target may also become completely ineffective, as the emissions cap is sufficient to force the envisaged switch to renewables.

This asymmetric interaction of emissions trading with a minimum renewable share target bears important policy lessons. Most prominently, it implies that the unintended consequences of the policy mix, i.e., higher renewable targets foster also more energy production by the dirtiest policy, may be particularly strong and thus costly if electricity demand is low. Our main example for the policy interaction is the EU, yet our research also relates particularly well to fast growing emerging economies like China that undergo drastic changes in demand for electricity. Divergences from projected electricity demand are likely to be particularly strong in fast growing countries. Hence, the interactions of emissions trading with a minimum renewable share target should also be considered carefully in fast growing economies like China.

In the following, we first discuss the existing literature on interactions of climate policy instruments and climate policy instrument behaviour. Second, we set up a simple partial equilibrium model for analysing the interaction of emissions trading and a minimum renewable share target in more detail. Third, we calibrate our model to the EU in 2030. Thereby we illustrate the economic consequences of the interaction between emissions trading and a renewable share target for the reference, low and high electricity demand projections of the EU's Roadmap for moving to a competitive low carbon economy in 2050 (European Commission, 2011) and aim to contribute to the assessment of the EU's 2030 climate policy targets. Fourth, we discuss the interaction of emissions trading and a renewable share target more broadly. We conclude with the main policy lessons and a short outlook to future research.

2. Lessons from the literature

In practice, the goal to mitigate climate change is one of many policy goals. Governments want to reduce air pollution, take energy security issues into consideration, want to create jobs and secure international competitiveness. Going back to Tinbergen (1952), we know that several policy targets need a similar number of instruments. Manifold goal-setting, as it is the case in the EU's climate and energy policy, necessitates therefore the implementation of several regulatory instruments.

Apart from additional policy goals, the occurrence of market failures additional to the climate externality justifies the implementation of multiple climate and energy policy instruments (Bennear and Stavins, 2007). For example, market failures – caused by a lack of credible information or myopic behaviour – may distort incentives to invest sufficiently into energy efficiency measures. Other market failures may arise due to the non-consideration of spillovers from accumulated knowledge and learning by doing on the benefits from new innovations in the energy sector. All these reasons may justify additional policy instruments. Following this argument, a considerable amount of literature evolved, that is engaged with the optimal choice and composition of climate and R&D policy portfolios.[2] Recent studies indicate that a combination of policies to cut emissions and research and development subsidies is necessary in order to mitigate climate change at least cost. Fischer and Newell (2008), Otto et al. (2008), Löschel and Otto (2009) and Acemoglu et al. (2012) show how technology externalities and path dependencies in technology choice justify this combination of subsidies and carbon emission regulation.

In contrast, Böhringer and Rosendahl (2010), Böhringer et al. (2008, 2009), Fankhauser et al. (2010) and Boeters and Koornneef (2011) show that overlapping regulation may have adverse effects on efficiency and effectiveness of policy portfolios. Böhringer and Rosendahl (2010) investigate the interference between emission and renewable quotas. They demonstrate that overlapping

[1] The options for abatement in the electricity sector and the related costs are discussed in detail in the literature on marginal abatement cost curves (see e.g. Delarue et al., 2010). Abatement costs are multidimensional functions that depend on several factors, such as fuel price ratios, installed capacities, load, and specific investment costs. For the sake of simplicity we refer to a model with a small set of abatement options that differ in their associated costs.

[2] For a comprehensive overview see Goulder and Parry (2008) and Goulder (2013).