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Trade in fossil fuel deposits for preservation and strategic action☆

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ABSTRACT

In the world economy with interdependent markets for fossil fuel deposits and extracted fossil fuel, some coalition of countries may fight climate change by purchasing and preserving fossil fuel deposits, which would be exploited otherwise. Assuming that deposits are traded on a market with a uniform price, we find that the outcome is efficient if the coalition is a price taker in both markets, but inefficient if it acts strategically in the deposit market but not in the fuel market, or acts strategically in both markets. The latter result demonstrates that Harstad's (2012, Theorem 1) 'efficiency-despite-strategic-action result' is not robust with respect to changes in the concepts of the deposit market and market (or bargaining) power. In a simplified parametric version of the game, a strategically acting coalition buys fewer deposits, consumes more fuel, and puts up with higher climate damage than in first-best.

1. Introduction

Fighting global change requires mitigating greenhouse gas emissions, notably emissions of carbon dioxide from burning fossil fuels. The ongoing international climate negotiations are unlikely to result in effective global cooperation soon. It is therefore important to improve our understanding of the conditions for successful sub-global cooperation and, in particular, of the performance of alternative unilateral climate policies.[1] While there is a large theoretical literature on demand-side unilateral climate policies, supply-side approaches are much less analyzed.[2] This paper focuses on the supply-side policy of purchasing fossil fuel deposits for the purpose of preventing their use. We aim to contribute to the understanding of how an international deposit market works, how it is interconnected with the fossil fuel market, and what the differences are in outcome, when a sub-global climate coalition does or does not exert market power in the form of distorting the prices of deposits and fuel to its own favor.

Bohm (1993), Harstad (2012) and Asheim (2013) are the only studies we know with an analytical approach to deposit trade. Asheim (2013) provides a distributional argument for deposit purchases in a Dasgupta-Heal-Solow-Stiglitz growth model. In a stylized parametric model, Bohm (1993) considers a sub-global climate coalition and derives conditions under which a combination of a purchase or lease of deposits for preservation and a fuel-demand cap implements a given emissions cap at lower costs than a stand-alone fuel-demand-cap policy.

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[1] Prominent examples are Markusen (1975), Copeland and Taylor (1995), Ulph (1996), Kiyono and Ishikawa (2013), Böhringer et al. (2014), van der Meijden et al. (2015) and van der Ploeg (2015).

[2] For studies combining the unilateral climate policies of capping fuel demand and supply in the absence of a market for deposits see e.g. Hoel (1994), Faehn et al. (2014) and Eichner and Pethig (2015).

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Following Hoel (1994), Harstad (2012) considers a sub-global climate coalition that sets its domestic fuel demand and fuel supply strategically, and he extends Hoel's setup by adding an international deposit market to the fuel market. Deposits of fossil fuel are characterized by the amount of fuel in the ground and by the costs to extract that fuel. The coalition's purchases of deposits for preservation or extraction turn out to implement the first-best under the conditions that all agents take the price of fossil fuel as given and that the carbon emissions from fuel consumption generate climate damage in the coalition only.[3] While this application of the Coase theorem is not surprising, more remarkable is his main result (Harstad, 2012, Theorem 1) that if the deposit market is in equilibrium the coalition implements the first-best, although it has the option to manipulate the fuel price through strategic use of its supply and demand of fuel. That' efficiency-despite-strategic-action result' runs counter to the plausible conjecture supported by numerous studies in other fields of economics,[4] that an agent's manipulation of the terms of trade creates allocative distortions. The principal message of the present paper will be that Harstad's results, in particular his Theorem 1, are not robust to an alternative, more conventional design of the deposit market in which the way the coalition exerts market power differs from Harstad's.

To be specific about the difference between Harstad's and our deposit market concept, it is necessary to describe Harstad's approach in some detail. On Harstad's (2012, p. 92) deposit market, any pair of countries may trade "some of their deposits at some price" and the market clears"… when there exists no pair of countries that would both strictly benefit from trading …". Harstad does not need to specify the prices of bilateral deposit transactions, but they obviously depend on the allocation of bargaining power (Harstad, 2010, p. 29) that may be weak or strong. An important implication is that this kind of market power does not cause allocative distortions when Harstad's deposit market is in equilibrium and does not spill over to the fuel market. Therefore, the outcome of the game is efficient, if the fuel market is assumed perfectly competitive. In his Theorem 1, Harstad presupposes that the coalition exerts market power in the fuel market in addition to its bargaining power on the deposit market. The market power in the fuel market takes the form of manipulating the uniform fuel price via the choice of caps on domestic fuel supply and demand. Harstad shows that the coalition's exertion of market power in the fuel market combined with the market power in the deposit market described above leave the allocation undistorted.

