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Permits vs. offsets under investment uncertainty

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ABSTRACT

This paper investigates interaction effects between permit and offset schemes, using the framework on Reducing Emissions from Deforestation and Forest Degradation (REDD+) as a test bed for evaluating the cost and benefit of including low-cost offsets in mandatory emission trading schemes. We use a real options model of firm-level investment decisions under stochastic prices to compare alternative emission trading and permit-offset linkage schemes. By isolating the critical design factors that drive energy investments, we seek to identify policy regimes that balance the different concerns in the polarized debate for and against the inclusion of offsets. Our findings indicate that a moderate offset quota is sufficient to contain investment crowding-out effects, while it still has a positive effect on profit distributions. In contrast, the classical permit price collar will not effectively change investment behavior, precisely because in a framework with multiple compliance instruments the volatility of cheaper offsets is the driving force for investment. Under these conditions, a price collar for offsets emerges as a largely overlooked policy option to foster investment incentives. A combination of offset quota and offset price collar leads to investment patterns that are almost identical to a regime without access to offsets.

1. Introduction

Since the signing of the Warsaw framework on Reducing Emissions from Deforestation and Forest Degradation (REDD+), the prospects for a large scale development of REDD+ have significantly improved (Recio, 2013). At the same time, the discussions regarding a top-down global carbon market have faded. In fact, many observers of international negotiations now argue in favor of hybrid international treaties combining both bottom-up and top-down approaches (Edenhofer et al., 2013; Ranson and Stavins, 2014). While this could be achieved through full linking of existing emissions trading schemes, the political appetite for this approach in the short-term is currently not at its highest (Green et al., 2014). Nonetheless, with the positive development at the 21st Conference of the Parties (COP21) in Paris, it is also likely that further integration between emerging GHG pricing schemes in the world will occur and will be perceived as desirable (Bodansky et al., 2014). In addition, one may expect that developing economies will demand some degree of support for their mitigation efforts from the rest of

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the world, including financial transfers. The main tool so far for such purposes that linked fragmented carbon markets was the Clean Development Mechanisms (CDM) under the Kyoto Protocol. However, as this mechanism is currently in palliative care (Kossoy et al., 2015), REDD+ could become a new framework toward bottom-up integration of carbon markets.

REDD+ is a relatively low-cost mitigation option (Kindermann et al., 2008) and, therefore, its integration in a global mitigation strategy could allow larger emissions reductions and lower overall abatement costs. While a large literature emphasizes the critical importance of pricing carbon in forests (Melillo et al., 2009), research on the design of integrative policies to address deforestation in developing countries, where most deforestation occurs, is only emerging more recently (Bento et al., 2015a,b; Lubowski and Rose, 2013; van Benthem and Kerr, 2013). One option is to link REDD+ as an emission reduction credit program unilaterally to major cap-and-trade programs in the EU, US, but also China and Korea (Angelsen and Rudel, 2013).[1] The crediting mechanism would enable major developing countries without binding caps to participate in the international carbon market (Tuerk et al., 2009). In addition, one-way linking would significantly strengthen the currently weak demand for REDD+ (Laing et al., 2015) and mobilize the funding needed to realize the REDD+ mitigation potential. This could also allow building operational best practices and the necessary institutions, in particular in developing countries (Green et al., 2014; Wehkamp et al., 2015). Such an incremental and polycentric approach to overcome multi-jurisdictional negotiations (Ostrom, 2009) could be a first step toward a global carbon market in the more distant future (Green et al., 2014). Politically, unilateral linking might be more palatable as countries keep more control within their own carbon markets (Tuerk et al., 2009).

However, the inclusion of REDD+ in the global carbon markets is a highly controversial issue in the climate policy debate. The key concern is that the availability of low-cost REDD+ credits – due to the low marginal costs of reduced forest emissions – may 'flood' the compliance market and 'crowd out' mitigation efforts in other sectors (Fry, 2008; Murray et al., 2009) as well as investments and research and development into low carbon technologies (Bosetti et al., 2011; Fuss et al., 2011). While reducing abatement and investment is the optimal response for cost-minimizing firms, the outcome may not be socially optimal. This would particularly be the case if REDD+ projects suffered from problems of additionality and permanence that could lead to "spurious" emissions reductions (Kerr, 2013; Lubowski and Rose, 2013). If the environmental integrity of offsets was not guaranteed, their dampening effects on investments in clean technologies would be undesirable. The disincentives to invest could in fact threaten the dynamic efficiency of the policy and increase the overall costs of achieving long-term decarbonization targets. Therefore, it is of high importance to assess the relevant design factors that determine the impact of an inclusion of REDD+ credits in a mandatory pollution control system.[2]

In this paper, we explore how the availability of multiple compliance instruments, permits and credits, affects an energy producer's incentive to invest in low-carbon technology. Alternative emissions trading schemes and linkage designs are compared using a real options model of firm-level investment decisions (Dixit and Pindyck, 1994) characterized by dependent and uncertain price paths for permits and credits. More specifically, our model is calibrated to the stylized features of a wide range of existing and emerging cap-and-trade programs in the EU, US, New Zealand and Korea (see Kossoy et al., 2015 for a review). They differ inter alia in terms of price stabilization mechanisms (e.g. price floor) and credit quotas (e.g. 13.4% in EU ETS). In addition, we explore alternative REDD+ pricing schemes discussed in the literature (e.g. indexed to carbon prices or opportunity costs of conservation as in Engel et al. (2015)) and how they affect the demand for REDD+ beyond the imposed quota by policy makers. Our aim is to identify linked policy regimes that balance the different concerns in the polarized debate for and against inclusion. This is undertaken by isolating the critical design factors that drive private investments into the transformation of the energy infrastructure.

In a nutshell, we model a representative agent in the energy sector who owns an old coal-fired power plant (as representative of cheap power plants with high emissions as in Szolgayova et al. (2008). This power plant can but does not have to be replaced by a wind park – representing all renewable technologies with high investment costs but no emissions. Similar to Fuss et al. (2011) the agent can surrender permits and offsets for compliance, but we introduce two novel model features consistent with real world policy schemes. First, the agent can decide how many REDD+ credits she will surrender, yet, this choice is subject to restrictions. Second, permit and credit prices are both assumed to be stochastic following two correlated Geometric Brownian Motions (GBM). Therefore, the REDD+ quota alone is not sufficient for explaining credit usage. We conduct several experiments using, amongst others, different values for the correlation parameter and the offset quota. We then deduce the agent's optimal strategy in terms of the chosen power plant type and the share of REDD+ credits. This enables us to explore how the policy design affects the agent's incentive either to invest in a low-carbon power plant or to postpone such an investment due to the option value of the fossil-based power plant.

The combination of uncertainty about the global climate policy regime and irreversibility of energy investments with the firm's possibility of waiting for new information relevant to the decision-making process makes our research context a prime candidate for a real options analysis. This framework has become a popular approach for the evaluation of the impacts of environmental policy on investment strategies (Fisher, 2000; Pindyck, 2000, 2002; Traeger, 2014), particularly in the energy

[1] Cap-and-trade systems set a binding cap on total emissions, but allow for trade of permits between regulated entities. In contrast, credit systems define a certain baseline, such as an absolute business-as-usual projection, and allow emission reductions that go beyond this baseline to be used as sellable credits (often referred to as offsets).

[2] The associated concerns about the establishment of a reliable system to measure, report and verify (MRV) and the setting of appropriate reference levels are, however, outside the scope of this paper.