We will adopt Harstad's analytical framework including his assumption that the fuel market clears after the deposit market. Our model differs from Harstad's only with respect to the design of the deposit market and in the way the coalition exerts market power in that deposit market. Specifically, we employ the standard concept of a market with a uniform price that clears when aggregate demand equals aggregate supply.[5] The observation that the coalition is the monopsonist in the deposit market is a compelling reason for assuming that it has market power. The coalition's market power in the deposit market of this paper consists of strategic manipulation of the deposit price via its choice of demand for deposits - and hence differs from Harstad's.

The uniform deposit price is a simplification, of course, as in many other economic studies. In the present context, it may be considered unsuitable, at first glance, because deposits are characterized by different extraction costs and hence are heterogeneous goods. However, the item traded on the deposit market will turn out to be 'fossil fuel in the ground', because countries will buy deposits only for the purpose to leave the deposits they purchased in the ground. Hence, different extraction costs do not influence the decision to buy (directly). They are relevant for the seller, however, because if he wants to sell a given amount of fuel in situ at a given price, he must sell the fuel contained in some of those deposits that he would have exploited in the absence of selling (because no country would buy deposits that fail to reduce total fuel supply). The seller therefore offers for sale the highest-cost deposits of his profitable deposits. Thus, the buyers get the largest possible amount of fuel in situ for their money, which certainly is in their interest. Apart from that defense of the uniform price, we refrain from entering into a comparison of the two deposit market concepts with respect to plausibility and operationalism. Such comparison is an important issue for implementations in practice. Our contribution is theoretical, however, and therefore focuses on the analysis of differences in outcomes.

Table 1 summarizes our results and how they differ from Harstad's. Whenever the coalition exerts market power *in our model*, either in the deposit market or in both the fuel and the deposit market, the allocation gets inefficient. This is in sharp contrast to *Harstad's model*, where the outcome of the game is efficient, when the coalition exerts market power in the deposit market, in the fuel market, or in both. Put differently, we show that Harstad's results are not robust with respect to our alternative deposit market concept.

The paper is organized as follows. In Section 2, we outline the model and characterize analytically the solution of the four-stage game model, in which the coalition accounts for the impact on prices and market equilibria of its demands and supplies of deposits and fuel. Section 3 elaborates the efficiency properties of the equilibrium of that game for alternative assumptions on the coalition's strategic action. First, we briefly consider the (first-best) benchmark case in which the coalition is a price taker in the markets for deposits and fuel along with all other countries. Then we assume that the coalition acts strategically in the deposit market, but takes the fuel price as given. Finally, we turn to the general case of Section 2, in which the coalition acts strategically in the markets of deposits and fuel. Strategic action turns out to always distort the allocation in the coalition's favor. We supplement the analysis of each case by studying a simplified parametric version of the game model to obtain more specific information on equilibrium allocations, in particular on prices, on fuel exports and imports, and on welfares. Section 4 concludes.

Table 1
Preview of results and how they differ from Harstad's results.

		In the deposit market, the coalition …		
		refrains from exerting market power	manipulates the uniform price in *our model*	exerts bargaining power in *Harstad's model*
In the fuel market, the coalition manipulates the price …	No	Outcome efficient Same in *Harstad's and our model*	Outcome inefficient Manipulation also affects fuel market equilibrium.	Outcome efficient Bargaining power leaves fuel market unaffected.
	Yes	Not investigated	Both kinds of price manipulations cause inefficiencies.	Outcome efficient

[3] Harstad (2012) mentions that important result only in passing in his section IV on generalizations. Crucial for this and his other first-best results is his assumption that the non-coalition countries do not suffer from climate damage. For reasons of comparability, we will adopt this assumption throughout this paper.

[4] See e.g. the results presented in Eaton and Grossman (1986) and Krugman (1986) in the context of strategic trade policy or in Cremer and Gahvari (2006) and Kempf and Rota-Graziosi (2010) in the context of tax competition.

[5] Recall that Harstad requires the additional equilibrium condition that there be no opportunity left for mutually beneficial trades in deposits.